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Preface

It is a great pleasure and honor for the JTTA Sports and Medical Science Committee to bring you the International Journal of Table Tennis Science No.6 under the name of ITTF (International Table Tennis Federation). This book consists of selected, peer-reviewed papers presented at ITTF-SSC11 (the 11th ITTF Sports Science Congress) held in Yokohama, Japan from April 25 to 30, 2009.

ITTF-SSC (ITTF Sports Science Congress) was commenced by the late Mr. Ichiro Ogimura. More than 20 years have passed since the beginning. In the early times, the late Prof. Nobuo Yuza dedicated himself to arrange the congresses, not only in Japan but in other countries. Later, people of the host countries of WTTC (World Table Tennis Championship) have taken initiatives and conducted ITTF-SSC in their responsibility. The 10th anniversary ITTF-SSC10 held in Zagreb 2007 is still fresh in our minds. It was very successful thanks to Dr. Miran Kondric and his co-workers. ITTF-SSC11 is the first step to the next decade anniversary. Dr. Kondric described the history of ITTF-SSC in detail in the web-site of ITTF-SSC10 (http://sportikus.kif.hr/~ittfcongress/congress_history.htm). Here I would like to describe the history of the congress book.

Initially, the book of ITTF-SSC was published in the name of International Journal of Table Tennis Sciences. The subtitle of the book is Proceedings of ITTF-SSC. Naming of this subtitle is a little strange because a journal and proceedings do not coexist in general. Anyway Mr. Ogimura tried and got the ISSN (International Standard Series Number) number for the journal. The ISSN number that he obtained from ISSN International Centre is 0966-9256. I have heard that the English Table Tennis Association helped him to get this ISSN number. Prof. Yuza and a few Japanese researchers worked very hard with Mr. Ogimura to lay the base of the journal.

Unfortunately, publication of the International Journal of Table Tennis has been quite irregular in the subsequent ITTF-SSC. The ISSN number was sometimes clearly expressed, but not other times. It has been almost forgotten in recent books of ITTF-SSC. The International Journal of Table Tennis Sciences No. 1 combined the books of 2 congresses; ITTF-SSC1 and ITTF-SSC2. The journals No. 2 and No.3 were published normally. Those books consist of the papers presented at ITTF-SSC3 and ITTF-SSC4, respectively. The ISSN number is specified in the journal from No.1 to No.3. Some changes happened from ITTF-SSC5. ITTF-SSC5 was held in conjunction with Science and Racket Sports (2nd World Congress). The papers presented at ITTF-SSC5 were published in the book of Science and Racket Sports II. The journal No.4 was intended to be published after ITTF-SSC6 but actually it was not published though several papers were submitted. When planning the book of ITTF-SSC7 in Japan, the local committee decided to include the papers presented at ITTF-SSC6 in the book of ITTF-SSC7. The book published after ITTF-SSC7 has the name; Table Tennis Sciences No.4 & No.5. This book has two parts, including the papers presented at ITTF-SSC6 and ITTF-SSC7. The title of the book is Table Tennis Sciences but the same ISSN number is shown in the book. ITTF-SSC8 was held in conjunction with Science and Racket Sports (3rd World Congress) again and thus papers of ITTF-SSC8 were published in the book of Science and Racket Sports III. The papers presented at ITTF-SSC9 and ITTF-SSC10 were published in the proceedings of ITTF-SSC 9 and 10, respectively. These proceedings have their own ISBN (International Standard Book Number)

numbers. ISBN numbers are given to impermanent books while ISSN numbers are given to permanent books. Our congress ITTF-SSC has a long history and it is held every 2 years steadily.

The above history is in a way not normal. The Editorial Committee in Japan discussed the style of the book, and finally decided to keep the ISSN number and revive the name “The International Journal of Table Tennis Sciences”. I hope that this style will maintain in the future issue of this journal.

At the end of this preface I would like to express sincere appreciation to people, organizations and companies supporting ITTF-SSC11 and its book. Dr. Kahn and members of the ITTF Sports Science Committee have been always encouraging us and giving us good advice during the process of planning. Members of JTTA Sports and Medical Committee share the work for ITTF-SSC11. Particularly, Prof. Kasai and members of the National Organizing Committee have been engaged in the preparatory work of every detail. Contribution of Prof. Kazuo Yoshida and members of the Editorial Committee of this journal is great for publication of this issue.

Yutaka Tsuji
Chair of 11th ITTF Sports Science Congress
Deputy Chair of ITTF Sports Science Committee

Proposal for rationalizing the initiation and training activities for beginners in table tennis by means of the instructional project

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Abstract: The rationalizing has as a purpose to improve the didactic technology, to develop the training strategies, to save time, as well as material and financial resources, to simplify the training process in order to achieve the quality of the training process efficiency.

The precision instrument for rationalizing is the scientific project or, to be more specific, in our case the instructional project. Rationalizing supposes a thinking process, pondering upon what we intend to do, and then aiming at the actual drawing up of the training plan.

Drawing up the instructional project supposes preliminary operations for assessing the whole activity of the previous season and especially the competitive and training pattern. Each stage is marked by a set of pragmatic questions. The more correct is the answer to the 5 questions: which are the objectives of the athletes' training, which are the resources of the training process, which is the instructional strategy, how is it put into practice and which is the assessment method, the easier it is to solve the 15 didactic operations and thus the results will be better. The instructional project drawn up aims at being accessible, easy and flexible, and to insure the achievement of the suggested objectives eliminating the risk at different strategic moments.

Keywords: Rationalizing, instructional project, initiation, table tennis

1. INTRODUCTION

The concept of didactic projection or instructional design is the result of interdisciplinary scientific research, as well as of some connections made among some theories which appeared in time, such as: the general theory of the work well done or the praxeology [3, 4], the principles of utilitarianism in the Anglo-Saxon philosophy [5], the principles of management [6], of the scientific classification or the taxonomy of the instructional objectives [1]

The ideas, the principles, the stages, the methodological operations which lay the foundation of the scientific projection have also been extrapolated in the educational science. Thus, it has been noticed that the performance of the didactic activity according to „well-thought didactic plans" is more efficient than the traditional empirical methods. The concern of certain specialists [2] for designing training plans for the teams which have been coached along the years has led to the conclusion that they can also become incredibly efficient in training the high-performance athletes.

To this purpose we firmly state that any coach (no matter how well endowed for his profession) is able to draw up efficient prospective plans if he rigorously obeys the stages, the operations, the rules and the didactic prescriptions we are going to list here.

2. PRELIMINARY OPERATIONS BEFORE DRAWING UP THE TRAINING PLAN FOR THE TEAMS AND PLAYERS

a) getting to know the maximum performance achieved, as well as the tendencies in the development of the sports event we are dealing with; getting to know the selection, the competition and the training patterns drawn up by the federation corresponding to the sport practiced by the coach;

b) Analyzing the activity carried out previously. Any time we set the goal of drawing up an instructional project (usually after each annual training and competition cycle, after the Olympic cycle, when taking over a team), it is necessary to make a thorough analysis of the whole activity carried out previously. We actually answer the questions "How did I perform during the competition?", "What performance did I achieve?", "Which was the efficiency of the training process carried out?". We also analyze the management areas which are connected to the answers to these questions, identifying the causal phenomena which have led to the effect phenomena.

Examples: motivations, logistics, financial resources, didactic materials, accidents;

c) Ordering the data and building up (improving) the competition patterns for the following season (or for the new Olympic cycle):

d) Working out a training plan according to the stages and operations.

3. CONTENTS OF THE INSTRUCTIONAL PROJECT IN TABLE TENNIS

3.1 Objectives of the athletes' training

a) Final objectives

- Tracking down the subjects with the best qualities for practicing table tennis and including them in the

advanced groups

b) Intermediary objectives

- The general physical development, the development of speed, mobility, address
- Learning the footwork and the specific movement at the tennis table

c) Operational objectives

- Learning the right forehand shot
- Learning the right backhand shot
- Learning the service
- Developing the motion skills required in table tennis and reinforcing them by means of competitions bouncing the ball on the paddle using the forehand and the backhand; the winner is the one who can do the greatest number of bounces, while running for 10 m, on sideways movement, who is the fastest, etc.
- The general physical development, the development of speed, mobility and address.
- Learning the footwork and the specific movement around the tennis table

d) The minimum performance expected

- Successfully passing the pre-established limits for the second stage of the initial selection

3.2 Resources of the training process

a) The contents of the programme.

Realization of some exercise structures for achieving the instructional objectives.

b) Age characteristics and motivations.

The children selected at the age of 6–8 are in a very favorable period for the table tennis selection: they have a well-developed skeletal structure, a good aerobic capacity, the coordination is at its best development period, they have the static and the dynamic balance, they are enthusiastic and they have a great assimilation capacity.

c) Logistics, financial resources, informational resources

Logistics

- Gym with 1-4 tables, balls and table tennis paddles, a robot, a box of balls, mattresses, skipping ropes, balls of different sizes and so on.

Financial resources

- The necessary resources for getting the competition equipment (paddles, equipment), for awarding prizes

Informational resources

- Video tapes of the competitions and training sessions, diagrams, photos, the video analysis of the children's movements.

d) Existing motion skills

It is achieved through:

- The physical education classes carried out during the pre-school education period;
- Fun activities (games) carried out together with their friends, colleagues, parents etc.

e) Training time

- 90-120 minutes for each training session, 2-3 training sessions a week.
- 60-70% of this time using the paddle and the ball, and the rest of the time consists in general physical training and specific physical training.

3.3 Instructional strategy

a) Methods

- Especially the repetition method. It has an important role in gathering the quantity of training and in forming some movement patterns based on the proper execution;
- alternating the effort with rest periods or with games;
- the algorithmic method;
- the competition - training analogy method.

b) Didactic material

- CD/DVD records from different competitions;
- methodical CD/DVD records;
- photos;
- diagrams;
- demonstrations of the coach.

c) Means

- physical training exercise;
- technical training exercise;
- movement learning exercise by means of games (who performs the most, who performs the best);
- coordination games;
- speed games;
- recovery and recreation methods: swimming, outdoor games.

d) Stages of activity

Stage I

- operational steps;
- preparation period I;
- measurements and tests I;

Stage II

- preparation period II;
- measurements and tests II;
- contest.

3.4 Practical application

a) The efficient coordination and application of the project.

It supposes the correct use of all the resources, demonstrations will be carried out in order to make up a performance which should be as correct as possible, watching video records, discussions with the athletes and their parents, mini-competitions for making up a top.

b) Medium cycles, micro-cycles, lesson plans.

The macro-cycle: for the period of time April-September (example)

Micro-cycles

- games and contests will be used because the training involves children without motion skill experience. The motion skill structures will be performed based on great micro-cycles, with a large number of repetitions and at low intensity;
- the reinforcement of the structures learned will be carried out by repeating them in simple combinations.

Sets of lessons

c) Shaping the effort dynamic

- by means of training with a duration of

90-120 minutes;

- the intensity and the complexity will be low during the first training period, while the training is based on the amount of exercise;
- during the pre-competition period, the complexity and intensity of the movements will be increased in the case of shots as well as in the field movement;
- the focus will be on the general physical training and later on the specific one.

3.5 Evaluation

It is achieved by:

- emphasizing the work quality;
- the AR-PR (achieved results/planned results) ratio;
- the training efficiency by the AR/DT (achieved results/ didactic time);
- physical and technical tests, as well as the coach's assessment.

Following the contents of the instructional project, we will easily identify the following aspects:

- drawing out the instructional project supposes preliminary operations for the assessment of the whole activity during the previous season and especially of the competition and training pattern;
- each stage is followed by pragmatic questions. The more correct we answer the five questions and solve the 15 didactic operations, the better the results achieved.

4. OBSERVATIONS CONCERNING THE CORRECT SOLUTIONS FOR THE DIDACTIC STAGES AND OPERATIONS

A few rules must be imposed from the very beginning, rules which must be strictly obeyed:

a) the order or the succession of these stages and operations (the design) must never be changed. Thus, this procedure has a standard.

b) the content of each operation must be written down accurately and using real data; we are not allowed to improvise, because any improvisation leads to serious instructional errors which are difficult to rectify later; after the firs cycle start over the operation two more times. "The new information" which appears during the process or which is gathered by means of testing is immediately introduced because this diagram is always "open" to new data;

c) we will insist on finding the best solutions, and even some original ones, for solving the 15 operations;

d) the results will not be seen immediately; they will be noticed only after a year and they will be materialized after two-three years of training.

In conclusion, we would like to draw the attention to the fact that the operational part, the actual drawing up of the training project is easier than it may seem. Using a pen and paper, write down the contents of the 5 stages and the 15 operations and you will realize that it helps you never to forget anything that you are supposed to do, the instructional process which is going to come will seem more clear and you will also discover unsuspected skills in yourself when it comes to rationalizing and creativity, skills which will undoubtedly improve the quality and the efficiency of the training process carried out.

REFERENCES

[1] W. L. Anderson , R. D. Krathwohl , P. W. Airasian and K. A. Cruikshank, *„A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives"*, Abridged Edition, Allyn & Bacon, U.K., 2001

[2] E. D. Colibaba, I. Bota, Jocuri sportive teorie si metodică, Ed.Aldin, Bucuresti, pp. 130-144, 1998.

[3] M. R. Gagne, „The Conditions of Learning and Theory of Instruction", fourth edition,Woodys-Books, USA, 1985

[4] T. Kotarbinski, *„Tratat despre lucrul bine făcut"*, Ed.Politică, Bucureşti, 1976

[5] J. S. Mill, *„Utilitarianism"*, Hackett Publishing Company, Inc, U.S.A., copyright, 2001

[6] W. F.Taylor, *„The Principles of Scientific Management"*, Elibron Classics http://books.google.com/books?id=3OOBMayrvAMC&pg=PP2&hl=ro&source=gbs_selected_pages&cad=0_1#PPP1,M1,2001

Research on table tennis player's cardio-respiratory endurance

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ABSTRACT

The circulatory organ ability of the high level is needed so that the table tennis player may play for 30 minutes or more. The evaluation of player's circulatory organ ability is possible from the measurement of the maximal oxygen consumption under the maximal effort. 5 players who belongs to the table tennis club of Waseda University participated in this experiment.

5 players are high-ranking on the Kanto Student, the Japan Student and World Junior championships.

K4B2 which is a portable oxygen consumption measurement machine analyzes a player's exhalation, and has the function to transmit the result to a personal computer.

The players hit the ball by forehand continuously for 1 minute. This experiment was done by three conditions, namely, mild hitting, topspin and smash. Additionally, between each test, they sat on the chair for 2 minutes rest.

Player hit the ball until exhaustion continuously in smash condition. After this experiment, oxygen consumption was measured until the heart rate decreased to 100 beats per minute. Players showed maximal oxygen consumption (ml/min/kg) in smash condition. When a hit ball was continuously carried out until it was completely exhausted by the forehand smash, the player's maximal oxygen uptake and a maximal heart rate showed maximal.

Moreover, the analysis from the viewpoint whether the energy efficiency of moving is high becomes important as for the evaluation of ability of player.The cardio-respiratory endurance of the high level is needed so that the table tennis player may play for 30 minutes Or more. The evaluation of player's cardio-respiratory endurance is possible from the measurement of the oxygen uptake. The players are evaluated from the measurement result of the oxygen uptake during the maximum effort. Subjects are six players who belong to the table tennis club of Waseda University. Six players have the ranking in The Kanto Student Championships, the all-Japan student Championships and World Junior Championships.

K4B2 which is a portable oxygen uptake measurement machine analyzes a player's expiration, and has the function to transmit the result to a personal computer. The players hit the ball by forehand long (L), a forehand drive (D), and the forehand smash(S)continuously for 1 minute, respectively.

In addition, between each trial, it sat on the chair for 2 minutes rest (R). Only in the forehand smash, the continuation hit the ball was performed to complete exhaustion. Rest was taken from the moment of being completely exhausted, and oxygen uptake was measured until the heart rate decreased to 100 beats per minute.

Under the conditions which carry out hitting the ball by forehand smash, a player's oxygen uptake (ml/min/kg) showed maximal. Under the conditions which carry out a hit ball by forehand smash, several players' oxygen uptake (ml/min/kg) showed maximal. When a hit ball was continuously carried out until it was completely exhausted by the forehand smash, the player's maximal oxygen uptake and a maximal heart rate showed maximal.

Moreover, the analysis from the viewpoint whether the energy efficiency of moving is high becomes important as for the evaluation of ability of player.

Keywords: oxygen uptake, k4b2, heart rate

1. **INTORDUCTION**

Mr. Ogimura commented table tennis to be "the sport which performs chess while carrying out 100m running". Although it is expressing table tennis simply, this text moves not only to front but to back or a horizontal direction in fact, chooses the optimal batting style and carries out the hit ball of the ball which comes flying at irregular timing and an irregular spin, and speed. And it is the sport as which the change of tactics is required, analyzing a partner's style.

At the place of a top level's fighting, it is high-level performance. Clearly high-level physical strength exists in the background of the player to develop.

The physical strength level of the top player which plays an active part in the world is very high, and digests an intense prolonged game on both sides of the recess for only 1 minute. The cardiac beats rate in the game of the case of attacked type players is in 170-180-beat the range for /, and it is reported that the degree of burden concerning the living body in a table tennis game is quite large.

Table tennis is the game which owner oxygen movement and non-oxygen movement mixed.

It is thought that exercise intensity also become high as the average heart rate under game of table tennis is in 110-170 b/min the range. The play domain of table tennis must be the narrowest of games, the speed of the ball in which the partner player moreover did the hit ball within about 0.50 - 1.75 seconds, a spin, and the direction of a hit ball must be predicted, and the optimal hit ball position and hit ball posture for the hit ball must be taken. Most rallies of top-class players end the number of hit balls within 5 including service less than 4 seconds. That is, it is the game which sandwiches for 10-15 seconds (time until one of both issues service after the one-point end), and repeats non-oxygen movement for about 4 seconds for 20 minutes.

This research aims to an improvement of the contents of physical workouts and technical training.

The oxygen uptake used as the index of the respiratory circulatory system under movement.

The continuation hit ball of the same subject was performed by the multi-practice method on training and oxygen uptake, heart rate were measured by k4b2.

2. EXPERIMENTAL METHOD

Subjects are five Waseda University table tennis club boy players. They took rest sufficient after the end of warming-up, equipped with telemetry k4b2 at the time of quiet, and measured oxygen uptake, heart rate, an amount of ventilation, etc.

It carried out to the beginning in order of the forehand for 1 minute (FH), the drive for 1 minute (DR), the smash for 1 minute (SM), the continuation forehand (FH+FW) ac-companied by footwork for 1 minute, the drive (DR+FW) accompanied by footwork for 1 minute, and the smash stroke (SM+FW) accompanied by footwork for 1 minute. The interval for 1 minute was taken and was made to rest between the subjects of each. The time which an experiment takes were for 14 minutes in total.

The pitching timing of a ball was set as per minute 60 times, and the ball was sent alternately with right and left only at the time of a footwork experiment. Moreover, footwork put the mark on the position of about 2/3 on a table tennis table (seeing from the course of a dominant hand), and the player moved to right and left regularly, and did the hit ball of it to them.

The feature of telemetry k4b2 was described. It is portable respiratory metabolism measurement equipment which can be measured on the field.

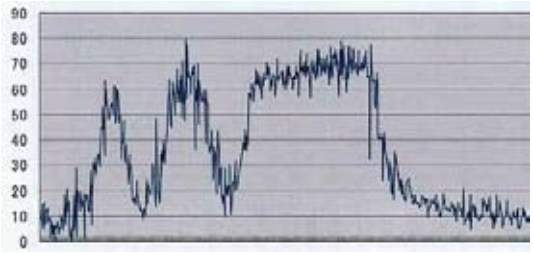
It has the oxygen sensor and oxygen uptake on dioxide sensor of high speed, high precision, and quantity stability. An original highly efficient digital turbines sensor corresponds to.

3. EXPERIMENTAL RESULT and DISCUSSION

Table1. Physical characteristic of the 5 subjects

Sub.	Age	H(cm)	W(kg)
A	19	175	63
B	19	159	58
C	20	177	67
D	20	174	68
E	21	170	64

Table 1 shows physical characteristics of the subjects.



| →L+R | →D+R | →S (exhaust) | →Recovery → |

Fig1.Oxygen uptake during each strokes of player

After performing the drive for 2 minutes at 60 times of a rate in 1 minute with long and inserting a break for 2 minutes in between, change of the oxygen uptake when going a smash by the same timing to complete exhaustion was shown in Fig. 1.

They are each values at the time of an end of oxygen uptake at the smash accompanied by footwork. The oxygen uptake, heart rate, ventilation, and exercise intensity,

Moreover, exercise intensity had reached to about 100% with regular movement on either side in man at the conditions of a continuous hit the ball.

In addition, when every person's data was analyzed in detail, maximal and the minimum of the heart rate in each style were seen at the last, heart rate increased gradually and maximum and the minimum became of the smash accompanied by footwork as the experiment was conducted on the hit ball conditions of each style.

From this result, it became clear that it was the practice for which the smash style accompanied by footwork strengthens the heart rate most in a table tennis.

REFERENCES

1) Dal Monte Antonio, Marcello Faina, Leonardo Leonardi, Antonio Todaro, Giuliano Guidi, Gianni Petreli. : Maximum oxygen consumption by telemetry. Sports culture review SDS. 3-12. No.l5 Jan-March l989. Sports school of C.O.N.I.

2) DaI Monte A., Faccini P., Faina M., Scarpellini

E. ：Energy cost of the tennis player. Scuola Dello Sport-C.O.N.I-Anno VIII-No . 17 P38-42 . October-December 1989.

3) Dal Monte A. , Faccini P. , Shermi C. , Introini E. ： Functional Evaluation and training model of the canoist. Scuola dello Sport-C.O.N.I-Anno IX-No. 18 P26-37. January-March. 1990.

4） Dal Monte A. , Leonardi L. M. , Faina M. , Antonio Todaro. ：A new micro O_2 wireless detector for on field stress test. New horizon of human movement, P47. Seoul 1988.

5) Faina M. , Gallozzi C. , Marini C. , Colli R. , Fanton F. ：Energy cost of several sport disciplines by minituarised telemetric O_2 measurement system. First IOC world congress on sports sciences, Colorado Springs USA, P76, 28 October to 3 November 1989.

6) Faina M. , Colli R. , Marini C. , Evangerista M. ： Functional models of training methods. Sports medicine applied to football, Roma 5-7 March 1990.

7) Faina M. , Colli R. , Marini C. , Scarpellini E. , Cama G. , Atanosio E. , Dal Monte A. ：On-field evaluation of energy expenditure during a performance . Aspects biochimiques et fisiologiques de la fatique musculaire. Creteil, France, 20-22 September 1990.

8) Faina M. , Gallozzi C. , Mirri C. , Scarpellini E. , Atanosio E. , Cama G. ：Energy costs in amateur boxing according to the number and duration of rounds. The safety of the athlete in olympic sports, International medical symposium. P43 Assisi Italy. 28 September-October 1990.

9) Junichi Kasai. ：The study of cardio-respiratory in Table Tennis -measurement of oxygen consumption during many ball practice by using telemetry system k4b2-. Department of Physical Fitness. WASEDA Univ. . 24, 69-73, 1992.

10) Junichi Kasai. ：The speed and the spin of balls in Table Tennis. Japanese Journal of Sports Sciences, Vol. 12 No.6, 372-378, June 1993.

11) Junichi Kasai. , Takeshi Mori. , Tyon Te Un. ：The study of cardio-respiratory in Table Tennis -measurement of oxygen consumption during footwork exercises by using telemetry system k4b2 -Department of physical fitness. WASEDA Univ. . 26, 17-26, 1994.

12) Junichi Kasai. , Takeshi Mori. , Tyon Te Un. ：The study of cardio-respiratory in Table Tennis -measurement of oxygen consumption during matches by using telemetry system k4b2-.Department of physical fitness. WASEDA Univ. . 27, 1995.

A Study on the Compilation of a Behavioral Scale for Timeout Decision of Taiwan's Table-tennis Players

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Abstract:Purpose: This research aims to explore the rules and regulations concerning the timeouts in table tennis matches, and to develop reliable and valid scale of reasons for calling timeouts. Method: Based on previous research, a questionnaire about timeout decisions is designed. With the help of item analysis and exploratory factor analysis, the discrimination of the scales, as well as the factors listed in the scales, are examined. A total of 369 questionnaires are distributed, and 352 are completed and returned. The valid response rate is 97.78%. Result: A good fit of the modality is indicated by structural equation modeling (SEM).(χ2 =176.88, df =86, χ2/df=2.05, GFI=0.94, SRMR=0.042, RMSEA=0.054, NNFI=0.95, CFI=0.96, PNFI= 0.76, PGFI= 0.67, CN=222.45) Conclusion: The scale of timeout decision is consistent with the empirical statistics, and it can be further applied to other relevant research.

Key words: table tennis, the rules of table tennis, timeout decision

1. INTRODUCTION

1. 1 Background and motivation

Since the rules of table tennis were changed radically in 2000, each player or pair has been entitled to claim a timeout in an individual match. These alterations in rules and regulations have certainly brought new challenges to the table tennis circles, and have made significant impact on the training in skill, tactic, and psychology.

As Leet and Rushall (1984) point out, during competitive matches, it is usually difficult for coaches to make decisions, and inappropriate decisions often affect the result of a match. Coaches have to make decisions in a very short time during every game. Therefore, this research attempts to study the timeout decisions made by players and their coaches, and it can be used as a reference for coaches, players, and relevant administrative organizations to understand the importance of calling a timeout. Indeed, the timeout regulations are beneficial to the progress of games, making it more competitive and exciting. If coaches and players take good advantage of their rights to call a timeout, they will have a chance to adjust their tactics, strategy, as well as psychology, and they may therefore turn the game around. However, an unreasonable timeout decision may have an opposite effect on the game. That is, when to ask for a break would influence the result, and the importance of timeout cannot be neglected. When is the right time to call a timeout? Under what circumstance is a timeout considered reasonable? Do coaches and players have the same idea of calling a timeout? The outcome of athletic games can be easily influenced by players' capabilities, including skills, the adjustment of strategies, physical and psychological preparation, all of which are essential for athletes' performance in matches. If players are not in their best condition before a match begins, which leads to errors in performance, the scores would be affected significantly. This is particularly true in table tennis matches, where players stand in a short distance, react to a fast-moving ball, and compete fiercely with their opponents. With the advancement in technology nowadays, coaches and players expect to perform perfectly in matches by making good use of the outcome of scientific research to prevent any possible factor from influencing their performance.

Table tennis is a complex sport that involves fierce competition and interaction between players. Small balls move back and forth speedily between players, and players have to judge the direction in which balls move and rotate, then stand at the right position, and make a good return. This process requires players' accurate judgment and quick reaction. In addition to step-by-step training, players need to participate in matches to examine the effect of training. By doing so, they are able to modify their training and enhance their advantages. This is an important issue in scientific training, which is emphasized nowadays. Gilovich believes that table tennis is a sport suitable for the research on decision-making. Making a decision (in other words, making up one's mind) refers to the process in which, based on available yet uncertain information, decision-makers choose the best option from the others. As Shao (1996), Liu (2002), and others point out, the ability to make a decision is the ability to take objective conditions into consideration, and decide on strategies, skills, action, targets, and possible solutions. They also claim that coaches' ability consists

of encyclopedic knowledge, wisdom, abundant experience, calmness, strategy, strong willpower, inspiration, and the ability to cope with emergency. Before matches start, coaches can choose the most satisfying decision to follow so that the result of matches will be better. During games, especially key ones and finals, however, coaches have to make a right, irreversible decision to increase the possibility to win. According to Wu, Meng, and Zhang (1999), to be a good decision-maker requires: 1. knowledge, including the theories of specific training and of related disciplines; 2. ability, including intelligence, teaching ability, and creativity; 3. the ability to deal with emergency. Any timeout decision influences players' skills, strategies, and psychology, and this is strongly related to the outcome of matches. As a consequence, coaches' decisions, either about training or the immediate advice in games, have direct influence on the effect of training and the result of matches. The famous tennis player Connors once said, when athletes' physical condition and skills are at peak, the final result is almost decided by their mental state on the court. (Wenberg 1988) The physical condition and skill of a player can be easily observed, but the mental state of a player cannot because it is a subtle inner factor. (Liao 1993) Therefore, in a match where two players that seem equally good compete with each other, knowing well their mental condition is very important.

In an important match, the decisions made by either coaches or players will affect the final result. Because of the alteration of rules, the difference in scores between athletes decreases, and more uncertainties arise. These phenomena are particularly important to coaches, who look at games closely and give advice to players. Liu (1995) believes that the result of a game can often decided within a very short time, so coaches cannot hesitate to make decisions. Their decisions need to be authoritative, and any argument about the decisions is not allowed. Because coaches are responsible for not only the effect of training but also the result of every match, their observation and analysis in a game must be sensitive and accurate.

The existence of the timeout regulations is of great importance.

Coaches and players need to put more emphases on the combination, as well as the flexible application, of skill and strategy. They also have to learn to improve their sense of observation so that they can make full use of one-minute timeout periods. As Barrow (1977) claims, an outstanding coach should act like an experienced psychologist, who is able to understand players' psychological state immediately, regulate their emotion, and adjust their condition during games to ensure their best performance, as well as the smooth progress of games. The leadership of coaches is meant to help athletes achieve their goals in a short time. How coaches and players take good advantage of the only timeout is certainly worthy of discussion.

1.2 The purpose of this research

In the past, table tennis coaches can only instruct the players between each interval of matches. Instructions of any kind at any other time are considered illegal and are prohibited by the rules. Violation of the rules, as a result, may lead to coaches expelled out of the game. During the breaks between games, coaches can only give advice concerning the next game, but this can not change the result of the previous game at all. Now players, or pairs, are entitled to call one timeout during each match, and this alteration in rules may be a crucial factor that defines the result of a competitive match. That is, a timely timeout can significantly affect the result of a match, retain advantageous situations, and adjust the mental state of players. To the contrary, an improper timeout can be counterproductive. Consequently, it is of great importance when coaches and players decide to call their only timeout. Even though many coaches and players have suggested the importance, as well as the influence, of timeout decisions in games, no empirical research is available. Previous research on timeouts is all about other sports, with none of them aiming at the timeout decision in table tennis matches. Thus, this research attempts to compile a scale of the reasons for timeouts, hoping to look at timeout decisions, as well as the attitude of players and coaches, in a scientific way.

Based on the above research backgrounds and motives, this research attempts to:

(1) Compiling a scale of good reliability, convergent validity, and discriminant validity.

(2) Serving as reference to relevant organizations of table tennis.

2. METHOD

The purpose of this research is to compile a scale of the reasons for timeouts. To begin with, literature review and analysis are conducted. Then, a pilot questionnaire on the reasons for timeouts was designed. The questionnaires were distributed to do a pilot. After item analysis and exploratory factor analysis of the returned pilot questionnaires, the revised scale printed as questionnaires were officially distributed to all subjects.

2.1 Scale compilation

On the basis of the theoretical scheme set up by Lin(2003), Duck and Corlett(1992), Wu, Meng, and Zhang(1999), Gilovich(1984), Liu and Huo(2002), along with other relevant literature and research, the scale "*Behavioral Scale of Reasons for Calling a Timeout*" was compiled. It contains 15 questions, which reflect faithfully the reasons for calling timeouts in genuine matches. After some suggestions provided by three experienced national coaches were taken into consideration, the questions were slightly adjusted. At

last, the pilot questionnaire on players' reasons for timeouts was completed. The questionnaire is divided into two sections: basic information of respondents and the scales of reasons for calling timeouts. The Likert 5-point rating scale is utilized, ranging from "always," "often," "sometimes," "seldom," and "never," each of which is given 5, 4, 3, 2, and 1 point in sequence.

There are 24 questions in the questionnaire, the aspects of them including attack, defense, strategy, and emotion.

2.2 Steps

(1) Stage 1

The pilot questionnaire was distributed to the table tennis teams from 12 universities nationwide. There are 200 subjects, among which 134 players are male and 64 are female. In this stage, by means of item analysis and exploratory factor analysis (EFA), the discrimination of the scale of the reasons for calling timeouts is examined.

(2) Stage 2

In this stage, the subjects are players taking part in the 2007 Selective Trial of Table Tennis National Representatives. After the contact with all teams, as well as the agreement from coaches and players, questionnaires were distributed to each member of all teams by the researcher in person. 378 questionnaires were distributed, with 369 of them returned and 9 invalid. The valid response rate is 95.24% (256 males and 104 females). The average age of male respondents is 19.82±3.28, and that of female respondents is 17.69±2.8.

The software LISREL is used for confirmatory factor analysis (CFA), which is meant to examine the general goodness of fit, reliability, and the discriminant validity of the scales.

The program of LISREL provides various Goodness-of-Fit Indices. This research takes the suggestions from Huang (2002, 2004), Qiu (2003), and Byrne (1989) as reference, which includes: (1) Chi-square（$\chi 2$）, which represents the Goodness-of-Fit between the hypothesized modality and empirical statistics. The smaller $\chi 2$ is, the better the Goodness-of-Fit is. (2) Generally speaking, a GFI (Goodness of Fit Index) exceeding 0.90 means good fit. (3) SRMR (Standardized Root Mean Square Residual) is the residual in average between the observed samplings and predicted matrix. A value of zero indicates perfect fit; a value less than 0.05 means good fit; a value between 0.05 and 0.10 is considered acceptable. (4) A ratio of $\chi 2$ to the degree of freedom ($\chi 2$/df), which is less than 1.0-3.0, indicates excellent fit. (5) AGFI (Adjusted Goodness-of-Fit Index) consists of the variance and covariance from the hypothesized modality. A value which is more than 0.09 is considered acceptable. (6) RMSEA (Root Mean Square Error of Approzimation) is a measurement of the difference between each degree of freedom. A value of RMSEA, which is less than 0.05, indicates good fit while a value below 0.08 is still considered reasonable. (7) NFI (Normed Fit Index) is the Goodness-of-Fit calculated on the basis of $\chi 2$, with a value ranging from zero to 1. (8) NNFI (Non-normed Fit Index) is the NFI after the degree of freedom is taken into consideration. A value of NNFI exceeding 0.90 means a good fit in the hypothesized modality. (9) CFI (Comparative Fit Index) is the outcome of calculation after the size of sampling is taken into consideration. A value of 1 means the modality is perfect while a value of zero has the opposite meaning.

3. RESULT

3.1 Pilot test of the Scales

This study adopted SPSS for Windows 12.0, a program for statistics, to do item analysis and exploratory factor analysis.

(1) Item analysis

In establishing the scale, this research adopted correlation analysis and internal consistent criteria to analyze scales items. Correlation analysis was administered through calculating product-moment coefficient between the individual item score and the total score. If they are significantly correlated ($p<.05$) and their product-moment correlation is higher than 0.30, the item is of good discrimination. Internal consistent criteria method is a way in which all the subjects' scores in the pilot test, which adopted a tentative item scale, are ranked from high to low. The top 27% are labeled as high scores, and the lowest 27% are labeled as low scores. Then, independent sample t-test was administered. If the CR value is higher than 3 and shows that they are significantly different ($P<.05$), it means it is able to be discriminate from one another. (Chiu, 2002)

Using the two methods mentioned, the result showed that the correlation coefficient of this *The Behavioral Scale of Reasons For Calling a Timeout* was between .310~.728; critical ratio locates among 6.385~18.382; and all the individual question items showed the ability to discriminate significantly from one another.

Each question in *The Behavioral Scale of Reasons For Calling a Timeout* includes: X1. I call for timeout because I am not prepared for the incoming serving pattern yet. X2. I call for timeout because the locations where my attacks and defenses ball hit in previous plays are bad. X3. I call for timeout because I want to change my tactic. X4. I call for timeout because I want to change my playing pattern. X5. I call for timeout because the opponent plays all too smoothly during previous plays. X6 I call for timeout for lifting up the player. X7. I call for timeout because the player is frustrated and lacks confidence. X8. I call for timeout because the clumsy resuming stance during balls flying to-and-fro in a row. X9. I call for timeout because the

rate of serving-error is too high in previous plays. X10. I call for timeout because the player did not play hard enough. X11. I call for timeout to adjust the strategy I adopted and let the player take a rest. X12. I call for timeout because I am affected by spectators and others outside the court. X13. I call for timeout because there is a problem in striking at balls returned from serving. X14. I call for timeout because there is a problem in striking at balls that are served from the opponent. X15. I call for timeout because there is a problem in a ball playing to-and-fro continuingly for a long period.

(2) Exploratory factor analysis

The exploratory factor analysis of this research adopted Principal axis factoring, Promax rotations, and oblique rotations to test the validity and factorial structure of the scales. There are four indices in *The Behavioral Scale of Reasons For Calling a Timeout*. Factor one, named as "strategy," includes three items that are mainly about factors of strategy and playing patterns played by players and players who adjust their tactics and playing patterns through calling for timeout. Factor two, named as "emotion," includes six items that mainly focus on players' mental state, and how they adjust their emotions and face such factors through calling for timeout. Factor three, named as "attack," includes two items that mainly focus on the factors which lead players to launch an attack, and how players adjust their tempo to do this by calling for timeout. Factor four, named as "defense," includes four items that are mainly about factors of players' defense and contingent striking pattern during a match, and how players adjust it through calling for timeout. Among those items, item 2 and 3 are deleted because they are greatly overlapped and contribute to a factor loading which is too low. The factor loading of four indices in *The Behavioral Scale of Reasons For Calling a Timeout* are located among .51 ~.75, .46~.71,.53~.75, and .44~71; characteristic values are 9.65, 2.01, 1.23, and .99 respectively; descriptive variances are 18.26, 17.56%, 12.29%, and 9.68% respectively; cumulative descriptive variances are 18.26%, 35.82%, 48.12%, and 57.8% respectively; total descriptive variance is 57.8%.

(3) Mean, standard deviation, kurtosis, and skew tests of the sample

This research used SPSS 12.0 statistics program to test each item's mean, standard deviation, kurtosis, and skew coefficient. The result showed that the means in the scales are between 2.74~3.40, standard deviations are between .94~1.12, kurtosis are between -.48~.14, skews are between -.89~.13. Consequently, the result can be seen as approximate normal distribution and thus is suitable to use Maximum likelihood for estimating parameters. Each item's correlation matrix, mean, standard deviation, kurtosis, and skew of *Free Time Management Scale* are shown in Table 1.

Table 1 Correlation matrix, mean, standard deviation, kurtosis, and skew of observed Variables

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
X1	1.00														
X2	.43*	1.00													
X3	.43*	.44*	1.00												
X4	.35*	.43*	.72*	1.00											
X5	.31*	.36*	.54*	.44*	1.00										
X6	.40*	.39*	.32*	.43*	.25*	1.00									
X7	.33*	.39*	.35*	.36*	.37*	.46*	1.00								
X8	.39*	.50*	.32*	.42*	.18*	.44*	.51*	1.00							
X9	.35*	.35*	.26*	.38*	.21*	.31*	.31*	.51*	1.00						
X10	.38*	.46*	.31*	.23*	.20	398	-431	.47*	.44*	1.00					
X11	.39*	.41*	.42*	.39*	.26*	.42*	.41*	.49*	.41*	.48*	1.00				
X12	.36*	.40*	.30*	.40*	.24*	.28*	.45*	.46*	.43*	.44*	.47*	1.00			
X13	.40*	.53*	.42*	.50*	.29*	.43*	.45*	.53*	.39*	.50*	.43*	.60*	1.00		
X14	.34*	.53*	.41*	.35*	.35*	.40*	.46*	.47*	.43*	.43*	.44*	.57*	.76*	1.00	
X15	.37*	.49*	.38*	.44*	.28*	.39*	.45*	.55*	.39*	.47*	.44*	510	.68*	.71*	1.00
Mean	3.00	2.91	3.40	3.30	3.43	2.96	2.91	2.74	2.83	2.79	3.01	2.80	2.96	2.99	2.95
SD	1.04	.98	.94	.96	1.06	1.08	1.06	.99	1.10	1.08	1.07	1.12	1.08	1.05	1.03
Skew	.02	-.11	-.40	-.22	-.48	-.07	-.12	.06	.14	.03	-.04	-.05	-.08	-.22	-.17
Kurtosis	-.53	-.75	.13	-.42	-.32	-.77	-.75	-.78	-.64	-.76	-.66	-.89	-.66	-.49	-.59

3.2 Compilation of the officially distributed scale

Based on the results of the exploratory factor analysis, along with the statistical technology of confirmatory factor analysis, theoretical modality of this research is examined. This is used in examining the construct reliability of individual observed variables and potential variables, convergent validity and the discriminant validity.

After the examination of whether the observed samples are in normal distribution, the confirmatory factor analysis of the scale is conducted. With the result of the 15 questions listed on the revised scale and the help of LISREL 8.52, the Goodness-of-Fit of the modality is estimated.

(1) Testing the Goodness-of-Fit of the whole modality

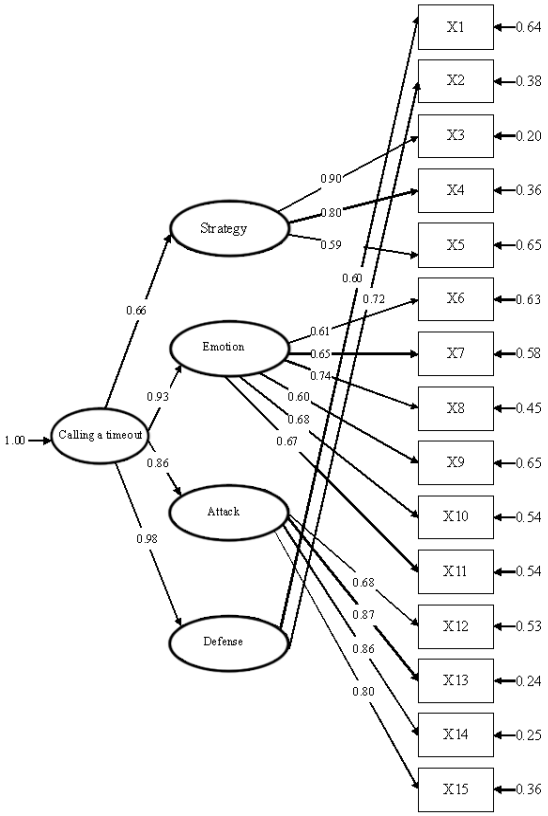

Fig. 1 Hand in the way obliquly in factor of two steps one of form of the amount of Behavioral Scale for Timeout Decision of table tennis

After the confirmatory factor analysis, along with the review of every Goodness of Fit Index, the hypothesized modality of this research is acceptable because it has passed various required standards. As a result, this modality accords with the empirical statistics, as shown in Table 2.

Table 2 Result of confirmative factor analysis to the whole scale

Measure Mode	χ^2/df	GFI	SRMR	AGFI	RMSEA	NFI	NNFI	CFI
Result of current study	**2.06**	**0.94**	**0.042**	**0.91**	**0.054**	**0.93**	**0.95**	**0.96**
Suggested values	**1.0-3.0**	**>0.90**	**<0.05**	**>0.90**	**<0.08**	**>0.90**	**>0.90**	**>0.90**

(2) The construct reliability of measured variable and potential variable

According to Huang (2002, 2004), the reliability of measured variables has to exceed 0.20, and to examine the reliability of potential variable, construct reliability is adopted. The value of it needs to be more than 0.60. Through the evaluation of reliability, the reliability of individual observed variables and potential variables can be examined. All of the estimated parameters from The Behavioral Scale of Reasons for Calling a Timeout have met the required standard, with the value of t exceeding 1.96. No obvious errors are found, either. The reliability of individual variables is between 0.35 and 0.81, and that of potential variables lies between 0.61 and 0.88. As a consequence, The Behavioral Scale of Reasons for Calling a Timeout is of good construct reliability, as shown in Table 3.

Table 3 Individual variables and the reliability of latent variables

Latent Variable	Measured Variable	R^2	Construct Reliability
Timeout Behavior			0.82
Defense	C1	0.36	0.61
	C2	0.52	
Strategy	C3	0.81	0.81
	C4	0.64	
	C5	0.35	
Psychological Emotion	C6	0.37	0.82
	C7	0.42	
	C8	055	
	C9	0.36	
	C10	0.46	
	C11	0.45	
Attack	C12	0.46	0.88
	C13	0.76	
	C14	0.74	
	C15	0.64	

(3) The experiment of convergent validity

On the validity of individual variables, this research aims at investigating the standardized loading of variables on their reflected factors. From Table 4, "The parameter estimation of four-factor hypothesized measurement models about table tennis timeout behavioral scale" indicates that all the standardized coefficients have significant results. On convergent validity, according to Huang (2004) and Anderson & Gerbing (1991), it can effectively be a factor indicator to its belonging category if the t-value is more than 1.96, which makes a significant difference. Meanwhile, it also shows the positive convergent validity.

Table 4 The parameter estimation of four-factor hypothesized measurement models about table tennis time-out behavioral scale

Parameter	Non-standardized parameter	Standard error	t value	Standardized parameter
δ1	0.62	0.02	----	0.60
δ2	0.71	0.07	10.27	0.72
δ3	0.84	0.01	----	0.81
δ4	0.77	0.05	15.36	0.64
δ5	0.62	0.06	11.25	0.35
δ6	0.66	0.02	----	0.37
δ7	0.68	0.07	9.99	0.42
δ8	0.73	0.07	11.05	0.55

δ9	0.66	0.07	9.39	0.36
δ10	0.73	0.07	10.34	0.46
δ11	0.72	0.07	10.33	0.45
δ12	0.76	0.01	----	0.46
δ13	0.94	0.06	14.66	0.76
δ14	0.90	0.06	14.58	0.74
δ15	0.82	0.06	13.63	0.64

Note.: Unlisted Standard error and t value are reference pointers; * $p < .05$

(4) The experiment of discriminant validity

The researcher applies the second order model to reveal the timeout measurement model of table tennis players in the end, so there is only one highest element. That is to say, there is no discriminant validity which is required to be tested.

4. DISCUSSION

4.1 Discussion

The implementation of the timeout clause has brought a dramatic change to tennis match. Each player or pair is entitled with one opportunity to claim a timeout period during an individual match. When players are well-matched in strength, a timeout period could incur dramatic changes and uncertainty to the result of a match. Making a timeout decision not only displays a coach's ability to give a quick response and guidance to the player, but also adds excitement and tenseness to the match. The result of the match is unpredictable when the match is every close in particular. At the same time, calling a timeout also suggests the importance of decision making by the player and the coach during the match. In a competitive game, players and coaches have to seize the uncertainty, and then come out with a proper policy. The decision of when to call a timeout during the match may make a difference. Moreover, if it happens in the tie-break period, it may affect the result of the whole match. Therefore, making good and reasonable use of timeouts is very important in a match.

First, this research reviewed related literature about table tennis timeout behavioral scales. After reviewing and arranging the literature, the researcher foud that there are very few timeout behavioral scales, and that previous research is mainly about the timeout decision in basketball and volleyball games. Due to the essential difference between sports, the rules of different sports are also very different. The research tried to focus on the appearance of the timeout rule and regulations in table tennis. The researcher proposed a list of various aspects, defense, strategy , emotion, and attack. The researcher further distinguished the differences between the timeout in table tennis and in other sports. Moreover, this research is different from previous research of timeout scale, which only used item analysis, exploratory factor analysis and the reliability test of alpha coefficient by Cronbach (Wu, 2004; Lin, 2003; Huang, 2001, Huang, 2004 & Duck & Corlett, 1992). This research adopted item analysis in pilot test and exploratory factor analysis. After deleting two items, the researcher underwent the second stage of examination and verification. With the advancement in statistical technology, Structural Equation Modeling (SEM) can facilitate researchers to strongly testify these scales theoretically via confirmatory factor analysis. This also becomes a new method of making scales, too. (Jöreskog & Sörbom,1993 and Huang, 2004). That is, after the researcher has finished item analysis and exploratory factor analysis, the researcher adopted SEM to conduct confirmatory factor analysis and construct reliability, convergent validity, and the test of discriminant validity. This examines the scales more carefully.

As a result, it could be found that the table tennis timeout behavioral scale in this research had more flexible measurement tools, including strategy, emotion, defense, and attack. The scale was of good internal consistence and construct validity. Meanwhile, through confirmatory factor analysis, it was proven that the modality had a good fit.

4.2 Conclusion

During the initial stage, the scale in this research was compiled with the help of existing scales of other sports. Previous timeout scales and timeout theories were mainly about basketball and volleyball games, in which coaches have more than two opportunities for calling timeouts or substituting players. This leads to the emphasis on the efficiency of calling a timeout for player substitution. However, owing to the differences in essence among sports and different times for calling timeouts, the rules of table tennis have been amended in the recent years. In the past, players only had a short break for guidance during each game, and the efficiency of guidance in the next game was the main concern. The new timeout rule allows the guidance for the game in progress and the next game, so it depends on the situation at that moment to make decisions. To sum up, the new game rule indicates the importance of using timeout period in the match, with strategy, emotion, defense and attack as the main concern. Table tennis timeout behavioral scale is considered as a measurement tool that accords with empirical statistics. Researchers in the future could make use of the compiled scale in this research to conduct further studies.

4.3 Suggestion

The achievement of the table tennis timeout behavioral scale not only facilitates table tennis players to seize good timeout time management, but also reminds coaches and players of the importance and uses of the right time to call a timeout during the match. Coaches and players should think highly of their timeout decisions and reflect themselves to make full use of timeouts. This is the ultimate goal of the scale in this research. In the future, more other variables could be taken into consideration in further research, such as

the professional quality of coaches and players, which could help them to figure out more appropriate timing for making timeout decisions.

REFERENCES

[1] 王俊明(2000)：問卷量表的編製與分析方法。載於張至滿、王俊明編:體育測驗與評鑑(139-155 頁)。台北:中華民國體育學會。

[2] 邱皓政(2002)：社會與行為科學的量化研究與統計分析。台北:五南。

[3] 余志國（2004）：論教練員在乒乓球比賽中暫停時機研究，湖北體育科技，23（4），506-509。

[4] 季力康（1994）：運動目標取向量表的建構效度-驗證性因素分析的應用，學育學報，18，299-308。

[5] 吳述成、孟令英、張斌(1999)：談教練員的決策能力，南京體育學院學報，第 13 卷，第 2 期，105-106。

[6] 吳明隆(2000)：SPSS 統計應用實務。臺北:松崗。

[7] 林如瀚（2003）：籃球教練在暫停時間的決策行為之心理歷程，國立臺灣師範大學博士論文。

[8] 邵桂子、滿江虹(1996)：教練員合理布陣的決策分析方法研究，浙江體育科學，第 18 卷，第 3 期，31-33。

[9] 黃永賢（2004）：排球教練請求暫停因素與專業知識認知之研究，中華民國 93 年度體育學術研討會專刊，84-93。

[10] 黃永賢（2001）：大專籃球教練在比賽中請求暫停因素之研究，成大體育研究集刊，6，59-73。

[11] 廖主民（1996）。教練行為描述。台灣師大體育研究，復刊號，二期，69-83。

[12] 劉玉華、霍海峰(2002)：論體育競賽中教練決策能力的構成，山西師大體育學院院學報，第 17 卷，第 3 期,26-27。

[13] Barrow, J.C.（1977）.The variables of leadership: A review and conceptual framework. *Academy of Management Review*,*2*, 231 -251.

[14] Duck, A., & Corlett, J.（1992）.Factor affecting university women's basketball coaches' timeout decisions. *Canadian Journal of Sport Sciences*, *17*(4),333-337.

[15] Gilovich,T.(1984).Judgmental biases in the world of sport. In Stravb, W.F.,& Williams, J.M.(Eds). *Cognitive Sport Psychology*. *17*,295-314.

[16] Leet, James & Rushall(1984).Intercollegiate teams in competition. Afield study to examine variables influencing contests results. Intern. J. Appl. *Sport Psych*, *15*,193-204.

[17] Nunnally, J.C.（1978）.*Psychometric theory*. New York: McGraw-Hill.

Perceived Motivational Climate of Female Table Tennis Athletes

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Abstract: The study determined the perceived motivational climate among the eight Women's National Collegiate Athletic Association (WNCAA) table tennis school teams and its athletes according to skill level: beginner, intermediate, and advanced. Respondents included 37 athletes in the 2007-2008 season (3 beginners, 24 intermediate and 10 advanced athletes) who completed the 33-item Perceived Motivational Climate Sport Questionnaire – 2 (Newton, Duda, & Yin, 2000) on a 5-point Likert scale. They consist of 90% of the total population in the eight participating school teams. This was utilized to assess the degree of perception to which their respective team's motivational climate is characterized in terms of the two higher-order scales/constructs, labeled the perceived mastery climate and perceived performance climate (Newton, et.al., 2000; Reinboth & Duda, 2006). Descriptive statistics and ANOVA were used to analyze the results. Responses indicated that among all the athletes of the WNCAA school teams and across all skill levels, the identified perception of the prevailing motivational climate was more of a mastery climate which indicated a very high mean scale description of 4.52 than of a performance climate which obtained a 2.645 moderate mean score. The advanced level and intermediate level athletes' degree on their perception of the motivational climate registered a Very High Mastery Climate – Moderate Performance Climate; whereas in the beginner's level, athletes registered a Very High Mastery Climate – Low Performance Climate. It also revealed that there were no significant differences that emerged between the perceived motivational climate of the athletes among all school teams and across all skill levels, thus we accept the null hypotheses. It clearly indicated that the school teams' motivational climate set by the coach and peers valued encouragement, effort/improvement, and that athletes under their care reported having a more positive experience with their sport and team structure. While improving and refining a player's technical and tactical skill is crucial for enhancing the quality of play, it is the improvement of the psychological aspect and an established motivational climate that would eventually allow her to elevate her play to a much higher level.

Keywords: Perceived motivational climate, Mastery climate, Performance climate

1. INTRODUCTION

1.1 Background of the Study

Why are there a growing number of young female participants in sport despite the rigorous physical tasks and sacrifices they are expected to undergo? What keeps them motivated to work hard even though they acquire less privileges and benefits from sport participation? How could their involvement in a team be sustained or maintained?

In sport settings these days, to realize and maximize one's potential -physically and psychologically – proper psychological capacity and motivation may be the edge that an athlete needs. The degree to which an athlete develops his/her psychological abilities is what ultimately determines the level at which that player can perform or exploit his/her skills at optimal level.

Results of a growing body of research stressed the significance of an athlete's motivation to achieve in order to maximize, as well as, enrich his/her sport experience. The motivation to perform as an athlete is vitally important to the success of that individual and/or the team. It is worthwhile therefore to discover how these sporting experiences may be maximized.

Studies have shown that an important social environmental influence assumed to nurture the fundamental needs of athletes is the motivational climate created by the coach (Ntoumanis, 2001; Reinboth, Duda, & Ntoumanis, 2004; Sarrazin, Guillet, & Cury, 2001, cited in Reinboth & Duda, 2006). The team climate established in the playing context, emphasizes the role of the coach and the athletes - which constitutes the whole 'team' --- and eventually would make one's 'taking part' fruitful. In the same manner, this composition – coach and players – make up the whole teaching-learning process wherein their better interaction would eventually be a significant factor in achieving success. The coach is in a highly strategic position. What he/she puts into the interaction (demonstration of learning skills, designing practice sessions, grouping athletes, giving recognition, evaluating performance, sharing their

authority, and shaping the sport setting) can greatly influence the participation – or 'engagement' of his/her athletes, wherein applied skills will be determined by the coach himself.

The premise of the research is that the nature of an individual's sport experience, in this case the sport environment, and how he/she interprets these experiences, influence the degree to which the motivational climates are perceived. It is, therefore, important to know and understand the differing motivational climates so that a more potent program of developing female competitors could be achieved.

It is also important to note that the suggestion being promoted is that everyone in the team must be directed towards the success of the team. If an individual player improves with regards to skill level and performance, the team improves, and for that reason the "team" gets better. This is the most satisfying undertaking that the coach and athletes will have. On the other hand, nothing destroys team unity more than an uneven application of team rules by coaches which could trigger reactions or responses among players that would adversely affect their performance as a team. Players are quick to sense when coaches have favorites or play favorites. The bond that holds teammates together begins to collapse. When a coach gives special treatment to the star and when the star takes advantage of this special treatment, such unfairness will definitely be an expression of disrespect for the other players and the team itself. The degree of unification of the group and positive climate requires that even if the members of the team differ in skill level and come from different backgrounds, their responsibility to the team is one and the same.

It is for this intention that the authors seek to explore and examine the perceived motivational climate of the female table tennis athletes competing in the team event of the 38th Women's National Collegiate Athletic Association (WNCAA) tournament. This athletic organization caters only to women's sports in which a number of prestigious Metro Manila women's colleges have participated in since the 1970's. This organization constantly strives to ensure quality sport experience or a setting to exhibit female excellence from the grade school level to the collegiate ranks.

The time has come to highlight the sport or define a positive outcome from a female perspective and to impact female athletes in a special way. Knowing their perceptions, competencies and values will enable the WNCAA organization, institution or school, through the athletic director, to plan and cater proactively to their needs and full development. It is essential for the coaching staff, school personnel and the WNCAA organizers to know how its female athletes perceive their respective team climate --- a key to discover why these female table tennis athletes perform as they do, and thus, give everyone an insight into carrying out the most effective means to boost their athletic performance and behavior.

Moreover, the purpose of this study is to lay the groundwork for table tennis coaches, trainers, and fellow athletes in the WNCAA, to look beyond the development of sport-specific skills as their prime mode of training and to provide them with information that would serve as valuable basis for setting the proper motivational climate that would enable female table tennis athletes to reach their top-level competence.

Statement of the Problem

This study aimed to examine the perceived motivational climate of collegiate female table tennis athletes as set by the coach and teammates during the team's athletic season. Specifically, this study:

(1) identified the perceived motivational climate of the athletes among all the WNCAA table tennis school teams.
(2) determined the perceived motivational climate of the athletes according to skill level:

a. Beginner

b. Intermediate

c. Advanced

The following null hypotheses presented in this study were:

H_1 - There is no significant difference between the perceived motivational climates among all the WNCAA table tennis school teams.

H_2 – There is no significant difference between the perceived motivational

climates of the WNCAA table tennis athletes across all skill levels:

a. Beginner

b. Intermediate

c. Advanced

1.2 Significance of the Study

Having an established and secure motivational climate is critical to the overall development of an athlete and these situation al factors - such as the team's motivational c limate, coach's and teammates' support - can influence the quality of the athletes' sport ex perience and well-being. The level at which the athlete's skill is performed is directly related to the level of the athlete's total conditioning – may it be physical or psychological.

There are no shortcuts to developing one's potential but by establishing the proper situational goal structure or climate, a team/athlete can reach top-level performance. It is important, therefore, to elicit one's perceived motivational climate and to know what would most likely be the prominent climate characterized by the team in general. These include team and/or athlete problems like dropout from the sport, declining participation or interest, and burnout which are compounded by the weak interrelationship among members of the team and coaching practices/strategies that may inhibit athletes from reaching their potential. Problems like these have to be avoided or be detected early on and thus focusing their efforts toward cultivating a team climate (environment) that could effectively lead to the attainment of their mission or goal. By having an acquired knowledge base about a team's motivational profile, this may, however, greatly help them overcome the widespread concern regarding issues of motivation at an early onset of participation.

The value of interaction, cooperation, hard work, enjoyment, effort and improvement are fostered, while high and low-level skills are cultivated at the same time through motivational activities. Hence, it is in this context that the findings of this study may be used to identify factors that may be related to the athletic performance of the present WNCAA table tennis athletes and which may improve the quality of the teams by providing the athletes with the best possible motivational climate.

Motivation as an important factor in the development of an athlete has always been an area of interest to the researcher. Being part of an educational community and the sport setting, as well as a coach handling one of the WNCAA table tennis teams, setting the proper environment that would elicit positive results from players and enable them to reach their top level performance is a continuous challenge. Embarking on this study will, altogether provide the researchers, as well as, the school institution, coaching staff, and the WNCAA with valuable insights for planning, formulating, and implementing new program policies and specific interventional strategies that will cater to the needs of WNCAA female table tennis athletes. Hopefully these findings may eventually contribute to the development of the sport in the local setting.

Of major concern in this present study is whether the findings of past researches regarding sport programs that are regarded as team sports (e.g., basketball, soccer, football, etc.) is also true with those considered as individual sport programs, such as the focus of this research, which is table tennis.

This study focused on an individual sport that has a 'team' event as part of the tournament category. The Table Tennis Team Event has been the category applied in competitions like the Women's National College Athletic Association (WNCAA). This is the category or event wherein the team effort consists of the sum of the individual efforts. The singles and doubles events are conducted and the results shall be combined and accumulated. To the authors' knowledge, any literature or research similar to this study's direction – an individual sport focusing on an athlete's skill level - is very limited. It is therefore highly interesting to examine the kind of training environment provided WNCAA female table tennis athletes with and whether this leads to better skill execution.

1.3 Scope and Limitations of the Study

This study was confined to female table tennis athletes participating in the 38th WNCAA tournament. The WNCAA table tennis athletes were well-represented as respondents of the study. Thirty-seven (37) out of forty-one (41) athletes which is 90% of the total population took part in the study.

The motivational climate in their respective teams as perceived by the respondents was determined by means of employing the most recent structured version, Perceived Motivational Climate in Sport Questionnaire – 2 (Newton, Duda, & Yin, 2000). This questionnaire is a self-report tool designed to characterize the team's perceived motivational climate. Two dimensions or scales of motivational climate, labeled, the perceived mastery climate and perceived performance climate, were analyzed in this study. Likewise, the probable link or influence of these two motivational climate constructs to the athlete's skill level in the current year – beginner, intermediate, and advanced, were examined and assessed in this study.

Due to the absence of a standard criteria for the assessment of table tennis skill, determining the skill level classification of the athletes was made by the coach, the researcher and/or test administrator (both skilled in table tennis and teaching/coaching table tennis), and was perceived by the athletes themselves. The simple skill level characteristics (see 1.5 Definition of Terms) were also enumerated and explained. The simple skill level/ability characteristics was expressed according to skill development, number of years of playing experience and the present credentials in terms of competition experience and general tournament results.

The relationship between mastery climate and performance climate was no longer explored since Pearson Product moment correlations revealed that according to previous research by others (e.g., Dahdal et al., 1998; Newton & Duda, 1999; Newton et al., 2000; Reinboth & Duda, 2006; Heuze et al., 2006) the two perceived scales of the motivational climate have no significant correlation, therefore, outlining their independence.

1.5 Definition of Terms

1. Motivation - the fire that drives people to succeed; conceptually defined as the collection of causes that engage someone to an activity, and the process that energizes and directs behavior (Wakefield, 1996, as cited in Mowling et al., 2004).

2. Motivational climate – the goal structure of the sport environment created by significant others (e.g., coaches, parents) which is deemed task and/or ego involving (Duda & Whitehead, 1998); refers to the individual's perception of environmental cues or factors and can ultimately affect an individual's state of task involvement (Roberts, 2001).

3. Mastery climate – a motivational climate which is characterized by an emphasis on effort, improvement, members' contributions to the team's efforts, and helping each other learn and foster task involvement (Ames, 1992b; Ames & Archer, 1988)

4. Performance climate – a motivational climate emphasizes interpersonal competition, rivalrous social exchanges, normative feedback, public evaluation, and social comparison and induces ego involvement (Ames, 1992b; Ames & Archer, 1988).

5. Skill level – refers to the:

a. beginner level - a skill level wherein a table tennis athlete has had no previous competitive experience from a recreational level but has qualified to be included in the college varsity level

b. intermediate level – a skill level wherein an athlete participated in school meets, district as well as regional meets since grade school or high school; at least a year of college varsity level experience

c. advanced level - a skill level wherein an athlete participated in school, district, regional and national events; a national athlete (training pool or a member of the present team); undergoing higher level of training and competition

2. METHODOLOGY

The descriptive method of research was used in the study. The variables investigated were the perceived motivational climate (mastery-involving and performance-involving climates) of the WNCAA table tennis athletes and their skill levels,

classified as beginner, intermediate, and advanced.

2.1 Conceptual Framework

The conceptual model of this study is illustrated below in Figure 1.

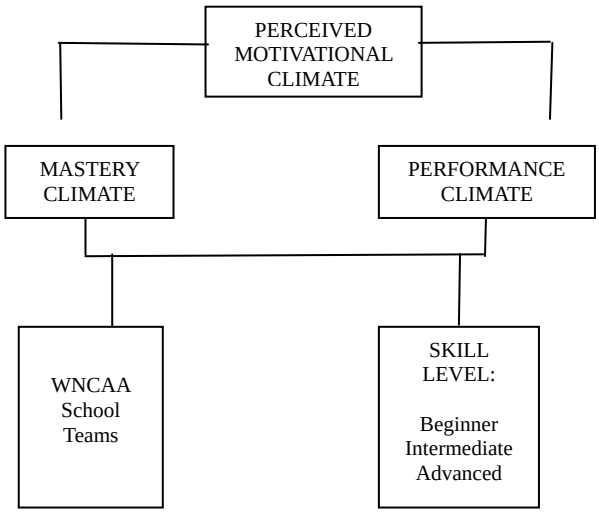

Figure 1 - Model of Conceptual Framework of the study

The frames present the two high order constructs of the perceived motivational climate – the mastery climate and the performance climate –and its implication to the skill level (beginner, intermediate, advanced level) of the female table tennis athlete.

2.2 Participants

The participants of the study are composed of thirty seven (37), out of the forty-one (41) or 90% of the total population, who are eligible collegiate female table tennis athletes, coming from the eight colleges competing in the school year 2007-2008 Women's National Collegiate Athletic Association (WNCAA) tournament. The WNCAA is a voluntary, non profit schools-based athletic organization that caters only to women's sports in which a number of prestigious Metro Manila women's colleges have participated in since the 1970's.

The respondents have been with the team a nd with their coach for a minimum of six mo nths, have competed in at least one major tou rnament, numerous tune-up games, thus allowing sufficient time for a coach-athlete relationship to develop (Jowett and Ntoumanis, 2004) and, as well as the establis hment of a motivational climate. According to some researchers (Miller & Roberts, 2004 ; Reinboth and Duda, 2006), the perceived motivational climate is likely to be established within 2–6 weeks.

Based on the developed criteria for determining the skill level of the participants (see 1.5 Definition of Terms), there were three (3) beginners, twenty four (24) intermediate and ten (10) advanced level female athletes. These beginners (n=3) became involved or were represented in this study so that their respective schools could meet the demands of completing a team line-up. These schools state that they have limited number of students trying out for the team and in so doing have to submit a lineup from these prospective trainees. All the participating schools have at least one or more intermediate level athletes, whereas the advanced level athletes (10) are only coming from two participating schools.

The questionnaires' initial portion included a request for athletes to answer truthfully and guaranteed them anonymity of responses. The researchers requested for the respondents to indicate their age, year level, as well as sought for the coaches' assessment in determining the skill level of their athletes based on the simple criteria or level characteristics.

Due to the absence of a standardized criteria or tool for the assessment of table tennis athletes' skill performance, the researchers, together with the coaches, identified the characteristics of the athletes in determining their skill level classification. The simple level characteristics are determined by the athlete's skill development, number of years playing experience and the present credentials in terms of competition experience and general tournament results.

2.3 Instrumentation

To find out the athletes' perception of the prominent motivational climate goal structures created by the coach and co-players, the researchers opted to utilize and apply the updated and improved version, the Perceived Motivational Climate in Sport Questionnaire – 2 (PMCSQ-2) developed by

Newton, Duda and Chi (2000) and consists of 33 items. This has also been examined, validated, and used as a reliable questionnaire to a quantity of studies (i.e. Balaguer et al., 1997; Cervell´o & Santos-Rosa, 2000; M.Fry and M. Newton, 2003; M. Reinboth, & J.L. Duda, 2006; J. Murcia, E. Gimeno and D. Coll, 2007;). It is a structured tool and a sport specific measure of the perceived motivational climate operating on sport teams, which is labeled as mastery climate (task-involving) and performance climate (ego-involving).

The female athletes' perceptions of motivational climate in their respective table tennis programs have been determined by this 33–item measure drawn from the most recent Perceived Motivational Climate Sport Questionnaire – 2 (PMCSQ-2; Newton et al., 2000). It consists of 17 mastery-involving and 16 performance-involving climate items (see Table 1).

In accomplishing the questionnaire, the respondents were asked to think about how they felt about playing for their particular team over the course of the season. Each item is preceded by the stem 'On this team…' and responses were indicated by using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The participants' response on each scale was averaged to yield a scale score. Mean scale scores were computed. The greater or higher their scores are on each construct, the greater is their perception of that climate.

TABLE 1 – Perceived Motivational Climate in Sport Questionnaire– 2 Items for Mastery Climate and Performance Climate (Newton, Duda, & Chi, 2000)

Items for Mastery-Focused Climate (17 items)	**Items for Performance-Focused Climate** (16 items)
1. On this team, the coach wants us to try new skills	1. On this team, the coach gets mad when a player makes mistakes.
2. On this team, each player contributes in some important way.	2. On this team, the coach gives most of his or her attention to the stars.
3. On this team, the coach believes that all of us are crucial to the success of the team.	3. On this team, the coach praises players only when they outplay teammates.
4. On this team, players feel good when they try their best.	4. On this team, the coach thinks only the starters contribute to the success of the team.
5. On this team, players at all skill levels have an important role on the team.	5. On this team, players are taken out of a game for mistakes.
6. On this team, players help each other learn.	6. On this team, players are encouraged to outplay the other players.
7. On this team, the coach makes sure players improve on skills that they're not good at.	7. On this team, the coach has his or her own favorites.
8. On this team, players feel successful when they improve.	8. On this team, the coach yells at players for messing up.
9. On this team, each player has an important role.	9. On this team, only the players with the best 'stats' get praise.
10. On this team, trying hard is rewarded.	10. On this team, players are punished when they make a mistake.
11. On this team, the coach encourages players to help each other.	11. On this team, the coach makes it clear who he or she thinks are the best players.
12. On this team, the coach emphasizes always trying your best.	12. On this team, players are 'psyched' when they do better than their teammates in a game.
13. On this team, players are encouraged to work on their weaknesses.	13. On this team, if you want to play in a game you must be one of the best players.
14. On this team, the focus is to improve each game/practice.	14. On this team, only the top players 'get noticed' by the coach.
15. On this team, the players really 'work together' as a team.	15. On this team, players are afraid to make mistakes.
16. On this team, each player feels as if they are an important team member.	16. On this team, the coach favors some players more than others.
17. On this team, the players help each other to get better and excel.	

2.4 Procedure

Consent was obtained from the respective school's College Athletics Coordinator (CAC) to conduct this study. The CAC signed an endorsement letter to the team coaches, trainers, and athletes to encourage them to respond to the questionnaire. Request for participation was made to coaches, trainers, and athletes of the different WNCAA table tennis teams for athletic season 2007-2008.

Upon verbal agreement with the coaches or trainers and the athletes, the researchers briefly mentioned the purpose of the study to the team. The questionnaires were administered by the researchers. The respondents were encouraged to answer the questionnaire with honesty and to clarify statement items if there was any difficulty understanding them. They were also informed that their involvement in the study is voluntary and that the results will be treated with utmost confidentiality.

Questionnaires were administered to all official WNCAA table tennis enlisted eligible athletes at the start of their respective practice sessions, which took about 15-25 minutes to accomplish. The instrument (PMCSQ-2) was administered to the teams on March 14-15, 2008 or before the end of the 38th WNCAA athletic season to ensure that a motivational climate was established. The researchers chose to administer the instrument near the end of this season, because we believe that within the particular level (collegiate), the participants are relatively changing their perceptions depending on the coach-created environment and/or which part of the training season (off-season, pre-season, or competition phase).

Upon completion, the accomplished questionnaires were collected and placed in an envelope and were classified per team. The results were tallied and tabulated for statistical treatment and analysis.

2.6 Statistical Treatment of Data

The descriptive statistics – mean and standard deviations – was used to determine the perceived motivational climate of the respondents.

The scores were then grouped and categorized accordingly to characterize the level or scale of the perceived performance and mastery climates of the respondents, as shown in Table 2. The range of scores was computed by subtracting the lowest scale (which is 1) from the highest scale (that is, 5) and dividing the difference by the number of selected group intervals, which is 5. Thus, an interval of 0.8 was obtained for each weighted mean score group.

Table 2 – Perceived Motivational Climate Description of Mean Scores

Description of Perceived Motivational Climate	Range of Scores
Very High	4.2 – 5
High	3.4 – 4.19
Moderate	2.6 – 3.39
Low	1.80 – 2.59
Very Low	1 – 1.79

The analysis of variance (ANOVA) was used in determining if there was an important difference on the perceived motivation climate among the WNCAA table tennis school teams, as well as, among the different skill levels of athletes (i.e., according to beginner, intermediate and advanced skill levels). Computations for the descriptive statistics and ANOVA were run through the Statistical Package for Social Science (SPSS).

3. PRESENTATION AND DISCUSSION OF RESULT

This chapter presents the data gathered through the research instrument used in the study.

The data gathered through the questionnaire were presented in the following section which tackles the answer to each of the research hypotheses, mainly focusing on the Perceived Motivational Climate among the WNCAA table tennis school teams and across all skill levels.

The following figures (Figure 2 and Figure 3), displayed the frequency on the distribution of responses according to the perceived mastery and performance climate, its mean and standard deviation among all

the athletes in the eight WNCAA school teams.

In Figure 2 it can be gleaned that among the thirty seven respondents, nine of them, which is the highest frequency, obtained a total weighted mean score of (reflect value) on the Mastery Climate. This shows that the perceived mastery climate of these respondents is very high.

It likewise showed a total mean score of 4.5199 with a standard deviation of 0.36248. This strongly suggests that the respondents among the eight WNCAA school teams perceive a strong or a very high mastery climate (see Table 3 for the Description of Mean Score).

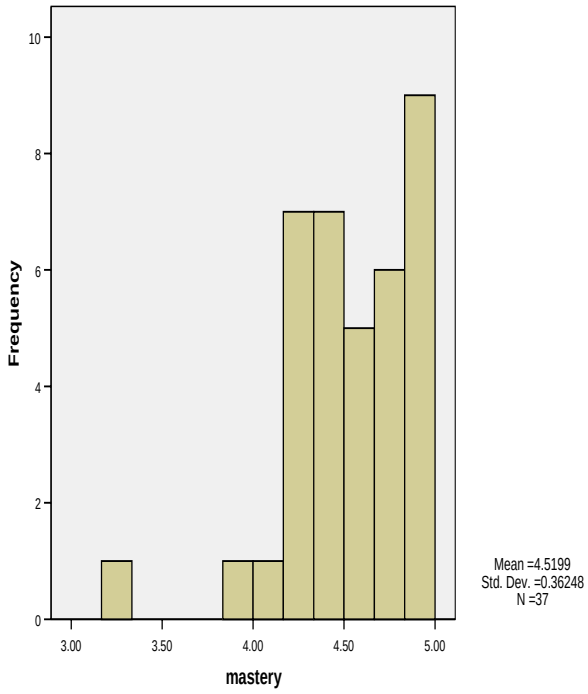

Figure 2 – Frequency of responses for the Mastery Climate Item Scales

Figure 3 likewise presents the frequency of responses for the perceived performance climate item scales. It displayed that among the thirty seven (37) respondents of the WNCAA school teams, the highest number, which was eleven (11), perceived the performance climate and their respective teams as moderate. Meanwhile, the least number of responses generated very low and high scores. The total mean score of 2.6453 likewise indicated that the degree of the perceived performance climate among the respondents from the eight WNCAA school teams is moderate.

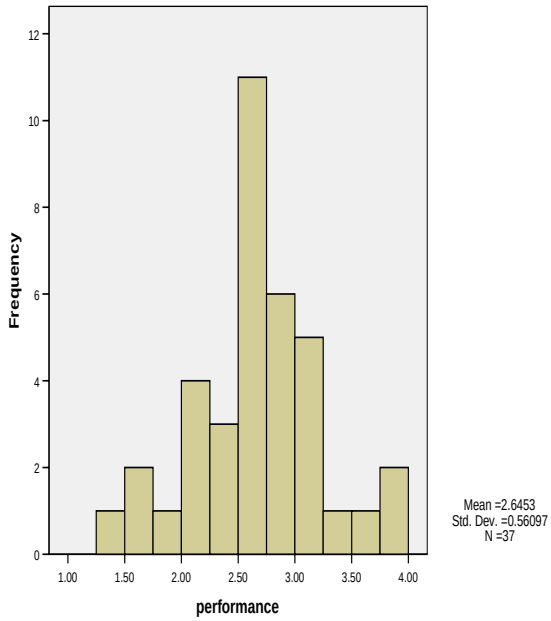

Figure 3 - Frequency of responses for the Performance Climate Item Scales

Table 3 presents the corresponding mean scores, standard deviations and description of the perceived motivational climate of the thirty seven athletes grouped according to the WNCAA table tennis school teams.

Table 3- Perceived Motivational Climate of Respondents by School

School	N	Perceived Motivational Climate			
		Mastery		Performance	
		Mean	Desc.	Mean	Desc.
1	7	4.36	VHigh	2.53	Low
2	6	4.89	VHigh	3.2	Mod
3	4	4.65	VHigh	2.53	Low
4	4	4.62	VHigh	2.58	Low
5	5	4.38	VHigh	2.71	Mod
6	4	4.53	VHigh	2.89	Mod
7	3	4.14	High	1.77	Vlow
8	4	4.46	VHigh	2.53	Low
Total/Ave.	37	4.52	VHigh	2.645	Mod

In the data gathered half of the school teams obtained a low mean score description in the perceived performance climate while three school teams had a moderate mean score. Only one school team (School 7, n=3) got a result of a very low perceived

performance climate. Among the three moderate scores of the school teams one, which is School 2 (n=6), got the highest value of 3.2 whereas School 7 registered the lowest mean score of 1.77.

In the perceived mastery climate seven out of eight school teams revealed a result of a very high mean score description ranging from 4.36 to 4.89. Only one school team (School 7) scored 4.14 which is equivalent to a high description. The highest mean score (4.89) is obtained by School 2 and the lowest mean score (4.14) is registered by School 7.

Looking closely at Table 3, it can also be noted that Schools 2 and 7 garnered the highest and lowest weighted mean scores respectively in both of the two high order scales of the perceived motivational climate namely performance and mastery climate.

Still based on Table 3, the general mean is 2.645 for the perceived performance climate with a moderate mean score description while in the mastery climate it presented a very high mean score description with a general weighted mean of 4.52.

Results showed that the athletes scored moderate in performance climate score and very high in the mastery climate. From all eight schools, the study revealed that the predominantly perceived motivational climate of athletes was a perceived mastery-involved climate.

The results therefore suggested that the majority of the athletes among all the school teams view that their coach and teammates gave importance to personal improvement and progress through high effort and mastery in playing table tennis or task execution in a way that they experienced more satisfaction from skill learning and accomplishing tasks as bases for recognitions and rewards as well as for them to achieve competence and success. As perceived by most of the respondents, the performance climate situations show a lesser prominence, where comparisons of performance and ability with peers were seldom observed.

As suggested in the literature concerning the female gender in relation to the goal perspectives and eventually their motivational climate, previous research (e.g., Duda, Chi, Newton, Walling & Catley, 1995; Duda, Olson, & Templin, 1991; Newton & Duda, 1993; Chie-der et al., 2003; Reinboth & Duda, 2006) indicated that the present group of female athletes were strongly task-oriented, recorded higher scores in perceived mastery climate than male players and reported higher perceptions of task-involving coach and peer motivational climates.

As suggested in previous research (e.g., Duda, Chi, Newton, Walling & Catley, 1995; Duda, Olson, & Templin, 1991; Newton & Duda, 1993; Chieder et. al., 2003; Reinboth & Duda, 2006), female athletes are strongly mastery-involving and/ or task-oriented rather than performance-involving or ego-oriented. The above results support previous findings that female athletes have the tendency to have higher perceptions of mastery or task-involving coach together with peer (teammates) motivational climate and lower scores in perceptions of performance or ego-involving coach and peer motivational climate.

Results from Table 4 indicated the sample size, means, standard deviations and score descriptions among the WNCAA table tennis athletes by skill level that was according to beginner, intermediate, and advanced levels.

Table 4 - Perceived Motivational Climate of Respondents by Skill Level

Skill Level	N	Perceived Motivational Climate			
		Mastery		Performance	
		Mean	Desc	Mean	Desc
Beginner	3	4.627	VHigh	2.583	Low
Intermediate	24	4.488	VHigh	2.62	Mod
Advanced	10	4.565	VHigh	2.725	Mod
Total/Ave.	37	4.52	VHigh	2.645	Mod

In the beginner's skill level (n=3), the perceived performance climate has a low mean score description with a weighted mean of 2.583. In the mastery climate, the beginner's mean is 4.627 which obtained a

very high mean score description. The beginner's level sample size was not excluded from the statistical treatment due to the fact that it is still part of the total population, represented by two schools, being conducted in the study. Subsequently, in the intermediate level (n=24), it shows that the perceived performance climate's weighted mean is 2.62 which is described to be moderate. On the other hand, the data had a very high score description of the perceived mastery climate at which it obtained 4.488 mean score. In the third skill level which is the advanced level (n=10), the weighted mean obtained for the perceived performance climate is 2.725 described to be of a moderate score result and a very high mean score of 4.565 for the perceived mastery climate.

The pattern of results of the mean scale score obtained in the performance climate is expected – that the order of skill level would be the advanced level as the highest score, followed by the intermediate and then lastly the beginner's level. This indicated that as revealed by Seifriz et al., (1992), the higher the skill level or competence the more likely they would be associated with the performance-involved setting. Surprisingly however, looking at Table 4 concerning the mastery climate mean scale score among the three skill levels, though it is assumed and expected that the beginner's level would garner the highest mean scale score since they are the ones who receive more of the step-by-step instruction and error correction, it is unexpected that the intermediate level would register a lower mean scale score (4.488) compared to the score of the advanced level (4.565). The pattern had a slight shift in the expected order on the outcome of the mean scale scores in the mastery climate. Two main explanations have been offered to account for the result: (1) it may be due to a larger sample size or that the bulk of the respondents is at the intermediate level (n = 24) versus the advanced level respondents (n = 10) and beginner's level (n=3) ; and (2) since the intermediate level are in a transition, with the basic skills already attained and quickly aspiring to go up a level higher, when complex movements and skills are increased there is that tendency for them to have difficulty in making big adjustments in receiving more tactical instruction and precise information that would result to performance worry and tension (Newton & Duda, 2000). It is thus speculated that this would occur only at an advanced level as it is in this level that most of the practice time is spent on the cognitive and tactical aspect of the sport.

In summary across all skill levels, the general weighted mean of the performance climate was described to be of a moderate mean score description with a result of 2.645, while the perceived mastery climate's general weighted mean was described to be very high obtaining a score of 4.52.

In accordance with previous studies, research reveals that having a moderate to high in both motivational climates - performance and mastery - is more likely to have positive motivational responses compared to having a profile that is low in perceived performance as well as a mastery climate (Dorobantu and Biddle, 1997; Goudas et al., 1994; Roberts et al., 1996; Standage and Treasure, 2002). According to the abovementioned researchers, this is also the model that has the second most positive outcome. The first indicating a high description in both performance and mastery climates.

Results also revealed that across all skill levels, the predominantly perceived motivational climate of the athletes demonstrated a mastery-involved climate since it obtained a very high mean scale score. Among the three skill levels only the beginner's level had a description of having a low weighted mean scale score on the perceived performance climate and had the highest mean score in the mastery climate. This result was assumed and that it is congruent to the study made by Castaneda and Gray (2007) stating that the optimal focus of attention for highly skilled batters is one that does not disrupt procedural knowledge and permits attention to the perceptual effect of the action, whereas the optimal focus of attention for less-skilled batters is one that allows attention to the step-by-step execution of the swing.

Balaguer, Duda, Atienza and Mayo (2002) found similar results when examining the relationship of perceived motivational climate created by the coach and dispositional goal orientation with team member's perceptions of their skill improvement, and their satisfaction with their personal and the teams level of play, competitive results, coach's instruction and attention among elite female handball

players.

The results wherein the advanced level group obtained a very high mean scale description of a perceived mastery climate and a moderately high score on perceived performance climate is congruent with other findings or thus explains the findings of the study according to Ericsson et al., (1993), Treasure (1997, cited in Dahdal et al.,1998) together with an extended study by Simon and Chase's (1973) work that it is due to deliberate practice theory that those with high skill level possess a quality that has high levels of effort and attention in executing tasks for the reason that they spend more time and attention during training and in which requires high level of training or practice

However, to most of the related studies (Seifriz, Duda and Chi, 1992; Dahdal et al., 1998; Castaneda and Gray, 2007), the present results do not necessarily suggest or greatly support the same findings which basically states that, perceptions of a performance climate (ego-involving) have been linked to the view that one must have inherently high ability to be successful and/or would foster greater levels of perceived competence among athletes. Their indications likewise suggested that those who perceive themselves as being highly competent adopted a mentality associated with competitive outcomes, rather than skill improvement. This rather does not hold true to the results of the present study since the athletes across all skill levels particularly the advanced level displayed a high amount of mastery-involving climate characteristics and a lesser prominence on the performance-involving climate and this may be due also to the very nature of the respondents being females. Over and over again there is much literature stating that females do not tend to demonstrate their ability in competitive situations, unlike males (White & Duda, 1994, cited from Petherick & Weigand, 2002).

On the other hand, findings from related studies still hold meaning in one aspect wherein based on the descriptive statistical results of the present study, although the participants across all skill levels registered a predominantly perceived mastery motivational climate, it is still to be noted and expected that among the skill levels, the advanced level registered the highest mean score (moderate description) in the performance climate indicating that as revealed by Seifriz et al., (1992), the higher the skill level or competence the more likely they would be associated with the performance-involved setting; and also in the study conducted by Ames (1992) stating that a performance-oriented climate, with its emphasis upon social comparison, high ability children would seem to thrive in either environment and in which, conversely, can be particularly harmful to low ability youth (Ames, 1992).

Table 5 shows the mean and standard deviation of the respondents in all skill levels.

Table 5 - SPSS

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
performance	Beginner	3	2.5833	.28183	.16271	1.8832	3.2834	2.31	2.88
	Intermediate	24	2.6198	.56803	.11595	2.3799	2.8597	1.56	3.94
	Advanced	10	2.7250	.63751	.20160	2.2690	3.1810	1.44	3.56
	Total	37	2.6453	.56097	.09222	2.4582	2.8323	1.44	3.94
mastery	Beginner	3	4.6275	.34467	.19900	3.7712	5.4837	4.24	4.88
	Intermediate	24	4.4877	.36611	.07473	4.3331	4.6423	3.29	5.00
	Advanced	10	4.5647	.38443	.12157	4.2897	4.8397	3.94	5.00
	Total	37	4.5199	.36248	.05959	4.3990	4.6407	3.29	5.00

The analysis using ANOVA (SPSS) was also utilized. While in Table 6, it revealed that there is not enough evidence to conclude that the athletes from three different skill levels have significantly different perceived performance motivational climate scores, $F(2,34) = 0.137$, $p = 0.872$, whereas the perceived mastery motivational climate scores obtained an $F(2, 34) = 0.291$, $p = 0.749$.

Table 6 - SPSS

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
performance	Between Groups	.091	2	.045	.137	.872
	Within Groups	11.238	34	.331		
	Total	11.329	36			
mastery	Between Groups	.080	2	.040	.291	.749
	Within Groups	4.651	34	.137		
	Total	4.730	36			

In view of that, the outcome of results may be mainly due to the different or varying number of respondents in the study. Therefore, there is not enough evidence to conclude (not enough to substantiate the evidence) or to say that there is a significant difference between the perceived motivational climate of athletes among all the WNCAA school teams and across all skill levels. Thereby, the results of the present study on the perceived motivational climate of the WNCAA table tennis athletes does not show any disparity in skill level and thus

still indicated the importance or emphasis of a mastery climate in promoting positive psychological outcomes in the table tennis teams.

In this study it was able to confirm that the hypothesis was true, that there were no significant differences among all the WNCAA table tennis school teams pertaining to their perceived motivational climate and similarly as with across the three skill levels. Indeed as hypothesized, no coaches and teammates emphasized a performance-involved climate in their teams.

Moreover, the findings of this study would add insight in identifying factors that may be related to the performance of the WNCAA table tennis athlete by providing them with enhanced psychological skills training and appropriate team climate.

4. SUMMARY, CONCLUSION AND RECOMMENDATION

4.1 Summary of Findings

This research sought to identify the perceived motivational climate among the eight WNCAA table tennis school team athletes and to determine the perceived motivational climate of athletes across all skill levels namely, beginner, intermediate, and advanced level. To come up with the output, this study concentrated on the two high order constructs of the perceived motivational climate namely, the mastery and performance climates. From all eight school teams, the findings of this study showed that the predominantly perceived motivational climate of athletes was a perceived mastery-involved climate. The gathered data revealed that the athletes (n = 37) across all skill levels showed low to moderate mean scale score in performance climate score and very high in the mastery climate.

Results in this study were able to confirm that the hypothesis is true, in which there was no significant difference among all the WNCAA table tennis school teams pertaining to their perceived motivational climate and consequently same as with the three skill levels which proved that their perceived motivational climate have no significant differences at all. Indeed as hypothesized, no coaches and teammates emphasized a performance-involved climate in their teams.

Our findings confirm our hypothesis that the coaches and teammates' support may significantly contribute to the team performance of female table tennis athletes and the motivational climate specifically, mastery-involved climate, adapted by the coach and the teammates.

According to achievement goal theory (Nicholls, 1989; Ames, 1992; Dweck, 1999), individuals are more likely to be optimally motivated when task-involved. In sport, for example, this adaptive pattern is predictable whether the athlete perceives skill level to be high, or realizes that his or her competence is inferior. Why should this be? The answer is that when task-involved, concern is with improving and giving one's all. Regardless of ability level, athletes should try to identify areas in which they can develop. Moreover, when task-involved, athletes judge their level of competence in terms of their own progress and effort. Consequently, an athlete's sense of confidence is more buoyant when task-involved (cited from Cockerill, 2002).

The researcher found these results very intensely motivating in the current work as a coach in the different areas in table tennis. By knowing the findings of the study, it was well thought of that such team motivational climate created by the coach enrich and encourage the quality of athletes' sport experience and well-being. On the side of the psychological development of the athlete, the researcher believes that the coach plays an important role in providing a mastery-involved climate emphasizing effort and improvement in the learning process, value of interaction, hardwork, cooperation, enjoyment, and sustainability in the sport shall be fostered. As pointed out by the studies of Smith and Smoll (1996) and Baker et al. (2003), they indicated that the quality and quantity of training and environmental factors would influence the acquisition of sport proficiency (or sport expertise). This evidently indicates that these two elements are crucial predictors of attainment. These researchers also added that adequate coaching is also one important possession of resource and that the coach is an important social agent in the sport activities.

Clearly, as thus emphasized by Fry & Newton (2003), that when young players perceive a highly task-involving motivational climate, their experience seems to be greatly enhanced, and perceptions of an

ego-involving climate may turn young players away from a program. This is what the study would aim to discover and find out, that the female table tennis athletes would be able to continue and sustain their involvement or participation in their sport as well as having a fruitful sporting experience (feel valued as individuals beyond their athletic roles and responsibilities) by emphasizing a mastery-involved climate in their respective school teams. In such a perceived motivational climate, if there is an improvement in the individual, therefore, the team in general gets better and performs well.

Furthermore, the findings of this study would provide a meaningful implication to coaches and athletes alike that in identifying factors that may be related to a better over-all performance and development of the WNCAA athlete, either physically and more so of the psychological skill aspect, would enforce a team climate that is deemed necessary.

4.2 Conclusion

Based on the findings of the study the following conclusions were drawn:

1. The identified perceived motivational climate of the female table tennis athletes among all WNCAA school teams is predominantly mastery-involved.

2. The degree of the perceived motivational climate deemed as more prominent by the WNCAA table tennis athletes across all skill levels is a mastery-involved climate indicating a very high mean scale.

3. The responses of the athletes in the two constructs according to the advanced and intermediate levels' degree on their perception of the motivational climate is Very High Mastery Climate – Moderate Performance Climate; whereas in the beginner's level, registered a Very High Mastery Climate – Low Performance Climate.

4. The hypothesis that there was no significant difference between the perceived motivational climate among all the WNCAA table tennis school teams was accepted and confirmed.

5. In this study, it confirmed and accepted that there was no significant difference between the perceived motivational climate of the WNCAA table tennis athletes across all skill levels specifically in the beginner, intermediate, and advanced level.

It is notable that the capacity of the coach (since the availability of coaching is one essential resource and is proven that it can significantly influence the ability of the athletes to engage in high quality training or competitive/positive sport setting or for acquiring success in performance) to enforce or devise an environment that fosters the most favorable learning thus becomes one of the most significant keys to an athlete's development and eventually achieving success. In view of the fact that most of the respondents or the bulk percentage of the respondents (n = 24) classified as having an intermediate skill level, it is therefore imperative that the coaches in these teams reinforce more of the mastery-involved climate. It is also important to understand the role of the coach in supporting the participants' development as true athletes and that these results therefore extend Balaguer et al.'s (2002) findings by demonstrating that perceived motivational climate is a source of athletes' perceptions of their team properties.

As indicated by the results, since the school teams registered a high mastery climate, coaches with beginners or intermediate athletes should focus on the proper fundamentals of the sport or primarily technical instruction and later build up on the tactical side of the sport by means of reinforcing more of the mastery climate which is the more suitable setting to utilize this. Likewise, it is also for this reason that for the female athletes to continue participation in this sport having a high degree of support, equal attention, enthusiasm and better facilitation skills is preferable to this level. These qualifications and strategies be applied to beginners and intermediate levels, a different level of facilitation skills would be also required to athletes in advanced levels or even the elite level since being highly skilled requires a balance of both climates or should be high on both is the more adaptive pattern.

Having said this, clearly, both the practice structure and the domain specific-knowledge

of coaches are highly relevant to the progression, sustained participation/involvement, and development of the female table tennis athletes in the sport. Thus, nurturing these athletes in these skill levels is imperative far more beyond the technical expertise, advancement without high psychological abilities, and tactical nature of the sport.

The results are, however, only based on a homogenous sample in nature. It only applies to the female table tennis athletes competing in the team event of the WNCAA. These are athletes playing an individual sport and who are in a team performing interdependent tasks. This would correspond with Newton et al. (2000), Seifriz et al. (1992) and Walling et al.'s (1993) suggestions that the more athletes perceive their coaches as emphasizing cooperation between teammates, individual members' contributions to the team's efforts, the more they perceive their team as a whole centered on the group's task even if they perform their individual events. The present results, though, may not be generalized to other competitive levels and male teams.

Results obtained clearly indicate that the school team's motivational climate created by the coach and teammates valued encouragement and positive reinforcement, that athletes under their care would report having more positive experiences with their sport and teammates, having more of technical instruction rather than offering harsh feedback, then they would more likely stay in the program, have lower levels of anxiety or pressure/tension, and report a high level of self-esteem for the coming athletic season. Consequently, this will increase the likelihood that the female athletes' participation in table tennis will be sustained and enhanced over time.

4.3 Recommendations

In the light of the conclusions drawn, the following are recommended:

1. The data set was quite small and needs to be expanded. Having a larger sample size and cross-section of various age groups (with equal distribution) is suggested in order to establish an expanded knowledge base and concern regarding issues of motivation.
2. Investigate and examine further the interaction between the Mastery Climate and Performance Climate employing the two-way ANOVA theory.
3. It would be important for future research to interview, survey, and observe (a qualitative study appropriate to this type of study) a coach, an individual player or a team to obtain a better picture of the actual motivational climate in a team setting at different phases of the athletic season.
4. This study should be replicated with athletes of both genders (since this study only examined a female athletes' perception of the motivational climate of the coach and teammates created in the table tennis teams competing only in the WNCAA); different sport disciplines (individual or team sport); several skill levels (possessing higher vs. lower degrees of ability); and from different training phases of a particular sport program, in order to determine, in a more reliable way, the interaction and interplay that exists between the motivational variables.
5. Likewise, it could also be directed towards later on designing a developmental program that intensifies and improves not only the physical aspect of the sport but also the psychological skill training suitable for the WNCAA table tennis teams.
6. It would seem that additional research should also be required to understand some other factors or concerns which influence differing motivational climate of athletes or the coach's perception themselves. A coach having to answer or respond to a different or their own version of a questionnaire pertaining to their preferred motivational climate.

REFERENCES

[1] C. Ames & J. Archer, "Achievement goals in the classroom: Students' learning strategies and motivation", *Journal of Educational Psychology,* 80, 260-267, 1988.

[2] C.Ames, "Achievement goals, motivational climate and motivational process,"*Motivation in Sport and Exercise,* pp161-176,1992, Champaign IL: Human Kinetics, 1992.

[3] J. Baker and S. Horton, "Nurturing sport expertise: Factors influencing the development of elite athlete." *Journal of Sports Science and Medicine,* 2, 1-9, 2003.

[4] I. Balaguer, J.L. Duda F.L. Atienza and C. Mayo, "Situational and dispositional goals as predictors of perceptions of individual and team improvement, satisfaction and coach ratings among elite female handball teams." *Psychology of Sport and Exercise,* 3(4), 293-308, 2002.

[5] A .Bandura, *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ, Prentice Hall, 1986.

[6] D. Chie-der, S. Chen, Hung-yu C. and Li-Kang C., "Male and female basketball players' goal orientation, perceived motivational climate, perceived ability, and the sources of sport confidence," *US Sport Academy – The Sport Journal,* 6 (3), 2003.

[7] I. Cockerill, *Solutions in Sports Psychology,* 2002.

[8] M. Dahdal, L. Guidone, A. Kapismalis and A. Palet, " The Relationship between motivationalclimateand intrinsic motivational nof basketball players in as Australian setting," 1988

[9] J.L Duda, J. Whitehead, "The relationship between motivational climate and intrinsic motivation of basketball players in an Australian setting," 1988.

[10] C.S. Dweck, Self-theories: Their Role in Motivation, Personality, and Development, . Ann Arbor, MI: Psychological Press, 1999.

[11] A. Enrado, "athletes' scholarship status to intrinsic motivation and motivational climate," *UP SEARCH and UP CHK Library*.

[12] M.Fry and M. Newton, "Application of achievement goal theory in an urban youth tennis setting.," *Journal of Applied sport Psychology*, 15, 50-66, 2003.

[13] A. Halliburton and M. Weiss, "Sources of competence information and perceived motivational climate among Adolescent female gymnasts varying in skill level," *Journal of Sport and Exercise Psychology, 24*, 396-419, 2002.

[14] J. Heuze, P. Sarrazin, M. Masiero, N. Raimbault and J. Thomas, "The relationships of perceived motivational climate to cohesion and collective efficacy in elite female teams," *Journal of Applied Sport Psychology* , 18, 201-218, 2006.

[15] C. Mowling, S. Brock, K. Eiler and M. Rudbili, "Student motivation in Physical Education," *JOPERD, 75*, 40-45, 2004.

[16] J. Murcia, E. Gimeno and D. Coll, "Young athletes' motivational profiles," *Journal of Sports Sciences, 6*, 172-179, 2007.

[17] M. Newton and J.L. Duda, "The interaction of motivational climate, dispositional goal orientations, and perceived ability in predicting indices of motivation," *International Journal of Sport Psychology, 30*, 63-82, 1999.

[18] M. Newton J.L. Duda and Z. Yin, "Examination of the psychometric properties of the Perceived Motivational Climate in Sport Questionnaire-2 in a sample of female athletes," *Journal of Sport Sciences, 18 (4)*, 275-290, 2000.

[19] J. Nicholls, *The competitive ethos and democratic education.* Cambridge, MA: Harvard University Press, 1999

[20] N. Ntoumanis, "A self-determination approach to the understanding of motivation in physical education," *British Journal of Educational Psychology, 71*, 225-242, 2001.

[21] C. Petherick,. and D. Weigand,, "The relationship of dispositional goal orientations and perceived motivational climates on indices of motivation in male and female swimmers., " *International Journal of Sports Psychology, 33*, 218-237, 2002.

[22] J. Pituk, " Goal perspective and perceived motivational climate among the league baseball players," *UP SEARCH and UP CHK Library,* 2004

[23] M. Reinboth, J.L. Duda, & N. Ntoumanis, . " Dimensions of coaching behavior, need satisfaction, and the psychological and physical welfare of young athletes," *Motivation and Emotion, 28*, 297-313, 2004

[24] M. Reinboth, & J.L. Duda, " Perceived motivational climate, need satisfaction and indices of well-being in team sports: A longitudinal perspective," *Psychology of Sport and Exercise, 7*, 269-286, 2006

[25] P. Sarrazin,, E. Guillet, , & F. Cury, "The effect of coach's task and ego-involving climate on the changes of perceived competence relatedness, and autonomy among girl handballers.," *European Journal of Sport Science, 1*, 1-9, 2001.

[26] T.K. Scanlan, & R. Lewthwaite, " Social psychological aspects of the competitive sport

experience for male youth sport participants: IV. Predictors of enjoyment," *Journal of Sport Psychology*, 8, 25-35, 1986

[27] J.J. Seifriz,,J.L. Duda, & L. Chi, "The relationship of perceived motivational climate to intrinsic motivation and beliefs about success in basketball," *Journal of Sport and Exercise Psychology, 14*, 375-391, 1992

[28] R. E. Smith, & F.L. Smoll, " Coach-mediated team building in youth sports," *Journal of Applied Sport Psychology, 9*, 114-132, 1997

[29] M.L. Walling, J.L. Duda, & L. Chi, "The Perceived Motivational Climate in Sport Questionnaire: Construct and predictive validity.," *Journal of Sport and Exercise Psychology, 15*, 172-183, 1993

[30] Women's Sports Foundation - A Matter of Health and Well-Being. Mon 14-Aug-2000. www.gogirlworld.org

[31] P. Xiang,, A. Bruene, & R. McBride, "Using achievement goal theory to assess an elementary physical education running program," *Journal of School Health, 74 (6)*, 220-225, 2004

Sports Students' Motivation for Participating in Table Tennis at the Faculty of Kinesiology in Zagreb

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Abstract: The purpose of this study was to find out the sports students' motives for participating in table tennis sport course at the Faculty of Kinesiology in Zagreb. The research aim was to provide findings for better planning of the programs. The subjects of this research were 138 students (114 males & 24 females), who took the course in table tennis at the University of Zagreb, Faculty of Kinesiology (KIF). The questionnaire used in this investigation to assess students' motivation consisted of 30 items. It was designed by Gill, Gross & Huddleston (1983) and is called "Participation Motivation Questionnaire". The PMQ was distributed to the subjects at the end of the semester. The data were analyzed by descriptive statistics, factor analysis and one way ANOVA. To analyse the motivational space the main component method was used and the number of factors was determined after Varimax rotation Method with Kaiser Normalization.

The top three motives for choosing table tennis were: "I Want to stay in a good shape;," "I love doing things I am good at;," and "I want to stay in good physical shape and healthy". It is interesting that females have the same top three motives as males and that the values are even higher than by males. For the sports students their intrinsic motivation is important and that's why at the bottom of the results scale there are assertions about extrinsic factors such as: "My parents and friends want me to compete", "I like to feel important" and "I want to be popular". The obtained results also indicate students' preference for a wider variety in table tennis, an increase in the challenge level in physical education classes and an increase in student motivation for participating in table tennis activities with higher demand of physical preparation.

Key words: table tennis, motivation, university sports students

1.0 INTRODUCTION

Table tennis enjoys quite large popularity among people in Croatia. First table tennis games took place in 1902, in the national library in Donji Miholjac. In 1939, Table tennis Federation was founded and after proclamation of independency of Republic Croatia, Croatian Table tennis Federation was founded in 1991 as one of the first sports organisations which nowadays count's almost one hundred clubs. Beside in clubs, table tennis is played in elementary and secondary schools, at the universities and in the dorms.

World famous Croatian table tennis players with remarkable international results are: Žarko Dolinar, Dragutin Šurbek, Antun Tova Stipančić, Branka Batinić, Tamara Boroš and Zoran Primorac.

Their successful sports careers have encouraged development of table tennis in Croatia [3].Table tennis, in Croatia, is included in educational process in elementary and secondary schools as well as at the faculties.

In the framework of physical and health education at the University of Zagreb, students can, among other sports, choose table tennis as their main sport.

University of Zagreb counts about 60.000 students from all over Croatia, which have various interests and knowledge in sport activities.

Specificity of Croatian universities, despite other European universities, is PE education, which is obligatory during first and second year of studying and has been introduced as electoral subject on senior years.

Contemporarily and attractiveness are significant characteristics of PE education, they tribute in educational sense and have general positive influence on the anthropological status of students.

It refers primarily to the imperative of preserving health and its improvement, as well as acquisition of

certain volume of motor information for rational and substantial usage of free time.

Analysis results of male and female student's interest confirm popularity or all racket sports, as tennis, table tennis, squash and badminton.

Faculty of Kinesiology in Zagreb is one of 33 faculties of the University of Zagreb.

Faculty's educational plan consists of, among others, obligatory and electoral courses, theoretical and workouts. Table tennis is electoral course and is offered to students since 2006. In frame of 30 hours of theory and workouts, students acquire knowledge of basic elements of table tennis game techniques and tactics, as well as methodical procedures in the process of acquisition of game elements.

In year 2006 electoral course TABLE TENNIS was elected by 69 students (winter and summer semester), in year 2007, 109 students, and in year 2008 there were 155 students.

Motivation processes are part of learning process in any human activity. According to Horga [2], the relationship between the motivational factors and the learning process is best reflected in the Hull-Spencer learning theory, expressed as the equation that the excitation potential, i.e. the desire to manifest knowledge equals the product of the motivating energy and the strength of knowledge.

Motivation has been the subject of research in many sports, but up to now, table tennis, as new sport at Faculty of Kinesiology, has not been in the focus of researchers.

The aim of this study was to identify students' motives for participating in table tennis sport course at the Faculty of Kinesiology in Zagreb. The purpose of this research was to provide findings for better planning of the programs.

2.0 METHODS

2.1. Subjects

The subjects of this research were 138 students (114 males & 24 females), aged 18 to 22 years, attending classes of Table tennis course at the University of Zagreb, Faculty of Kinesiology (KIF).

2.2. Variables

The Gill, Gross & Huddleston (in Horga, [2]) questionnaire, called "Participation Motivation Questionnaire", was used in this investigation.. The PMQ was distributed to the subjects at the end of the semester. Thirty items quote following reasons to engage in table tennis with a distinct component:

1. Skills (SPOS)
2. Friends (PRIJ)
3. Winning (POBJ)
4. Energy (ENER)
5. Travel (PUT)
6. Fitness (FORMA)
7. Experience (DOZI)
8. Team work (GRUPR)
9. Parental wish (ZELA)
10. Ability (SPRET)
11. New friends (NOVIP)
12. Expression of personality (OSOB)
13. Relaxation (OPUS)
14. Awards (NAGR)
15. Good techniques (TEH)
16. Work (RAD)
17. Actions (AKC)
18. Socializing (DRUZ)
19. Out of home (KUCA)
20. Competitions (NATJ)
21. Important (VAZN)
22. Group (EKIP)
23. To be better (BOLJI)
24. Health (ZDRAV)
25. To be popular (POP)
26. Challenge (IZAZ)
27. Work of coach (TREN)
28. Awards (NAGR)
29. Fun (ZABA)
30. Sport Equipment (OPR)

The items were arranged in such a way that each participant marked his/her level of agreement or disagreement with each statement by numerical marks 1-5 (a five-grade scale of the Murphy-Likert type).

2.3. Methods

The basic statistical parameters of the variables were calculated. To analyse the motivational space the main component method was used and the number of factors was determined after Varimax rotation method with Kaiser Normalization.

3.0 RESULTS AND DISCUSSION

The analysis of response frequency to particular levels on the Likert scale, as well as the average results and standard deviations of the questionnaire items, led to conclusion that, among the motives for engaging in sports, the highest mean values were ascribed to all benefits which sport gives. It is interesting that females have the almost the same motives as males and that the values are even higher than by males. The top four motives (Table 1.) for choosing table tennis were: "I want to stay in good physical shape and healthy;" (V24. ZDRAV), "I want to keep myself in form;" (V6. FORMA) "I like to do what I am successful at;" (V12. OSOB), and "I Want to have a fun" (V29. ZABA).

Only in one variable, there is a significant difference between male and female students (V5. PUT). Namely, female students choose certain sport (table tennis), to realize their aspiration for travelling, while male students consider that variable less significant.

As it can be concluded out of results (Table 1), for the sports students their intrinsic motivation is important and that's why at the bottom of the results scale there are assertions about extrinsic factors such as: "My parents and friends wants me to compete", "I like to feel important" and "I want to be popular".

Results shown in the research can be presumably explained by the fact that the questionnaire was conducted in the selected group, among the kinesiology students, whose idea of sports benefit is very closely linked to their choice of any sport.

Table 1 Basic statistical characteristics and ANOVA

	Men			Woman				
Var	N	Mean	Std. Dev.	N	Mean	Std. Dev.	F	F-sig
V1.SPOS	114	4,49	,707	24	4,67	,565	1,300	,256
V2. PRIJ	114	4,24	,944	24	4,63	,576	3,754	,055
V3. POBJ	114	4,44	,729	24	4,42	,584	,019	,890
V4. ENER	114	4,30	,677	24	4,58	,654	3,552	,062
V5. PUT	114	3,96	1,080	24	4,63	,647	8,304	,005
V6. FORMA	114	4,69	,551	24	4,88	,338	2,422	,122
V7. DOZI	114	4,47	,641	24	4,75	,442	4,043	,046
V8. GRUPR	114	4,09	,847	24	4,38	,770	2,349	,128
V9. ZELJA	114	3,01	1,279	24	3,25	1,113	,735	,393
V10. SPRET	114	4,14	,986	24	4,33	,917	,778	,379
V11. NOVIP	114	4,31	,832	24	4,54	,779	1,610	,207
V12. OSOB	114	4,67	,527	24	4,83	,381	2,161	,144
V13. OPUS	113	4,04	,939	24	4,42	,717	3,351	,069
V14. NAGR	113	4,04	1,101	24	4,50	,834	3,799	,053
V15. TEH	114	4,55	,692	24	4,67	,702	,535	,466
V16. RAD	114	4,26	,753	24	4,63	,711	4,662	,033
V17. AKC	114	4,39	,748	24	4,67	,637	2,747	,100
V18. DRUZ	114	4,21	,936	24	4,63	,647	4,266	,041
V19. KUCA	114	4,28	,759	24	4,50	,722	1,684	,197
V20. NATJ	114	4,32	,720	24	4,33	,917	,011	,918
V21. VAZN	114	3,68	1,141	24	3,83	1,049	,390	,533
V22. EKIP	114	4,15	,895	24	4,17	,868	,008	,930
V23. BOLJI	114	4,41	,750	24	4,52	,593	,434	,511
V24. ZDRAV	114	4,76	,485	24	4,88	,338	1,154	,285
V25. POP	114	3,53	1,123	24	3,67	1,007	,320	,572
V26. IZAZ	114	4,43	,728	24	4,46	,721	,030	,862
V27. TREN	113	3,64	1,061	24	3,63	1,245	,002	,961
V28. NAGR	114	3,99	,907	24	4,17	,816	,766	,383
V29. ZABA	114	4,56	,610	24	4,79	,415	3,106	,080
V30. OPR	114	4,50	,707	24	4,71	,751	1,685	,196

Seven significant factors have been extracted, by using the Component Analysis of variance, which altogether explained 66% of the whole space being analyzed, (Table 2.)

After Varimax Rotation with Kaiser Normalization accomplishing all seven factors were named (Table 3)

Table 2 The final values of the factors and the percentage of the space variance explained

	Initial Eigenvalues		
Var	Total	% of Variance	Cumulative%
V1.SPOS	11,25	37,585	37,585
V2. PRIJ	1,921	6,402	43,987
V3. POBJ	1.524	5,079	49,065
V4. ENER	1,442	4,808	53,873
V5. PUT	1,281	4,268	58,142
V6. FORMA	1,258	4,195	62,336
V7. DOZI	1,162	3,874	66,211
V8. GRUPR	,941	3,137	69,384
V9. ZELJA	,900	2,999	72,347
V10. SPRET	,765	2,549	74,896
V11. NOVIP	,714	2,378	77,275
V12. OSOB	650	2,165	79,440
V13. OPUS	,623	2,077	81,518
V14. NAGR	.590	1,965	83,483
V15. TEH	,560	1,867	85,349
V16. RAD	,524	1,747	87,096
V17. AKC	,491	1,638	88,734
V18. DRUZ	,471	1,569	90,303
V19. KUCA	,425	1,415	91,718
V20. NATJ	,343	1,145	92,863
V21. VAZN	,325	1,082	93,945
V22. EKIP	,307	1,024	94,969
V23. BOLJI	,271	,904	95,873
V24. ZDRAV	,240	,800	96,674
V25. POP	,221	,737	97,410
V26. IZAZ	,200	,667	98,078
V27. TREN	,177	,590	98,667
V28. NAGR	,171	,571	99,238
V29. ZABA	,129	,430	99,669
V30. OPR	,099	,331	100,000

The first factor exploits nearly one fourth of the total space variance explained (37.585%), based on which a conclusion can be made that most motives share a significant common space. The other six factors together exploit approximately the same variance as the first. All seven factors together exploit 66.2% of the total space variance.

Main projections of the statements offered in the questionnaire on the first factor are those related to popularity and importance that sportsmen achieve through sports, i.e. victory.

Therefore, that factor has been named POPULARITY. At first sight, we might be wondering at such high percentage of that variance, since statements related to health were ranked the highest, but obviously questions in the questionnaire were not evenly represented, namely, there was more questions related to success, competition and popularity, but those relating to health, and good physical condition. Such a lowered variability diminishes correlation between variables, which is a consequence of first factor variance quantity extraction.

The second factor is defined by the motives related to the usual moment that the sportsman experiences through the sports he/she is engaged in. This encompasses the motives such as: I like company, and meeting of new friends; like to spend time with my friends; etc., but also: I want to learn to exercise properly; I want to do something; etc. Therefore, this factor is named FRIENDS.

The third factor, determined by the motives related to health and good condition, is named HEALTH&FITNES.

Fourth factor, named ENTERTAINMENT is defined by statements as: I like to entertain; I like to be a part of a group; I like to go out.

Fifth factor is mostly determined by conclusions in relation to travelling, but also to other sports relating events, and is named SPORTS TRAVELLING.

Conclusions related to the social position that can be accomplished through sports, determine significantly sixth factor, so it is named SOCIAL STATUS.

Reason for practicing sports, (table tennis) not being listed on any of extracted factors, that explains the best seventh factor, is intrinsic, e.i. I'd like to be relaxed; I'd like to free my energy; is named RELAXATION THRU SPORTS.

Table 3 Factorial structure matrix

	Component						
	1	2	3	4	5	6	7
VP25	,789						
VP21	.741						
VP3	,594	,418					
VP20	,567	,312					
VP14	,539	,431					
VP15		,731					
VP18		,564		,330			,348
VP2		,562			,406		
VP11		,559		,314	,400		
VP17	,464	,494					,374
VP30		,461	,349	,444			
VP6			,673		,418		
VP1			,663				
VP23			,634	,327			
VP24			,584				
VP10			,539			,503	
VP29				,813			
VP22				,574			
VP26	,498			,528			
VP19	,424			,495			,364
VP12		,325	,331	,344			,307
VP5					,770		
VP9					,651	,388	
VP7			,351	,392	,512		
VP28	,368					,707	
VP27						,666	
VP8				,308	,390	,457	,365
VP13							,797
VP4	,333		,438		,398		,548
VP16	,400	,441					,514

4.0 CONCLUSION

Insight in the position of statements that influenced the most interpretation of seven extracted factors in this research, leads to conclusion that sports students choose table tennis from few reasons. The most important is to become popular and to make new friends. Results can partly be explained thru the fact that in Croatia sportsmen are often presented as celebrities in the public, thru the media, while the health aspect is ignored.

But, the fact is that students choose table tennis primarily for positive reasons, such as health aspect. The fact is also that sport students are a selected group, whose enrolment to Faculty of Kinesiology is result of their consciousness of health benefits acquired by regular sport activities.

However, some limits do exist, especially due to methodology. Factor analysis of the motivational structure has been applied to relatively small sample; therefore the results will serve the research purposes above all. Recommendation is that the results should be confirmed in a larger investigation.

5.0 REFERENCES

[1] Barić, R. (2007). The relationship of coach's leadership behaviour and his motivational structure with athletes' motivational tendencies. Unpublished doctoral dissertation. Ljubljana: University of Ljubljana, Department of Psychology.

[2] Horga, S. (1993.) Psihologija športa. [*Psychology of sport. In Croatian.*]. Zagreb: Fakultet za fizičku kulturu.

[3] Uzorinac, Z. (1999). Stolnoteniske legend. [Table tennis legends]. Zagreb: Prosvjeta d.d.

[4] Vallerand, R.J. & Fortier, M.S. (1998). Measures of intrinsic and extrinsic motivation in sport and physical activity: a review and critique. In *Advances in Sport and Exercise Psychology Measurement*, Duda, J. (ed.). FIT: Morgantown, WV; p. 81-101.

Investigation of Underlying Psychological Factors in Elite Table Tennis Players

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Abstract: The importance of psychological factors in successful sports performance has been acknowledged both academically and anecdotally. Yet the amount of time that coaches and athletes actually spend on mental practice as compared to physical practice belies its significance. A key component in developing a foundation for psychological intervention programs is to understand the psychological status of athletes. The purpose of this investigation was thus to identify the psychological factors that influence the performance of elite table tennis players in Taiwan. Participants were 130 elite table tennis players (Mean age = 18.73, Mean sport years =10.01, Males = 84, Females = 46), who were recruited during the National Squad Try Out. Two questionnaires designed by the authors were utilized for data collection: a Demographic Information Sheet and a Table Tennis Player Psychological Skills Questionnaire. Descriptive statistics were computed for data analysis.

The results indicated that

a) "Lacking Confidence", "Overstress", and "Unable to Cope with Opponent's Tactics", were the top three psychological factors which interfered with the player's performance during competition.
b) "Dwelling on early mistakes", "Focusing too much on competition outcome", and "Focusing too much on body mechanics and movements", were the top three barriers that prevented players from focusing their attention during competition.
c) "Worrying about opponent's ability", "Perceived low skill", and "Poor performance before competition" were the top three causes of "Lacking confidence".
d) "Fear in unable to achieve specific goal", "Too strong desire to win", and "Expectation of significant others" were the top three causes of "Overstress".
e) "Muscle tensed up", "Poor technique", and "Applying inappropriate tactic" were the top three causes of "Unable to cope with opponent's tactics".
f) "Not feeling good physically", "No goals", and "This competition is not important to me" were the top three causes of "Lack of Desire to Win".
g) "Non-optimal condition in training", "Non-optimal mental preparation and readiness", and "Don't know how to prepare" were the top three causes of "Poor pre-competitive mental preparation".
h) "Understand coach's instruction but can't do it technically", "Unable to hear coach's instruction and mind blank during competition", and "Unable to understand coach's instruction" were the top three causes of "Problems in following coach's instruction".

Keywords: Table tennis, Psychological factors, Psychological skill training

1.Purpose

a) To rank the importance of the psychological factors affecting the performance of elite table tennis players in Taiwan.
b) To understand the reasons affecting psychological factors that influence the performance of elite table tennis players in Taiwan.

2.Methods

Participant

Participants were 130 elite table tennis players (Mean age = 18.73, Mean sport years = 10.01, Males = 84, Females = 46), who were recruited during the National Squad Try Out.

Questionnaire

The Psychological Skills Questionnaire for Table Tennis Player designed by the authors of this study was administered to study participants. Although a few items were added to meet the purposes of the study, the items of this questionnaire were mainly based on the questionnaire used by the Sport Science Committee of the International Table Tennis Federation during the 2007 World Championship.

Procedure

a) Ask for coaches' agreement to allow their players to participate in this study.
b) Bring questionnaires to the competition venue.
c) Instruct players on how to fill out the questionnaire.

d) Answer questions raised during filling out of the questionnaire.
e) Check questionnaire for missing data.
f) Ask players to refill the questionnaire if necessary.

Data Analysis and Statistical Work

Descriptive statistics were used.

3. Results

Table 1 shows the importance of the psychological factors that influence table tennis performance.

Table 2 shows the reasons that influence the important psychological factors.

Table 1. Importance of the psychological factors that influence table tennis performance

Importance by order	Psychological factors that influence performance
1	Lack of confidence
2	Overstress
3	Unable to cope with opponent's tactics
4	Inability to focus during competition
5	Poor pre-competitive mental preparation
6	Lack of desire to win
7	Problems in following coach's instruction
8	Other

Table 2. Reasons that influence the important psychological factors

Psychological factors that influence performance	Reasons that affect the psychological factors
Lack of confidence	1)Worry about opponent's ability, 2) Perceived low skill, 3)Poor performance at previous competition
Overstress	1)Fear of failure to achieve specific goal, 2)Too strong of desire to win, 3)Expectation of significant others
Inability to cope with opponent's tactics	1)Muscle tensed up, 2)Poor technique, 3)Applying inappropriate tactic
Inability to focus during competition	1) Dwelling on earlier mistakes, 2) Focusing too much on competition outcome, 3)Focusing too much on bodily mechanics and movements
Poor pre-competitive mental preparation	1)Sub-optimal condition in training, 2)Non-optimal mental preparation and readiness, 3)Don't know how to prepare
Lack of desire to win	1)Not feeling good physically, 2)No goals, 3)This competition is not important to me
Problems in following coach's instruction	1)Understand coach's instruction but can't do it technically, 2)Unable to hear coach's instruction and mind blank during competition, 3)Unable to understand coach's instruction
Other	Luck, injury, thinking too much…

4. Discussion and conclusion

The purpose of this investigation was to identify the psychological factors that influence the performance of elite table tennis players and to understand the reasons which influence the important psychological factors of elite table tennis players in Taiwan. "Lacking confidence", "Overstress", and "Inability to cope with opponent's tactics" are ranked as the top three psychological factors that interfere with the player's performance during competition. This result is consistent with that of Jhuang (2004). Many table tennis players are plagued by low confidence. Sources of low confidence come from "Worrying about opponent's ability", "Perceived low skill", and "Poor performance at previous competition". Gathering and analysis of the opponent's technical and tactical information should help to ameliorate undue worrying. Findings from past studies have revealed that coach's behavior is related to the player's mental reaction during interaction. (Smith, Smoll, & Curtis, 1979 ; Smith, & Smoll, 1990). Providing challenging but achievable goals and positive feedback especially during adverse condition are useful ways to boost the player's confidence.

"Overstress" is ranked second on the list of the psychological factors which interfered with the player's performance during competition. Hollenbeck & Brief (1987) suggested that individual differences in goal orientation affect athlete's stress. People with high motivation will set higher goals and bring stress to themselves. In addition, too much focus on the outcome of competition and the expectations of significant others also generate overstress.

Even the high-skilled player sometimes finds it difficult to effectively cope with changes in their opponent's strategy. It happens frequently when a table tennis player with low self-confidence is playing against a better opponent. Physically, the perception of anxiety exerts influence on muscular contraction coordination. Mentally, anxiety also interferes with appropriate focus of attention and other cognitive processes. Inappropriate muscular contraction and poor mental function greatly reduces the player's ability to cope effectively to the opponent's tactic change. The provision of mental training is thus imperative in helping players manage anxiety and rectify this problem. However, from the results of the survey, adequate training on the execution of different tactics is also important. Providing simulations with a variety of tactics could prove useful, especially to high level players.

The participants of this study were elite table tennis players in Taiwan, therefore generalization and application of these findings to players with lower skill levels or in other countries should be treated cautiously. Nevertheless, the findings of this study clearly indicates that in order to reach optimal performance, coaches and sport scientists should focus on the development of athletes' self-confidence, stress management, and coping skills, in addition to physical conditioning and technical training. Psychological programs should be integrated into the daily training routine. Although the current study focuses on table tennis players, the role of coaches on the development of athlete's psychological strength should not be underestimated. Athletes learn skills, including psychological skill, mainly from coaches. Coaches also provide feedback that strongly affects the athlete's motivation and confidence. Future studies should look into factors that related to the coach's role in the development of athletes' psychological skills.

5. References

[1] Cohn, P. J. (1991). An exploratory study on peak performance in golf. **The Sport Psychologist, 5,** 1-14.

[2] Chih-Hsiung Jhuang. (2004). **The Psychological Skill Comparison between the Tabletennis Players of Different Skill Levels.** Unpublished master thesis, National Taiwan Normal University, Taipei City.

[3] Hollenbeck, J. R., & Brief, A. P. (1987). The effects of individual difference and goal origin on goal setting and performance. **Organizational Behavior and Human Decision Processes, 40,** 392-414.

[4] Horen, T. S. (1984) Expectancy effects in the interscholastic athletic setting: Methodological considerations. **Journal of Sport Psychology, 6,** 60-76.

[5] Loehr, J. E. (1984). How to overcome stress and play at your peak all the time. **Tennis, March,** 66-76.

[6] Li-Chiang Jou. (2003). **Eight Superstar's victory note.** Taipei：New Naturalism Co., Ltd.

[7] Mahoney, M. J., Gabriel, T. J., & Perkins, T. S. (1987). Psychological skills and exceptional athletic performance. **The Sport Psychologist, 1(3),** 181-199.

[8] Pi-Ren Su. (2003). **Ping-Pang Sport Education and Training.** Beijing, Publisher of the people physical education.

[9] Rejeski, W., Darracott, C., & Hutslar, S. (1979). Pygmalion in Youth Sport: A Field Study. **Journal of Sport Psychology, 1,** 311-319.

[10] Smoll, F. L., & Smith, R. E., (1988). Reducing stress in youth sport: Theory and application. In F. L. Smoll, R. A. Magill, & M. J. Ash (Eds.), **Children in sport**(pp.229-249). Champaign, IL: Human Kinetics.

[11] Smith, R. E., Smoll, F. L., & Curttis, B. (1979). Coach effectiveness training: A cognitive-behavioral approach to enhancing relationship skill in youth sport coaches. **Journal of Sport Psychology, 1,** 59-75.

[12] Smith, R. E., & Smoll, F. L. (1990). Self-esteem and children's reactions to youth sport coaching behavior: A field study of self-enhancement process. **Developmental Psychology, 26,** 987-993.

[13] Westre, K. R., & Weiss, M. R. (1991). The relationship between perceived coaching behaviors and group cohesion in high school football team. **The Sport Psychology, 5**, 41-54.

[14] Weinberg, R. S.(1988).**The Mental Advantage: Developing Your Psychological Skill In Tennis.** Champaign, IL: Human Kinetics.

[15] Wen-Nuan Jeng. (1996). **Review of the out of gear in sport competition.** Special issue of Sport science in Taipei Training Center of Republic of China Sports Federation, 66-73.

[16] Yu-Huei Lian. (1995). **The effect of strategy of stress disposition on adolescent tennis players in Taiwan.** Master thesis of Graduate Institute of Sports Science in National Taiwan Sport University.

[17] Yi-Min Liou. (1992). **Psychological of athletic.** Taipei: Publisher of Guei Guan.

Software Used As Tactical Tool and of Training for Table Tennis

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Abstract: A commmon technique for evaluating the performance of a player is to count the errors and successes in a match, this can be automated with an auxiliar software installed in the laptop of the coach of a player, and it can be used as tactical tool and of training, for the account of each type of error and/or success, for example drive vs underspin; topspin vs topspin; or any another combination that the coach choose. In this way, the coach can get instantaneous statistics of errors and/or successes; and therefore to suggest the adquates changes to improve the play of the player or for to obtain better results in the scoreboard in a tournament match.

With this software, the coach only needs to type in the name of each type of error and/or success to count, in each button; and it starts counting. For each type of error/success there is: one button; one counter per each game and a total counter. Also for each counter there is a percentage indicator. In this way, the coach can see the quantity and the percentage of errors and successes: per type; per each game and for the entire match, it making clear where are the weakness and fortresses of his player, in order to propose tactical changes in a match or specific exercises in training sessions with the goal of to improve the play of his player.

The same buttons and counters are available for both players of a match; therefore it also can be used in order to find the weaknesses of the opponent player and to take advantage of these.

This auxiliary software stores the sequence of accounts and (if is available) the scoreboard sequence in a Microsoft Access type file; therefore the entire information can be reviewed and analyzed later. It can be used in tournaments or in training sessions together with, or without, the electronic scoreboards. It can be used periodically to see the evolution of the player.

The use of this software together with electronic scoreboards, has benefits as: a special computer connected to the network and to internet, it can automatically broadcast the scores from all the tables to the entire world through internet; anyone with a laptop connected to the local network and with special software, it can receive all the scores or only one in particular.

This software is ready to receive the scores from any electronic scoreboard (any table) interconnected to the network, complementing the information of the counters with the information of the scoreboards.

Keywords: Tactical Tool and of Training, Auxiliary Software, Electronic Scoreboard.

1. INTRODUCTION

One of the techniques for the evaluation of the performance of a player is to count the quantity of successes and errors versus different types of strokes received in a match, with this, beside of evaluating; we can see which strokes are necessary to correct and to practice.

This same technique can be used in a tournament match, since upon knowing the weak strokes, it can be established or to modify the tactic of play to minimize the effect of this and for to take advantage of the more effective strokes.

Normally the coach or an auxiliary person can be to taking note manually of these counts, it writing points or lines in a paper, for each type of error or success, and then to observe where there are more density of marks, it detecting thus the weak and/or strong points.

Just like the video, the use of computers and of special application software is something very common in our days. Although the video is of great utility, cannot to provide numerical statistic neither standing out immediately the strong and weak points of a player, but computer software can do it: to provide immediately numerical statistics.

In this work we developed computer auxiliary software for carryout the accounts described previously and additionally to do some basic statistics that will be useful for the coach but for him would need time to do, and the time is very limited in a tournament match. Therefore this software simplifies the work of the coach and improves the support given to the player.

This software beside was designed thinking in the use of electronic scoreboards as the introduced in the 10th SSC of 2007 [1], for simultaneously to receive the score of the game, it adding this information to the errors counters and filing in the hard disk of the computer, for

later review; analysis or simulation of replay of the match.

With the correlation of the information from the scoreboard with errors and success counters, we can find any possible emotional or psychological relation, if the errors are frequently happening in special situations, as in the last points of each game or in the critical points. In this way we can evaluate if is necessary to improve the psychological aspect and self confidence of the player.

2. SOFTWARE DESCRIPTION

This software was made in Visual C, it using Microsoft Visual Studio [2], to be run in Windows over PC, it utilizing a simple to use interface and friendly for the user.

The screen that shows this software is divided in 3 principal sections:

- Scoreboard Section;
- Player 1 Counters Section;
- Player 2 Counters Section;

In the following paragraph are described each one of these sections.

2.1 Scoreboard Section

The central part of the screen of this software was prepared to show the information from the scoreboard. Here we can choose and show: the number of table; the names of the two players (one row for each player) and the current game number. For each player it is shown: the server player; the current scoreboard; the total games won and the current and final score for each game.

The table number is chosen using two buttons, one button is for increase the table number and the other is for decrease. The initial table number shown is the number 1. Upon electing the number of table, if the computer is connected to the scoreboard network, automatically it will receive the information of the score from the electronic scoreboard in the chosen table.

In order to receive the current count from the scoreboard chosen, it is necessary to have an interface board that connects the PC to the scoreboard network. In the case of the electronics scoreboard from the reference [1], a CAN interface is needed.

The figure 1 shows the scoreboard display section.

Fig. 1 Scoreboard Display Section.

Also here some numerical data are observed that are calculated automatically with the information received from the electronic scoreboard. These values shown in the last 3 columns are: the points won with the own service over the number of own services done, this information is for each player. This is a similar data upon showing in the tennis matches, where it is common to show the efficiency of the first service. The penultimate column shows the time of the last point counted. The last column shows the total duration of the match.

If the computer is not connected to the scoreboard network, there are 2 buttons to increase the counts of points for each player. Also there are buttons to increase and decrease the current game number. Theses buttons are not needed when the information is received through the electronic scoreboard network.

When the computer is connected to the network, this section is useful by it self, to see the scoreboard of the table selected and for file the sequence of points. In this way, this software could be used without utilizing the sections of counters of errors and successes.

2.2 Counters Sections

Each one of the 2 sections of counting (one for each player) is divided in 2 subsections:

- Subsection for the counters of successes;
- Subsection for the counters of errors.

For each subsection of counters of errors and successes there are several lines, where each one of these lines contains a text indicator where should be typed the name or description of the error or succeed to count.

Just to the right side of this name, is an account increment button. To the right side of this button, is the display of the total current count of this concept during the entire match, along with the percentage value of this account with respect to the total current sum of the subsection, that is to say of all the types of errors (or of successes) of a player.

More to the right side is the display of the account of this same concept (error or succeed) but now divided for each game, and now the percentage shown is that of the account for each game in relation to the total of that concept during all the match (with respect to the information from the first column). With this, we can observe the changes that are occurring during the match and in each game.

The figure 2 shows a line of the described display. The headers for each column are the same that for the central section (scoreboard section)

Fig. 2 A Line of the Counter Section.

The lines or rows are placed in groups of errors and groups of succeeds for each player, conforming the subsection mentioned previously. This is useful for the calculation of the percentages described in past paragraphs, as it is shown in the figure 3.

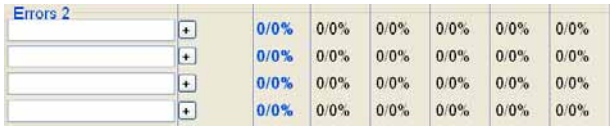

Fig. 3 Subsection of Set of counters.

The figure 4 shows the full section of counters, where it can be seen the 2 subsections of errors counter and successes counter.

Fig. 4 Section of Set of counters.

The figure 5 shows the full screen that this software display.

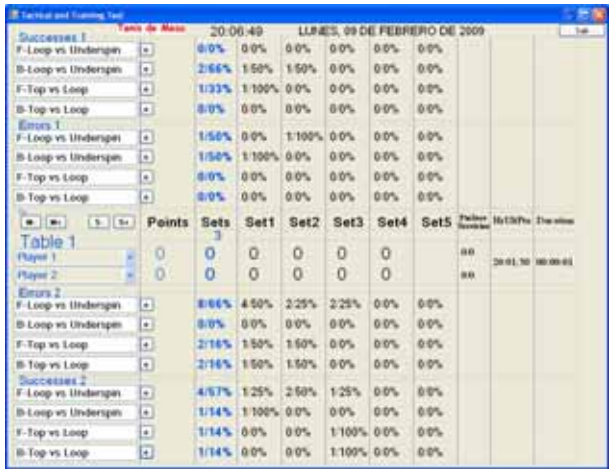

Fig. 5 Full Display.

In the upper part of the figure 5 it observes the section of counters for successes and errors of the player 1. It can see that is divided en the successes counter part and in the errors counter part.

In the central area it observes the scoreboard section and in the lower parts the section of the counters for the player 2.

In parallel to the displaying of all the information in the screen, it is saving in a file of Microsoft Access type, the counting sequences beside with the time (hour:min:seg) when each point occurred.

The format for each register in this file is shown in the Table 1.

The register file is useful for to do later analysis of the information and also to “replay” a match.

When the error counters are correlated with the real and current scoreboard, in the post match analysis of the file is when also can be detected if the errors are occurring in special situations, as at the end of a game or in very important points. This could be an indication of lack of self-esteem and bad self confidence of the player. In consequence it can be suggested special session for personal development and self-esteem for improve the self confidence of the player or to propose training match with specific handicaps or with similar conditions as the conditions occurring in a real tournament match where it has been detected the higher frequency of errors.

Table 1 Register File Format.

Register Number	
Time	
Name of Player 1	Name of Player 2
Total Games of Player 1	Total Games of Player 2
Game 1 (Score)	
Game 2 (Score)	
Game 3 (Score)	
Game 4 (Score)	
Game 5 (Score)	
Counter S1 of Player 1	Counter S1 of Player 2
Counter S2 of Player 1	Counter S2 of Player 2
Counter S3 of Player 1	Counter S3 of Player 2
Counter S4 of Player 1	Counter S4 of Player 2
Counter E1 of Player 1	Counter E1 of Player 2
Counter E2 of Player 1	Counter E2 of Player 2
Counter E3 of Player 1	Counter E3 of Player 2
Counter E4 of Player 1	Counter E4 of Player 2

Also it can be seen if the errors are concentrated at the end of the match or when some time of play has elapsed, it suggesting bad physical preparation of the player.

3. FUTURE IMPROVEMENTS

In this first version of this software, are included basic statistic calculations that are of utility for the coach and for the player.

Surely there are many others calculations that can be of great utility. Each coach could have some specific algorithm or equation that is useful for him, but it is hard to calculate and to use in a real tournament match, because the calculation time that it can be needed.

When these calculations are programmed in a computer, they are no taking time for the coach, because are made instantaneously giving immediately results; therefore they can be utilized in a real tournament match.

In consequence of all things mentioned previously, this software is open to receive any suggestion for changes and improvements from the coaches or even from the mathematical specialist interested in the sport (table tennis).

Mathematical calculations as the standard deviation; varianza; interpolation and prediction methods as square minimums, etc., it can be programmed for use it in a

practical and fast form, it giving results for table tennis. Even with only the information of the scoreboard, it could try to do some calculations; predictions or estimations.

Another change or improves that can be done to this software, is that the results in place (or beside) of been shown in numerical form, it will be shown in graphical form (a graph say more than one thousand numbers), it making easier the observation of trends by the coach.

In future versions of this software will be included graphs, also as the most outstanding suggestions that we receive. The reader is invited to send suggestion to change and to improve this software.

The distribution of the information in the screen, also can be modified in order to do more easier to read for the coach.

Also we will do software version for use in PDA equipment, which for its lower size than a laptop, are easier to carry.

4. CONCLUTIONS

This is the first version of computer software that takes advantage of the use of electronic scoreboards and statistic calculations and simple mathematics, for to evaluate and help to improve the performance of the table tennis sportsman.

The only thing that is needed is that the coach or an auxiliary person introduce the initial data to the software (table number; names of the players and the names for each error and success that will be counted) and after that only needs to go pressing the buttons to increasing for each error or success to count. It doing this it will be showing continuously the accounts and the percentages of errors and successes for the entire match and also for each game.

Even that the video is of great value for the study of the play of a player, it is not common to utilize it during a real tournament match in order to give statistics results instantaneously. Because this software shows instantaneously results during a real match, it is of great utility to help to propose tactics for the play, because it shows the strokes with more success and in consequence to take advantage of these strokes. Also after it has been seen the strokes with higher number of errors, the tactic can be changed to modify the trend to make those errors and to minimize its effect.

Also it is useful to help to propose routines and training programs in order to correct the strokes that are more commonly failed in a match.

In the training sessions, this software can be used periodically in order to see and to file the player evolution and the effect that the training makes over him.

This software also can be utilized uniquely for to receive; to show and to file the information of an electronic scoreboard from a selected table in the network of electronic scoreboards.

The use of auxiliary software and of electronics scoreboards in a network gives the opportunity of applications that will help to the growing and the development of the table tennis.

REFERENCES

[1] Arturo Méndez P, “Design of an Electronic Scoreboard for Table Tennis”, *10th ITTF Sports Science Congress*, pp. 131-137, ISBN 978-953-6378-69-2, 2007.

[2] Microsoft, *Microsoft Visual Studio 2008 Documentation*.

[3] Microsoft Access Handbook

[4] MCP2510 Datasheet, Microchip Technology Inc. 2007, DS21291F.

Comparison of Rally Time in XXIX Beijing (2008) and XXVIII Athens (2004) Olympic Table Tennis Tournaments

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Abstract: The XXIX Olympic games of Beijing (2008) are the second Olympic tournaments organized under the modification of Table Tennis regulations (series of two serves, 11th points set). The purpose of this study was to compare the rally time of the Beijing (2008) and Athens (2004) Olympic tournaments. Rally time differences for Men and Women in both Olympic tournaments concerning the first round up to the quarter finals were also studied. The sample of the study was the total number of single games that were held during the Olympic Games in Beijing (n=119, male=60 & female=59). The results showed that rally time oscillated from 4:48'' to 7:31''in total. Men's rally time in set fluctuated from 4:48" to 5:33" and Women's from 5:00" to 7:31". The two factors repeated measures analysis of variance (Olympic tournaments x rounds) was used in order to determine if significant variance existed between Olympic tournaments. The analysis of data revealed that Women's set rally time increased in Beijing (2008). Significant differences were found for Women in Olympic tournaments ($p<0.05$) and also in the first three rounds of the Beijing Olympic Tournament ($p<0.05$). These findings indicate that longer rally time in table tennis should be taken in consideration and should be examined more in next high level tournaments especially after the prohibition of speed glue. Thus, knowledge of the above characteristics can help coaches to provide the appropriate methods for table tennis training.

Keywords: Rally time, Olympic tournaments, Match analysis**.**

Introduction

Olympic Tournaments are organized every four years. Men and Women who compete in those tournaments are classified among the high level ones. Olympic matches are usually analyzed in every detail, which shows the importance of this tournament.

The XXIX Beijing (2008) was the second Olympic Table Tennis Tournament which was organized after the 2001 International Table Tennis Federation (I.T.T.F) modification of rules (series of two serves, 11th points set). XXVIII Athens (2004) was the first Olympic Tournament during which I.T.T.F. new rules were established. Numerous of tournaments at all levels and in all categories have been played by both Men and Women using the same rules between the last two Olympic tournaments which might mean that players got accustomed to the use of these regulations.

According to the I.T.T.F. regulations [1], "A rally is a period during which the ball is in play" and "the ball is in play from the last moment at which it is stationary on the palm of the free hand before being intentionally projected in service until the rally is decided as a let or a point". The duration of rallies can be a very important indicator regarding physical training in table tennis while adaptation to changes of new rules is in correlation with training technology [2].

Beijing (2008) Table Tennis Olympic tournament rally time seems to be longer compared to that of Athens (2004). These findings should be taken in consideration and should be examined more thoroughly in next high level tournaments especially after the prohibition of speed glue.

Methods

The total number of games that were held during the Olympic Games in Beijing (n=119), in Men (n=60) and Women (n=59) singles from groups to quarter-finals was used as a sample. Data was received from the official "Beijing 2008" web page http://en.beijing2008.cn and from www.nbcolympics.com. DVD and video tapes verification was also conducted.

The process of data collection was the following: each time an athlete was in service position and simultaneously with threw of the ball, a digital chronometer was placed in use. The Rally time was recorded until the point ended. Time data collection was conducted with precision of seconds for set and minutes for games and was recorded on to special result form. No data collection was recorded in other cases of the game being interrupted. No other factors such as time-out, changes of table side between sets were counted.

Results

The two factors repeated measures analysis of variance (Olympic tournaments x rounds) was used in order to determine if significant variance existed between Olympic tournaments. The analysis of data revealed that Women's set rally time increased in Beijing (2008).

Table 1. Beijing 2008 Men Rally Time

Men	Rally Time MAX	Rally Time MIN	Set/Round (X±SD) SEC	Match/ Round (X±SD) SEC
1st Round	37:24	15:55	5:00±00:37	28:47±07:17
2nd Round	40:03	19:59	05:04±00:42	29:53±06:11
3rd Round	50:16	18:56	05:33±01:05	30:23±10:26
4th Round	26:24	17:40	04:54±00:55	26:24±09:56
5th Round	31:57	16:41	5:06±00:58	23:11±06:24
	Games Max	Games Min	Mean/Set	Mean/ Match
Total	50:16	15:55	5:06±00:17	27:31±03:07

Significant differences were found for Women in Olympic tournaments ($p<0.05$) and also in the first three rounds of the Beijing Olympic Tournament ($p<0.05$). Mean time of rallies in Men is 5:06´´±00:17´´in sets and 22:31´´±3:07´´in games (table 1) while in Women it is 5:47´´±1:01´´in set and 32:23´´±5:22´´ in games.

Concerning the duration of the Beijing Olympic tournament the longest matches lasted 50:16´´ for Men

Table 2. Beijing 2008 Women Rally Time

Women	Rally Time MAX	Rally Time MIN	Set/Round (X±SD) SEC	Match/ Round (X±SD) SEC
1st Round	46:28	16:06	5:00±00:51	28:15±09:39
2nd Round	40:09	19:53	05:33±01:09	30:27±09:04
3rd Round	42:14	18:35	05:45±01:04	27:26±07:14
4th Round	1:03:40	19:51	07:31±01:50	40:01±14:46
5th Round	47:31	25:58	5:06±00:58	35:48±10:22
	Games Max	Games Min	Mean/Set	Mean/ Match
Total	1:03:40	16:06	5:47±1:01	32:23±5:22

and 1:03:40´´ for Women while the shorter one was 15:55´´ for Men and 16:06´´ for Women.

Tables 1 and 2 show the detailed rally time for each round, the Longer and Shorter match in tournament, Standard deviation per round for set and matches and mean per set/ match in five analyzed rounds.

Men rally time in Beijing (2008) compared to that in Athens (2004) is longer in set/ matches in almost every round fig. (1-2).

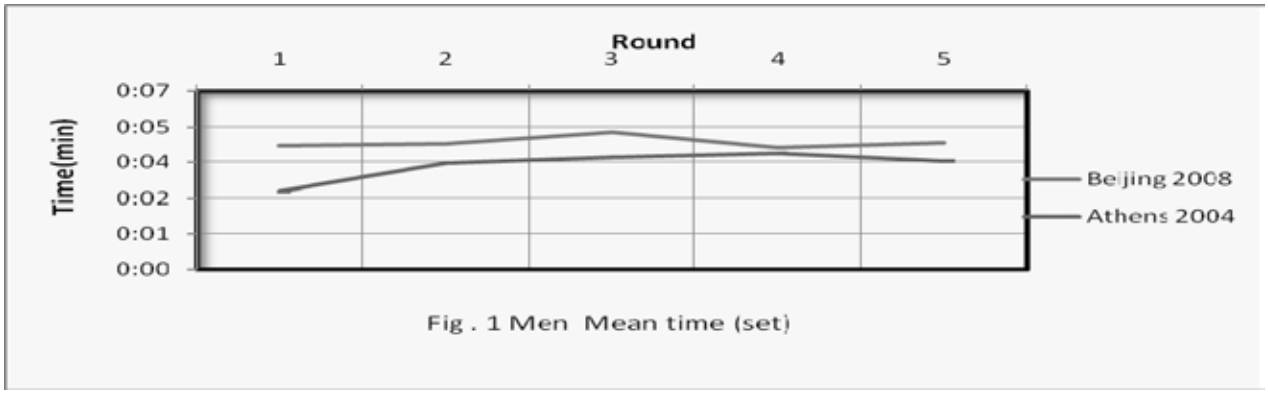

Fig.1 Rally time per round (set)

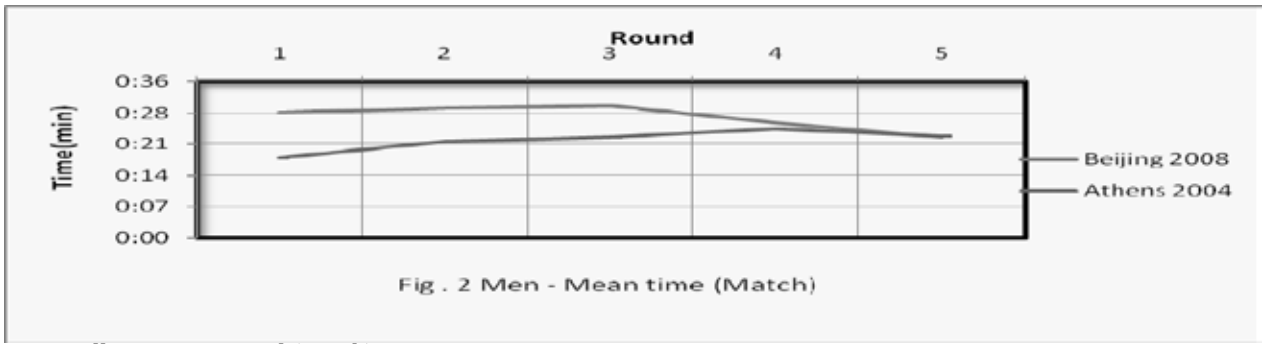

Fig.2 Rally time per round (match)

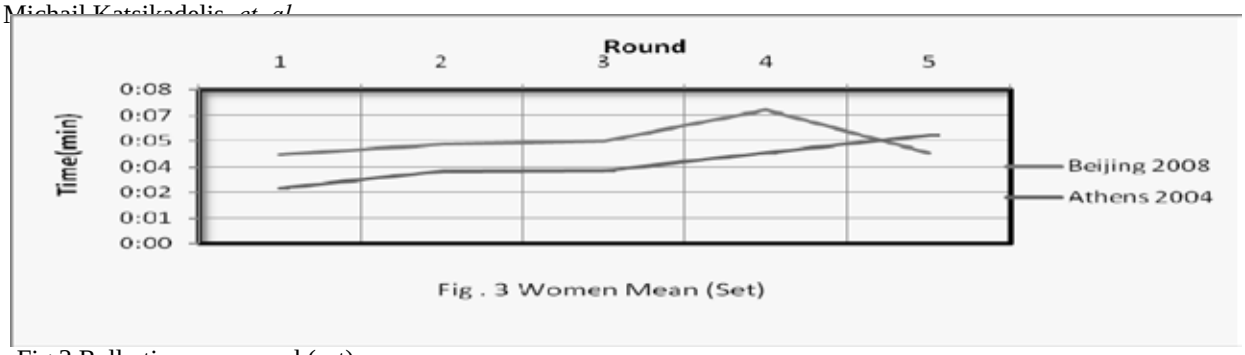

Fig.3 Rally time per round (set)

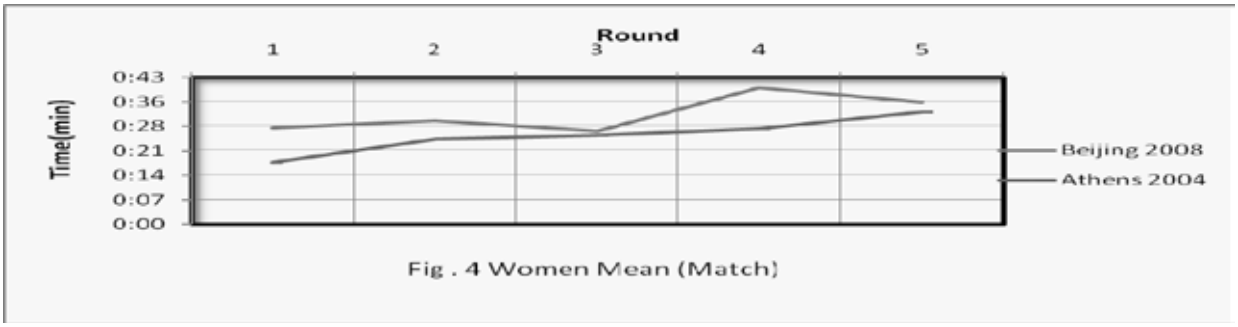

Fig.4 Rally time per round (match)

Women's rally time in Beijing tournament is longer compared to that in the Athens Olympic tournament Fig (3-4).

Discussion

From the analysis of the results it was obvious that the rally time in both Men and Women was longer in the Beijing (2008) Olympic Tournament compared to Athens (2004). Match rally time was increased up to the third round for Men and up to the fourth round for women in the Beijing Olympic Tournament.

Men's Beijing (2008) rally time was slightly longer in relation to the one in Athens (2004). The time difference was not statistically important even though it is noticeable that the mean of the set/match rally time is longer in Beijing (2008) in the first three rounds. After the 4th round, the mean of the rally time is almost the same as the one in Athens. This could be due to the fact that Men adapted faster to the new I.T.T.F. rules.

Statistically, a significant difference was achieved in Women rally time in the first three rounds of the Beijing tournament. The rally time got longer up to the fourth round. This might be accounted to single elimination system of play which means that more advanced players "meet" each other after a few rounds [3]. Every new round in Beijing (2008) was longer in the mean of the rally time except for the 3th round which might be accidentally shorter in the mean of the match rally time.

Results show a statistically significant difference in Women rally time between two tournaments. Beijing (2008) rally time was longer compared to that of Athens (2004). This might mean that women's rally takes longer time and a point is not easy to finish. Concerning the corresponding studies that are reported [4, 5, and 6]; there is an increase in rally time with the new 40mm ball which is more obvious in Women's games. This increase was also noticed in the first Olympic tournament with the new regulations. However, we must take into consideration that the style of women's play can be a decisive factor in the duration of games [7].

Concluding, we would like to stress that it was not easy to compare the foundings of this study since there are not enough bibliography reviews of rally time. Of course more research is needed in order to obtain more valid results. However, the new glue rules regulation might affect rally time also.

The next target is the realization of new measurements and greater range of tests, to act in a consultative manner

and in relation to the fact that training is what plays the main role as well as the will of trainees to achieve better results. Rally time should be taken into consideration during the training procedure.

REFERENCES

[1] The Laws of Table Tennis. *I.T.T.F. Regulation Handbook,* 2.5.1. p.24

[2] Djokic, Z. ITTF scored a goal (changes of rules in table tennis during 2000-2003.10th ITTF Sport Science Congress, Zagreb, 2007

[3] Katsikadelis, M., Pilianidis, T., & Vasilogambrou, A. Real play time in table tennis matches in the XXVII Olympic Games "Athens 2004". 10th ITTF Sport Science Congress, Zagreb, 2007

[4] Takeuchi, T. The effect of the 40mm diameter ball on table tennis rallies by elite players. Table Tennis Sciences no 4&5. 26,267-277, 2001

[5] Seve, C. A propos de la balle de 40mm. France Tennis de Table Magazine,758,12-13, 2001

[6] Zhang, X. A technical investigation into the ITTF Large Ball Tournament in Suzhou. Table Tennis Sciences no 4&5. 6, 55-58, 2001.

[7] Tang, H., Mizoguichi, M., Toyoshima,S. Speed and spin characteristics of the 40mm table tennis ball. Table Tennis Sciences no 4&5. 27,278-284, 2001.

Footwork in Relationship with Strokes and Efficacy during the 29th Olympic Games Table Tennis Final

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Abstract:

Introduction and Aim of the study: Table tennis literature displays many efforts about the study of both the development of the game technique and the match and notational analysis. However those works were principally based on the observation and survey of some of the most important aspects: the strokes, the direction of the movements and the efficacy (won, lose, mistakes, etc.). This study aims to elaborate another kind of analysis including the footwork technique (different kind of steps). The most important thing, considering the best player technique, is the best execution of the movement and steps, for reaching in the shortest time the right position, and playing the best stroke.
Methods:
1. Environment: 29th Olympic Games in China - Man's table tennis singles final
2. Population: the n°1 (W. H.) and the n°2 (M. L.) in the world ranking
3. Data collected: footwork technique (different kind of steps), strokes and efficacy.
4. Analysis: it has been analysed the contingency table about Footwork/Strokes and Footwork/Efficacy.
Results: The two considered players use mainly the One step (30% and 29%) to return the services, W.H. uses very often the Turn step (17%) to hit the ball with Topspin or Counter topspin. On the other side M.L. prefers to use a more balanced footwork technique, using a combination of Chassè and Turn step (14% and 14%). W.H. uses more frequently the topspin (14%)and the Counter topspin (15%), M.L. prefers the Counter topspin (17%) followed by Topspin (13%). It is possible to notice that the players do not use one step (13%-11%) during the game phases and W.H. does not use one step in particular to hit the ball with a forehand Topspin (10%). The players use in particular the One step in a neutral way (without efficacy, 63% and 72%), W.H. uses the Turn step with good results (25%) but also in a negative way (21%). During the match M.L. is able to use with more positive results every different kind of steps. He shows negative performances using the Chassè (25%) and the Crossover (23%).

Keywords: Footwork technique, Strokes, Match analysis, Performance analysis, 29th Olympic Games

1. INTRODUCTION

Table tennis is one of the most popular and widespread sport in the world and it can be considered a very complex sport and its development is still in progress. Studies on Table tennis show that many factors are worth of consideration. These are technique, game plan joined with psychological and physical aspects. Table tennis literature shows several studies about the development of the game technique [1, 2]. Regarding the technique, different studies have been carried out: Qualitative game analysis [3] and Analysis on technique and tactics of one player [4]. Moreover, Ripoll H. [5] considered the strokes' psycho-motor aspects and Rodano R. [6] the biomechanics ones. Such studies were principally based on the observation of one of the most important technical aspect: the strokes. By observing the best player technique, it is clear the importance of the execution of movements, steps and shifts. Footwork skills are very important and it should be pointed out the importance of studying, training and developing them in order to obtain high performance results. It is important to notice that the best execution of movements is fundamental for reaching in the shortest time the right position , and playing the best stroke [7].
This study is based on a standard step classification that has been shown during The 10th Anniversary ITTF Sport Science Congress 2007 [7] and on a previous pilot study about the comparison of the steps performed by international and national players [8].
Table tennis literature displays many studies about the match and notational analysis [3, 4, 10]. Such works were principally based on the study and the observation of some of the most important aspects: the strokes, impact position of the ball on the table, istant of the service and moment when the point finished, direction of the movements and efficacy (results and type of error). This study aims to elaborate a new type of analysis including also the footwork technique, analyzing different kind of steps in relationship with strokes and efficacy.

1. METHODS

The starting point of this work was the analysis of Man's table tennis singles final of the 29th Olympic games in China (video recorded from television). The players considered were the n°1 (W. H.) and the n°2 (M.

L.) in the world ranking and the data collected for every player are: footwork technique (different kind of steps), strokes and efficacy. This study is based on the analysis of the contingency table about Footwork/Strokes and Footwork/Efficacy.

2.1 Footwork

The following Steps' classification used to elaborate this study has been previously shown during The 10th Anniversary ITTF Sport Science Congress 2007 in which they have been introduced a study suitable to analyze the game technique at a high level to improve the training and, of course, the agonistic results [7, 9].

Steps' classification:
1. One step
2. Short and medium steps
   a. side to side or "chassé"
   b. slide step
   c. turn step
3. Crossover

This classification is based on a right hand player and it could be referred also to a left hand one in perfectly symmetric way [7].

One step: is a small step played starting from the ready position or during other game phases, keeping one foot still and moving the other one towards the ball. The foot that plays the movement should immediately comes back into the ready position.
One step footwork is used when the ball is played very quickly by the opponent and there is insufficient time to get into the right position for playing the stroke. This type of step is mainly played to return short services or balls played very close to the net [7].

Short and medium steps: all those movements played from the ready position or during other game phases and involving the movement of both feet. These steps allow players to cover short or medium distances, towards the ball for playing the strokes, with very high speed[7].
a. Side to side or "chassé": if the movement is on the right side, the left foot moves first and has to get close to the right one, which will move on the right side. So that, at the end of the movement the player will get back on the ready position[7].
b. Slide step: if the movement is on the right side the right foot moves first, followed by the left one which will slide in the same direction. So that, at the end of the movement the player will get back on the ready position[7].
c. Turn step: is the movement played by a player who wants to play a forehand stroke from the backhand corner. This step could be done following the chassé or slide step technique. It is especially useful for playing the forehand topspin from the backhand corner[7].

Crossover: is used when the player has to cover a long distance in a short time. Crossover footwork should not be used for short distances. The player is in the backhand corner waiting to cover most of the table with the forehand. The player initiates movement to the right by tacking a step with the right leg into a wide stance. The left leg crosses over in front of the right leg as contact is made. As the follow-through is completed the right leg is brought forward. At the end the right leg finishes in a wide position ready to push back to the left [1].

2.2 Strokes

Regarding the strokes, it follows the classification proposed by Tepper G. [1] without description.

Strokes' classification (forehand or backhand):
1. Service
2. Topspin
3. Push
4. Block
5. Topspin counter topspin
6. Flick
7. Smash
8. Drive
9. Lob

2. Effect of the strokes, efficacy

To evaluate the effect of the strokes 5 codices were used. Each stroke was classified and described in the following table:

Symbols	Description
#	perfect execution, winning stroke, assigns the point
+	good execution of the strokes, creating a favourable situation
0	neutral stroke, transition action, without advantages
-	negative execution of the strokes, creating a better situation for the opponent
=	error,mistake, losing stroke (out, net, etc.), assigns the point at the opponent

2.4 Methodological aspects

- During the match, each action has been classified by: step, stroke and result (efficacy).
- Only the last step before the stroke (or before the attempt to hit the ball) has been considered in this analysis.
- Data have been collected in a 15x7 table for every player, in which different types of steps (in columns) and strokes (in lines) have been taken into account.
- It has been also considered the efficacy of the strokes and the date have been collected into a 5x7 table for every player, in which different types of efficacy (in columns) and steps (in lines) have been

taken into account.

- Problems emerged because of the difficulty in recognizing and discerning "stroke without step", "step without stroke" and the last step before the attempt to hit the ball. This is made even more complex by the fact that often many quick steps' combination are involved.
- Another problem was to decide the different efficacy (+, 0 or -) of the strokes during the game actions, to relate the strokes with the success of it.
- Data have been collected looking at the match with the slow motion and looking at one player each time.

3. RESULTS

The first analysis of the data is based on the comparison of the footwork technique used by the two players taken into account (W.H. and M.L.).
The following table reports all the different steps' frequencies calculated in percentages:

Footwork/Player (%)	W.H.	M.L.
One step	30	29
Service	17	18
Turn step	17	14
Stroke without step	13	11
Chassè	11	14
Crossover	8	11
Slide step	4	3

The most frequent step is the One step, both the players perform the One step very often (W.H.: 30% and M.L.: 29%) to return the services. W.H. plays the Turn step with a frequency of 17%, whereas M.L. use it with the 14%. M.L., the winner of the match, plays Chassè 14% and W.H. plays it with the frequency of 11%. Analysing the Stroke without a step, both the athletes have high percentages (W.H.: 13% and M.L.: 11%). It is important to notice that the two players considered do a movement during the execution of the service and this step has been included into the analysis of the steps (W.H.: 17% and M.L.: 18%).

The second analysis of the data is based on the comparison of the strokes played during the match considered.
In the following table, the most important strokes' frequencies have been calculated in percentages and it has been added the lowest data (last line):

Stroke/Player (%)	W.H.	M.L.
forehand service	17	18
forehand Topspin	14	13
forehand Top counter Top	15	17
forehand push	9	14
backhand block	12	6
backhand Top spin	10	5
other strokes	23	27

The most frequent stroke is the forehand service (W.H.: 17% and M.L.: 18%). The second one is the forehand Topspin counter topspin (W.H.: 15% and M.L.: 17%) and it shows the offensive characteristics of their play. W.H. uses with the 14% forehand Topspin and M.L. the 13%. The most important difference is that M.L. uses in a balanced way the forehand push (14%) and the backhand block (12%); W.H. prefers to use the two strokes considered the 9% and the 6%. Another important difference is about the execution of the backhand Top spin (W.H.: 10% and M.L.: 5%).

The analysis of the data has been continued comparing the technical characteristics of the two athletes by the relationship between footwork and strokes. The most frequent step is the One step and both finalists use it to return the services with the forehand push but with big differences. W.H. returns in a more balanced way (forehand push:27% and backhand push: 24%); whereas M.L. prefers play the forehand push (47%) more than the backhand push (24%) after the execution of a One step. It is interesting to consider that the most used strokes is the Topspin counter topspin and both the players prefer doing it after a Turn step (W.H.: 45% and M.L.: 46%). The same stroke has been played after a Crossover step (W.H.: 31% and M.L.: 27%) and after a Chassè (W.H.: 14% and M.L.: 14%).

The last part of the analysis of the data is based on the relationship between footwork and efficacy (results) of the strokes.
In the following table all the different results' frequencies have been calculated in percentages:

Efficacy/Player (%)	W.H.	M.L.
#	4	3
+	16	11
0	63	72
-	1	2
=	16	13

This relationship shows that the most part of the movements or steps have been followed by neutral strokes (W.H.: 63% and M.L.: 72%). W.H. realized many steps with positive results (#: 4%, +: 16%) but at the same time he has done lot of mistakes (=: 16%). M.L. realized more steps followed by neutral strokes (O: 71%), he has been less efficient in the attack and counter attack game phases (#: 3%, +: 11%) but he has done less important mistakes (=: 13%).

The last phase of the analysis shows the importance of the game phases followed by positive (+) and very positive results (#). W.H. usually wins actions without a movement (36%) or with a Turn step (27%) and M.L. plays this kind of actions with a Crossover (43%) or with One step (29%). Considering the positive actions (+), W.H. has used a Chassè (31%) and a Turn step

(20%). M.L., the winner of the match, used in a more balanced way the different footwork techniques (Turn s.: 23%, one s.: 20%, Chassè-crossover and Stroke without a step: 17%). The same kind of analysis will be done about heavy mistakes (=), W.H. did many mistakes after a One step (28%), after a Turn step (23%) and after a Stroke without step (21%). M.L. did less mistakes of the opponent (M.L.: 34, W.H.: 43) and in a more balanced way considering the different kind of steps (Chassè: 24%, Crossover: 21%, Stroke without a step: 18%, One step and Turn step: 18%).

4. DISCUSSION AND CONCLUSION

The statistical results of the analysis are important to study in depth the technical aspects about Table tennis: steps and strokes. It is important to underline that both the players perform the One step very often, especially to return the services and it is possible to consider this step the most important one. The most frequent stroke is the forehand service and the second one is the Top spin counter Top spin. It is fundamental to notice the importance of the services and the footwork technique performed to return the services of the opponent. These data show also the offensive characteristics of the modern play.

The statistical results of the analysis carried out on the two finalists display inter individual differences in the characteristics of the step movements, strokes and efficacy. Analysing the data it is interesting to notice that W.H. returns the services in a more balanced way, using forehand and backhand push. Another important difference is about the execution of the backhand Top spin (W.H.: 10% and M.L.: 5%).

It is possible to consider the winner of the match (M.L.) more able to use in a balanced way the strokes and the footwork technique. The loser (W.H.) realized many steps and strokes with positive results but at the same time he did a higher number of mistakes. Probably this is the reason why he lost the final. W.H. did the most part of the mistakes with the use of a One step and Turn step, returning the services and playing forehand attacks after a Turn step.

Comparing different players' technique can also allow a deep analysis of the game plan and futher studies on a larger number of matches, using the same methods, will permit a better understanding of the technical aspects.

It will be fundamental to improve the knowledges about Table tennis studying and analysing footwork and the relationship between footwork and strokes.

Again another useful use of this study is could be represented by the tactical use that can be displayed starting from a deep knowledge of footwork and strokes. Knowing one's values and one's faults in performing the movements and the strokes is important to ameliorate one's technique, but it's even more important to know values and faults of the challenger from the tactical point of view in order to get better agonistic results.

REFERENCES

[1] Tepper G., *ITTF Level 1 coaching manual*, 2003, www.ittf.com

[2] Deniso P., Fruscione P., Quintiliani M., Tennistavolo, preparazione fisica , tecnica e didattica, Società stampa sportiva, Roma, 1992

[3] Leser R., Baca A., R., Kain H., Qualitative game analysis in table tennis, *Proceedings book of The 10th Anniversary ITTF Sport Science Congress*, 2007, p.99-103

[4] Hao Zhe, Cai Xue-Ling, He Fei, Hao Yu-Jiao, Analysis on technique and tactics of Ryu Seung-Min in men's singles table tennis final and semi final of the 28th Olympic games in Athens, *Proceedings book of The 10th Anniversary ITTF Sport Science Congress*, 2007, p.374-382

[5] Ripoll H., Comprendere ed agire: la soluzione del conflitto semantico-sensomotorio nello sport, *Scuola dello sport*. Parte prima: 1989, n° 17, p. 23-28. Parte seconda: 1990, n° 18, p. 38-43

[6] Rodano R., Del Rossi D., Manoni A., Del Leva P., Mallozzi L., Carvelli E., Cinematica nel Tennistavolo: applicazione di un sistema di elaborazione automatica dell'immagine televisiva ELITE alo studio della cinematica del tennistavolo, *Scuola dello sport*, 1991, n° 21, p. 50-56.

[7] Malagoli Lanzoni I., Lobietti R., Merni F., Footwork techniques used in table tennis: a qualitative analysis, *Proceedings book of The 10th Anniversary ITTF Sport Science Congress*, 2007, p.401-408

[8] Malagoli Lanzoni I., Lobietti R., A pilot study to compare footwork techniques used in Table tennis, P*roceedings book of The World Congress of Performance Analysis of sport VIII*, Magdeburg, Germany, 2008, p. 58-62.

[9] Ak E., The use of split-step by table tennis players in Turkey, *Proceedings book of The 10th Anniversary ITTF Sport Science Congress*, 2007, p. 312-315

[10] Wu X. Z., Escobar-Vargas J., Notational analysis for competition in table tennis (part I: based format analysis, p.104-108) (part II: non-format analysis, p. 109-118), *Proceedings book of The 10th Anniversary ITTF Sport Science Congress*, 2007.

Grip Strength in Young Top-level Table Tennis Players

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Abstract: Introduction. Table tennis is an individual and asymmetric sport in which a great number of shots are performed at high velocity and power involving the dominant body side. The aim of this study was to determine the presence of force production differences between dominant and non-dominant upper limbs in young top-level table tennis players. **Methods**. A total of 63 players (38 males and 25 females), aged between 10 and 13 years participated in this study. All subjects carried out a simple grip strength test using an isometric handgrip dynamometer (Takei 5101; Tokyo, Japan). Once handgrip dynamometer was adjusted to the size of the player's hands, each subject performed three attempts with each hand alternatively trying to reach the peak force in the three first seconds. Two-minutes rest period between attempts was established. Tests were executed maintaining the standard position (from stand position, extending the arm next to the body and maintaining a neutral grip with the palm oriented to the tight) and the best result for each hand was registered. A 2x2 ANOVA was performed in order to examine the interaction between sex group and laterality (dominant and non-dominant hand). **Results**. Males showed higher levels of grip strength than females both with the dominant and non-dominant hand (20.2±3.5 and 18.2±1.4 kgf for dominant and non-dominant hand in female players, respectively vs. 27.1±5.1 and 22.4±4.1 kgf for dominant and non-dominant hand in male players, respectively). Also, male and female players showed higher levels of grip strength when they used the dominant hand, although these differences were more remarkable in the male players.

Keywords: Handgrip dynamometry, Isometric force, Laterality, Young table tennis players.

1. INTRODUCTION

Table tennis is an individual asymmetric sport, in which hits with great speed and power [1]. Technical actions that take place during the game are unilateral at the trunk and upper extremities level. Thus the dominant side of the player goes into action repeatedly and exclusively.

Table tennis is an opposition sport, in which the most basic rule of the game is to hit a ball with a racket using a specific technique with the intention of sending it toward a free space away from the opponent [2].

Table tennis is characterized by consecutive series of fast and powerful hits against a lightweight ball. This has an alternating aerobic-anaerobic requirement, caused by short and intermittent efforts and incomplete recoveries. Moreover, the dominant arm is totally involved. The different positions that the link racket-arm may assume may also develop the technique of this sport.

In recent years a series of regulatory changes in the size and weight of the ball, quick glue ban, etc., have been produced this led to modifications in the characteristics of the racket.

This is a preliminary study for assessing the strength of upper extremities developed by young players of high level.

2. METHODS

A total of 63 players (38 males and 25 females), aged between 10 and 13 years and ranked between 1st -20th in Spanish national table tennis ranking for youth during the last two years were included in the study (Table 1). All subjects carried out a simple grip strength test using an isometric handgrip dynamometer (Takei 5101; Tokyo, Japan). Once handgrip dynamometer was adjusted to the size of the player's hands, each subject performed three attempts trying to reach the peak force in the three first seconds and alternating each hand. A rest period of two minutes was established between each attempt. Tests were executed maintaining the standard position (from stand position, extending the arm next to the body and maintaining a neutral grip with the palm oriented to the tight) and the best result for each hand was registered. A 2x2 ANOVA was performed in order to assess the interaction between sex group and laterality (dominant and non-dominant hand) ($p<0.05$).

Table 1. General characteristics of participants.

	n	Age (years)	Competitive experience (years)
Males	38	12.0±1.1	4.8±1.2
Females	25	11.9±0.9	3.7±1.0
Total	63	12.0±1.0	4.2±1.0

3. RESULTS

The values of grip strength test recorded, for males and females, are presented in Table 2 and Figures 1 and 2. In any case, data showed statistical differences between dominant and non-dominant hands, and a clear influence of sex factor on the ability to generate grip strength regardless of laterality. Indeed, male players were able to generate higher levels of grip strength than female players with both dominant and non-dominant hands (Tables 2 and 3). Also, male players showed greater differences between dominant and non-dominant hands than those found in female players (Figure 2).

Table 2. Values of grip strength test (kilograms of force [kgf]) for male and female players (mean ± sd). RH: right-handed. LH: left-handed.

SEX	HAND	n	Non Dominant (mean±sd)	Dominant (mean±sd)
Males	**RH**	25	22.5±3.9*	27.44±5.2*
	LH	13	22.0±4.4*	26.408±5.1*
	Total	38	22.4±4.1*	27.1±5.1*
Females	**RH**	16	18.2±1.6	20.0±2.2
	LH	9	18.4±0.9	20.6±1.6
	Total	25	18.2±1.4	20.2±3.5

*p<0.001 between male and female players.

Table 3. 2x2 ANOVA results.

Source	Type III sum of squares	gl*	F	Sig
Sex	89.303	1	23.188	0.001
Error (sex)	30.810	8		
Hand	62.603	1	16.032	0.016
Error (hand)	19.680	8		
Sex*hand	707.996	1	40.798	0.001
Error (sex*hand)	25.859	8		

*only 8 of 25 female players were left-handed

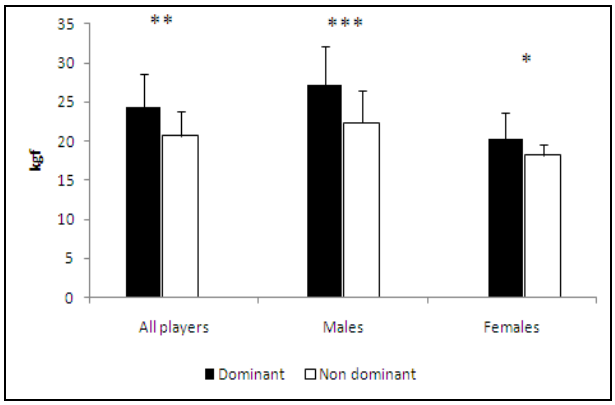

Figure 1. Grip strength (mean ± sd) for complete group, males and females players. *p<0.05, **p<0.01, and ***p<0.001 between dominant and non-dominant hands.

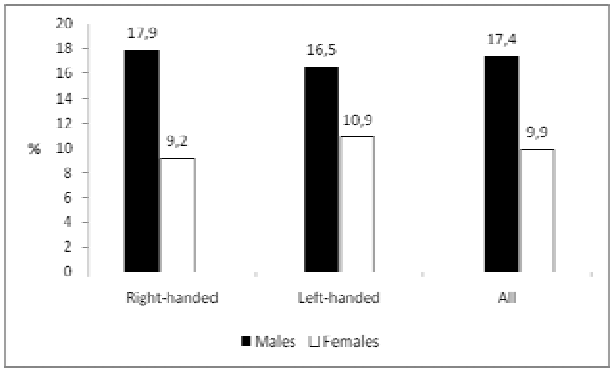

Figure 2. Percentage differences between dominant and non-dominant hands.

4. DISCUSSION

The values obtained in this study are directly related to subsequent and coordinated motor actions that are developed in this sport. This combination of skills must be accurate in space-time and with a high degree of automation. This precision, defined as the ability of positioning the body segments in one place and in a particular moment, is affected by fatigue during the game. This leads a decline in physical performance, including strength, thus low rates of strength could be related to a neuromuscular fatigue and poor technique [3].

In general, in the table tennis, the maximum strength

hand is not the most important requirement even though it has some significance during the game since the strength needed to overcome resistance is smaller than in other racket sports such as badminton [4, 5]. Absolute strength is required in situations where only the arm muscles have to be used [4], such as the forehand topspin shot or backhand loop and in situations where the player is acting or out of the position to make the hit.

In Table 2, males showed higher levels of grip strength than females regarding both dominant and non-dominant hand (20.2±3.5 and 18.2±1.4 kgf for dominant and non-dominant hand in female players, respectively *vs.* 27.1±5.1 and 22.4±4.1 kgf for dominant and non-dominant hand in male players, respectively). Both male and female players showed higher levels of grip strength when they used the dominant hand.

In this study significant differences between the dominant and non-dominant hand were obtained, both for males and females. As indicated by Hanten et al. (1999) [7], if one knows the maximum strength of one hand, one can estimate the value of other hand with a variation of 13%. The results obtained in our study are very similar to the rate establish by Hanten (1999): percentage differences between dominant and non-dominant hand were between 16.5 and 17.9% for male players, while these differences ranged between 9.2 and 10.9% in female players (Figure 2).

When a comparison between right-handed and left-handed players was performed, no statistical differences were found in both male and female players. (Table 2).

4. CONCLUSIONS

Hand maximum strength is higher in the dominant versus non-dominant hand, both for left-handed and for right-handed young table tennis players.

The maximum grip strength measured in both hands is higher in male than in female players.

By means of assessing the maximum grip strength of the dominant hand, it is possible to predict the maximum grip strength of the non-dominant hand with an estimated error of 9-18%.

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REFERENCES

[1] P. Faccini, M. Faina, E. Scarpellini and A. Dal Monte, “Il costo energetico nel tennistavolo”, *Scuola dello Sport*, Vol. 8, No. 17, pp. 38-42, 1989.

[2] W.P. Hanten, “Fuerza máxima de empuñadura en sujetos normales de 20 a 64 años de edad”, *J-Hand-Ther*, Vol. 12, No. 3, pp. 193-200, 1999.

[3] N. Gusi, "Efectos biomecánicos de la fatiga” *Apunts. Educación Física y Deportes*, No. 26, pp. 43-50, 1991.

[4] F. Pradas, *De la iniciación al perfeccionamiento en el juego de dobles. Un caso práctico*. In D. Cabello, Fundamentos y enseñanza de los deportes de raqueta y pala, (pp. 95-100). Granada, Spain: Facultad de Ciencias de la Actividad Física y del Deporte. Universidad de Granada, 2002.

[5] Omosegaard, B. (1996). *Physical training for badminton*, Denmark: Malling Beck.

[6] T. Reilly, N. Secher, P. Snell and C. Willians, *Physiology of Sport*. London: E&FN SPON, 1990.

[7] W.P. Hanten, “Fuerza máxima de empuñadura en sujetos normales de 20 a 64 años de edad”, *J. Hand Ther.*, Vol. 12, No. 3, pp. 193-200, 1999.

Puzzlement That The Edge Ball Dispute Brings To Table Tennis Match and Its Solution.

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ABSTRACT

The table tennis match has adopted 11-point-system which increased the victorious contingency of both sides of match and made the contention of the competition fiercer too. In the match, with the increasing of the scope of striking the ball by athletes, the chance that the ball touches the edge of the playing surface at the both sides of the table is obviously enhanced. Edge ball or outside, a point difference may influence the result of win or defeat of the match. In the various table tennis matches of the most recent two years, the edge ball dispute appeared again and again and often broke the competition especially at the side of the table nearest to the assistant umpire. This kind of situation is perplexing the normal operation of the match. Solving the dispute of the edge ball, referees should pay more attention and improve the observing angle to make the accurate judgment; Coaches and athletes should be in line with spirit of respecting the fact and fair play, respect referees' final judgments.

Keyword: edge ball, side of the table, referee, sportsmanship

1. posing of the problem

In the table tennis matches of the recent years, the dipute from the athlete to the edge ball appeared again and again. No matter in the match of 2007 National City Game in Wuhan, or in the match of 2008 China's table tennis open tournament, there were disputes between athletes and referees to the edge balls. And that would always broke the game. Even in the rigorously organized 2008 Beijing Olympic Game, such disputes had happened a lot. Among all these disputes, the one happened in the men's singles eighth-final, since the dispute still couldn't be solved through repeated replay, the pause of the game lasted for 4 minutes and 3 seconds, with a result of a scene of embarrassment during the match.

It is very important to know that whether the ball touched the edge, or touched the side under the edge. Even though there's only one point disparity, if it happens at the the critical moment of game point or game ball, it will greatly influence the results. So the disputes of edge balls are normal in table tennis matches. The main problem we face today is how to deal with disputes of edge balls quickly to ensure the smooth process of the match when such disputes happen.

2. Research Methods

This thesis uses the methods of Literature, Video analysis, interview experts and so on to research the disputes of edge balls.

3. Results and analysis

3.1 With the increasing of the scope of striking the ball by athletes, the chance that the ball touches the edge of the playing surface at the both sides of the table is obviously enhanced.

The table tennis match has adopted 11-point-system which increased the victorious contingency of both sides of match and made the contention of the competition fiercer too. In the match,with the expansion of the scope of the competition, the scope of activity of the athletes on the two sides of the table is increasing. While the number of the forehand large angle striking and backhand sideways striking is increasing, the opportunity that the ball would touch the edge on the two sides is increasing obviously. According to the rule, if the ball touches the the edge of white side line and light gray side, it is an edge ball. If it touches the light gray side under the edge, it is outside.

3.2 The factors which affect the accurate judgement for the edge ball

3.2.1 The impacts of the table tennis equipments for the accurate judgement for the edge ball

Table tennis is the smallest ball in all the ball games. The color of the balls for table tennis games are commonly white, almost the same color with the side line's, and also quite similar with the edge of the side face's light grey. The speed of the ball during the game is very fast, when the edge ball appears, the ball is just rubbed over the edge of the table quickly. In view of contrast of the color difference, it is not being very clear whether the ball touching the edge of white side line and light gray side or touching the light gray side which has caused certain difficulties to accurate judgments.

3.2.2 The impacts from the vice umpire's attention and viewpoint

According to the rule of the game, the vice umpire should decide the if the ball has touched the edge of the nearest table during the game. The judgement of the game is mainly decided by chief umpire, the vice umpire should also give consideration to the turning over of the scores, he doesn't adjudge the judgement

initiatively, so his attention for the edge ball appeared in the nearest sideline is a little bit inadequate.

The height of deputy umpire's seat is generally relatively low. Assistant umpire's sight after sitting down is to look at the table straight ahead. While assistant umpire deciding whether or not the ball in play touches the edge of the playing surface at the side of the table nearest to him, who can only see the coincidence to the side of ball and table from the top down; lack the suitable observation angle as to the placement of the ball.

3.3 The factors that affect the quick solve of the dispute of the edge ball

3.3.1 A few athletes are lack of the sportsmanship and the consciousness of fair play

Although the athletes could see the edge ball most clearly because they have the best distance, angle and attention,some athletes fight for the edge ball every time and totally ignore the other side's view; some athletes adhere to the personal opinion obstinately, like such dispute happened in the men's singles' semi-final in Beijing Olympic Games, an athlete put forward the objection repeatedly to the judgments that the referee had made, so the match was stopped for 100 seconds; other a few athletes lack the sportsmanship and the consciousness of fair play, they refuse to take a just attitude to the edge ball that the other side shows while the dispute appears.

3.3.2 The effect of repeated video is not that good

When the dispute of edge ball happens, the vision of the video of the edge ball's touch point from the top down is not that clear. We should mention the dispute of the edge ball in men single's eighth-final in Beijing Olympic Games again, the video had been repeated for three times, but it still couldn't be judged with full satisfaction. Withal, an athlete said, " The video repeat can't ensure the accuracy, right? I have watched the replay, but it still can be considered to be a strike, you can also discuss it."

3.3.3 The umpires'view can be influenced by the disputed athlete

From the repeated video we can see, when the dispute of edge ball happens, the athletes like to emphasize their own points of view, sometimes, they will repeat their opinions again and again to make the referee change his mind. At the moment, any hesitation from the referee will be the hope and encouragement to the athletes to go on disputing.

4 Conclusion and suggestions

4.1 conclusion

The size of the ball is very small ,and the speed of the ball is very fast. So it is inevitable to have dispute about the edge ball in the match. In a table tennis match, the referee should make a decision with the matter of fact. To solve the edge ball dispute, firstly, the referee should improve the ability of judging the edge ball; and the referee should insiste on his right decision outcome, and explain nothing about the details; and also, he should respect the fact that is admited by the athletes from both sides. In a word, the referee should solve the problem as soon as possible, and let the match go on.

4.2 suggestions

4.2.1 The height of the assistant umpire's chair should be increased. And the assistant umpire should pay more attention on observing the edge ball happened on the edge line which is nearest to him.

4.2.2 We should make the color of the table side line more different from the color on the edge of side of the table. So that it is more easy for us to tell them.

4.2.3 If we will play the picture recording, we should play the close-up slow motion of the edge ball.

4.2.4 We should strengthen education in fair competetion for the athletes and the coaches. And we also should uphold the the style of playing of being practical and realistic. The athletes should respect their rival, and submit to the referee.

References

1. The Laws of Table Tennis (2007 RMTY)
2. Referee's Delimma: Technology First? Or humanity First? (Oct 2007 Xinhua net)
3. Samusuonuofu Peiersen's Dispute on The Match Edge Ball Become The Blueh (Aug 2008 sports world net)

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Nutrition for Table Tennis

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Abstract: Nutrition for Table Tennis Competitors

Health Canada has produced a Food Health Guide for eating well and our BC Provincial Table Tennis Association has used it as a motivator, including parts of it to promote better performance among our athletes. In this paper I shall attempt to entangle the four main Food Groups in order to create well balanced meals to suit the average Table Tennis competitor. During Table Tennis competitions it is also important to manage and monitor the athletes' dehydration levels, prevent hyponatremia and promote recovery.

Key Words: carbohydrates, dehydration, fats, hyponatremia, oxalates.

Nutrition for Table Tennis Competitors

Motivation

Good health, growth and maturation depend mainly in a proper diet. It can have a significant effect in the ability of Table Tennis athletes to train and perform well during competition. Maintaining proper dietary habits plays an important role in establishing a healthy life style and will drive the Table Tennis athletes to better performance and also enhancing recovery. Our athletes usually have several matches in one day and a competition may last for 2-7 days. During some multi-sport events, Table Tennis players can be active for 10 or more days.

Specific problems like combining foods based on their glycemic index, commercial products, eating disorders, special diets, weight management and vegetarianism are well beyond the scope of this paper. Parents and coaches should consult a sport nutritionist when necessary. Here you will find simple and practical recommendations about diet and hydration for training and competition.

General Recommendations

In order to supply adequate nutrients and energy for optimum performance, an athlete's diet must be well balanced. This will also provide for the repair and maintenance of tissues and for growth. Attention should be focused on the five following areas:

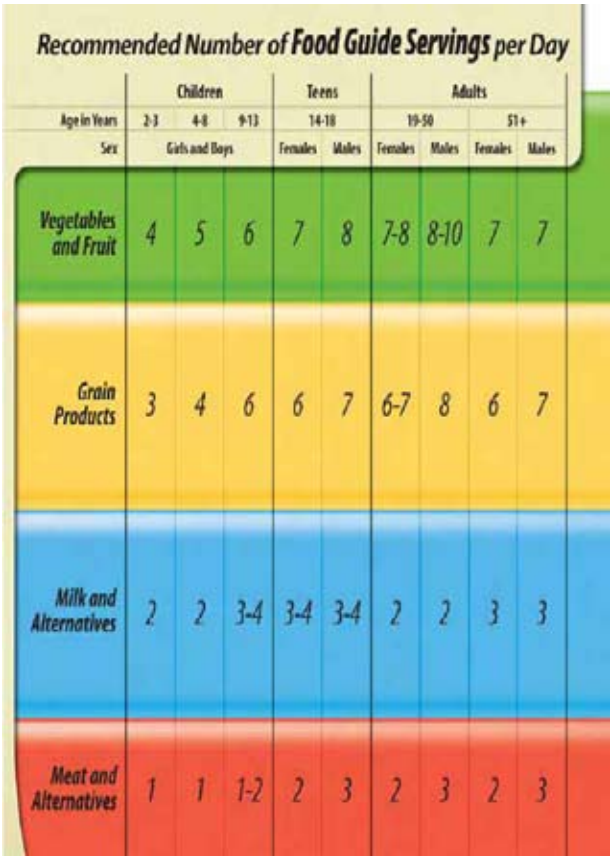
1. Eat a variety of foods – combine grains, vegetables, fruits, milk products and meat
2. Energy intake – energy requirements vary according to age, gender, body composition and type of activity related to intensity and volume.
3. Carbohydrate consumption – this is the main energy source for Table Tennis athletes. Carbohydrates stored in muscles can be depleted after an hour, depending on the intensity of the matches.
4. Fluids - the need for water increases since players perspire and ventilate. Dehydration can lead to a decrease in performance.
5. Protein – some protein is necessary to provide for adequate maintenance of muscle mass and for repairing tissue.

Canada's Food Guide

This guide (Table 1) reflects a dietary model that supplies recommended levels of essential nutrients, which help to reduce the risk of chronic disease. The key messages are:

1. Enjoy a variety of foods
2. Emphasize cereals, grain products, fruits and vegetables.
3. Choose low-fat dairy products, lean meat and food prepared with little or no fat
4. Perform regular physical activity to achieve and maintain a healthy body weight.
5. Limit the intake of salt, alcohol and caffeine.

Table 1



Recommended Number of Food Guide Servings per Day

	Children			Teens		Adults			
Age in Years	2-3	4-8	9-13	14-18		19-50		51+	
Sex	Girls and Boys			Females	Males	Females	Males	Females	Males
Vegetables and Fruit	4	5	6	7	8	7-8	8-10	7	7
Grain Products	3	4	6	6	7	6-7	8	6	7
Milk and Alternatives	2	2	3-4	3-4	3-4	2	2	3	3
Meat and Alternatives	1	1	1-2	2	3	2	3	2	3

Dietary Intake for Pre-Competition

On competition day, the main objective is to ensure that the Table Tennis player is well hydrated and has sufficient energy to meet the challenges of the matches for the day. Coaches and athletes should focus on:

1. The quality and volume of familiar food to be available
2. Food should be over 60% carbohydrate
3. Fat content should be 20% or less
4. Sufficient fluid is available
5. Snacks for between matches.

The Coaching Association of Canada has recommended the following for pre-event meals:

Best choices for **breakfast meal**:
Cereal – with low-fat milk
Yogurt – low-fat, plain or fruit
Fruit
French toast and/or pancakes – with no added butter or margarine
Egg dishes – not fried
Ham or steak – if lean/not fried (small amounts)
Potato – not fried
Rice – not fried
Noodles, Pasta
Toast – with limited amounts of butter/margarine
Muffins – try jam or jelly, not butter
Beverages – Athletes should drink plenty of fluid!
Bottled water
Fruit juice – fresh, canned, cartons
Skim milk, Ovaltine

Best choices for **lunch** or **dinner meals**:

Fruit and vegetables, fruit and vegetable juices – fresh, canned, cartons
Soups – broth-based
Meat, Fish, Poultry – broiled, roasted, baked, barbecued, poached (reasonable portions; trimmed fat; skin from chicken removed)
Cold cuts – turkey, chicken, lean beef, lean ham (reasonable portions)
Meat alternatives – beans, peas, and lentil dishes if these are familiar foods; gas produced when these foods are not part of the usual diet can cause discomfort.
Vegetables – steamed, boiled, baked
Potatoes – baked, boiled, mashed (without butter/margarine)
Rice – steamed, plain
Noodles – plain
Pasta – plain or tomato or vegetable sauce
Bread – rolls, crackers, all breads
Salads – bean, peeled fresh vegetables, fruit salad, low-fat cottage cheese; (small amount of dressing)
Desserts – fruit, yogurt (low fat), custards, puddings
Cheese – in moderation

Foods to Avoid

- **Fatty food**s, because they are slow to digest
- **Protein-rich food**, because they are slow to digest and are not needed as fuel during exercise
- **Alcoholic beverages** such as wine, and beer, because they can have a dehydrating effect.
- **Spicy foods** may be difficult to digest prior to exertion. (When traveling in other countries, athletes can bring a few favourite spices if they are already used to them.)

Prior to exercise, **fibre-rich foods** like whole-grain bread, cookies, and whole-wheat cereals, dried fruits (prunes, etc.) stimulate digestion and induce elimination. These foods should be avoided, especially if the athlete has diarrhea.

- **Gas-producing foods** like cabbage, broccoli, onions, and carbonated drinks, make some athletes feel bloated.

Coffee, tea, cola, and chocolate may cause diarrhea, which can have a dehydrating effect.

Foods to avoid

(**Breakfast**)
- Whole milk, cream
- Fried eggs
- Side bacon, sausage
- French fries, hash browns
- Fried rice
- Cream or butter sauces
- Doughnuts, Danish, pastries
- Croissants

- Butter, margarine

(**Snacks, lunch, or dinne**r)

- Cookies, crackers, chips, granola bars,
- Cream soups
- Fried fish, meat, or poultry
- Buttered, sautéed, creamed vegetables, or soufflés
- Fried potatoes
- Butter or cream sauces
- Pâté, sausages, processed meats, liverwurst
- Potato and macaroni salad, creamy coleslaw
- Pies, ice cream, pastries

Digesting Period

The meal size and food choices will vary depending on the time between eating and performing. Athletes must allow sufficient time for digestion. High kcal meals, especially those high in fat content, take longer to digest than lighter snacks. The guidelines below should be used when planning meal times relative to a training session, a competition, or a series of competitions held on the same day. Coaches should be aware of individual tolerance levels for food. Experiment with these guidelines in practice, in order to establish an appropriate protocol for each athlete.

(1) Allow 3-4 hours for a large meal (approximately 500-800 kcal or more) to digest.
(2) Allow 2-3 hours for a smaller meal (approximately 300-500 kcal) to digest.
(3) Allow 1-2 hours for a small snack or blender/liquid meal to digest, or whatever the athlete's own tolerance indicates.

If the athlete will be competing within the next 2 hours, small quantities of carbohydrates are the best choice: fruit, beverages, low-fat crackers, bread, yogurt, and/or well-cooked pasta. The athlete should also drink plenty of water. (When the athlete is traveling, bottled water should be used.)

Table 2 refers to a lunch menu suggested by the Sport Innovation (SPIN) Summit.

Table 2

	Serving	Calories	Carbohydrates (g)	Fibre (g)	Sugar (g)	Protein (g)	Fat (g)
Spinach & lettuce salad, sunflower seed, balsamic dressing	1 cup	137	5	1.5	1	2	12.5
Grilled chicken breast with skin in hunter sauce	8 oz	380	4	0	1	45	23
Steamed vegetables	4 oz	55	8	2.5	2.6	2	2.5
Roasted potatoes	4oz	110	25	2	2	2	0
Mango passion mousse	157g	300	32	2	24	4	18

This vitamin packed meal delivers a great balance of carbohydrates, protein and fibre. You can shave 20 grams of fat and 180 Calories off this meal by removing the skin from the chicken. Since the spinach contains oxalates, we are not able to absorb the iron from spinach. Spinach is still a good source of folic acid, vitamin A, vitamin K and vitamin C. The mango mousse has 30% of your daily requirement of Vitamins A and C.

Prevent Dehydration and Hyponatremia

Fluid replacement is probably the most important nutritional concern for an athlete. Table Tennis matches are sometimes held under hot and humid conditions and much fluid can be lost through the skin, sweat glands and lungs from breathing. If this fluid is not replaced at regular intervals during training or competition, it can lead to dehydration. A dehydrated athlete has a decreased volume of blood circulating throughout the body. Three main effects are noticeable in that the amount of blood pumped with each heartbeat decreases; exercising muscles do not receive sufficient oxygen and resulting fatigue causes performance to suffer.

Approximately 60% of body weight is water. Research has demonstrated that dehydration, even 2% of body weight, can adversely affect athletic performance. Therefore, drinking water is a necessity. However, drinking water only does not replace the electrolytes lost in perspiration and the performance

boosting carbohydrates. Water is definitely good, but should be taken in moderation. A large amount of fluid is unnecessary and in some athletes can result in bloated stomach, puffy fingers and ankles, headaches and confusion. These are warning signs of a condition called hyponatremia.

Hyponatremia occurs when blood sodium concentration falls to an abnormally low level, precipitating a rapid and dangerous swelling of the brain that can cause seizures, coma and death. Fatal hyponatremia in athletes is rare, but is has claimed the lives of marathon runners and military recruits. Hyponatremia is often associated with prolonged exercise, but it can also occur at rest when too much fluid is ingested too quickly. Athletes should reduce risks by ensuring that fluid intake does not exceed sweat loss and ingesting sodium containing beverages and foods to maintain an electrolytic balance for physiological homeostasis and performance.

The consumption of fluid replacement containing sodium helps to retain water in the body and increases the absorption of fluid from the intestines into the muscles. Recent research has suggested that a 6-8% of a glucose or sucrose sport drink with about 110 mg of sodium per an 8oz serving empties from the stomach as fast as plain water. An ideal fluid replacement is one that tastes good for the athlete, does not cause gastro-intestinal discomfort or distress, promotes rapid fluid absorption and maintenance of body fluid, and provides energy to the working muscles during intense training and competition.

The amount of fluid athletes can tolerate **varies from person to person**, but usually ranges between 10-15ml per kg of body weight per hour.

Table 3

Body weight	Approx. amount of fluid absorbed per hour (ml)	
	From	To
30	300	450
40	300	600
50	500	750
60	600	900
70	700	1050
80	800	1200
90	900	1350

Table 4.0

Beverage	CHO concentration	Electrolytes
Gatorade	6%	Proper concentration
Powerade	7%	Low sodium, High potassium
AllSport	8%	Low sodium, High potassium
Met-Rx Ors	8%	High sodium, Low potassium
PowerBar Perform	7%	High sodium, Low potassium
Revenge	4%	Low sodium, High potassium
Soda pop	10-12%	Low sodium, High potassium
Endurox	15%	High sodium, Low potassium
Orange juice	11%	Low sodium, High potassium
Rehydralyte	2.5%	Very high sodium and potassium

Strategies to Promote Recovery

In Table Tennis competitions where there are several matches on the same day, athletes and coaches choose wisely the type and quantity of food and snacks to be consumed. Generally, it is recommended to consume snacks high in carbohydrates between matches, and to ensure that there are sufficient sport drinks available. A substantial meal should be eaten after the last match of the day.

Delaying carbohydrate intake after training or matches will reduce glycogen stores and interfere with the ability of the muscles to recover. Several research studies show that consuming carbohydrates immediately after training or competition is beneficial for recovery. Carbohydrates drive muscles to absorb more glycogen in order to reload the athlete faster. This in turn minimizes fatigue associated with high volume training or gruelling tournament matches during a Table Tennis competition. Preferably within 30 minutes after the last match the athlete should consume some carbohydrate and repeat this for every two hours until the next meal. This allows muscle energy stores to be replenished at a faster rate than waiting until mealtime. Some athletes prefer to consume carbohydrates in a liquid form rather than solid, since exercise can dull the appetite.

The following chart (Table 4.0) is example of fluid replacement drinks.

Table 4.1 suggests a reasonable amount of carbohydrates to be consumed relative to body weight:

Table 4.1

Body weight (kg)	Quantity of carbohydrate to consume up to 30 min. after activity and every 2 hours until the next mealtime (gm)
30	45
40	60
50	75
60	90
70	105
80	120
90	135
100?	150?

Other strategies to consider are:

- The last meal of the day after training or competing should be high in carbohydrates, adequate in protein and low in fat.
- Consume moderate amounts of salt
- Select vegetables and fruits, especially those which are rich in potassium.
- Pack non-perishable foods to take to the playing hall. Jennifer Gibson, the Sport Nutritionist for the B.C. Table Tennis team, has this message for our athletes. She works as a sport dietician for SportMedBC.

Nutrition for Table Tennis

Nutrient Timing

- Plan to eat every 3-4 hours. Do not skip meals!
- Develop a nutrition timeline for training and competition

Nutrient Balance

- Breakfast: ¾ food groups + fluids
  - -Cereal with milk + fruit
  - -Egg + 2sl. Toast + orange juice
- Snack: 1-2 food groups + fluids
  - -Yogurt + fruit
  - -Low fat granola bar
- Lunch: ¾ food groups + fluids
  - -Lean meat sandwich + fruit + yogurt + water
  - -Vegetable soup + fruit + cheese string + water
  - -Vegetarian pizza (thick crust) + fruit + water
- Snack: 1-2 food groups
  - -Yogurt + fruit
  - -Low fat granola bar
- Dinner: ¾ food groups + fluids
  - -Pasta + meat sauce + salad
  - -Chicken stir fry with rice and veggies
  - -Chicken burger + milk + baked potato

Competition Nutrition

- Know what the menu will be ahead of time
- Pack non-perishable foods and fluids for traveling
- Increase your fluid intake. Aim for 1 cup per hour of travel and continue upon arrival.
- Take a multivitamin to help reduce illness
- Be conscious of risks for food poisoning
- If you have a nervous stomach, drink liquid meals at competition and above all
- Eat familiar foods

References:

1. **Canada's Food Guide.**
   www.healthcanada.gc.ca

2. **Introduction to Competition, The Coaching Association of Canada.**
   www.coach.ca

3. **Gatorade Sports Science Institute, Volume 16 No.1.**
   www.gssiweb.org

4. **Optimal Dietary Intake, U.S. Anti-Doping Agency.**
   www.usantidoping.org

Analysis on Technique and Tactics of Lin Ma and Hao Wang in the Men's Single Table Tennis Final in the 29th Olympic Games

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Abstract: The competition for the most important gold medal of the men's single table tennis final in the 29th Olympic Games in Beijing, was between two players with pen-hold grip of China, Lin Ma and Hao Wang. During the competition, the two of them both took fully advantage of the characteristic of pen-hold grip, which made the game a very classic example. In order to prove up the characteristics of the tactics and technique of Lin Ma and Hao Wang and to supply some references for the players with pen-hold grip. With the methods of three-phase indexes, documentary review, video observation, and taking Lin Ma and Hao Wang as the research target, the characteristics of Lin Ma and Hao Wang's tactics and technique in the men's single table tennis final of the 29th Olympic Games in Beijing were systematically analysed and done some research. The analysis and statistical results were that Lin Ma's score rate was 64.7%, the applied rate 17.9% in phase of attack after service; the score rate was 56.3%, the applied rate 33.7% in phase of attack after receiving; the score rate was 45.7%, the applied rate 48.4% in phase of be locked in stalemate. Hao Wang's score rate was 52.2%, the applied rate 24.2% in phase of attack after service; the score rate was 50%, the applied rate 27.4% in phase of attack after receiving; the score rate was 43.5%, the applied rate 48.4% in phase of be locked in stalemate. The data indicate the score rates and applied rates of both the players are all excellent in phase of attack after receiving, which efficiently shows that the two players with pen-hold grip have very good ability in dealing with receiving and attack after receiving. During the competition, the two players all took fully advantage of pen-hold grip, they are fast attack in close-table, wrist is agility, and they are good at dealing with pick-hitting in short court. Lin Ma's consciousness of tactics was correct and clear, he weakened and restrained from Hao Wang's attack after receiving by some change of service , took the initiative of the competition. And Hao Wang's service failed to restrain the attack after receiving of Lin. Ma.

Keywords: Table tennis; Lin Ma; Hao Wang; Analysis on techniques and tactics.

1. INTRODUCTION

Pen-hold grip has always been the mainstream of table tennis in Asia. In recent years, the representative of playing with pen-hold grip inverted rubber racket adhibited inward pimples rubber, Chinese players Lin Ma and Hao Wang, have taken new techniques on the basis of strengthening their own abilities, they have solved some problems of pen-hold grip and have opened a wider field of progressing the technique. The competition for the most important gold medal of the men's single table tennis final in the 29th Olympic Games in Beijing, was between two players with pen-hold grip of China, Lin Ma and Hao Wang. Both of them had defeated their separate opponents , Swedish veteran Persson and Chinese competitor Liqin Wang in the semifinal. During the competition, the two of them both took fully advantage of the characteristic of pen-hold grip, which made the game a very classic example. In order to prove up the characteristics of the tactics and techniques of Lin Ma and Hao Wang and to supply some references for the players with pen-hold grip inverted rubber racket adhibited inward pimples rubber. This article has systematically made some analysis and done some research on the five games between Hao Wang and Lin Ma in the men's single table tennis final in the 29th Olympic Games in Beijing by the methods of documentary review , video observation and three-phase indexes. Now,made report as follows:

2. MATERIAL AND METHODS

2.1 research subjects

The article has taken the five rounds between Hao Wang and Lin Ma in the men's single table tennis final in the 29th Olympic Games in Beijing as research object and has made some analysis on the techniques and tactics of Lin Ma and Hao Wang. Lin Ma, male, 28 years old, is a Chinese table tennis player of pen-hold grip, the second place in the world in the year of 2008. Hao Wang male, 25years old, is a Chinese table tennis player of pen-hold grip, the first place in the world in the year of 2008.

2.2 Methods

Documents review: search and consult some papers in Journal of Beijing Sport University, Journal of Sport, Journal of Shanghai Sport College, ect[1-12].

Three-phase indexes[1-3]: the 5 rounds between Lin Ma and Hao Wang in the final game of men's single of table tennis in the 29th Olympic Games in Beijing were systematically analyzed by the methods of three-phase indexes.The three-phase indexes meant that the subjects' features of techniques and tactics were analyzed by calculating the scoring rate and using rate in the phase of attack after service(PAS), the phase of attack after receiving(PAR) and the phase of be locked in a stalemate(PLS). The calculating formulas were as follow:

Scoring rate of a phase=[scoring points of the phase

÷(scoring points of the phase + losing points of the phase)]×100%

Applied rate of a phase=[(scoring points of the phase + losing points of the phase)÷(total scoring points + total losing points)]×100%

Score rate was divided into 4 grades: excellent, good, pass and fail to pass. Applied rate was a reference standard in general. The evaluating criteria is in table 1.

Video observation: Lin Ma and Hao Wang's characteristics of technique and tactics were studied by video observation and statistics.

Table 1 Evaluating standard of three-phase indexes analysis method

Grades	PAS		PAR		PLS	
	score rate(%)	applied rate(%)	score rate(%)	applied rate(%)	score rate(%)	applied rate(%)
excellent	70		50		55	
good	65	25-30	40	15-25	50	45-55
pass	60		30		45	
fail to pass	┌ 59		┌ 29		┌ 44	

Notes: PAS= phase of attack after service; PAR =phase of attack after receiving; PLS= phase of be locked in a stalemate.

3. RESULTS AND ANALYSIS

3.1 Analysis on the characteristics of the technique and tactics of Lin Ma

The analysis results of Lin Ma by the three- phase indexes is in table 2.

Phase of Attack after Service(PAS): Lin Ma's scoring rate in PAS is 64.7% and is quite near to good. The applied rate (17.9%) is low, which indicates that Lin Ma's way of getting points in PAS wasn't showed enough, and that he was not active enough in attacking after service and was too smooth. It also showed that Hao Wang knew well about Lin Ma's service and had controlled Lin Ma's attack after service. Lin Ma's scoring rate in the second round is 100%, which means the rate of his successful attack after service is remarkably high, however his applied rate is low(15%). Lin Ma's service was mostly short, bias and certer , combining with using long angle shot to opponent's body, suppressed or weakened opponent's attack. Attacking after service, was mostly by backhand position sideways angle loop drive and forehand position angle loop drive.

Table 2 Analysis results of Lin Ma by three-phase indexes *

Games	PAS				PAR				PLS			
	SP	LP	SR%	AR%	SP	LP	SR%	AR%	SP	LP	SR%	AR%
1	3	2	60	25	4	3	57.1	35	4	4	50	40
2	3	0	100	15	3	4	42.9	35	5	5	50	40
3	1	1	50	11.8	4	2	66.7	35.3	1	8	11.1	52.9
4	3	1	75	22.2	2	3	40	27.8	6	3	66.7	50
5	1	2	33.3	15	5	2	71.4	35	5	5	50	50
Add up	11	6	64.7	17.9	18	14	56.3	33.7	21	25	45.7	48.4

* The men's single table tennis final in the 29th Olympic Games in Beijing

Notes: score point = SP; losing point = LP; core rate = SR; applied rat e= AR

Phase of Attack after Receiving(PAR): Lin Ma's coring rate (56.3%) in PAR was excellent and the applied r a t e (33.7%) was also the maximum of excellent level, which means Lin Ma knew the service of Hao Wang well and was initiative to response and attack after receiving with a higher rate of success. It can initiatively made score straight by some opportunities and combining with changes of spin , long or short , point of fall . It also showed that Hao Wang's service was not good enough, he failed to control the attack after receiving of Lin Ma.

Phase of be Locked in a Stalemate(PLS):The scoring rate (45.7%) of Lin Ma in PLS was pass, applied rate (48.4%) was good in PLS. Lin Ma took the advantage of attack in PAR to be initiative in PLS, Lin Ma initiatively made score by controlling Hao Wang by forehand position straight loop drive, backhand position sideways angle loop drive in big angle,and combining with backhand position angle or straight block.

3.2 Analysis on the characteristics of the technique and tactics of Hao Wang

The analysis results of Hao Wang by the three- phase indexes is in table 3.

Phase of Attack after Service(PAS): Wang Hao's scoring rate in PAS was 52.2% and failed to pass. The using rate (24.2%) was nearly good, which showed that Wang Hao was initiative in PAS but the success rate was

low. It also showed that Wang Hao's service was well controlled by Lin Ma which had made it difficult for Hao Wang to attack or fail to do so. Lin Ma can made score straight by attacking Hao Wang's ball off court mostly . which was an important reason of Hao Wang's high rate of failing in PAS. Hao Wang's service had less change, was mostly servicing forehand underspin service, side underspin , short bias and certer , combining with servicing topspin straight and side underspin straight.

Phase of Attack after Receiving(PAR): the scoring rate (50%) of Wang Hao in PAR was excellent, his using rate (27.4%) was also the maximum of excellent level. It showed that Hao Wang was initiative in PAS and the success rate was high. It also had showed that Hao Wang knew the characteristics of Lin Ma's service well, attack initiatively by the back-of-racket penhold backhand loop horizontally. Wang Hao's means of scoring was mostly backhand position straight or angle loop drive horizontally, forehand in short court angle smash, combining with backhand position sideways straight loop drive.

Table 3 Analysis results of Hao Wang by three-phase indexes *

Games	PAS				PAR				PLS			
	SP	LP	SR(%)	AR(%)	SP	LP	SR(%)	AR(%)	SP	LP	SR(%)	AR(%)
1	2	2	50	20	4	3	57.1	35	3	6	33.3	45
2	4	2	66.7	30	1	3	25	20	4	6	40	50
3	2	2	50	23.5	3	1	75	23.5	6	3	66.7	52.9
4	2	2	50	22.2	2	4	33.3	33.3	3	5	37.5	44.4
5	2	3	40	25	3	2	60	25	4	6	40	50
Add up	12	11	52.2	24.2	13	13	50	27.4	20	26	43.5	48.4

* The men's single table tennis final in the 29th Olympic Games in Beijing
Notes: score point = SP; losing point = LP; score rate = SR; applied rat e= AR

Phase of be Locked in a Stalemate(PLS): The scoring rate (43.5%) of Wang Hao in PLS was failed to pass, but the using rate (48.4%) was high, which showed that Wang Hao was quite positive in attacking after receiving in PLS although the success rate was low. There were many bouts ball in PLS . Hao Wang's fault was mostly backhand position return loop drive, and rush at forehand position loop drive.

4. DISCUSSION

4.1 The characteristic of Lin Ma's technique and tactics

Lin Ma suppressed or weakened opponent's attack after riceiving by changes of spin , long or short and point of fall , was mostly servicing left side underspin , underspin straight short ,combining with left side underspin long service. because the route of the ball was changeable, he was able to make his opponent passive to receive, and made the chance for himself to attack. After service, controlled opponent to try for next initiative by forehand position angle loop drive and combining with straight loop drive, was mostly using backhand position sideways loop drive, backhand position straight loop drive horizontally and adding loop,which was mostly used backhand position long ball returned by opponent push. but it use rate was less. On the receiving, was mostly drop shot at center line or deflection backhand position , look for opportunity during drop shot. In the Phase of being locked in a stalemate after 5 time bouts, Lin Ma's score means was mostly by point of fall of loop drive and cadence of block in backhand position, during counter-loop drive, became suddenly into block, would control opponent's cadence of counter-loop.

4.2 The characteristic of Hao Wang's technique and tactics

Hao Wang's service was mostly forehand position underspin center service or angle short service, combining with sideways underspin and side topspin angle short service, to cooperate with the attack after service, but his service was always controlled, which made the chance for him to attack quite little or made him passivity attacked. So the scoring rate of Hao Wang in PAS failed to pass, the initiative mistakes were of large quantity. while receiving opponent's service,was mostly attack, combining with backhand loop drive in s hort court, to suppress or weaken opponent's attack. But the Hao Wang's faults in backhand position were not less during the Phase of being locked in a stalemate. Faults were not less in the backhand position horizontally loop drive and forehand position defending

4.3 The characteristic of tactical consciousness of Lin Ma and Hao Wang

Consciousness is the reflection of the extension world in human brain. The awareness of tactics refers to the stratagems, activities and approaches which are formed in the player's brain on the basis of a series of knowing, observing and the analysis on the characteristics of the techniques and tactics of the opponent in order to fight against them. As a result of the fact that activities are dominated by the consciousness of the brain, only if we have correct awareness of tactics, can we carry out the correct tactical activities[4,5]. As the two top table tennis players in the world, Lin Ma and Hao Wang are more or less the

same in technique, the competition between them turned out to be the contest of wisdom, the use of tactics and courage. Lin Ma restrained the attacks after receiving of Hao Wang with the use of the spin of the ball and the various lengths and falling point of the ball. Although the scoring rate and using rate of both players in PAR were excellent, Lin Ma did a little better. Hao Wang's technique of serving off and the use of tactics were not good enough, though the changeable falling point of the ball and spin had restrained Lin Ma's attack after receiving to some extent. But he failed to reduce Lin Ma's rate of successful attack after receiving which turned out to be excellent (56.3%). In the PLS, both of the players were active in attacking, however, taking the advantage of falling point of the returned ball and spin, Lin Ma restrained Wang Hao's exertion of the pen-hold backside hit which he was best at . Lin Ma's awareness of tactics and the use of it were correct and clear and he took the initiative of the competition. Finally, Lin Ma defeated Hao Wang and won the champion at a score of 4:1.

There are similarities between table tennis competitions and wars. During the whole history, there were a lot of examples of the small defeating the big, and the weak defeating the strong. In a table tennis competition, in order to win, one must firstly have an extension opinion of the characteristic of technique and tactic of the opponent and be clear about advantages and shortcomings of it, and the advantages and disadvantages of his/her own characteristic at the same time. And make the idiographic tactic on the basis of that in PAS and PAR. That is to say you should avoid, dispel, control or weaken the opponents' advantage, and use your advantage to attack the opponents' shortcomings, and only through doing this can you win. Lin Ma's winning the game efficiently showed that his awareness of tactics and the use of it accorded with the inherent law of winning table tennis games. That is, dispelling or weakening the opponent's advantage and attacking his shortcomings with your own advantages[6].

Only when a table tennis player qualified with a strong mind, a good character and mental quality and unique techniques, tactics, physical force and capacity, can he reach the top peak of table tennis in the world[7]. The table tennis is small, light and quick, its technique is various, it's changeable during the competition, at the same time, the differences of the physical strength and tactics of top players from different countries are little. In this situation, the key of winning the game have turned into how to fully bring into the positive aspects of intelligence, characteristics and mental factors of players[8]. Innovation is the exhaustless impetus of table tennis[9]. We should encourage and advocate the technical innovation cooperated by scientific researchers, coaches and players[10]. Beside the practiced techniques, the players should also have consummate consciousness. Only when the technique armed with consummate awareness of tactics, can it bring into a greater effect[11]. The correct understanding of the law of winning table tennis games is the precondition of the scientific training. It is the unceasing innovation that endues table tennis with new impetus[12].

5. CONCLUSION

Lin Ma's consciousness of tactics was correct and clear, he took the initiative of the competition. His consciousness of tactics and use of it tallied with the law of winning the games of table tennis, which was the fundament of his winning the game. Through changing table tennis' spin, point of fall and long or short, Lin Ma restrained or weakened Hao Wang's attack after receive. Although the scoring rate and use rate of both players in the phase of attack after receiving were excellent, but Lin Ma did better.

The technique of service and the use of the tactics of Hao Wang was not good enough, although the point of fall,spin had weakened Lin Ma's attack after receive to some extent, he failed to restrain Lin Ma's attack after receiving thoroughly, which resulted in his passivity. During the phase of be locked in a stalemate, both of the players were initiative and active to attack , the bouts was of great quantity, but Lin Ma's return was better, and it had restrained Hao Wang's technique of playing horizontally table tennis with pen-hold grip which he was most accomplished in.

The two players with pen-hold grip have very good ability in dealing with receiving and attack after receiving.They all took fully advantage of pen-hold grip, they were fast attack in close-table, wrist was agility, and they were good at dealing with table tennis in short court.

REFERENCES

[1] Li JL, Yang H, Zhao X, "Technical Analysis of Main Opponents of Chinese Man's National Table Tennis Team".*Journal of Beijing Sport University*,Vol. 27, No. 6, pp. 830-833,2004...

[2]Liu D H, Dong Y, "Analysis on exemple of table tennis' technique and tactcs in the rule of 11 points" . *journal of sport college of Haerbin* , Vol.22,No.3,pp. 80-81,2004

[3] Dong Y, Xu W, Liu YL, "Analysis on technique and tactics of Chines main table tennis player in rule of 11points" , *Chinese Sport Coach* ,No.1,pp.40,2003..

[4] Zhang Hui, Hohmam Andress. "Athletic Diagnosis of Table Tennis Matches through Mathematic Simulation",.*Journal of Shanghai Physical Education Institute* , Vol.28,No.2,pp. 68-72,2004

[5] Su PR. "New Viewpoints on Table Tennis Tactics". *Journal of Nanyang Teachers College* , Vol.2,No.12,pp. 85-87 ,2003

[6]Zhe Hao, Xueling Cai, Yujiao Hao, Jingjing Zhang, Manliang Hao. "Analysis on Ryu Seungmin's Technique and Tactics in Man's Single Table Tennis Final and Semifinal of the 28th Olympic Games in Athens". *Journal of Beijing Sport University.* Vol.30,No.2,pp. 258-260,2007

[7] Wu JX, Lin ZM, Liu YH. "An Analysis of Victory and Defeat Factors in Table Tennis Matches". *Journal*

of Hubei Sport Science,No.2,pp.19-22,1998.
[8] Liu YT. "Research on Intelligence of Table Tennis Player". *Journal of Physical Education*, No.1,pp. 113-115,1996.
[9] Wei ,QZ . "The Innovation is a Motive Power of Ping-pong Sport". *Journal of Jianghan University*, Vol. 32,No.1,pp.85-87,2004.
[10] Su PR. "A Study of the World Table Tennis Technical Innovations in the 20th Century —Combining A Comparison Between Chinese And Foreign Table Tennis Technical Innovations. *Academic Forum of Nan Du*, Vol.21,No.3,pp.,92-95,2001
[11] Qin H. "Actical Awareness Raising in Table Tennis Playing". *Journal of Weinan Teachers College(Social Sciences*), 2004,Vol.19,No.2,pp..93-95
[12] Administation Center of Tabletennis and Badminton Affiliated to theNational administration of Sports and Physical Culture.. "Retaining the Dominant position of Chinses Table-tennis and Furthering Renovation and Scientific Training". *Journal of Chengdu Education Institute*, Vol.26, No.1, pp.74-78, 2000

A Comparison of Exercise Intensity on Different Player Levels in Table Tennis

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Abstract: The aim of the present study is to compare the physical fitness of table tennis players and the exercise intensity during a table tennis singles match with special reference to the different player levels. Thirty-three healthy men volunteered to participate in this study. They were divided into three samples: recreational level, regional level and league level. All players were subjected to a VO_2max Fitness Test on the motorized treadmill. Measuring heart rate was realized with the monitors Polar RS800 during three table tennis matches. The samples of heart rate were stored in 1 second intervals and were transferred to the software ProTrainer 5. The matches were played on 3 games to 11 points with opponent from the same player level. The results showed significant differences in aerobic capacity (VO_2max) and resting heart rate among the players on the recreational, regional and league level. The best values were in the league players. We found a significant positive relationship between player levels and heart rate responses. The table tennis skill level was a significant factor in the level of exercise intensity in the singles matches.

Keywords: exercise intensity, table tennis, heart rate.

1. INTRODUCTION

Exercise intensity is the amount of physical power, expressed as a percentage of maximum, the body uses in performing an activity [5, 13].

There are several ways to measure exercise intensity. The first method measures the amount of oxygen consumed by the body as an activity is performed. This method is expressed in studies as the percentage of maximum oxygen consumption (% VO_2max). Another method of measurement works with the increased heart rate that occurs with exercise. This method is usually expressed as a percentage of maximal heart rate (% MaxHR) [5, 7]. A simpler method than monitoring heart rate is the Rating of Perceived Exertion (RPE). RPE is a subjective measure and asks the exerciser to think about how hard they feel their body is working against a standardized scale. RPE can be the primary means of measuring exercise intensity if individuals do not have typical heart rate responses to graded exercise [3]. Another method for measuring exercise intensity is the Talk Test. Like the RPE, the Talk Test is subjective and should be used in conjunction with taking a pulse. The Talk Test has been confirmed as a simple and accurate method of gauging intensity that doesn't require any equipment or learning [5].

In our study we used monitoring heart rate to measure exercise intensity in the table tennis matches. The heart rate increases (approximately) linearly up to the deflection point, where the heart rate reaches lactate threshold. In the aerobic mode, in the range of heart rates of about 120–180 beats/min, a linear relation exists between exercise intensity and heart rate. At increased levels of intensity oxygen supply becomes insufficient and the required energy will have to be produced by the muscle without oxygen (anaerobic). The blood supply to the muscle and the accompanying heart rate will increase at a lower degree. The curve will show a kink, or a deviation from the straight line will become visible [4, 5, 7].

Measuring heart rate is the method most often used to evaluate intensity in everyday life or to set the level of exercise in physical training. Low, moderate and high levels of exercise intensity, as measured by heart rate, are defined as follows: Low (or Light) is about 40-54 % MaxHR, Moderate is 55-69 % MaxHR, High (or Vigorous) is equal to or greater than 70 % MaxHR [5, 7].

Heart rate monitoring during table tennis competition can be a sign of the exercise intensity especially in the aerobic mode, the condition of players and a useful indicator for further planning of the training process with the aim of achieving the best possible results [2]. We also must reflect that heart rate can response to mental stress during the table tennis game. A table tennis match involves a combination of periods of maximal or near maximal work and periods of moderate and low intensity activity. Match intensity can vary considerably depending on the players´ level, style and sex [8, 12].

2. PURPOSE

The purpose of the present study is to compare the physical fitness of table tennis players and the exercise intensity during a table tennis singles match with special reference to the different player levels.

3. METHODS

3.1 Method of selecting subjects

Thirty-three healthy men between the ages 18 and 30 volunteered to participate in this study. The subjects

were divided with regard to their player (skill) levels into 3 samples with 11 individuals:

a) The recreational level – beginners. These individuals play table tennis only as a recreational sport 5-10 times a year. They can play the basic stroke. They never played table tennis competition.

b) The regional level - players from regional competition. These individuals play table tennis 2-3 times a week. They played regular table tennis competition for minimum 5 years.

c) The league level - players from the first league. These individuals play table tennis 5-6 times a week. They played the highest table tennis competition for minimum 3 years.

In table 1, characteristics (mean ± standard deviation) of age, height, weight and body fat are shown for selected samples.

Table 1 Basic characteristics of selected samples

	Recreational players	Regional players	League players
Number	11	11	11
Age [years]	25.4 ± 2.5	23.6 ± 3.1	24.7 ± 4.6
Height [cm]	177.8 ± 7.2	185.4 ± 7.7	174.1 ± 6.8
Weight [kg]	81.6 ± 7.8	86.9 ± 9.3	71.6 ± 5.2
Body fat [%]	21.5 ± 5.3	18.2 ± 5.9	12.5 ± 3.1

3.2 Methods of data analysis

All players were subjected to a VO_2max Fitness Test on the motorized treadmill at the Laboratory of Sport Medicine. To begin the exam, subjects were fitted with a respiratory mask, covering their mouth and nose, and were connected to a cardiac monitoring device - 12 Lead EKG. The workload increased every minute until maximum heart rate was achieved and the test concluded with a three minute recovery period at a light workload. All data were recorded continuously throughout the test period. Testing was administered using the motorized treadmill HP Cosmos Pulsar 4.0 MED. Specifications: speed 0 to 40 km/h; elevation -25 % to +25 %; running surface 190 cm x 65 cm.

Measuring heart rate was realized with the Polar RS800 wrist heart rate monitor (Polar Electro Oy, Kempele, Finland). The RS800 is designed for the elite level endurance athletes. The new Wear Link W.I.N.D. transmitter with 2.4 GHz transmission is disturbance free of all other electronic devises. The samples of heart rate were stored in 1 second intervals and were transferred to the software ProTrainer 5 (Polar Electro Oy, Kempele, Finland). This is sophisticated software designed to analyze the results with versatile graphs and to use different reports for long-term development follow-up. This telemetric system has been previously validated [4].

Measuring heart rate was realized in every player during three table tennis matches. The matches were played on 3 games to 11 points with opponent from the same player level.

Mathematical-statistical data processing was done using the software S-PLUS (mean, standard deviation, Kruskal-Wallis test - chi square, 2 degrees of freedom).

4. RESULTS AND DISCUSSION

4.1 Characteristics of physical fitness

Maximal oxygen uptake or aerobic capacity (VO_2max) is the maximum capacity of an individual's body to transport and utilize oxygen during incremental exercise, which reflects the physical fitness of the individual. In our study VO_2max is expressed as a relative rate in milliliters of oxygen per kilogram of bodyweight per minute (ml/kg/min). This expression is often used to compare the performance of athletes. We measured VO_2max when oxygen consumption reached a steady state despite an increase in workload [1].

Absolute values of VO_2max are typically 40-60 % higher in men than in women. The average young untrained male will have a VO_2max of approximately 3.5 liters/minute and 45 ml/kg/min. The average young untrained female will score a VO_2max of approximately 2.0 liters/minute and 38 ml/kg/min. These scores can improve with training and decrease with age, though the degree of trainability also varies very widely: conditioning may double VO_2max in some individuals, and will never improve it at all in others. World class male athletes, cyclists and cross-country skiers typically exceed 75 ml/kg/min and a rare few may exceed 85 ml/kg/min for men and 70 ml/kg/min for women [1,6].

Heart rate is determined by the number of heartbeats per unit of time, typically expressed as beats per minute. It can vary as the body's need for oxygen changes, such as during exercise or sleep. Resting heart rate (RHR) is a person's heart rate at rest. We found out the RHR in the morning, after a good night's sleep, and before individuals get out of bed. RHR is usually between 60-80 beats/min; males tend to have a lower rate than females, and the resting rate tends to fall with age. Resting heart rate is also generally lower in those who are physically fit. A sharp increase in resting heart rate is usually a sign that something is wrong. It may indicate illness, injury, emotional stress, or overtraining [5, 7, 10].

Maximal heart rate (MaxHR) is the highest number of times the heart can contract in one minute. MaxHR is good index to set an individual's training. MaxHR serves as a marker for exercise intensity. MaxHR is genetically determined, it's an individual number. MaxHR does not reflect the level of fitness and tends to be higher in women than men. MaxHR testing requires the person to be fully rested. We measured MaxHR during the VO_2max Fitness Test as the highest beat frequency during this test. MaxHR is usually assumed to be 220 minus the person's age in years, but actual

measurements indicate a wide variation [5, 7, 10].

In table 2, characteristics (mean ± standard deviation) of VO_2max, RHR and MaxHR are shown for selected samples.

Table 2 Functional characteristics of selected samples

	Recreational players	Regional players	League players
Number	11	11	11
VO_2max [ml/kg/min]	42.7 ± 4.2	48.6 ± 4.8	**62.1 ± 5.1**
RHR [beats/min]	67 ± 5	62 ± 4	**54 ± 4**
MaxHR [beats/min]	189 ± 5	191 ± 6	**196 ± 5**

The results showed significant differences in VO_2max (KW test: 21.34 > $\chi^2_{0.01;2}$) and RHR (KW test: 18.56 > $\chi^2_{0.01;2}$) among the players on the recreational, regional and league level at the 0.01 level of significance. The best values were in the league players.

4.2 Heart rate responses

During a table tennis match the heart rate slowly increased as the game continued (see Fig. 1).

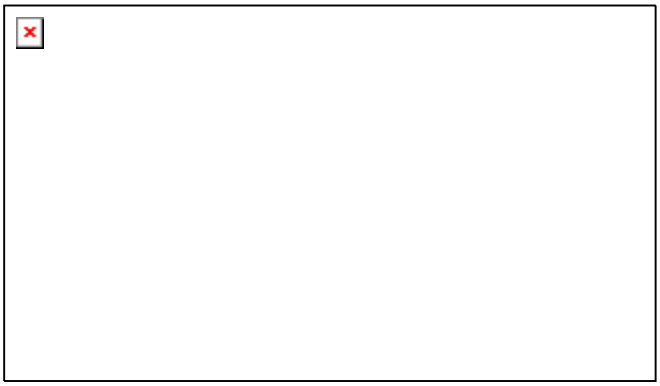

Fig. 1 Variations of the heart rate during a table tennis match (the league level).

The mean heart rate (MeHR) and % MaxHR during table tennis matches are shown in table 3 (mean ± standard deviation).

Table 3 Heart rate responses of selected samples during table tennis matches

	Recreational players	Regional players	League players
Number	11	11	11
MeHR [beats/min]	115 ± 11	141 ± 12	**156 ± 15**
% MaxHR [%]	57 ± 5	70 ± 6	**78 ± 7**

We found out a significant positive relationship between player levels and heart rate responses - MeHR (KW test: 36.11 > $\chi^2_{0.01;2}$) and % MaxHR (KW test: 27.73 > $\chi^2_{0.01;2}$) at the 0.01 level of significance.

The recreational players´ value corresponds to value 110 beats/min of Seliger [11], to the mean value 119 ± 17 beats/min of Yukiya [14] and to mean heart rate 112 ± 17 beats/min of Yoshida [13]. This level of exercise intensity cannot develop the cardio respiratory fitness.

The regional players´ value corresponds to results of Shimizu et al. [12] in trained students (143 ± 9 beats/min). Our mean values are lower than the value of 167 beats/min [Rittel and Waterloh, 9], of the Kagaya´s [8] values 160 to 170 beats/min and of the average values from 162 to 172 beats/min during official competition matches [Djokic, 2].

The fact that the results thus vary from literature to literature might have arisen from the difference in the individual endurance ability and also in the quantity of physical exercise depending on the technical level of the opponents during the match.

5. CONCLUSION

Our study investigated the physical fitness of table tennis players and the heart rate responses to playing table tennis with special reference to the skill levels. The results showed significant differences in VO_2max and RHR among the players on the recreational, regional and league level. The best values were in the league players. We found out a significant positive relationship between player levels and exercise intensity. The table tennis skill level was a significant factor in the level of exercise intensity in the official matches. This has implication for the training of table tennis players, which should resemble match intensity.

REFERENCES

[1] C. Bouchard, A. Ping, R. Treva, J.S. Skinner, J.H. Wilmore, J. Gagnon, L Perusse, A.S. Leon and D.C. Rao, Familial aggregation of VO_2max response to exercise training: results from the HERITAGE Family Study. *J. Applied Physiol.*, Vol. 87, pp. 1003–1008, 1999.

[2] Z. Djokic, "Heart rate monitoring of table tennis player," In A. Less, J.F. Kahn and I.W. Maynard (Eds.), *Science and Racket Sports III*, Routledge, New York, pp. 21-22, 2004.

[3] C.C. Dunbar and M.I. Kalinski, Using RPE to regulate exercise intensity during a 20-week training program for postmenopausal women: a pilot study. *Percept. Mot. Skills*, Vol. 99(2), pp. 688-690, 2004.

[4] R.J. Gretebeck, H. Montoye, D. Bailor, A.P. Montoye, Comment on heart rate recording fields studies. *J. Sport Med. Phys. Fitness*, Vol. 31, pp. 629-631, 1991.

[5] H.K. Hiilloskorpi M.E. Pasanen, M.G. Fogelholm, R.M. Laukkanen, A.T. Manttari, Use of heart rate to predict energy expenditure from low to high activity levels. *Int. J. Sports Med.*, Vol. 24(5), pp. 332-336, 2003.

[6] T.E. Hyde and M.S. Gengenbach, *Conservative*

Management of Sports Injuries. 2nd ed.; Jones & Bartlett, Sudbury, Mass, p. 845, 2007.

[7] L. Jospin and V. Fayt, “Monitoring effort during increasing levels of training exercises in table tennis,” In A. Less, J.F. Kahn and I.W. Maynard (Eds.), *Science and Racket Sports III*, Routledge, New York, pp. 31-36, 2004.

[8] H. Kagaya, Heart rate during playing soft tennis, table tennis and badminton. *J. Physical Fitness Japan*, Vol. 51, pp. 109-110, 1975.

[9] H.F. Rittel and E. Waterloh, Radiotelemetrie bei Tennis, Badminton und Tisch Tennis spielen. *Sportarzt Sportmed.*, Vol. 7, pp. 144-150, 1975.

[10] R. Robergs and R. Landwehr, The surprising history of the „HRmax = 220 – age“ equation. *J. Exerc. Physiol.*, Vol. 5, pp. 1-10, 2002.

[11] V. Seliger, Energy – speed relation and optimal speed during level walking. *Int. Z. angew. Physiol*., Vol. 25, pp. 104-110, 1968.

[12] N. Shimizu, S. Makoro and K. Okamoto, Work intensity table tennis exercise as measured from heart rate variation. *Bull. Univ. Osaka Pref*., Vol. 33, Ser. B, pp. 49-60, 1981.

[13] H. Yoshida, Exercise intensity in ball games: Especially three new games. *J. Tokyo Kasei Gakuin Univ*., Vol. 35, pp. 403-408, 1995.

[14] S. Yukiya, Intensity of required physical education program consisted of circuit training, badminton and table tennis. *J. Wayo Women´s Univ.,* Vol. 24, pp. 279-289, 1983.

Analytical study for some offensive skills for advanced level junior players in the ITTF pro-tour Egypt 2008.

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The research aims for studying some of the offensive skills for table tennis advanced level juniors in the ITTF pro-tour championship that was held in Egypt 2008 using the descriptive survey method on a sample of (1760) strokes in (15) matches starting from the semi-quarter finals.

The most important results can be summarized as follows:
- The most efficient stroke was the smash stroke, comes after the spin stroke then the counter stroke.
- The most efficient smash strokes were the ones dropped into areas 4, 5, 6.
- The most efficient spin strokes were the ones dropped into areas 7, 8, 9.
- The presence of significant increase in the efficiency of offensive smashes and spin and counter stroke in the second game.

Key words: Analysis – efficiency - offensive skills – advanced level - juniors.

Introduction:

Table tennis is a sport that is characterized with severe competition between players especially if they belonged to the high level standard which makes the winning opportunities very rare, and then the player who is mentally and tactically well-prepared will be always the closer to win due to the very special nature of this sport which is characterized with a small high speed moving ball and the varied and complicated playing situations that always change according to the level of the opponent's technical and tactical skills and his physical abilities.

Add to this dealing with a fast moving small ball and several strokes that differ in speed, spin, direction and strength. Here we figure out the great need of very special physical, technical, tactical and mental abilities to face the challenges of competition in this furious game. (1:2)

In table tennis Match Analysis Systems became a basic tool to prepare and analyze performance for competitions besides being a very important coaching tool that aims for enhancing the player's performance. (5:94)

Match analysis in table tennis can be defined as the process of monitoring and recording the technical and tactical performance for players for the aim of analyzing this performance afterwards to point out the points of strength and the points of weakness.

Analysis can be divided into 2 types: Quantitative and Qualitative. The first type "quantitative" is applied during competitions, but the qualitative is applied after competitions to determine the weakness points and try to make necessary performance corrections to avoid falling in the same mistakes in the coming events. (16:104)

Table tennis is also characterized with a fast dynamic performance and both players always shift the offensive and defensive situations which explains the need to master several offensive and defensive skills in addition to the ability to choose the most appropriate skill in the most appropriate time and the most appropriate game situation (12:6)

Also many researchers clarified the importance of match analysis in table tennis as a prominent tool for defining the most modern technical and tactical performance aspects and their effect on the final match result. Analysis helps also in defining 2 important elements:

1- Evaluation and anticipation.
2- Systemizing the process of decision making in coming events. (5) (17) (18) (7)

The researchers assume that as a result of the great progress and development in the technical and tactical performance in table tennis, the offensive skills became more efficient in scoring more points and winning more championships. All the players' results depend on their technical and tactical level of performance that is applied in competition and differs as well between the beginnings of the game than the middle than before its end.

And as the main problem in this research lies in defining the efficiency of some offensive skills for high level table tennis juniors which pushed the researchers to establish a connection between the offensive tactical performance and the technical

performance and determining the degree of efficiency for each stroke, the used bat face, the direction of the stroke and the time of using this stroke. This will give us the necessary information to build up the required training programs and employ these programs into effective offensive processes which will help in determining the points of strength or weakness and how to work on developing them.

Former researches performed in the same field:

Due to the importance of the offensive strokes in table tennis and their effect on the final results of matches, the researchers used some scientific researches that wer performed in a field that is related fo the research topic as:

-All these studies confirmed the importance of studying the offensive skills in table tennis; also the researchers were benefited through using these researches in performing the research procedures in this study.

Research aims:

The research aims for studying some of the offensive skills for table tennis advanced level juniors through performing the following duties:

1- Identifying the efficiency degree of each type of the offensive strokes as a research sample according to the zone on the opponent's side.
2- Identifying the efficiency degree of each type of the offensive strokes as a research sample according to the order of performing the stroke inside the same point.
3- Identifying the efficiency degree of each type of the offensive strokes as a research sample according to the face of the bat used in performing the stroke.
4- Identifying the efficiency degree of each type of the offensive strokes as a research sample according to performing the stroke in each game inside the match.

Research questions:

1- What is the appropriate zone for directing the most efficient stroke?
2- What is the order of the most efficient stroke inside the same point?
3- What is the bat face used for performing the offensive strokes in the research samples?
4- What are the most effective offensive strokes used in each game inside the match?

Related researches:

Due to the importance of offensive strokes in table tennis and its effect on matches' results, the researchers used some scientific related researches as: Safwat Ali 1994 (11), Sherif Saleh 2001 (12), Sherif Saleh 2002 (13), Khaled Hegazy 2003 (6), Sun Qi Lin et Al 2003 (15), Hazem El-Shalakany 2006 (4), Wu Xiao Zhu el Al 2007 (16), Yasser Ghoneim and Ahmed Soubhy 2008 (18).

All these researchers confirmed the importance of studying and analyzing the offensive strokes in table tennis, also these reearches helped in setting up the procedures of this current research.

Research procedures:

Research Method:

The descriptive method with the survey technique was used for its suitability to the research nature.

Research Sample:

15 games were monitored starting from the qualification for the quarter finals during the ITTF pro tour that was held in Mubarak Arena – Alexandria – Egypt "from 2 to 5 April, 2008", were 1760 point were recorded and monitored and 97 points were ignored for the reason of the player's presence in the ball way or for bad shooting.

Table (1): Research samples and variables.

N=1760

Variable		Statistical significance		
		N=	Percentage %	Chi Square
Type of offensive stroke	Spin	997	56.648	448.419**
	Smash	454	25.795	
	Counter	309	17.557	
Used Racket face	Front	1146	65.114	160.809**
	Back	614	34.886	
Performance Order of Offensive stroke	1st	894	50.795	251.814**
	2nd	378	21.477	
	3rd	488	27.727	
Offensive stroke dropping area	Area 1	3	0.17	747.795**
	Area 4	33	1.875	
	Area 5	32	1.818	
	Area 6	42	2.386	
	Area 7	804	45.682	
	Area 8	402	22.841	
	Area 9	444	25.227	
Offensive stroke efficiency	Point scored	278	15.795	747.795**
	Staying in Offensive mode	694	39.432	
	Rally occurrence	169	9.602	
	Switching to defense mode	309	17.557	
	Point lost from return	107	6.08	
	Losing a direct point	203	11.534	

Research variables:

In terms of the research aims, the researchers determined the technical and tactical variables as follows:

First: Playing situations and the characteristics of the offensive strokes:

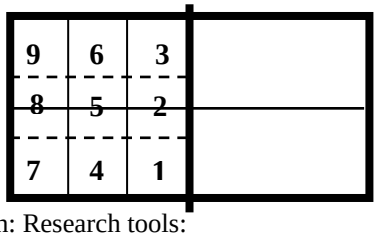
- Type of the offensive stroke
- The used face of the bat
- The order of using the offensive stroke

- The place of landing for the offensive stroke

Second: The result of the stroke where the stroke's efficiency lies according to 5 levels:

1- Scoring a point
2- Staying in the offensive situation
3- Starting a rally
4- Successful return from the opponent
5- Losing the point

Third: Dividing the table zones on the opponent's side:



Fourth: Research tools:

The researchers made a referral survey for the scientific articles and researches to determine the most suitable tools for data collection as follows:

1- Computer device "P 4" that includes a Sony DVD player.
2- 2 digital cameras "Panasonic" used for recording matches.
3- CD's and DVD's where the matches research samples are copied after recording.
4- Data recording sheet that was developed through the researchers and that was organized according to the sequence of the monitored variables and situations. (attachment no. 1)

Fifth: stability and reliability of the data recording sheet:

The data sheet was evaluated through some experts to confirm the reliability of the sheet contents.

The researchers used the application and reapplication after a specific time range after setting up the terms and conditions of data collection on a number of 100 points from the Pro Tour championship that was help in Egypt 2008 that were excluded from the points of the research sample. After 3 days the sheet was reapplied on the same number of points. Then statistical processing was applied to clarify the relation between each variable in both applications, then the arithmetic mean was calculated (0.97) as a significant difference to prove the stability of the data sheet.

Also another expert analyzed the same number of points that was compared to the second application to confirm the reliability of the data sheet and the simple correlation factor was (0.95) that was enough to confirm both of the stability and reliability of the data collection sheet.

Steps of performing the research:

After designing the data collection sheet the researchers analyzed the variables that are related to the offensive skills through the DVD player on the PC where the sample points were viewed and analyzed through:

1- Normal motion
2- Slow motion
3- Frame by frame
4- Stop cadre

After data collection the results were statistically processed through Cross tabulation for calculating the percentage and the repetitions of the efficient offensive strokes using the following equation:

Efficiency degree:

$$\frac{\text{Total of the repetitions below the efficiency level x the adjacent degree for the efficiency level}}{\text{Total number of repetitions}}$$

Results Discussions:

Table (2) offensive stroke efficiency as per dropping area
n = 1760

Offensive stoke type	Dropping area	Statistical indicators	Offensive stroke efficiency						Total	Efficiency
			Point scored	Staying in Offensive mode	Rally Occurrence	Switching to defensive mode	Point Lost from return	Losing a direct point		
Spin	Area 7	N=	55	177	60	137	52	64	545	2.732
		Percentage %	5.517	17.753	6.018	13.741	5.216	6.419	54.664	2.732
	Area 8	N=	29	68	22	41	23	36	219	2.685
		Percentage %	2.909	6.82	2.207	4.112	2.307	3.611	21.966	2.685
	Area 9	N=	27	57	36	51	22	40	233	2.554
		Percentage %	2.708	5.717	3.611	5.115	2.207	4.012	23.37	2.554
Total		N=	111	302	118	229	97	140	997	2.68
		Percentage %	11.133	30.291	11.836	22.969	9.729	14.042	100	2.68
Smash	Area 1	N=	3						3	5
		Percentage %	0.661						0.661	5
	Area 4	N=	30	3					33	4.909
		Percentage %	6.608	0.661					7.269	4.909
	Area 5	N=	29	3					32	4.906
		Percentage %	6.388	0.661					7.048	4.907
	Area 6	N=	42						42	5
		Percentage %	9.251						9.251	5
	Area 7	N=	7	125					132	4.053
		Percentage %	1.542	27.533					29.075	4.053
	Area 8	N=	4	100					104	4.038
		Percentage %	0.881	22.026					22.907	4.038
	Area 9	N=	8	97			3		108	3.991
		Percentage %	1.762	21.366			0.661		23.789	3.991
Total		N=	123	328			3		454	4.251
		Percentage %	27.093	72.247			0.661		100	4.251
Counter	Area 7	N=	20	27	21	27	4	28	127	2.591
		Percentage %	6.472	8.738	6.796	8.738	1.294	9.061	41.1	2.591
	Area 8	N=	8	13	15	25		18	79	2.367
		Percentage %	2.589	4.207	4.854	8.091		5.825	25.566	2.367
	Area 9	N=	16	24	15	28	3	17	103	2.718
		Percentage %	5.178	7.767	4.854	9.061	0.971	5.502	33.333	2.718
Total		N=	44	64	51	80	7	63	309	2.576
		Percentage %	14.239	20.712	16.505	25.89	2.265	20.388	100	2.576

Table (3) offensive stroke efficiency as per performance order
n = 1760

Offensive Stoke Type	Performance order	Statistical indicators	Offensive stroke efficiency						Total	Efficiency
			Point scored	Staying in Offensive mode	Rally Occurrence	Switching to defensive mode	Point Lost from return	Losing a direct point		
Spin	1st	N=	65	167	81	145	56	79	593	2.668
		Percentage %	6.52	16.75	8.124	14.544	5.617	7.924	59.478	2.668
	2nd	N=	26	58	13	31	17	18	163	2.945
		Percentage %	2.608	5.817	1.304	3.109	1.705	1.805	16.349	2.945
	3rd	N=	20	77	24	53	24	43	241	2.531
		Percentage %	2.006	7.723	2.407	5.316	2.407	4.313	24.173	2.531
Total		N=	111	302	118	229	97	140	997	2.68
		Percentage %	11.133	30.291	11.836	22.969	9.729	14.042	100	2.68
Smash	1st	N=	60	114					174	4.345
		Percentage %	13.216	25.11					38.326	4.345
	2nd	N=	19	135					154	4.123
		Percentage %	4.185	29.736					33.921	4.123
	3rd	N=	44	79			3		126	4.278
		Percentage %	9.692	17.401			0.661		27.753	4.278
Total		N=	123	328			3		454	4.251
		Percentage %	27.093	72.247			0.661		100	4.251
Counter	1st	N=	21	25	21	30	4	26	127	2.614
		Percentage %	6.796	8.091	6.796	9.709	1.294	8.414	41.1	2.614
	2nd	N=	6	9	8	22		16	61	2.197
		Percentage %	1.942	2.913	2.589	7.12		5.178	19.741	2.197
	3rd	N=	17	30	22	28	3	21	121	2.727
		Percentage %	5.502	9.709	7.12	9.061	0.971	6.796	39.159	2.727
Total		N=	44	64	51	80	7	63	309	2.576
		Percentage %	14.239	20.712	16.505	25.89	2.265	20.388	100	2.576

Table (4) offensive stroke efficiency as per racket face used
n = 1760

Offensive Stoke Type	Racket face	Statistical indicators	Offensive stroke efficiency						Total	Efficiency
			Point scored	Staying in Offensive mode	Rally Occurrence	Switching to defensive mode	Point Lost from return	Losing a direct point		
Spin	Front	N=	76	187	81	166	76	100	686	2.593
		Percentage %	7.623	18.756	8.124	16.65	7.623	10.03	68.806	2.593
	Back	N=	35	115	37	63	21	40	311	2.871
		Percentage %	3.511	11.535	3.711	6.319	2.106	4.012	31.194	2.871
Total		N=	111	302	118	229	97	140	997	2.68
		Percentage %	11.133	30.291	11.836	22.969	9.729	14.042	100	2.68
Smash	Front	N=	120	314			3		437	4.254
		Percentage %	26.432	69.163			0.661		96.256	4.254
	Back	N=	3	14					17	4.176
		Percentage %	0.661	3.084					3.744	4.178
Total		N=	123	328			3		454	4.251
		Percentage %	27.093	72.247			0.661		100	4.251
Counter	Front	N=		3	4	9		7	23	1.826
		Percentage %		0.971	1.294	2.913		2.265	7.443	1.826
	Back	N=	44	61	47	71	7	56	286	2.636
		Percentage %	14.239	19.741	15.21	22.977	2.265	18.123	92.557	2.636
Total		N=	44	64	51	80	7	63	309	2.576
		Percentage %	14.239	20.712	16.505	25.89	2.265	20.388	100	2.576

Table (5) offensive stroke efficiency as per the game order
n = 1760

Offensive Stoke Type	Game Order	Statistical indicators	Offensive stroke efficiency						Total	Efficiency
			Point scored	Staying in Offensive mode	Rally occurrence	Switching to defensive mode	Point Lost from return	Losing a direct point		
Spin	1st game	N=	26	72	24	60	11	37	230	2.7
		Percentage %	2.608	7.222	2.407	6.018	1.103	3.711	23.069	2.7
	2nd game	N=	38	73	31	46	24	30	242	2.855
		Percentage %	3.811	7.322	3.109	4.614	2.407	3.009	24.273	2.855
	3rd game	N=	24	55	22	73	25	26	225	2.564
		Percentage %	2.407	5.517	2.207	7.322	2.508	2.608	22.568	2.565
	4th game	N=	20	76	37	31	19	40	223	2.673
		Percentage %	2.006	7.623	3.711	3.109	1.906	4.012	22.367	2.673
	5th game	N=	3	26	4	19	18	7	77	2.429
		Percentage %	0.301	2.608	0.401	1.906	1.805	0.702	7.723	2.429
Total		N=	111	302	118	229	97	140	997	2.68
		Percentage %	11.133	30.291	11.836	22.969	9.729	14.042	100	2.68
Smash	1st game	N=	38	97					135	4.281
		Percentage %	8.37	21.366					29.736	4.281
	2nd game	N=	30	63					93	4.323
		Percentage %	6.608	13.877					20.485	4.323
	3rd game	N=	29	83					112	4.259
		Percentage %	6.388	18.282					24.67	4.259
	4th game	N=	18	55			3		76	4.118
		Percentage %	3.965	12.115			0.661		16.74	4.119
	5th game	N=	8	30					38	4.211
		Percentage %	1.762	6.608					8.37	4.211
Total		N=	123	328			3		454	4.251
		Percentage %	27.093	72.247			0.661		100	4.251
Counter	1st game	N=	11	14	15	21		18	79	2.506
		Percentage %	3.56	4.531	4.854	6.796		5.825	25.566	2.506
	2nd game	N=	10	14	12	19	3	14	72	2.542
		Percentage %	3.236	4.531	3.883	6.149	0.971	4.531	23.301	2.542
	3rd game	N=	17	13	11	20	4	11	76	2.816
		Percentage %	5.502	4.207	3.56	6.472	1.294	3.56	24.595	2.816
	4th game	N=	3	20	6	16		10	55	2.636
		Percentage %	0.971	6.472	1.942	5.178		3.236	17.799	2.636
	5th game	N=	3	3	7	4		10	27	2.074
		Percentage %	0.971	0.971	2.265	1.294		3.236	8.738	2.074
Total		N=	44	64	51	80	7	63	309	2.576
		Percentage %	14.239	20.712	16.505	25.89	2.265	20.388	100	2.576

From table (2) we realize that the smash stroke is considered to be the highest offensive stroke in its efficiency degree 4.25, before the spin stroke with a degree of 2.57. The high efficiency degree for the smash stroke can be referred to the short flight time of the ball that is hit from a level higher than the net level opposite to other strokes that are hit form a lower level and takes a longer flight time. Also the smash stroke is performed with high strength which is confirmed in many researches (10:283) (3:115) other than the rest of the offensive strokes' strength that is defined by how low it is performed than the net level.

Also in the same table, we can figure out the high efficiency of the smash strokes that are directed into zones 1 – 6 then into zones 4 – 5 more than the remaining zones. This means that the middle zone is the most effective zone for directing the smash strokes. The researchers refer this to the high flight arc for the ball after bouncing in the opponent's side as a result of the very acute angle of bouncing which makes it too difficult for the opponent to return the stroke.

From the same table we find it clear that the spin strokes are always directed to the base zones in the opponent's side "zones 7 – 8 – 9" which proves the assumption of the researchers who agree with Sherif Saleh – 2002 (13) and Mohamed Abd Allah – 2007 (10) that the spin strokes is characterized with high ball rotation which cause the ball to confuse the opponent's decision concerning taking the best defensive action because he can not anticipate the angle of bouncing and

the direction of the ball after bouncing. And the available timing for the opponent to choose the appropriate defensive action is very small to give him the chance to deal with the amount and the direction of ball spin.

From Table 3, we can figure out that the second offensive spin stroke had the highest efficiency in comparison to the other orders of spin strokes as the first spin stroke is performed to open the table for the player in the offensive situation not to finalize the point. So the second stroke's aim will be finalizing the point as already proved in the analysis. Besides, the chop strokes from the players in the defensive situations are mostly slow which gives the offender the chance to place highest amount of rotation to make it difficult for the opponent to return. Also it gives the offender the chance to return the ball outside the boarders of his half which gives him the chance to place the highest amount of spin in the ball. (9) (13).

Concerning the offensive smash strokes, table 3 shows that the first smash stroke had the highest degree of efficiency when compared to the second or the third stroke. This can be referred to the surprise element in the first stroke is higher than smash strokes in other order as it can be easily anticipated if it was the second or the third in order, but the first one is performed in the highest speed and strength more than any other offensive stroke. (3) (10). This high speed and strength applies more surprise on the first stroke which is enough to confuse the opponent which in turn increases the efficiency degree on the first smash stroke in order.

As for the forehand counter, we figured out that the third one in order has the highest efficiency degree as the change in direction is mostly applied on the third stroke as if the first and second strokes were directed to the right side of the defender, the third will be directed towards his left side and vice-versa, which confuse the defender and comes the third ball in order to finalize the point.

From table 4, it is clear that the offensive backhand spin strokes had a greater degree of efficiency than the offensive forehand spin strokes, this can be referred to the position of the hand wrist joint when performing the backhand strokes is more flexible and agile to offer the highest amount of spin to the ball as the anatomical body position allows offering either highest right or left side spin in addition to the basic top spin. But in case of using the forehand offensive spin stroke, the only available side spin will be to the left side only as the anatomical body position does not allow applying the right side spin. So it is much more difficult for the defender to deal with a ball with 2 types of side spin in addition to the basic top spin than dealing with one side spin in addition to the basic top spin. (9)

Concerning offensive smash strokes, we can figure out from the analysis that the forehand smash is more efficient than the backhand smash and this can be referred to the increase in the arm swing distance in the forehand smash – as it is performed latelary - than the swing in the backhand smash – as it is performed in front of the player's body – which decreases the amount of strength and speed in the backhand smash than the forehand smash. (13) (2).

Also it is clear from the same table that the efficiency degree of the counter offensive backhand strokes is higher than the degree of efficiency of the counter offensive forehand strokes as the backhand stroke is performed in front of the player's body and the player's position is directly behind the ball which is suitable and comfortable for performing the stroke. But the forehand is performed beside the player's body which decreases the amount of control on the ball and the player might not be able to place his feet or entire body to place the highest efficiency in his counter forehand stroke

Form table 5 we can conclude the increase of efficiency for spin and smash to the highest degrees during the second game in the match and this can be referred to the increase in the players' fitness and skill level after finishing the first game that can be used only for exploring the opponent's technique in different playing situations other than enhancing the efficiency of the performance itself. But when the second game begins, the players are well introduced to each other and both are well prepared physically and motivationally so comes the chance for the strokes efficiency to be obvious due to concentration in performing smash and spin strokes.

But for counter strokes, the highest efficient degree was obvious in the third game as it needs studying the footwork of the opponent and this might take a longer time than other techniques.

Conclusions:

1- The highest degrees for efficiency for the offensive strokes were for the smash, spin then the counter stroke respectively.
2- The most efficient smash strokes were the ones directed into areas 4, 5, 6.
3- The most efficient spin strokes were the ones directed into areas 7, 8, 9.
4- The second spin stroke was the most efficient in regard to its order inside the same point.
5- The first smash stroke was the most efficient in regard to its order inside the same point.
6- The third counter stroke was the most efficient in regard to its order inside the same point.

7- The backhand spin was more efficient than the forehand spin.
8- The forehand smash was more efficient than the backhand smash.
9- The smash and spin stokes were highly efficient during the second game.
10- The counter stroke was highly efficient during the third game.

Recommendations:

1- Coaches should plan to train their players to drop smash strokes into areas 4, 5, 6 to increase the strokes efficiency.
2- Coaches should plan to train their players to drop spin strokes into areas 7, 8, 9 to increase the strokes efficiency.
3- Driving the players' attention towards training on backhand spin strokes more than forehand spin strokes as backhand spin strokes are more efficient.
4- Driving the player's attention to the importance of the offensive smash, spin and counter strokes.
5- Using questionnaires to analyze table tennis matches.
6- Applying more researches to design programs that aim for developing the efficiency of performing offensive strokes for table tennis juniors.

References:

1- Ahmed S. Salem: The effect of mental training on developing some movement skills for table tennis juniors (unpublished Ph. D thesis – The faculty of physical education – Alexandria university, 2004)
2- David Hewitt: How to coach table tennis. (The national coaching foundation, William Collins & sons Co. LTD, London, 1990)
3- Elien W. Farg – Salwa E. Fekry: Reference in table tennis, training and teaching (El-Ma'aref establishment – Alexandria, 2002)
4- Hazem M. El-Shalakani: The relation between some skills and the results of table tennis matches (unpublished M. Sc. Thesis – The faculty of physical education – Banha university, 2006)
5- Katsekadelis Michael et Al: Real play time in table tennis matches in the XXVIII Olympic games Athens 2004 (10th ITTF sports science congress – Croatia, 2007)
6- Khaled S. Hegazy: The effect of rules modifications in table tennis on some technical and tactical aspects for high level players (unpublished M. Sc. Thesis – The faculty of physical education – Alexandria university, 2003)
7- Leser Roland et Al: Qualitative game analysis in table tennis (10th ITTF sports science congress – Croatia, 2007)
8- Li juan Yu et Al: Computer diagnostics for the analysis of table tennis matches (International Journal of sports science and engineering, 2008)
9- Magdy A. Shawky: Theory and application in table tennis (Arabic publishing center, 2002)
10- Mohamed A. Abd-Allah: Scientific basics in table tennis and tools of measurement. (Ayat publishing center – Zagazig, 2007)
11- Safwat A. Ali: Technical characteristics for the spin stroke in table tennis (unpublished Ph. D. Thesis – The faculty of physical education – Zagazig university, 1994)
12- Sherif F. Saleh: A program for developing the performance of spin stroke in table tennis in terms of kinematical characteristics (unpublished Ph. D. Thesis – The faculty of physical education – Tanta university, 2001)
13- Sherif F. Saleh: Analytical study for the individual tactical performance of table tennis players in terms of the new table tennis rules 2001 (The scientific journal for the faculty of physical education "for ladies" – Alexandria university, 2002)
14- Sun Qi-lin and Liu Dong-Hua: The analysis of the forehand break-through tactics of eleven points rule (8th ITTF Sports Science Congress - Paris, France – 2003)
15- Sun Qi-Lin (CHN) and Liu Dong-Hua (CHN), Research on the rule of score change in the 11 score game (8th ITTF Sports Science Congress - Paris, France – 2003)
16- Wu Xiao Zu & Escobar V. Jorge: Notational analysis for competition in table tennis "Part 1" (10th ITTF sports science congress – Croatia, 2007)
17- Wu Xiao Zu & Escobar V. Jorge: Notational analysis for competition in table tennis "Part 2" (10th ITTF sports science congress – Croatia, 2007)
18- Yasser K. Ghoneim, Ahmed S. Salem: The efficiency of some tactical workout aspects in table tennis high level doubles (4th Ichper. SD middle east regional congress – Alexandria 2008)

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Construction of Norms for Skill Test Table Tennis Players

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Abstract: The purpose of this study was to construct the norms for evaluating performance of players in Table Tennis Skill Test. Since, there is a lack of standardized evaluative criteria in Table Tennis for assessing the ability, grading and predicting the performance of Table-Tennis players, an effort was undertaken to construct Norms for Skill Test for junior and senior Table Tennis Players. For this purpose 816 male, 410 Junior and 406 Senior, state and national level Table-Tennis players of different states in India were randomly selected to serve as subjects. The performance of Table Tennis players in Table Tennis test battery of four test items, Namely, Alternate Push Test, Target Service Test, Alternate Counter Test and Fore Hand Drive on Target Test with foot movement after playing backhand push, constructed by Pushpendra Purashwani and Dr. A.K. Datta, was chosen for the purpose of the study. The data was collected by administering the test for the selected test items during the Summer Coaching Camps and Regular Training Sessions of various districts, different Ranking Table Tennis Tournaments and State and Inter-District Table-Tennis Championships in the year 2006. The data, which was collected by administering tests, was statistically treated to develop norms for all the test items. The two normative scales, namely, the Percentile Scale and 7 Sigma Scale were constructed for the junior and senior table tennis players of state and national level. The norms were constructed by using Percentile and 7 Sigma Scale techniques analyzed through statistical packages, the scores were further classified into five grades i.e. very good, good, average, poor and very poor under Normal Distribution.

Keywords: Skill Test, Norms, Scales, Grades, Normal Distribution.

1. INTRODUCTION

Among different games and sports, Table Tennis is an extremely fast indoor game. Today, it is an accepted fact that Table Tennis is the most popular racket sport in the world and the second most popular participation sport. After the introduction of sandwich rubber it has become an extraneously speedy game. As Table Tennis can be played by a young and old person, that's why, it is called as "LIFE TIME SPORT".

Evaluation is essential in the process of teaching and coaching. Through evaluation, a teacher/coach can know the extent to which learning has taken place. Hence, the teacher/coach must be aware of some evaluation techniques, which will enable him to measure the student's/player's skill objectively and classify them initially as well as by measuring the progress made by them. There are few skill tests in various physical activities, which help to measure the playing abilities of the students/players in different games and sports

Sports skill test are designed to measure the basic skills used in the playing of a specific sport. Because of the wide range of skills in most sports, a selection of the most important skill is invariably necessary. The selection is usually based keeping in mind the literature available, opinion of experts as well as by applying appropriate statistical techniques. The skill items collectively are called test battery. The skill test helps the students to evaluate their performance in the fundamental skills the game and to provide an incentive for improvement. The test also serves the purpose of helping the teachers/coach to measure student's/player's performance and to evaluate their own teaching/coaching procedure and programme.

Norms are necessary if the test scores are to be adequately interpreted. There are several types and it depends on the purposes of the test and the characteristics of the group to be tested as to which type is selected. The procedure for developing norms starts with the collection of scores on the test from a large sampling of students from the population for which the test was intended. The large collection of scores can be converted into some type of normative scores. On the basis of these norms performance and achievement can be adequately evaluated, scores can be properly interpreted and groups can be compared.

There is a lack of standardized evaluative skill tests in Table Tennis for assessing the ability, grading and predicting the performance of Table Tennis players. The scholar had undertaken a study in Master of Philosophy in Physical Education, titled "Construction of A Skill Test for Table Tennis Players." The study was appreciated by various people, namely, Officials of T.T.F.I., Senior Coaches posted at NSNIS, Patiala, SAI Coaches, Physical Educators and Players. Everyone desired that had norms were constructed, this would have been an excellent skill test. Keeping the response from various quarters, the scholar was motivated to add

something worthwhile to the existing test by developing norms. Hence, a study was undertaken to Construct Norms for Skill Test for Table Tennis Players.

2. MATERIALS AND METHOD

Main objective of the study was to construct norms for skill test for male Table-Tennis players. For this purpose 816 male, 410 Junior and 406 Senior, state and national level Table-Tennis players of different states in India were randomly selected to serve as subjects. Table Tennis skill test constructed by Dr. Pushpendra Purashwani and Dr. A.K. Datta was chosen for the purpose of the study.

The performance of Table Tennis players in Table Tennis test battery of four test items, namely, Alternate Push Test, Target Service Test, Alternate Counter Test and Fore Hand Drive on Target Test with foot movement after playing backhand push were chosen as the criterion measures.

Alternate Push Test

Purpose : To measure the ability to execute push stroke.
Equipment : Balls, Rackets, Table, Twine, Twine Stands, Stop Watch and Score sheets.
Attachment and Table Marking : Twine was fixed on the clamp parallel to net assembly at a height of 20 cm. above the net.
Test Administration : The subject was instructed to warm-up and practice before the actual administration of the test. He was asked to make the numbers of push returns with the controller for a period of 30 seconds. Subject had to keep the ball in between of rope and net. Controller started the rally on the command "Start" having sufficient balls in hand/pocket to continue the rally in case ball goes out of play.

Fig.1. Subject Performing Alternate Push Test

Chances : Two chances were given.
Scoring System : One return was counted when ball crossed in between the net and the rope. Half a return was counted when ball touched the rope but passed in between net and the rope and no return was counted when ball crossed over the rope. Best score of two chances in a period of 30 seconds was considered as the final score.

Target Service Test

Purpose: To measure the serving ability.
Equipment: Balls, Rackets, Table, Marking Chalks/Tapes and Score sheets.
Table Marking : Two target areas of 30 X 15 cm. were marked on the side line on both sides at the distance of 37.5 cm. from the net and 5 was marked in that area. Two more target areas of 80 X 40 cm. were marked on the side line both sides at the distance of 12.5 cm. from the net and 3 was marked in that target area. The remaining area of half of the table, 1 was marked as indicated in Fig.2.

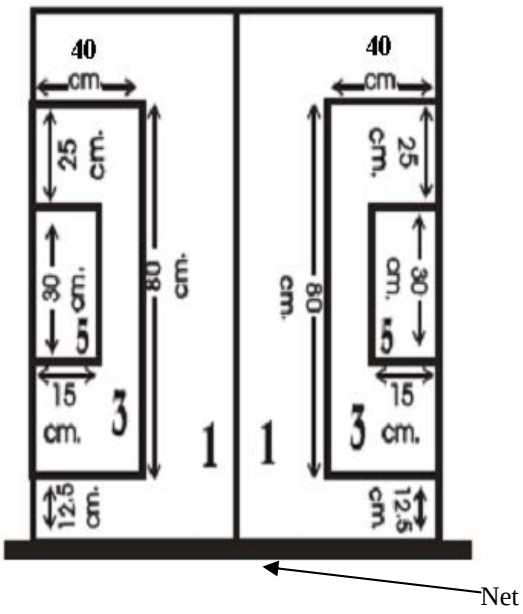

Fig.2. Target Service Test

Test Administration : The subject was instructed to warm-up and practice before the actual administration of the test. He was asked to serve from the left side of the table (in case of right handed players) and vice-versa for left handed players and I.T.T.F. Rules were followed strictly in this regard. Any kind of legal service was permitted.

Fig.3. Subject Performing Target Service Test

Chances : Two chances each comprising of three attempts were given.
Scoring System : Score was given according to the bounce of the ball in the marked areas. The total of best out of two chances (each chance comprised of three attempts) was counted as the score of the subject in Target Service Test.

Alternate Counter Test

Purpose : To measure the counter stroke ability.
Equipment : Balls, Rackets, Table, Stop Watch and Score sheets.
Test Administration : Subject was asked to make the numbers of rallies of alternate counter (one forehand and one backhand) at the left corner of the table with the controller for a period of 30 seconds after sufficient warming up and practice. Controller started the rally on the command "Start" having sufficient balls in hand/pocket to continue the rally in case the ball goes out of play.

Fig.4. Subject Performing Alternate Counter Test

Chances : Two chances were given.
Scoring System : Maximum numbers of returns were counted by an observer out of two chances of 30 seconds each.

Fore Hand Drive on Target Test with foot movement after playing Back Hand Push

Purpose : To measure the Drive Ability.
Equipment: Balls, Rackets, Table, Marking Chalks/Tapes and Score sheets.
Table Marking : Two target areas of 30 X 30 cm. from the corner point of the table were marked at the both corners of single portion of the table, and in those areas 5 was written. Two more target areas of 55 X 55 cm. from the corner point were marked at both corners of single portion of the table, and 3 was marked in those areas. In the remaining areas of the half of the table, 1 was marked as indicated in Fig.5.

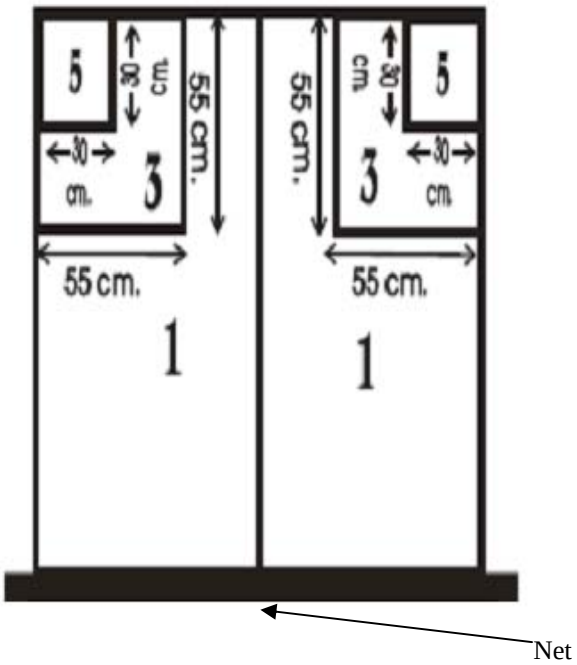

Fig.5. Fore Hand Drive on Target Test with foot movement after playing Back Hand Push

Test Administration : The controller fed the ball and the subject was asked to attack forehand drive with foot movement from left side of a particular half after playing backhand push from at the left corner of the table (in case of right handed player) and vice-versa for left handed players within 5 returns. Sufficient numbers of trials were provided.

Fig.6. Subject Performing Fore Hand Drive on Target Test with foot movement after playing Back Hand Push

Chances : Two chances comprising three attempts each were given.
Scoring System : Score was given according to the bounce of the ball in the marked areas. The best of two chances (each comprising of three attempts) was counted as the score of the subject.

Procedure of Test Administration

The test items were administered to all the subjects by the research scholar himself. The scores of each test items were recorded by the research scholar on the basis of performance in test. Each subject followed his own warming up procedure before actual performance. The subjects were given adequate demonstration, practice trials and required instructions for all tests. The subjects were exhorted to give their best performance.

The data was collected by administering the test for the selected test items during the Summer Coaching Camps and Regular Training Sessions of various districts, different Ranking Table Tennis Tournaments and Inter-District Table-Tennis Championships in the year 2006.

The data, which was collected by administering tests, was statistically treated to develop norms for all the test items. Two scales, namely, Percentile Scale and 7 Sigma Scale were constructed. Further, the scores were classified into five grades i.e. very good, good, average, poor and very poor. The analysis was done by using Statistical Package for Social Science 12.0 for Windows and Microsoft Excel 2007.

3. RESULTS

Two normative scales, namely, Percentile Scale and 7 Sigma Scale were constructed for the purpose of the preparation of the norms for the skill test for male junior state and national Table Tennis players, male senior state and national Table Tennis players and players of both categories (state and national). The percentile norms provided a basis for interpreting an individual's score in terms of his standing in a common group. It informs the player of the percentage of players who scored above or below his score. Thus, Percentile Scale was considered as appropriate scale. Zero Percentiles was located at the lowest score in the data, from which the Percentile table was constructed and 100^{th} Percentile was placed at the highest score.

The other scale i.e. 7 Sigma Scale was constructed for two reasons. Firstly, it was based on normal probability and considers mean and standard deviation values of the distribution and for that reason considered a standard scale. Zero and 100 in the sigma table were located at a point three and a half sigma either side of the mean.

In the Percentile Scale, in Alternate Push Test, the highest performance scores were 26, 23, 26 and 31 and lowest performance scores were 10, 12, 10 and 10 for the group of Junior State, Junior National, Senior State and Senior National Table Tennis Players respectively. In Target Service Test, the highest performance scores were 13, 13, 15 and 15 and lowest performance scores were 3, 2, 3 and 3 for the group of Junior State, Junior National, Senior State and Senior National Table Tennis Players respectively. In Alternate Counter Test, the highest performance scores were 42, 47, 45 and 49 and lowest performance scores were 16, 12, 12 and 18 for the group of Junior State, Junior National, Senior State and Senior National Table Tennis Players respectively. In Fore Hand Drive on Target Test with foot movement after plying Back Hand Push, the highest performance scores were 13, 13, 13 and 13 and lowest performance scores were 1, 0, 1 and 1 for the group of Junior State, Junior National, Senior State and Senior National Table Tennis Players respectively, and in both categories (junior and senior male Table Tennis players), the highest performance scores were 31, 15, 49 and 13 and lowest performance scores were 10, 2, 12 and 0 for the test items of Alternate Push Test, Target Service Test, Alternate Counter Test and Fore Hand Drive on Target Test with foot movement after playing Back Hand Push respectively.

Table 1

Percentile Scale for Both Categories (State and National Male Table Tennis Players)

Percentile Score	Alternate Push Test	Target Service Test	Alternate Counter Test	Fore Hand Drive on Target Test
100	31	15	49	13
95	22	13	42	11
90	22	13	40	11
85	21	11	37	11
80	20	11	36	9
70	18	9	32	9
60	17	9	30	9
50	17	9	28	7
40	16	7	27	7
30	15	7	25	6
20	14	6	22	5
10	13	5	20	3
0	10	2	12	0

In 7 Sigma Scale, with respect to Alternate Push Test, the highest performance score were 25, 27, 27 and 33 and lowest performance scores were 5, 7, 5 and 6 for the group of Junior State, Junior National, Senior State and Senior National Table Tennis Players respectively. In Target Service Test, the highest performance scores were 15, 15, 15 and 15 and lowest performance scores were 0, 0, 0 and 1 for the group of Junior State, Junior National, Senior State and Senior National Table Tennis Players respectively. In Alternate Counter Test, the

highest performance scores were 42, 54, 52 and 59 and lowest performance scores were 6, 4, 7 and 9 for the group of Junior State, Junior National, Senior State and Senior National Table Tennis Players respectively. In Fore Hand Drive on Target Test with foot movement after plying Back Hand Push, the highest performance scores were 15, 15, 15 and 15 and lowest performance scores were 0, 0, 0 and 0 for the group of Junior State, Junior National, Senior State and Senior National Table Tennis Players respectively and in both categories (junior and senior state and national male Table Tennis players), the highest performance scores were 29, 15, 55 and 15 and lowest performance scores were 4, 0, 3 and 0 for the test items of Alternate Push Test, Target Service Test, Alternate Counter Test and Fore hand Drive on Target Test with foot movement after playing Back Hand Push respectively.

Table 2

7 Sigma Scale for Both Categories (State and National Male Table Tennis Players)

7 Sigma Score	Alternate Push Test	Target Service Test	Alternate Counter Test	Fore Hand Drive on Target Test
100	29	15	55	15
90	27	15	50	15
80	24	14	44	13
70	22	12	39	11
60	19	10	34	9
50	17	8	29	7
40	14	6	24	5
30	12	5	19	4
20	9	3	14	2
10	7	1	8	0
0	4	0	3	0

Distribution of Grades under Normal Distribution

The scores were further classified into five Grading scales viz. very good, good, average, poor and very poor under Normal Distribution. This classification has been done to make the selection criteria simpler, easier and better.

Table 3
Grading for Both Categories Under Normal Distribution
(State and National Male Table Tennis Players)

Test Items	Very Good	Good	Average	Poor	Very Poor
Alternate Push Test	> 23.26	18.97 – 23.26	14.69 – 18.97	10.4 – 14.69	< 10.4
Target Service Test	> 13.21	9.98 – 13.21	6.76 – 9.98	3.53 – 6.76	< 3.53
Alternate Counter Test	> 42.21	33.41 – 42.21	24.62 – 33.41	15.08– 24.62	< 15.08
Fore Hand Drive on Target Test	> 12.29	9.02 – 12.29	5.76 – 9.02	2.49 – 5.76	< 2.49

Table 3 shows that the performance has been divided into five categories, namely, very good, good, average, poor and very poor. In Alternate Push Test the performance under five categories starting from very good, good, average, poor and very poor were more than 23.26, 18.97 to 23.26, 14.69 to 18.97, 10.4 to 14.69 and less than 10.4 respectively. In Target Service Test the performance under five categories starting from very good, good, average, poor and very poor were more than 13.21, 9.98 to 13.21, 6.76 to 9.98, 3.53 to 6.76 and less than 3.53 respectively. In Alternate Counter Test the performance under five categories starting from very good, good, average, poor and very poor were more than 42.21, 33.41 to 42.21, 24.62 to 33.41, 15.08 to 24.62 and less than 15.08 respectively. In Fore Hand Drive on Target Test with foot movement after playing Back Hand Push the performance under five categories starting from very good, good, average, poor and very poor were more than 12.29, 9.02 to 12.29, 5.76 to 9.02, 2.49 to 5.76 and less than 2.49 respectively

4. DISCUSSION

Percentile scales for all the four test items for male junior state and national Table Tennis players, male senior state and national Table Tennis players and players of both categories (state and national) taken together were constructed. Percentile scale seems to be appropriate because the highest performance in skill test receives the maximum scores whereas the lowest performance in the test items receives a score of 0. This type of scale is only suitable for the sample selected as in future an excellent player may exhibit better performance than the maximum performance of the

scale in comparison to the given sample. In that case, still the performance will be given the maximum score. This seems to be the lacuna in the percentile scale as this is only suitable for the given group and it does not take into consideration any performance i.e. either good or bad in future. Further, the other drawback noted in the percentile scale was that the similar performance credits different score which seems inappropriate. Such a finding may be due to the limited range of performance as players were categorized into four specific groups, namely, junior state, junior national, senior state and senior national Table Tennis players.

Keeping the drawbacks of percentile scale in mind, it was thought appropriate to construct 7 Sigma scale. This scale was appropriate for all the test items as a specific performance got a specific score. However, it was noted that there was a slight difficulty in giving score at extreme ends of the scale because for a similar performance different scores could be credited. This happened because of the nature of the test as any performance cannot score more than the permissible limit in Target Service Test and Fore Hand Drive on Target Test with foot movement after playing Back Hand Push.

Keeping the drawbacks of percentile and 7 sigma scale in mind, it was thought appropriate to categories players into five categories i.e. very good, good, average, poor and very poor. The results revealed that performance can be easily divided into five categories without encountering any difficulty. Hence, grading under normal distribution proved to be the most suitable way of categorizing players as the drawbacks of the percentile and 7 sigma scale were eliminated. Keeping the educational reforms in mind, there is a trend to award grades rather than the score in order to reduce stress and anxiety among the players. Thus, grading under normal distribution yielded a suitable scale.

Recommendations

In the light of conclusions drawn, the following recommendations are made:

1. The normative scales constructed by Research Scholar may be used to evaluate the performance of junior and senior table tennis players of state and national level.
2. The normative scales constructed in this may be used in sports schools, sports hostels, school education departments and professional students of physical education for motivation, classification and grading purposes.
3. A similar study may be undertaken with Table-Tennis players of different levels i.e. colleges, universities and inter-national levels.
4. Since, Table Tennis has become a popular game for women, similar study may also be conducted on women Table-Tennis Players.

REFERENCES

[1] Barry L. Johnson and Jack K. Nelson **"Practical Measurement for Evaluation in Physical Education"** (Delhi; Surjeet Publishers, 1982), p. 258-59.

[2] David H. Clarke and H. Harrison Clarke, **Research Process in Physical Education** (Englewood Cliffs, N. J.: Prentice Hall Inc., 1984), p. 226.

[3] Harold M Barrow, Rosemary Mc Gee and Kathleen A. Tritschler, **Practical Measurement in Physical Education and Sports** 4th Ed., (Philadelphia: Lea and Febiger, 1989), p. 40.

[4] Jane A. Mott and Aileen Lockhart**, "Table Tennis Backboard Test," Journal of Health and Physical Education**, 17, No.9 (November, 1946), p. 550.

[5] Larry Hodges, **Table Tennis, Steps To Success** (Champaign, Illinois: Human Kinetic Publishers, 1993), p.1.

[6] Ted A. Baumgartner and Andrew S. Jackson, **Measurement for Evaluation in Physical Education and Exercise Science**, 4th Ed. (Wm. C. Brown Publishers, Kerper Boulevard, Dobuque, U.S.A., 1992), p.177.

The Playing Posture, Activities and Health of the Table Tennis Player

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Key words:
Posture, Biomechanical effects, Health.

Background:
A close observation of a typical table tennis player shows that the posture (while playing) reveals a peculiarity. The peculiar posture might put excessive biomechanical pressure on the waist/hip region of the player's dominant side. Also, it could be observed that the dominant upper limb exhibits relative hypertrophy compared to the non-dominant limb; this might make the dominant limb more predisposed to biomechanical syndromes.
Aim:
To find out the adverse effect(s) (if any), the peculiar playing posture and the high level of shoulder girdle muscle activities of the table tennis player may have on their health (both in and out of play) and suggest ways of reducing such effect(s).
Method:
A study was carried out on some able bodied and challenged players. Questionnaires were given out to all the players, asking for history of unilateral pain on the dominant upper limb, the waist/hip region of same side and how long the athlete had been involved in the game. Measurements of the circumference of the midpoint between the shoulder and the elbow joint of both upper limbs were compared: this was used as a measure of the activity of the dominant upper limb- in each case.
Result:
A significant percentage (25%) of the respondents reported nagging pain on the dominant upper limb. This was made up of challenged amateur and professionals; no able bodied athlete (amateur or professional), reported upper limb pain. 25% of the respondents reported troublesome unilateral hip/waist pain; this was made up of challenged athletes only. No able bodied athlete (amateur or professional) reported unilateral hip pain.
Conclusion:
The study shows that the characteristic posture of the athlete and the high level of physical activities of the dominant limb may predispose the player to special biomechanical changes; this could lead to chronic pain and discomfort. The above applies especially to the challenged athlete.
. The table tennis player may benefit from specially designed physical therapy measures which emphasize the strengthening of rotator cuff muscles of the dominant side. It might also serve some useful purpose if postural correction maneuvers are performed regularly (out of play) by the athlete. This could be done with the assistance of a physical therapist.

The Playing Posture, Activities and Health of the Table Tennis Player

Introduction:

A close observation of a typical table tennis player (while in action), will reveal that the athlete exhibits some characteristic posture which is peculiar to this group of athletes.

The posture may probably affect the normal biomechanics of the athlete, in and out of play and by extension their overall health. In addition, it could also be observed that most athletes show a relative hypertrophy of the dominant (stroking) limb.

In order to evaluate these observations and any harmful effects they may have on the biomechanics of the athlete and their health, a study was carried out of a group of players preparing for the 2008 Beijing Olympics and some others during their routine training.

The Table Tennis Player in Action

A. The characteristic posture of a typical player could be described as follows:

1) Neck deviated towards the dominant limb.
2) Trunk partially flexed with scoliosis concave to the dominant side.
3) Dominant limb in ulnar deviation, vertical abduction of the shoulder with a partially flexed elbow.
4) Lower limb with a partially flexed hip, knee and ankle dorsiflexors.

B. Special Features Observable in Some Table Tennis Players:

1) Relative hypertrophy of the stroking (dominant) limb, especially the shoulder girdle muscles.
2) Some degree of scoliosis (in some athletes).

C. Method of selection of subjects:

Each prospective subject was briefed on the aim of the study and what would be involved in respect of measurement taking. The study group also explained some of the contents of the questionnaires to them. Each of the prospective subjects who consented to taking part in the study was thereafter given a questionnaire to fill. After filling the questionnaire, the relevant measurements were taken on each subject and the values recorded for further analysis.

D Materials and Methods:

The questionnaire sought to know the type of play (professional or amateur), age group, sex, how many years each subject has been playing the game, which side is dominant, history of chronic pain on the dominant upper limb, history of chronic pain in the waist/hip region and whether or not the subject exhibits dexterity for the game on both sides.

A total of 40 athletes responded to the questionnaire.
A measurement of the circumference of the upper arm at the midpoint between the tip of the acromion process and the most prominent part of the lateral epicondyle of the same side was taken for both upper limbs in each subject. The value for the dominant upper limb was designated as C1 in each case, while that of the non-dominant arm was represented by C2; both were measured in centimeter.
The relative activity index of the dominant limb, (hereafter simply referred to as RAI), which is taken as a measure of the activity of the athlete resulting from engagement in the game of table tennis, is obtained by subtracting C2 from C1 i.e. (C1-C2).The results were expressed in centimeters.
A mean RAI was calculated for the various groups in the study i.e. all the professionals, all the amateur, the challenged professionals, the challenged amateur, the able bodied professionals, the able bodied amateur, the female group and the males.
The results of the above are as shown in the table below (Table 1).

Table 1

S/N	Athlete Group	No of athletes	Age Group		Duration Playing game		Limb Pain		Dominant limb		Dexterity	Hip/Waist Pain		Mean C1-C2
			<20yrs	>20yrs	<5yrs	>5yrs	yes	no	right	left	both	yes	no	
1	Amateur(total)	16	6	10	0	16	8	8	14	2	0	2	14	1.1
2	Professional (total)	24	2	22	2	22	2	22	11	5	8	8	16	1.5
3	Challenged Amateur	12	4	8	0	12	8	4	10	2	0	2	10	1.0
4	Normal Amateur	4	2	2	0	4	0	4	4	0	0	0	4	2.0
5	Challenged Professional	14	0	14	2	12	2	12	8	4	2	8	6	2.3
6	Normal Professional	10	2	8	0	10	0	10	3	1	6	0	10	0.3
7	Male (total)	24	2	22	0	24	4	20	17	3	4	4	20	2.0
8	Female (total)	16	6	10	2	14	6	10	8	4	4	6	10	1.0

Questionnaire:

Tick the boxes as applicable.
1 Age □ < 20 years □ > 20 years
2 Sex □ male □ female
3. How long in competitive play □ below 5 years □ above 5 years
4 Type of play □ professional □ amateur
5 Dexterity for the game □ (ambidextrous) both hands □ single hand
6 History of persistent dominant limb (limb used for stroking) pain □ yes □ no
7 Any past history of persistent unilateral back/hip pain on dominant side □ yes □ no.

9 Engagement in another competitive sport aside from table tennis □ yes□ no
10 Which side is dominant □ left □ right?
11 Persistent dominant side neck pain □ yes □ no

Observation/findings:

1. Out of a total of 40 athletes on whom the study was carried out, 4 exhibited negative relative activity indices in the dominant limbs, 14 recorded zero relative activity indices, while 22 had positive values.
2. Those who exhibited zero and negative relative activity indices were from both the professional and amateur classes; also, there was no sex discrimination.
3. Nagging upper limb pain was reported by 10 out of the 40 athletes i.e. 25 % of the respondents.
4. 8 out of all the 16 amateur athletes who responded i.e. 50% reported upper limb pain on the dominant side.
5. Only 2 out all the 24 professional athletes (8 %), claimed to have been experiencing significant limb pain on the dominant side.
6. None of the normal amateur or normal professional reported pain in the dominant limb.. The implication of this is that the pain reported by the amateur (both normal and challenged) and the professionals (both normal and challenged) was solely from the challenged members of each athlete group.
7. Out of a total of 12 challenged amateur athletes, 8, (67%) claimed to have been experiencing limb pain in the dominant upper limb, while only 2 out of 14 challenged professional athletes (14 %) reported pain.
8. Only 4 out of 24 male athletes (18%) reported limb pain on the dominant side, while (37.5%), i.e. 6 out the 16 female athletes agreed that they had pain on the dominant side.
9. Only 10 out of 40 respondents i.e. (25%) reported unilateral hip/waist pain on the dominant side.
10 No able bodied athlete, (professional or amateur) reported unilateral hip/waist pain.

11. While only 2 out of all the 16 amateur athletes i.e. (13%) reported unilateral hip/waist pain, 33 % of all the professionals i.e. 8 out of 24, reported same.

12 In respect of challenged athletes, 2 out of 12 challenged amateur i.e. (17%), reported unilateral hip/waist pain, while 6 out of 14 challenged professionals i.e. 43 % also reported in the affirmative.

13. While only 4 out of 24 males i.e. 17% reported unilateral hip/waist pain, 6 out of 16 females i.e. 38%, reported same.

14. The mean relative activity index (MRAI) was found to be (2. 0) in the males while it was 1.0 in the females.

15. The mean relative activity index in professionals was 1.5, while it was 1.1 in the amateur group.

16. The MRAI in challenged professionals was 2.3 while the challenged amateur had a value of 1.0

17. While able bodied professionals had a MRAI of 0.3, the able bodied amateur recorded 2.0

Analysis:

From the above findings, we could infer as follows:

1. The fact that only a small percentage (8%) of the professionals (compared to the amateur class (50%), reported nagging pain in the dominant upper limb showed that the more intensive the activities of an athlete is, the more the ability to adapt to pain.

2. The observation that none of the able bodied athletes (both professional & amateur), reported upper limb pain in the dominant limb probably indicates that the able bodied athletes are able to adapt to pain (in the upper limb) better than the challenged athletes.

3. The finding that a high percentage of the professionals -mainly the challenged- (33% compared to 13% in the amateur group) reported unilateral hip pain may probably be due to the fact that more biomechanical changes are involved in an average professional compared to a challenged amateur.

4. The ability of the challenged to adapt to pain is probably not as good as that of the able bodied.

5. A comparison of 1 and 3 above shows that the ability to adapt to pain (in the waist/hip region), may not increase with increased intensity of physical activities in the athlete as it's the case in the upper limb.

6. The fact that the MRAI of males (2.0) was higher than that of females (1.0) may be due to the fact that the former are naturally more muscular than the latter; therefore their activities are likely to lead to a higher increase in muscle mass for similar activities.

7. The higher figure for MRAI in the challenged professional (2.3), compared to the challenged amateur (1.0), may be due to the likely higher activity level of the former under similar situations.

8. The shoulder pain reported in about 25% of the athletes was probably a result of chronic arthritis or rotator cuff impingement.

9. The playing posture of the athlete probably has some harmful effect on the back and hip- as 25% reported low back/hip pain on the dominant side.

10.The higher MRAI in the able bodied amateur players compared to the able bodied professionals is difficult to explain as one would have expected the professionals to have a higher value.
However, this might have been due to poor nutritional state in majority of the able bodied professionals, leading to muscle bulk loss.

Limitation of Study:

1. The postures of the athletes prior to commencing the game could not be ascertained.

2. Observer error e.g. the difficulty in accurately locating the tip of the acromion process in very muscular athletes.

3. The reliability of information gathered from subjects.

Discussion and Suggestions:

The likely health implication of findings:

Hypertrophy of the upper limb and shoulder girdle muscles could lead to 'the rotator cuff impingement syndrome'. In this study, about 25% of the subjects reported troublesome upper limb pain.

Scoliosis (concave) to the dominant side, with pelvic tilt, may lead to early degenerative ligament and disc changes in the lumbosacral region- with the attendant morbidity.

The pelvic tilt on the hip and knee of the dominant side may lead to accelerated degenerative changes on the dominant side.

Suggested Preventive Measures:

As the playing postures cannot be avoided, there is a limit to the preventive measures that could be adopted. Below are some measures that might reduce the harmful effects of the peculiar posture on the athlete:

a) The medical team, especially the physical therapist, should encourage/device specific exercises to correct the scoliosis arising from play. This should be done whenever the athlete is not engaged in sporting activities.
b) The challenged athletes would definitely need special attention as the study shows that they are less able to adapt to pain.
c) The medical team should encourage athletes to use both limbs for stroking whenever this is practicable.
d) The physical therapist attached to the team should encourage rotator cuff muscles strengthening on the stroking side.

e) Conclusion**:**

From the above study, it could be said that the posture of a typical table tennis player- while in action- may affect the normal biomechanics of the dominant side; this will obviously have health implications for the athlete while in active play and probably after retiring,

However, if the above preventive measures are adopted, healthy living -during both active playing life and retirement- may be guaranteed for athletes.

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References:

[1] R.J. Hawkins & J. C. Kennedy 'Impingement syndrome in athletes', American journal of sports medicine, vol.8, No 3 151- 158

[2] Christopher M, Bono, MD[1] 'Low Back Pain in Athletes' American Journal of Bone & Joint Surgery 86: 382-396 (2004).

[3] Young Sub Kwon M. S. & Len Kravitz. 'How do muscles grow'?

Effectiveness of Shadow Practice in Learning the Standard Table Tennis Backhand Drive

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Abstract: The purpose of the study was to examine the performance of college students using shadow practice in learning the standard Table Tennis backhand drive. Twelve students from different Physical Education classes were divided into two groups. The Experimental Group was asked to do shadow practice in combination with multi-ball practice. The Control Group performed single ball backhand drills for every pair of subjects alternating with multi-ball practice. The two groups were analyzed in three testing stages. The test was conducted on one subject at a time. Each subject was instructed to hit the fed balls to the designated target area at the opposite court (crosscourt) within the optimal height. The number of balls that hit the specified target area and cleared the optimum height marker was counted and became the subject's score. First, the pre-test, which was conducted after being given instructions on how the backhand drive is done. Second, a post-test was done after the sixth day of continuous training. And finally, the retention test was given after three calendar days after the post-test. There was a significant improvement of the mean and standard deviation scores from the pre-test to post-test in both the Experimental and Control Groups. The Experimental Group went from a mean score of 67.2 ± 17.8 to 81 ± 10.37 while the Control Group went from 64.57 ± 20.59 to 81 ± 14.25. Both groups were able to retain their mean scores in the retention test (83.6 ± 13.01 for the Experimental Group and 78.9 ± 10.88 for the Control Group). Although the mean score of the Experimental Group was higher, there were no significant differences in the scores from the Post to the Retention tests of both groups ($p > 0.05$). The study revealed that both the Experimental Group and Control Group had a significant change in their scores in the post-test phase of testing. Both Experimental Group and Control Group were able to retain their scores.

Keywords: Backhand Drive, Learning, Block Practice

1. INTRODUCTION

Shadow exercise, also known as shadow practice or shadow play, is described as a repetitive action mimicking a specific skill used in a particular sport.

Shadow play is an effective technique used to learn the proper form needed for the correct execution of a skill by using repetitive action (Letts, 2007). It is not only useful in table tennis but also in other field of sports because it develops a player's consistency in producing a standard skill like a proper bat swing, judo throw, bench press, etc. Gold Medalist Olympian wrestler, Ken Chertow, used this drill to develop speed and conditioning as well as improve the retention and confidence of his wrestling techniques (Chertow, 2008). Larry Hodges mentioned in his Instructor's Guide that physical training is important in table tennis (Hodges, 1989); shadow play can be a great work out and can improve the techniques of a table tennis player. According to the Royal Navy website, a table tennis player must have a total control over the ball (Royal Navy, 1999). Shadow play can help the player in conditioning his/her muscles on the correct position of the racket and correct form of how it feels like.

In table tennis, shadow play is when a player practices his stroke technique without the ball. It is like a form of role playing wherein the stroke is played just as it would in a normal rally. The absence of the ball allows the player to concentrate on getting his technique correct, and what the correct technique feels like. Shadow play can be a valuable training tool if done with proper attention to form (Letts, 2007). Furthermore, the exercise will benefit players of all levels, but most especially beginners. In the researcher's informal interview of a table tennis team in large Metro Manila University, varsity players reported a refinement of their strokes after shadow play and have since incorporated this exercise in their training.

The basic strokes used in Table Tennis executed using either the forehand or the backhand are drive, topspin, smash, push and flick (Tepper, 2005). This study focused on the effectiveness of shadow play on the backhand drive as it is an important skill to learn. As Hodges (1993) stated, that a well developed

backhand balances a good forehand in covering the table during play. Points can be easily scored if the ball is given to the backhand side of an opponent with a weak backhand drive skill. On the other hand, a powerful attack from the backhand side is the least an opponent can expect.

The backhand drive is a very useful technique in Table Tennis. It can complement the forehand by making backhand attacks more powerful and could also compensate for players who have slower footwork. Although the forehand drive is a more complicated skill than the backhand drive, we cannot discount the benefits of having a powerful backhand drive. It can be used to set-up for a more powerful attack or, it could be the actual attack itself. The backhand drive is very useful in game play and would enhance a Table Tennis player's attack arsenal.

As a point of reference, it should be noted that the forehand drive requires a longer range of muscle movement as compared to the backhand. The initial position of the arm is extended and weight shifted to the racket arm. In executing the forehand drive, the arm swings simultaneous to the weight shift to the other leg while twisting the waist. In the backhand drive, the initial position of the arm is flexed at the elbow and weight is centered. The skill is executed by extending the arm while simultaneously doing a minor weight shift from the support leg to the dominant leg with little or no waist movement. Thus, the execution of the backhand drive is simpler than that of the forehand drive (Royal Navy, 1999).

Florendo and Bercades (2007) examined the effects of shadow practice in learning the forehand drive. Thirty-two subjects (N = 32) were randomly assigned to either an Experimental or a Control Group. The Experimental Group (N = 16) performed shadow practice while waiting for their turn to practice with multi-balls. The Control Group (N = 16) practiced with a single ball for each pair while waiting for their turn to practice with multi-balls. The consistency and accuracy skills test was used to determine the participant's pre-test, post-test and retention test scores. Data analysis revealed that both groups showed a significant change in the scores for the pre-test to the post-test ($p < 0.05$). However, only the Experimental Group was able to retain their scores in the retention test. The authors concluded that using shadow practice is a mode for effective skill instruction. Florendo recommended that a study be conducted to ascertain if the same technique is effective for learning a different skill (Florendo, 2003, p. 15).

The main purpose of the present study was to see the performance of college students in the commonly used consistency and accuracy skills test using shadow practice in learning the standard backhand drive. This in turn, will allow us to observe the effectiveness of shadow practice. The present study specifically aimed to see the performances between two different conditions; using shadow practice in combination with multi-ball practice and using one ball per pair of students in combination with multi-ball practice which were the same methods used by Florendo and Bercades (2007).

2. METHODOLOGY

Subjects

Subjects were twelve volunteer students from a large University located in Quezon City who were enrolled in different Physical Education classes; specifically a Physical Education 1 lecture class, a Basketball, Judo, Bowling and Swimming class. All subjects were those considered pure beginners in table tennis. Students enrolled in Table Tennis were purposely excluded. Those who ever held a table tennis racket or played racket sports were also excluded from the study. Data collection was done during the Summer Session, hence the low number of subjects.

Originally, there were thirteen participants who volunteered for the study. The group was composed of eleven females and two males. Ideally, both groups should have had an equal number of subjects because they were trained in pairs. However, due to scheduling issues and backing out of participants in the Experimental Group, an unequal distribution was effected. The Experimental Group members decreased because one of the female participants was not able to attend the post-test which forfeited her participation in the study. Among the group, there were two subjects who were left-handed and ten subjects who were right-handed. The subjects were mainly females due to the exposure of the majority of males to recreational table tennis.

The subjects were divided into two groups: an Experimental (N = 5) and a Control (N = 7).). The Experimental Group (E) used shadow practice in combination with multi-ball practice; and the Control Group (C) practiced with one ball per pair of students in combination with multi-ball practice.

Procedure

The Table Tennis table was modified by attaching a string to the vertically extended net posts. The string was placed directly above and parallel to the net with a height of fourteen inches. This modification was done to serve as a guide for the subject to make sure that the ball clears the net within optimal height (see Figure 1).

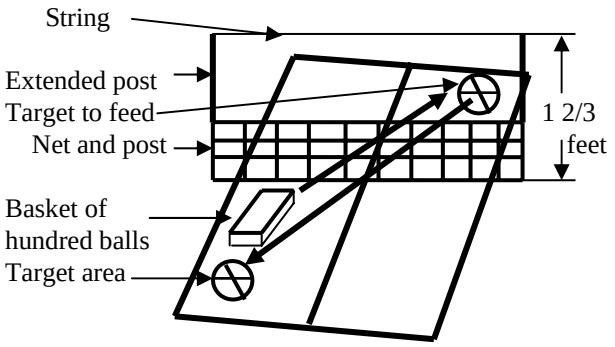

Figure 1 Research Instrument (Right-handed subject)

A total of 100 trainer balls were used for the multi-ball practice session. Two persons, a ball feeder and a stroke-counter, administered the test. A metronome was set to 60 beats per minute to be used as a guide for the ball feeder.

The test was conducted on one subject at a time. Each subject was instructed to hit the fed balls to the designated target area at the opposite court (crosscourt) within the optimal height. The number of balls that hit the specified target area and cleared the optimum height marker was counted and became the subject's score. There was a slight modification for left-handed subjects (see Figure 2), but the task remained essentially the same.

The consistency and accuracy of the subjects in executing the backhand drive were tested during the pre, post and retention tests.

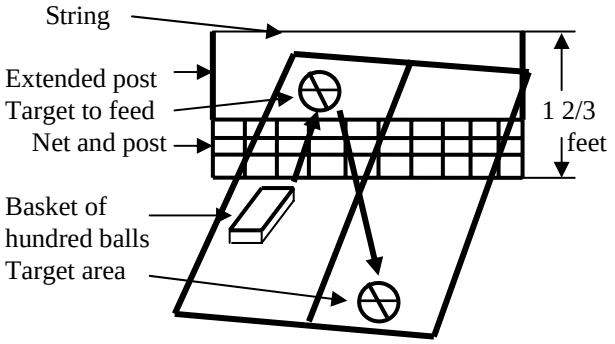

Figure 2 Research Instrument (Left-handed subject)

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The task was to perform the standard backhand drive. The instructions were as follows: Preparatory phase: arm should be relaxed; the racket angle should be approximately 90º and the wrist should be loose. Execution phase: bring racket straight toward the waist then extend elbow forward; contact should be made in front of the body, then follow through (Hodges, 1993). All subjects were also advised to, "always contact the ball as low to the table as possible, within six inches of it. That way, it won't bounce as high on the far side. It will also make it easier to serve short" (Hodges, 1993).

Immediately after the initial briefing, the subjects were given the Pre-test to establish the baseline data. The participants were randomly assigned to practice conditions after the pre-testing phase, the Experimental Group used shadow practice, in combination with multi-ball practice while the Control Group practiced by performing backhand strokes in combination with multi-ball practice.

In the practice sessions, each one of the twelve subjects practiced multi-ball drills, wherein the ball feeder fed separate balls for each stroke instead of using only one ball (Letts, 2008).

The subjects of the Control Group were instructed to strike the ball diagonally and try to keep their movement in a "controlled" manner and were not allowed to smash the ball even after gaining some ball control over their strokes in the course of the five- day treatment period.

The Experimental Group was asked by the instructor to perform shadow practice of the backhand drive and were allotted five minutes to continuously perform the exercise (Florendo and Bercades, 2007). The first set was done before the multi-ball practice session and the second set of shadow practice was done afterwards.

Following the five-day treatment period, the subjects were subjected to a Post- test. They followed the same procedure as the Pre-test.

After the post test, the subjects were given a three-day rest period then was given the Retention test which followed the procedures done during the pre and post tests. The number of balls to hit the specified target area will be the subject's Retention test score.

Data Analysis

Data was analyzed using the *t*-test to determine significant changes in the two groups' pre-test, post test and retention test. Independent sampling was used to determine significant difference between the two subject groups' post and retention test. Whereas, paired sampling was used to determine the pre-test and post-test, as well as post and retention test between both subject groups. The level of significance was set at $p = 0.05$.

3. RESULTS AND DISCUSSION

Table 1 shows the mean scores between the pre-test and post-test of the Experimental Group which were significantly different. It shows that there is no significant difference between the mean scores in the post and retention test. The findings suggest that the beneficial effects of using shadow practice are not temporary in nature but can positively affect the learning of the standard backhand drive

Table 1 The Experimental Group Backhand Skill Test Scores

	Mean score	Standard deviation	*t*	Sig. (2-tailed)
Pre-test	67.2	17.8		
Post test	81	10.37	-3.82	0.02
Retention test	83.6	13.01	-1.05	0.35

Table 2 shows the mean scores of the pre-test and post-test of the Control Group. The Control Group played with a single ball as they waited for their turn to practice with multiple balls. They were able to improve their performance even if they spent some of the time picking up the ball rather than keeping it in play. The multi-ball practice session greatly helped them in developing a certain level of automaticity because it involved consistent stimulus-response mapping "where the stimulus pattern always calls for the same response" (Schmidt, 2004). The Control Group was also able to achieve high scores in their post-test. The Control Group scored lower in the retention test as compared to the Experimental but the difference between the scores from the post-test to the retention test was not significant (see Table 3).

Table 2 The Control Group Backhand Skill Test Scores

	Mean score	Standard deviation	*t*	Sig. (2-tailed)
Pre-test	64.57	20.59		
Post test	81	14.25	-2.80	0.031
Retention test	78.86	10.88	0.74	0.49

Table 3 shows that there are no significant differences between the Experimental Group and Control Group in their pre-test, post-test and retention test scores ($p > 0.05$).

Table 3 Independent samples t-test

	t	Sig. (2-tailed)
Pre-test	0.23	0.82
Post test	0	1
Retention test	0.69	0.51

In this study, both groups were able to execute the backhand drive effectively as early as the pre-test as compared to Florendo and Bercades (2007). Their [Florendo and Bercades] mean scores on the Forehand Drive Pre-test for the Control Group was 37.3 ± 14.99 and for the Experimental Group was 36.8 ± 16.37 while this study shows a mean score of 67.2 ± 17.8 for the Experimental Group and 64.57 ± 20.59 for the Control Group. Even with the factor of a string that has been used in the current study, the subjects still obtained higher scores as compared to the study done by Florendo and Bercades (2007) which did not make use of a string. The comparison of the results show that the backhand drive is simpler to execute than the forehand (Royal Navy, 1999) as evidenced by the high scores obtained by both groups (Control and Experimental) in the current study, considering them pure beginners in the skill during the pre-test.

The Experimental Group performed better than the Control Group as the retention test mean scores show 83.6 ± 13.01 and 78.86 ± 10.88 respectively which were consistent with Florendo and Bercades (2007) score of 83.4 ± 10.40 and 78.3 ± 12.42 for the Experimental and the Control respectively. In the current study, there were no significant differences ($p > 0.05$) from the post-test to the retention test for both groups (Experimental and Control) which means that both groups were able to retain their scores. This means that for this study, both shadow practice and single-ball practice combined with multi-ball practice can help beginning level players learn the consistent and accurate backhand drive.

4. Conclusion and Recommendations

A total of twelve Diliman volunteer students with a mean age of 18.33 ± 1.99 were used as subjects of this study. All were considered pure beginners in the sport of table tennis. Pre-test results for the Control Group were 64.57 ± 20.59 and 67.2 ± 17.80 for the Experimental Group. This means that both groups started equally and results indicated that they had performed at a high level. They were asked to report for five days of treatment after which a post-test wherein the Experimental Group achieved a mean score of 81 ± 10.37, was administered after three days from the

post-testing phrase.

The study revealed that both the Experimental Group and Control Group had a significant change in their scores in the post-test phase of testing. Both Experimental Group and Control Group were able to retain their scores (83.6 ± 13.01 and 78.86 ± 10.88 respectively, $p > 0.05$ for both groups). The result of this study contradicted those of Florendo and Bercades (2007) wherein only the Experimental Group was able to retain their scores. For this study, both shadow practice and single-ball practice combined with multi-ball practice can help beginning level players learn the consistent and accurate backhand drive. This proves that shadow practice does improve the backhand drive skill of beginners; hence, an effective method for skill instruction.

For further studies on the subject, it is recommended that height of the string from the net post extension be reduced to six inches (originally fourteen inches) to have a higher standard. The lower the height of the string, the more difficult it is for the subjects to score a successful shot. Also, in practical application to the sport, the closer to the top of the net a drive becomes; the shorter the distance the ball travels therefore, making the shot faster and harder to block.

It is also advised that the study should be done with an equal number of participants. Thirty-two subjects evenly divided into the two groups should be sufficient for this study (Florendo and Bercades, 2007, p. 4).

And finally, since both groups performed multi-ball practice, a comparative study between multi-ball and shadow practice should also be done in future studies to see which one would be a more effective training method.

REFERENCES

[1] Chertow, K. (2008). *Shadow Wrestling*. Retrieved May 2008, from http://www.kenchertow.com/training_tips/training_exercises/te_shadow_wrestling.html

[2] Florendo, F and Bercades, D (2007). The effectiveness of shadow practice in learning the standard forehand drive. 10th Anniversary ITTF Sports Science Congress Proceedings Book. University of Zagreb, Faculty of Kinesiology; Croatian Table Tennis Association; International Table Tennis Federation. May 18-20, 2007.

[3]Ganczaruk, S. (2008). *Badminton No Walk in Park*. East Valley Tribune. Retrieved May 2008 from http://www.eastvalleytribune.com/?sty=10317

[4] Hodges, L. (1993). *TABLE TENNIS: Steps to Success*. Illinois: Human Kinetics Publishers, Inc., p. 27, 107.

[5]Hodges, L. (1989). Instructor's Guide to Table Tennis. Retrieved May 2008 from www.usatt.org/organization/instructors_guide.pdf

[6] Letts, G. (2007). *Table Tennis/Ping Pong*. Retrieved August 2007, from http://tabletennis.about.com/od/glossary/g/shadowplay.htm

[7] Letts, G. (2008). *Multiball Table Tennis Training – Using Multiball in Your Ping-Pong Practice.* Retrieved May 2008, from http://tabletennis.about.com/od/trainin1/a/multiball.htm

[8] Myers, H. (1977). *Table Tennis*. London: The Riverside Press, Ltd.

[9] Pilger, R. (2008). *Improve Your Skill In Your Boxing Training Workout Routines With These Shadow Boxing Techniques*. Retrieved May 2008, from http://www.approvedarticles.com/Article/Improve-Your-Skill-In-Your-Boxing-Training-Workout-Routines-With-These-Shadow-Boxing-Techniques-/62056

[10] Royal Navy (1999). *Table Tennis*. Retrieved May 2008 from www.teachpe.com/gcse/Table Tennis.pdf

[11] Schmidt R. and Wrisber C. (2004). *Motor Learning And Performance , Third Edition.* Illinois: Human Kinetics Publishers, Inc., p. 77.

[12] Tepper, G. (2005). *ITTF Coaching Manual Level 1*. As cited in USA Table Tennis Magazine Volume 76, Number 3. May/June 2005.

APPENDIX

Shadow Group (Experimental)	Gender	Age	Pre-test	Post-test	Retention test
1	F	19	80	91	90
2	F	18	65	82	92
3	F	18	65	78	84
4	F	17	40	65	61
5	F	18	86	89	91

Single-Ball Group (Control)	Gender	Age	Pre-test	Post-test	Retention test
1	M	17	36	85	79
2	F	18	45	55	60
3	M	24	83	95	92
4	F	21	58	80	73
5	F	18	86	93	79
6	F	20	58	70	78
7	F	18	86	89	91

RAW DATA

Testing dates: April 18/25/29, 2008

Historical, Traditional and Cultural Significance: The Untold Story of "Liha"/ Sandpaper Rackets of Table Tennis in the Philippines

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Abstract: With the advent of technology, the use of table tennis rackets has become significant in the development and propagation of the sport where it has greatly affected the speed and spin of the ball, style and the level of play. Little has been known about the sandpaper or "Liha" (in Filipino term) rackets by most modern player now, unlike the "Hardbat" which the Americans have popularized. However, both "liha" and hardbat have been popularly played in the Philippines during the American colonization. It has its own humble beginnings and has great influence in the contemporary games of Philippine table tennis. The study aims to explore "Liha" table tennis rackets and its influence in the Philippine table tennis setting. Using a cultural-historical activity theory approach, the researchers have drawn from a widespread database that included published materials, pictures and video transcripts of events, interviews, field notes and texts produced by prominent table tennis personalities and the Table Tennis Association of the Philippines (TATAP). The following data were gathered:

I. Popularity – Hardbat and Liha became so popular during the American colony of the Philippines through the efforts of TATAP's first president, the late Senator Sergio Osmeňa when several world-class players in the likes of Martin Reisman, Richard Bergman and Johnny Leach were invited to play in the 1st Philippine Invitational of Champions in 1952
II. Events conducted – Included in some regional and national table tennis events
III. Underground "Liha"- The unrevealed story where it is being kept privately in most areas especially in Cebu City where the late Mr. Sergio Osmeňa resided
IV. Champions produced which started off as Liha players – The late Teofilo Ybanez and current Southeast Asian Champion Richard Gonzales
V. Physical fitness for elders at Marikina and Malabon Table Tennis Club in Metro Manila
VI. Fiestas-"Liha" events in fiestas; e.g. Sinulog Fiesta of Cebu City –Central Philippines
VII. Rules – Modified Rules compared from the ITTF Rules

In conclusion, the game of table tennis using "Liha" rackets has its benefits in the Philippine table tennis scene. The researchers do not wish to propose and inform the table tennis community to include "liha" to its present "rubber" tournaments but rather suggest having it as an added "variant" to be legalized and recognized in table tennis events. It can be played by young and old individuals who do not only want to enjoy the game because of its longer rallies but also to maintain an optimum level of fitness , fun and a "fallback" grounds from the present fast-paced game of table tennis.

Keywords: "liha", cultural historical activity theory, variant, table tennis, Philippines

1. INTRODUCTION

1.1 Background of the Study

Equipment in table tennis play an important role in enhancing the performance of a player**.** Rackets are much more interesting of table tennis miscellanea since they are more personal than other items of equipment. It can be of any size, shape or weight as long as it is flat and rigid (ITTF Handbook). From the earlier vellum battledores of the late 19th century (Crayden, R., 1995), the pimpled rubber faced racket of the 1920's, the introduction of the "sponge" in the 1950's to the present times of the" Gluemania" of the 1990's, table tennis rackets have greatly affected the speed and spin of the ball, the style of play as well as the level of performance of players. With the advent of technology, the use of table tennis rackets has become significant. At present, table tennis has become a fast-paced sport that different proposals are being addressed by many for it to be slowed down in terms of the speed and spin of the ball. Many argued that it is becoming more "boring" since rallies end shorter than those of the earlier times in general sense. Unfortunately, these proposals has remained futile to no avail because of the continuous innovations of table tennis equipment particularly rubbers, which is designed to "kill" or confuse opponents in an instant. As a matter of fact, it is only in this era that we encounter the word "equipment junkies" half joke / half "name calling " to other players to other players.

Similarly, other sports have also their own means of innovations. Take the case of lawn tennis for example. It has a clay, shell, and grass court, where we consider as "variants", which has been popularly played in tournaments like the French, Wimbledon and Australian Open. A Champion in all these said events in a calendar year is called a grand slam winner. Martial arts have karate, taekwondo, kung fu, judo and muay thai and even the slow Chinese " Tai chi" as a form of exercise. Nobody ever predicted that mixed martial arts of fighting, called 'UFC" would be that popular nowadays and even televised. Though this kind of UFC had its reputation of "hiding" underground for decades too. In other words, the researchers perceived that sports need to have a "variant" of their own to keep themselves abreast with sporting the world while suiting to one's technical, physical and psychological capabilities.

While we admit that Philippine table tennis is still outmoded when compared to the fast paced modern table tennis world. Little has been known about the sandpaper or "Liha" (in Filipino term) rackets by most modern player now, unlike the "Hardbat" which the Englishmen and Americans have popularized. However, both "liha" and hardbat have been popularly played in the Philippines most especially during our American colonization. It has its own humble beginnings and has great influence in the contemporary games of Philippine table tennis.

Table 1 shows the difference between a "Liha"/sandpaper and the sandwich rubber.

Table 1 – Difference between a "Liha" and a Sandwich rubber

"Liha" / Sandpaper	**Sandwich Rubber (Pips out and inverted)**
Longer rallies	Shorter rallies
Less Spin	More spin
Less speed	More Speed
smaller ball (38 mm)	bigger ball (40mm)
Easier rules	More complicated rules
less advantage in service	can gain advantage in service

The main characteristics of a "Liha" game are:

1. Longer Rallies (low intensity and longer duration form of activity)
2. One player normally attacks and the other player defends. (formerly)
3. Exciting to watch than the conventional "rubber" game where points takes a lot of time to gain
4. Elders here only use the ' Liha" as means for exercise to promote better health, "fun" and fitness

1.2 Statement of the Problem

This study aims to explore "Liha" table tennis rackets and its influence in the Philippine table tennis setting. Using a cultural-historical activity theory approach, the researchers have drawn from a widespread database that included published materials, pictures and video transcripts of events, interviews, field notes and texts produced by prominent table tennis personalities and the Table Tennis Association of the Philippines (TATAP).

1.3 Significance of the Study

Most of the international table tennis enthusiasts are not aware that the " liha"/ sandpaper game is prevalent in the Philippines although played in the "underground" world. Some perceive that this kind of play is a "poor man's" sport mostly played by low to middle income based individuals. Others recognize it as a means to make money through "underground betting". But there is more than just these things.

This study serves to guide and inform table tennis aficionados that the "liha"/ sandpaper game is something that they should be proud of as Filipinos because of its humble beginnings. Once taught by our colonizers and slowly, the Filipinos after all these years were able to "refine" the skill in playing at its highest standard despite being kept for years and not shown to the outside world. Such high standard of play are even shown in the "You Tube" of internet proudly proving this fact to the world.

While together, it can also be an integral part in the promotion of fitness and health especially among middle to old ages since it is a "low intensity, longer duration" type of activity where the researchers would like to emphasize what "liha" is all about aside from being perceived as "money game" in the Philippines.

Finally, it also serves to guide and motivate especially our national sports association, clubs, and school athletic leagues to come up with comprehensive programs in the promotion of recreation and fitness with some degree of high level of competition for both local and hopefully in the international scene.

2. POPULARITY

The Philippines was once colonized by the Spaniards, Japanese and the Americans. It also has a rich cultural heritage. Among them, the Americans had great influence in the promotion of table tennis in the country. Hardbat and Liha became so popular during the American colony of the Philippines through the efforts of TATAP's first president, the late Senator Sergio Osmeňa of Cebu City when several world-class players in the likes of Martin

Reisman, Richard Bergman and Johnny Leach were invited to play in the 1st Philippine Invitational of Champions in 1952 witnessed by at least 10,000 spectators in an arena as personally accounted for by Mr. Reisman during his Philippine visit. This was the first official international table tennis event organized in the Philippines. The figures below are some of the highlights of the said event.


TOMORROW—THEY MAY MEET AGAIN

Reisman, Cartland Sweep Debut Matches

Figure 1 – Published Article during the 1st Philippine Invitational of Champions in 1952

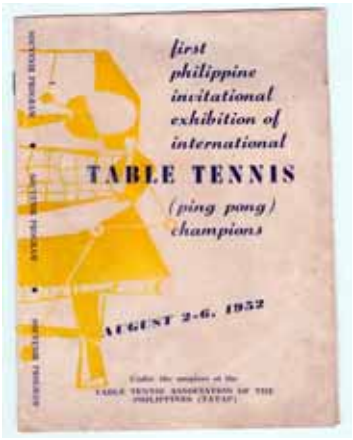
first philippine invitational exhibition of international

TABLE TENNIS

(ping pong) champions

AUGUST 2-6, 1952

Figure 2 – Souvenir Program

Figure 3 - Pictures and Dedications/Signatures of Former World Champions Richard Bergmann, Martin Reisman and Johnny Leach

Figure 4 - Philippine's "1001 Electric Chop" Teofilo Ybañez and Martin Reisman in an Exhibition Match (top photo); Martin Reisman and Richard Bergmann (right photo)

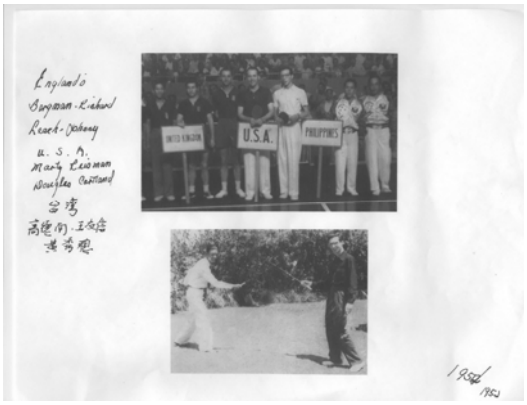

Figure 5 - During the Opening Ceremonies with Philippines' Teofilo Ybañez and Ernesto Pingol, USA;s Martin Reisman and Douglas Cartland, United Kingdom's Richard Bergmann and Johnny Leach (top photo); Martin Reisman (bottom photo)

The staging of this event opened the door for Philippine Table Tennis producing top players during those times in the likes of Teofilo Ybañez, once called the "1000 chop", Ernesto Pingol, Bienvenido Alcantara among others. It became very popular especially in the City of Cebu and later on expanded to the other provinces and cities including Metro Manila. It also became a diversion for betting. Even with the introduction of the sponge in 1952, the use of the "liha" table tennis rackets were still popular in the Philippine Table Tennis scene even though it was banned to

participate in rubber tournaments. So slowly, it started to become an “underground world” because of the rubber rackets being recognized by the International Table Tennis Federation. Aside from that reason, there is no “international springboard” that’s why it became “underground playing” in a sense. But still, other clubs maintained its tradition. Most recently, in one of the researcher’s email communication with Mr. Reisman, the former made a remarkable comment quoted as saying: *In 1952, I had the pleasure of spending time in the Philippines during the early and middle fifties. At that time, I played a series of matches against your two best players, Ebanyez (referring to Mr. teofilo Ybañez) and Pingol as well as against Richard Bergmann and Johney Leach, both world champions in Rizal Stadium before a crowd of ten thousand. This international match also included two Hongkong and two players from Taiwan. I had many friends, among whom was Sergio Osmeña. We often played at his estate in Cebu and Manila. Doug Cartland and I played several times in the Philippines, once going down to Cebu under the sponsorship of Sergio Osmeña. Another time, we were paid $5,000 by Amanda Araneta, the sugar baron to play a match on his sugar plantation. He built a special arena for the match and even made money on the promotion. With 80,000 workers cutting sugar cane on his field, thousands came to watch us play.”*

3. SOME POPULAR EVENTS CONDUCTED

In some events where the ITTF rule is implemented, “liha”/sandpaper events also take center stage by including them in these regular “rubber” game events. This is where a lot of “unknown” liha players from the different parts of the country gather and vie for top honors. It is interesting to note that in most "rubber" regional tournaments are done, the aged coaches bring out their liha bat and start playing liha with betting money at stake especially among old rivals bringing with them the pride and glory of their hometown city or province. The following are some of the events conducted in recently:

1. 1st LOPUE’S Liha-Kahoy Table Tennis Tournament; June 28-29, 2008, Bacolod City

Figure 5- Event Logo

This is the first event where both “liha” and plain wooden rackets called “ kahoy” were played. It was held at the southern part of the Philippines, Bacolod City where it is both a haven for “rubber” and “ liha” players. Previously there used to have an event of this sort but mostly played at a lower level and usually unknown to the table tennis community because of its tradition on hardcore betting. This event produced top players mostly from the middle ages to compete and vie for top honors both in team, doubles and individual events. Doubles using ”liha” rackets are very exciting to watch because of its longer rallies that’s why in team events, the deciding match is normally in doubles. Winners are given trophies, medals and especially cash prizes where a lot of competing players vie for.

2. 1st Philippine National Table Tennis Championship slated on October 27-31, 2008 at Philsports Arena (ULTRA) in Pasig City,Metro Manila, Philippines

Figure 6 – Our National Governing Body Logo (Table Tennis Association of the Philippines)

This event was held last year where it also coincided with the national selection of rubber players for the Southeast Asian Games in 2009 in Laos. “Liha” was featured as a special national event. The rules are the same but it is more systematic because of the involvement of the Department of Local and Interior Government which is the umbrella organization of all the different local government units in the country both cities and provinces. Team and individual events were played. The researcher, Mr. Peter Cua voluntarily solicited funds from various private sectors where aside from the medals and trophies awarded to “liha” players, cash prizes incentives were also given. Otherwise, no good players will come out from the “underground” with no money at stake. Mr. Cua understood this psychology very well and it did work well. Here are some pictures and highlights of the event:

Figure 7 - Current Southeast Asian Champion Richard Gonzales (green and yellow shirt) also winning the “Liha” Men Singles Event during the 1st Philippine National Table Tennis Championships (October 27-31, 2008)

Figure 8 - Cebu City Team winning the Men's Team " Liha" Event

4. UNDERGROUND "LIHA"

For the first time, this unrevealed story of "liha" will come out in the open for in decades since its inception, it has always been kept private and exclusive in most areas in Cebu City, Cavite City, Marikina City, Malabon, Navotas, Cagayan De Oro, Iligan City and Manila. Top players would engage in private "underground" betting, which also serves as their means to supplement their livelihood. A number of top players even in the national team failed to continue their studies because of too much poverty and it is where playing "liha" that provides them money for food even for the day just to get by.

Fortunately, some players have their own managers who take care of their training, transportation and meal allowances and most especially the money that they put during betting where they get a certain percentage if that player wins. Sometimes, featured matches are organized similar to that of a cockfight arena where there is even a middleman or locally termed as "Kristo" who facilitates betting among the players with their own manager and also from the spectators. It is still prevalent today and this tradition will continue. The researcher, Prof. Oscar Yoshihiro S. Santelices, who was the head coach of the national team in the early 1990's personally witnessed a classic match that was supposed to take place in the national table tennis team venue where then rising "liha" star Mr. Richard Gonzales engaged then national champion Mr. Richard Ching in a classic duel between " Liha" and "Rubber" with ITTF rules. The said researcher had to call off the match because he was not informed that the said "secret" duel would take place in that venue where the national team was training. Aside from that reason, gambling is generally prohibited. With that, one sees why it's been kept "underground for that reason. And besides, hundreds of "liha" and rubber enthusiasts flocked the venue to the hysteria of the security guards who were manning the venue. Nevertheless, that classic encounter still ensued in a different venue with hundreds who watched and put in their bet and also witnessed as to who and what racket is better, a " liha" or a "rubber" player. Mr. Ching won that match. Later then, Mr. Gonzales made it to the national team using this time a long pimpled and ordinary pimpled rubber that represent the timing of a "liha" bat. These are just some documented events that took place which will be long remembered.

The researchers, remembered, of whom were personally coached and handled by some Filipino " lihador (one who plays liha)" friends who served as trainers during their younger days of rubber playing. The researchers feel that they have a moral obligation to reciprocate the patience and kindness of these "lihadors" by informing now to the table tennis community of their unique skills and traits that they possess.

5. CHAMPIONS PRODUCED WHO STARTED OFF AS LIHA PLAYERS

Among many players who made it to the national team and started off as "liha" players, two popular names have come out whom the researchers think have brought honor and pride for the country; **Teofilo Ybañez** and **Richard Gonzales.** Both researchers feel lucky enough to have played with them. Even the late champion Mr. Teofilo Ybañez whom the researchers described as "the great chopper of the Philippines". Incidentally, both this great table tennis players hail from the city of Cebu. Here are their brief sports achievements:

1. Teofilo Ybañez – One of the most feared table tennis player in the early 1950's because of his well known " 1000 chop". He sparked his teammates during the 1952 Invitaitonals held in Manila where former champions Martin Reisman, Johnny Leach, Richard Bergmann and Douglas Cartland. This fabulous player can use "liha", hardbat and rubber. At some point, Mr. Cua remembered an informal staged money game of Mr. Teofilo Ybañez where he intentionally switched from hardbat to plain rubber or liha then vice versa This is one sneak tactic which confused his opponents by being able to accustom to the sudden style of the racket. This proved how versatile he handled rackets of different qualities.

2. Richard Gonzales – perhaps the youngest and for many the greatest table tennis player in both "liha" and "rubber" since Mr. Ybañez. His life and times in table tennis was dated back when he was eleven and encouraged by his father in his hometown in Cebu City. Under the tutelage of his father also a "lihador' himself, he would engage in betting against seasoned "lihadors" from the different

place in his province. He was once named " King of Liha" in the Philippines in the early 1990's and would challenge any player whether be "liha" hardbat or rubber even in the national team by just using his "liha". His dream match with former national champion Richard Ching will still be long remembered in years. He won the bronze medal in the 1999 SEA Games in Brunei with the researcher, Prof. Santelices as his coach. In 2005, he won the silver medal in men singles and a bronze medal in the men's team event. And just recently in the Southeast Asian Table Tennis Championships in Jakarta, Indonesia last October, 2008 he finally won the Gold medal in the Men Singles, a bronze in team and doubles event paired with his playing coach Henberd Ortalla, younger brother of Mr. Jose Ortalla, Vice-president of the Table Tennis Association of the Philippines. All these achievements are already part of history for Philippine Table Tennis. And to think that his training started off as a "liha" player and carrying this rare skill over modern pimple rackets and winning the gold in international event. Both researchers believe that there is some "technical connection" about him being a lihador and mastering over his modern rubber pimples racket including his footwork.

6. PHYSICAL FITNESS FOR ELDERS AT MARIKINA AND MALABON TABLE TENNIS CLUB.

Aside from the City of Cebu where "liha" was popularly played, there are also two prominent places in Metro Manila where "liha" is also popularly played especially among elders; in Malabon and Marikina Table Tennis Clubs. The researchers both visited these clubs and interviewed its officers and some of the popular and old players.

The Malabon Table Tennis Club, where it has a modest number of more than 30 members at present was founded in 1969. Most of its members are great "lihadors" in the likes of Arsenio Francisco and Erning Baldonado where their main objective was purely "underground" betting. Arsenio Francisco had great influence in "liha" where his family from his children down to his grandchildren were great "lihadors". Aside from having great "liha" matches that were staged in this suburb in Metro Manila, their top players would invade other provinces to challenge their top players in money betting. Even the great Mr. Teofilo Ybaňez would visit this club and also challenge their players. Later on, their club slowly drew more interest in elders who realized that playing "liha" contributed to good health. This is evident when a number of their members are "senior citizens" (aged 65 and over). The oldest member at 79 years old is Mr. Ver Navarro. According to Mr. Ramir Francisco, the present no. 1 player and son of the great Arsenio Francisco, old players play regularly because of its health benefits. The sweat that they get alone from playing liha for a long duration of time relieves some of the common health risk factors most especially an increase in stamina or cardiovascular endurance. More players in Malabon Table Tennis Club play "liha" than rubber. And this is the only club in the whole of Philippines which has an "electronic" scoreboard. They only have 1 table but top of the line. Here are some of the pictures taken during the researchers visit.

Figure 9 – The Venue

Figure 10 – Some of the club members with the researchers

The Marikina Table Tennis Club has a larger membership dates back from the mid 1950's. Its proud founder was Dr. Benjie Rivera who built a table tennis club with only 1 table beside their residence. The club produced both champions in "liha" and rubber. However, rubber became more popular. Later on, the club transferred to the Marikina Sports Complex which is just beside its original venue. It drew more members with more tables.

According to its incumbent president Mr. Sonny Ramos, the club institutionalized a morning fitness program for middle age to senior citizen from 6:00 a.m. – 8:00 a.m. as part of their physical fitness training. This drew more participants, some of which became a regular routine for them just before reporting for work. Mr. Ramos emphasized the importance of

physical fitness for every citizen in Marikina that is why he still manages this program. Some prominent differently able players are also regularly seen in this club. Mr. Rogelio Cezar, the President of the Philippine Table Tennis Association for the Differently Able (PHILTTADA), a National Champion Paragames player said that he together with his other teammates in the likes of former national player and paragames player, Mr. Pablo Catalan practice “liha” to keep their fitness at an optimum level and hone their skills in pimple rubber through using “liha”. Aside from this, the club also has at least two major “liha” tournaments every year and invites players from other areas not only in Metro Manila but also from nearby provinces. Presently, it has more than 50 “liha” members a lot of which are senior citizens. The following are picturea which the researchers took during their visit.

Figure 10 – Action shots

Figure 12 – Group picture of club members with the researchers

7. LIHA EVENTS IN FIESTAS

In Cebu City where “liha” originated, there is a special “liha” event held every year called the “Sinulog” Festival. This is an occasion even foreigners look forward to because of its rich tradition. They celebrate this event on January this year, but the event was held last February so that the organizers can prepare better. The event was called “Cebu Table Tennis “Liha” Championships”. One of the highlight of this event is the traditional “Ping-pong Dance” using “liha rackets. Four events were contested namely:

1. Team Event
2. Singles Open
3. Inter-Barangay (smaller district)
4. Senior Citizens (65 years and over)

The best players mostly from the southern part of the Philippines participated in this momentous event. The highlights of the event were two special awards given to distinguished persons who not only contributed in the development of “liha” in the Philippines but also brought honors internationally. They were the late Senator Sergio Osmeña, the first TATAP President for his invaluable support in the development of both “liha” and rubber and Mr. Richard Gonzales, the current Southeast Asian Table Tennis Champion. The award for Mr. Gonzales was jointly donated by one of the researcher, Mr. Peter Cua and Mr. Winston Jimenez. While the award for the late senator Sergio Osmeña was donated by Mr. Gee Batayola representing the “liha” players of Cebu. Both these awards were handed by TATAP Regional President Ms. Jessica Jawad.

Figure 13 – Ping-pong Dance

Figure 14 – Ping-pong Dance 2

Figure 15 – "Lihadors" in action

Figure 16 – Winners with Mr. Richard Gonzales

8. MODIFIED RULES OF "LIHA" ASCOMPARED TO THE ITTF RULES

The game of "liha" has its own unique rules which somewhat differs from the ITTF Rules. The basic rules are:

1. 38 mm balls either white or orange are used compared to the current rule on Rubber which uses the 40mm ball
2. " Easy Serve and Easy Return" from right to right half court – player can catch the ball if you do not like your opponents service unlimited times.
3. Game is up to 20 points
4. If score reaches 19-all, first player who reaches 5 points wins the game
5. Best of three games to win a match
6. Player can touch the table with his freehand

9. CONCLUSION

The study led the researchers to draw the following conclusion:

1. The game of table tennis using "Liha" rackets has gain benefits in the Philippine table tennis scene.
    a. "Technical wise" – the late Teofilo Ybaňez and most recently Richard Gomzales has somehow shown and proven it from their astonishing international record in rubber tournaments.
    b. "Economical wise" --- for us 3rd world countries, it is economical to use because all you need is a simple wooden racket and a piece of "Liha"/sandpaper.and yet still embrace the 3 very essentials in a sport :COMPETITIVE , FITNESS AND FUN
2. The researchers do not wish to propose and inform the table tennis community to include "liha" rackets to its present "rubber" tournaments but rather suggest having it as an acceptable added "variant" to be legalized like another category and hopingly ITTF will recognize such table tennis event as a form of "revival "for more senior players to participate even internationally. In the most recent email communication with Mr. Peter Cua andMr. Scott Gordon, the President of the U.S. Hardbat Association, the latter mentioned in their website: *"Most recently, Reisman has been hard at work developing an international organization for promoting sandpaper table tennis. Yes, you read that right- the old sandpaper paddles that have been illegal since the early 1960's are making a comeback. Actually, they never totally went away – a large continent of players on the* ***Philippines*** *who call the game " liha" play competitive sandpaper a a very high level and Marty is working to bring them together with the hardbat movement and introduce the world to a game-and—sound that is sure to excite. Think sandpaper is "old School"? Think again."*

In another email correspondence, Mr Gordon also said that "*Another idea is to stress that "liha" is not something you are asking for-* ***it already exists and is a lasting cultural fact in your country.*** *Instead, you have observed many benefits of "liha", and that you are proposing that the ITTF would be wise to consider duplicating those same benefits by providing avenues for international "liha" competition. And, that you are , in a sense, offering to help them do that."*

3. It can be easily played by young and old individuals who do not only want to enjoy the game because of its longer rallies but also to maintain an optimum level of fitness , fun and a "fallback" grounds from the present fast-paced game of table tennis so as yet to continue to patronize and stay in the table tennis community.

REFERENCES

[1] Brown, K. and Cole, M. (1997). Fifth Dimension and 4-H: Complimentary Goals and Strategies. FOCUS: A Monograph of the 4-H Center for Youth Development. 1997

[2] Crayden, R., The Story of Table Tennis – the first 100 years, 4:14-18, 1995.

[3] Cuico, B. (Personal and Cell phone Communication), February 12, 2009.

[4] Francisco, R. (Video Interview), February 4, 2009

[5] Gonzales, R. (Cellphone Interview), February 28, 2009.

[6] Gordon, S. (Email Correspondence), August 8, 2008 – January 12, 2009

[7] Gordon,S.,(Quote),http://www.hardbat.com/hbmarty.html

[8] Gurney, G. Table Tennis – the early years. 8:26-29.

[9] Jawad, J. (Personal Communication), February 14, 2009

[10] Nuque, Marcial (Video Interview), February 7, 2009.

[11] Ortalla,J. (Personal Communication), October 15, 2008.

[12] Ortega, J. (Video Interview), February 4, 2009.

[13] Ramos, S. (Video Interview), February7, 2009.

[14] Reisman, M. (Email Communication), August, 2008

[15] Salvador, S.T., (Personal Communication), December, 2008

[16] Thomas J. and Nelson J. Researh Methods in Physical Activity. Champaign, IL: Human Kinetics

[17] The International Table Tennis Federation Handbook on Table Tennis, 2007

Investigating the level of T.T. sport's family transference (generation by generation) in Iran national champions

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ABSTRACT

The objective of this research is to study the level of family transference and training in **T.T** in national champions of this field in Iran.This study is descriptive one and has been carried out by means of telephone and face to face interview. The statistic population of this study is composed of Iran **T.T** players, among whom 232 people (181) female, (61) male were interviewed. To analyze data (chi-square) non – parametric statistical method in P<%5 Level was used. The results showed that about half of this population were under 30 (n = 122) and about another half were above 30 (n = 110). More over from 232 individuals 129 people were playing at national level, and finally the main result of research showed that amount of family training has a meaningful relation with the amount of championship level (P=%43).So it can be concluded from this study that the families who in this way cause developing championship level and spreading **T.T** sport in national level in Iran should be supported and we can use the champions' family in order to develop and train championship.

Key words: Family transference, Training Champions, Interview, Table tennis.

1. Purposes

Learning is an absolutely personal function, because there is no particular general method or skill for every body in each condition that s/ he is in it so teaching the learning procedures means teaching knows and un knows and teaching what should be done .In modern world, training also had many changes, so that it has got common from public schools to private institutes and in many cases using in absentia education and even training by media has also been used in most cases, and it seems that we can follow a kind of family training by the motivation and energy of champion and observevation and interest of his relatives. Of course the level of culture, the amount of population, social rules and existing facilities for sport can influence on the type of this education (training)that has platted the methods and different training theories in different countries. Public education – private education – individual education and this training have happened in sport too that can be traced back to the way of talents identification. Considering the existence of a national sport in some countries, it can be thought if that sport field has been transferred generation by generation it's also affected by the culture and geography of that country? The purposes of this survey is the influence of the role of champion in a family, like, father, mother, or first order relatives in developing and training the champion in this field and transference of championship to the next generations .It should be noted that the role of experience in this field can not be denied and championship in this field is time – consuming and we can't rely just on talent. We should at first find the training methods that can be fruitful sooner and use them for expedition and development of championship and it's continuance in different ranks of age. Regarding the achier results, our goal can be expanding a new kind of training by families, meaning that by financial and technical support of champion in family and by creating encouragement of first champion to form new generation of **T.T** champion.

2. Method

The methodology of this survey has been descriptive and the number of samples was 232 Iran **T.T** players who were interviewed unrandomly face to face or telephone, from which 61 were males and 171 females, and half of which were above 30, the rest were 30. 129 people had the experience of champion ship in different national levels. For data analyzing nonparametric statistical method was used (chi = square in %5level).We encountered with the following barriers during survey.

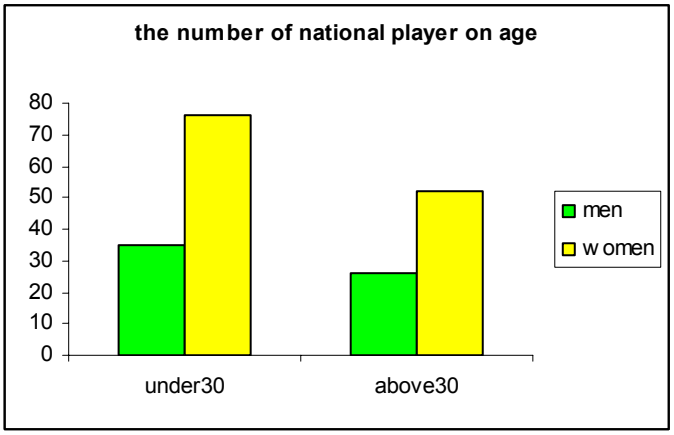
1-The samples were not in a specific range of age.

2- We couldn't determine the exact number of adults who themselves have trained a champion child.

Table 1-The number of subject on age

subject	Under 30	Above 30	n
Male	35	26	61
female	76	52	171
sum	N=232		

Figure1.The numbers of national player on aged above and under 30



3. Results

The main results of survey showed that there is a meaningful relation ship between family training and the level of championship (P = %43).

Table 2- Annualizing data by chi- square.

education / Subject	Championship player	Family transfer	percent Family transfer	df	X^2	Meaningfully level
Male	33	24	72.72%	1	7.605	0.043
female	38	24	63.15%			
sum	71	48				

Figure2.The level of family transfer in women tennis player

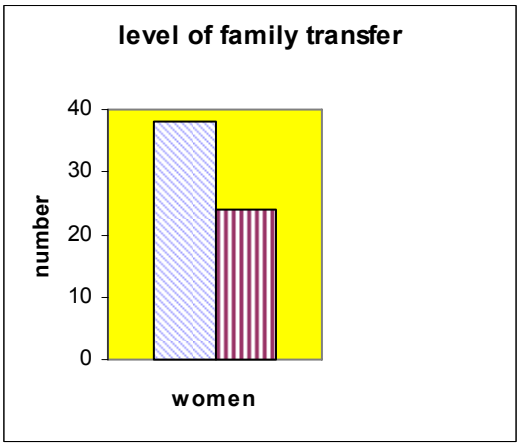
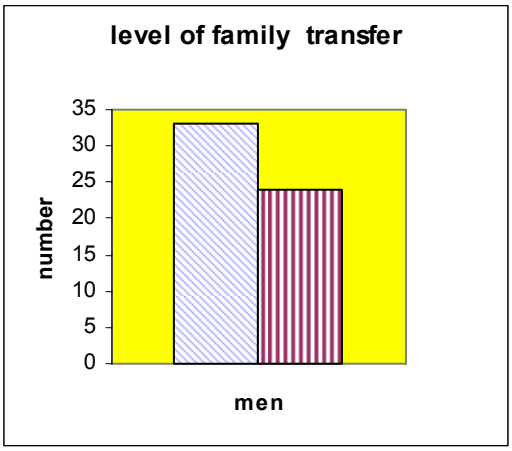


Figure3. The level of family transfer in men tennis player



4. Discussion and Conclusion

Considering culture and rules and customs in Iran, the family has a significant role in training and supporting the children, especially for reinforcing champion ship sprit in next generations, has a clear image Like:

Ehtesham zadeh family with 3 generation championship in continental and national level.

Some other examples are

Alamiyan Family.

Ehteshamzadeh Family

Limochi Family.

Omrain Family.

Jafari pour Family.

Lotfollahnasabi Family.

Rahnama Family.

Rahnama family

Samet Family.

If we pay attention to this important factor that we can create a backbone in national and championship level by financial and technical support of families who are champions themselves, and use the presence of champions in family in a organized form for training, transference of experiences and promotion of championship motivation in next generation. Regarding the individualistic characteristic of this field we can guarantee the reduction of training costs in **T.T** federation and associations. In addition to introducing the champion's family to sport society and use the method of family training, for training the champions in national level.

6. References

[1]-proceeding book. (2007).Chiu – juju. Zagreb. Page: 210-211.

[2]- The proceeding book of the ninth international T.T congress. (2005).Limo chi – shanghais .page 302 – 304.

[3]- Table Tennis Illustrated. (2007) .The official journal of the international Table Tennis federation– no: 69 – page: 16-17.

[4]- Table Tennis Illustrated. (2008).The official journal of the international Table Tennis federation– no: 11 – page: 22-23.

The Measuring Ball Spin at the Service in Table Tennis by Junior player

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Abstract: The purpose of this study was to clarify for the junior elite academy table tennis players to improve and strengthen by recognizing their own data. The serve ball rotation data was presented to the coaches and the players in September and December to examine the effects on the serve techniques and practice method. However, the players started to become more conscious of serve ball rotation, which can be considered effective for their future technical improvements.

Key word: table tennis ball spin high speed camera

1. INTRODUCTION

In any ball sports, the ball's rotation is a big factor in performance. For example, in baseball, a pitcher throws a variety of breaking balls according to the number of spins and pivot angles. Especially in table tennis, it is a very important factor.The serve ball rotation is considered the most important key which can be technically self-controlled by each player during the match. On the other hand, in general practice, the coach's personal sense is strongly affected, so in many cases the instructions may not be clear to everybody. Therefore, the serve ball rotation was measured, and the data was shown to the players and coaches as a visual objective to help them to recognize it. As a result it was considered helpful in producing effective practice for the future.

In this study NTC's (National Training Center) junior elite academy table tennis players' serve ball rotation was measured. The data was shown to the players and coaches in September and in December to compare the

changes in rotation and player awareness. Thus, this study was aimed to suggest and help improve practice methods.

This study was also carried out as part of the Sports Medical and Science study projects in 2008 at National Sports Science Center as project study B " Table tennis serve ball spin and motion. "Study method:

2. METHOD

2-1. Subjects

The subjects were six players of the elite academy. The second measurement in December had only four subjects since two of them were absent due to injury or matches played overseas. The characteristics are shown below in the table 1.

table 1 the players' characteristics

subject	sex	grade	dominant hand	play type / grip
Sub.A	male	1st JHS	right	Shakehand Attack type
Sub.B	male	1st JHS	right	Shakehand Attack type
Sub.C	male	1st JHS	right	Shakehand Attack type
Sub.D	female	2nd JHS	right	Shakehand-cut Militant type
Sub.E	male	1st JHS	left	Shakehand Attack type
Sub.F	female	2nd JHS	right	Shakehand Attack type

2-2. Measurement of serve ball rotation

(1) About the measurement of serve ball rotation:
Based on the preceding study by the group of Ushiyama[1)] each player's serve motion was photographed by a high speed camera which can produce 600 exposures per second. The players were instructed to serve a ball three times in three different serve conditions according to

table 2.

The number of spins were totaled by digitizing a marked point on the ball and calculated out from the direction and distance from the served point according to the video picture.

Table 2 Three test serve conditions

test motion no.	conditions
1	Simillar serve motion with two different ball rotations
2	Simillar serve motion with different course and speed
3	Subject's self-specified rotation serve

(2) Study on the players' awareness of serve ball rotation:

This research was conducted on the four players whose data was available in December. For questions 1 and 2, they were required to answer with YES, Not clear or NO. To question 3 they were required to answer with YES, Not Clear, NO or No idea. Furthermore, to question 2 and 3, the players who answered YES were asked to explain in detail such as Q.2 = Did you try to change anything? , and Q.3 = How did it change?
The questionnaire is included below in table 3.

Table 3 questionnaire

question no.	questions
1	Since the Sep.measurement, have you been more consious to the serve ball's spining amount?
2	Since the Sep.measurement, have you tried to invent your practice to change the rotations?
3	Compared to the Sep.measurement, have you realized any change on your serve ball rotation amount in December? (regarding your specified 3 type of serves on the test motion no.3)

3. RESULTS AND STUDY

From the two aspects of the three serve motions ball rotation comparison in Sep. and Dec. (Figures 1, 2) and the players awareness research (Tables 4, 5, 6), the results were examined to see how it can affect practice improvement. However, as previously noted, the Dec. measurement only included four subjects, and the Sub.C had done only two serve motion tests.

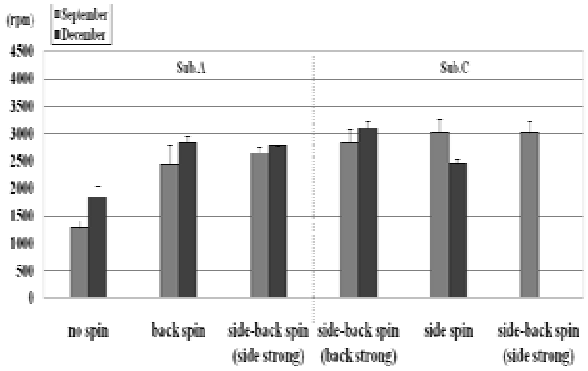

Fig.1 Sub.A・Sub.C serve ball spinning comparison

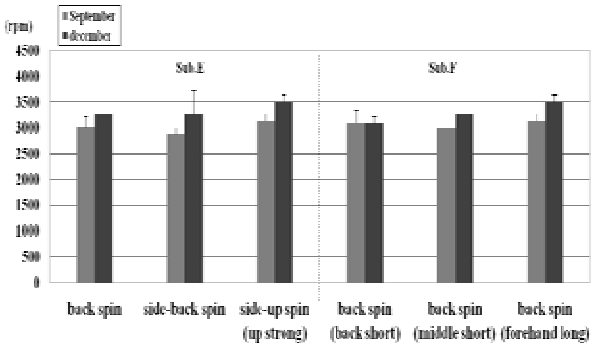

Fig. 2 Sub.E・Sub.F serve ball spinning comparison

Table 4 Awareness on serve ball spinning amount

Q1. Since the Sep.measurement, have you been more consious to the serve ball rotation amount?		
YES	4	Sub.A, C, E, F
Not clear.	0	
NO.	0	

Table 5 Invention to make any change

Q2. Since the Sep. measurement, have you tried to invent your practice to change the rotation amount?		
YES	1	Sub.C
Not clear.	3	Sub.A, E, F
NO.	0	

Table 6 Change on the serve ball spinning amount

Q3 Compared to the Sep.measurement, have you realized any change on your serve ball rotations in December? (regarding your specified 3 type of serves on the test motion no.3)			
Sub.A	Knuckeball	NO	
	Down rotation	NO	
	Side-Down rotation(Side Strong)	YES	Rotations increased due to focusing swings.
Sub.C	Side-Down rotation(Down Strong)	Not clear	
	Side rotation	Not clear	
Sub.E	Down rotation	YES	More rotations were recognized.
	Side-Down rotation	YES	Ball position lowered by the net.
	Side-Up rotation (Up Strong)	YES	More balls were kept on the table.
Sub.F	Down rotation (Back Front)	NO	
	Down rotation (Middle Front)	YES	Rotations seemed to be decreased.
	Down rotation (Forward Deep)	YES	Side rotation seemed like increased and down rotation decreased.

3-1. About Sub.A

In all three serve motions, the amount of rotation had a tendency to increase. However, regarding the knuckleball serve, it was determined to be more effective without intentional spins so are not necessary here. Regarding the player's awareness, according to table 4, from Sep. measurement Sub.A paid more attention to the spins. Therefore as a result the amount of rotation seemed to increase. In addition, from the table 6, Sub.A expressed the reason for the increase which was due to the focusing swings. Among all, regarding the Side-Down rotation serve (Side Strong), since the Sep. measurement, Sub.A tried a more intensive serve practice which seemed to result in the increased rotation.

3-2. About Sub.C

The amount of rotation increased and also decreased in different motions. From the awareness research in table 5, Sub.C expressed in detail that the serve practice was done focusing on making more impact at the moment when the racket contacts the ball, which showed the player paid more attention to produce effective practice by self invention.

However, according to table 6, Sub.C answered that the change in the serve ball rotation was not noticeable. Thus, it can be assumed that what had been focused on and what changes are recognized by the player are not always the same.

3-3. About Sub.E

Similarly to Sub.A, the amount of rotation tended to increase in all three motions. From the awareness research in table 4, Sub.E became more conscious of serve ball rotation from the Sep. measurement and seems to have resulted in the increase of the amount of spin in all serve motions. Furthermore, from table 6, Sub.E answered about the changes in detail on each serve as follows: for the Down rotation serve more spins were recognized and it matched to the reality. As for the Side-Down rotation serve, the ball position seemed to lower when passing the net compared to before. For the Side-Up rotation serve (Up Strong) more balls were kept on the table. In neither case, the spin change was not mentioned. However, assuming from all the results, Sub.E seemed to improve the serve technique and gained more spins.

3-4. About Sub.F

The spins increased in two serve motions and decreased in the other. From the awareness research in table 6, regarding the noticeable change on spins, Sub.F answered the spin seemed to be less than before on the Down rotation serve (Middle Front.) However, figure 2 shows rotation tends to increase; therefore, it can be said that the player's recognition and reality do not always match. On the other hand, regarding the Down rotation serve (Forward Deep), the player realized that the side rotation increased but down rotation decreased. Figure 2 shows the tendency of increased spin is probably due

to the increased side rotations.

4.CONCLUSIONS

This study was intended to examine how recognition of objective data would affect to improve practice method to the junior elite academy table tennis players by measuring and comparing serve ball rotation in Sep. and Dec. and performing awareness research. The summary is as follows:

Since the Sep. measurement, making the players pay more attention to their serve ball spin, the rotation tended to increase in Dec. for most players. Among all, there was only one player who tried to invent intensive serve practice. Regarding the change in serve ball rotation, the results were varied. Some realized the same as reality and some did not notice any change. The others felt differently from the reality.

From this result and study, it cannot be concluded that this practice was effective for this purpose. However, it is a fact that this study could make the future promising for the elite table tennis players by them becoming more conscious of the serve ball rotation and obtaining a self-controlled useful technique in the match. Moreover, it made them realize the existence of other players who were more aggressive at improving their serve practice. This would surely motivate and lead them into the invention of better practice methods, strengthening themselves for the future.

REFERENCES

1) Yukihiko Ushiyama et al. “Measuring top-spin amount of university table tennis players” Niigata University Education and Human Science Department Journal, 5(2), 231-236, 2003.

2) “International Journal of Table Tennis Sciences”No.3 (1996) ITTF-International Academy of Table Tennis Sciences

3) “International Journal of Table Tennis Sciences”No.1 (1992) ITTF-International Academy of Table Tennis Sciences

4) “TABLE TENNIS SCIENCES NO. 4&5 ITTF SPORTS SCIENSE COMMITTEE”

5) Takashima N, “A table tennis tactics notebook” Table Tennis Kingdom, 2002(in Japanese)

6) Fuji M, “Fountain of table tennis knowledge” Table Tennis Kingdom Table Tennis Kingdom, 2003(in Japanese)

The examination for evaluating skills during the rally of the Table Tennis game

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Abstract: The purpose of this study was to examine the method for evaluating skills of table tennis players during the rally of the game. An incidence angle, speed and height of the balls passing above the net were investigated for both winners and losers. In this study, these three factors were defined as the characteristics of the hit ball. In order to observe those three factors, infrared laser units were set up 0.3 m from the net. The intervals of the time which were required for the balls to pass through two fixed units were measured. Those data were digitized and recorded in a personal computer. The above-mentioned characteristics of the hit ball were calculated. The results showed the following tendency. A winner's ball has a larger incidence angle than that of loser's one. On the other hand, the speed and height were not important factors in order to win the games. However, higher the skill levels, the higher the hit ball position and more the speed. It was found that a large incidence angle was necessary to win. In conclusion, observing an incidence angle gives coaches and players the possibility to evaluate skills of table tennis even in different skill levels.

Key words: table tennis incidence angle ball speed ball height evaluating skill

1. INTRODUCTION

Methods of skill evaluation using VTR are adopted in various kinds of sports. As for volleyball, the game analysis and the skill evaluation software such as "Data Volley" and "Touch Volley" are developed.[5)] However, as for table tennis, the software that can evaluate the skill of the player is not developed. It is not sufficiently clarified in the case of table tennis how to analyze the game. That is because table tennis is individual competition, there are many patterns of matches and the rally is very speedy. Therefore, development of game analysis system is very difficult. It is expected that the skill evaluation of more advanced strategy analysis and the player becomes possible, if such software can be developed.

In February, 2000, The International Table Tennis Federation (ITTF) officially adopted a larger ball of which the diameter is 40mm.[2)3)] As a result, a rally continues more than before. It has been reported that the probability that the player loses who hit balls over the table is high.[1)] Still very few attempts have been made for evaluating the skill of table tennis players. To evaluate the skill of the player, it is necessary to clarify the characteristic of the balls hit by the player. The purpose of this study was to examine the method for evaluating skills of table tennis players during the rally. An incidence angle, speed and flight height of the balls passing above the net in both winners and losers were investigated.

2. METHODS

2.1 Experimental device

Infrared laser units were set up 0.3m from the net. The units were assembled as shown in Figure 1. The infrared laser unit has an emitting laser and an optical receiver. A total of 16 infrared lasers unit comprising left 8 and right 8 were set up. The distance between adjacent infrared lasers is 0.04m. When the ball passed the unit, time and channel number were recorded in the PC. The state of the measurement was videotaped. The experimental devices are shown in Figure 2.

Figure 1 The lasers units of the measuring system

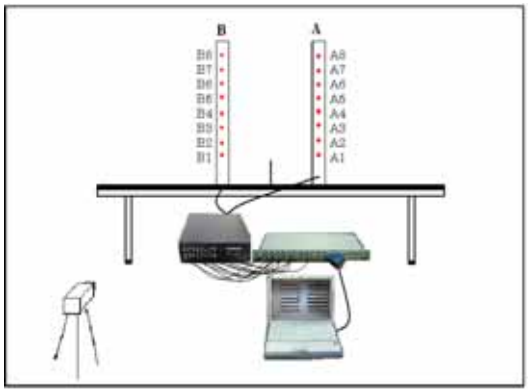

Figure 2 The experimental devices

2.2 Procedure of measuring

The signals from units were converted into a digital code via DAQCard-6024E at 10 kHz. These signals were recorded in the personal computer. Figure 3 shows the personal computer screen when balls passed the infrared lasers.

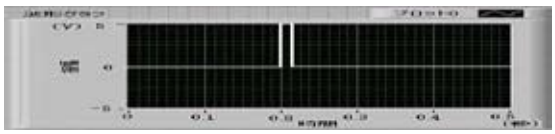

Figure 3 The PC screen when the ball passed the infrared lasers

2.3 Subjects

In this study, 8 males who belonged to Niigata University Table Tennis Club were selected as subjects. Four of them have a high skill standard to participate in the All-Japan Championship. The subjects were asked to warm up to perform one's best in matches in this measurement. After that, the subjects played three games matches.

2.4 Calculation

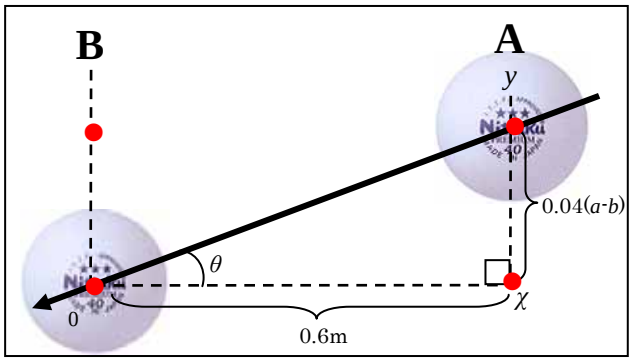

Figure 4 The basic concept of trajectory of the ball

2.4.1 Incidence angle of hit ball

The incidence angle (θ) of the balls when passing above the net was calculated by the following equation.

$$\theta(\mathrm{deg}) = \frac{180}{\pi} \cdot \tan^{-1}\frac{y}{\chi}$$

An example of calculated incidence angle is shown in Figure 4.

χ: The distance of between two laser units (0.6m)

y: The height of difference infrared laser of A and B units ($0.04(a-b)$m)

2.4.2 Ball speed

The speed (v) of the ball passing right above the net was calculated by the following equation.

$$v(\mathrm{m/sec}) = \sqrt{0.6^2 + \{0.04(a-b)\}^2} \ / \ (Tb - Ta)$$

a: The channel number of the laser interrupted by passing ball before the net

b: The channel number of the laser interrupted by passing ball after the net

0.6: The distance of between two laser units (A and B)

$0.04(a-b)$: The height of difference infrared laser of A and B units

Ta: Time when the laser light is interrupted by passing ball before the net

Tb: Time when the laser light is interrupted by passing ball after the net

The number 0.6 in the above equation means the distance between two laser units (A and B), and the expression $0.04(a-b)$ means the height of difference

infrared laser A and B units.

The measurement units of length and time are m and sec, respectively.

2.4.3 Height of a ball above the net from table surface

The height (h) of the ball passing right above the net was calculated by the following equation.

$$h\ (\mathrm{m}) = \frac{1}{2}\ [\{0.04(a-1)+0.18\}+\{0.04(b-1)+0.18\}]$$

The number 0.04 and 0.18 in the above equation mean the distance between adjacent infrared lasers and the lowest height of the lasers from the surface of the table, respectively.

The coordinate of the point which is the center between the lasers interrupted by ball was used to obtain the height of the ball right above the net.

3. RESULTS AND DISCUSSION

3.1 Incidence angle of hit ball

The average incidence angle of balls of winner and loser is shown in the Figure 5. The results of Figure 5 were obtained from all rallies of all matches. The incidence angles of the hit balls by the winners were larger than that of the losers. A significant difference was found between winners and losers ($p<0.05$). The average incidence angle is shown in Figure 6 for each match. The tendency indicated that a winner has the larger incidence angle than that of the loser. In the match of sub.A and sub.C, the incidence angle of the hit ball of sub.A was much larger than that of not skilled player (sub.C) ($p<0.01$). It was shown that an incidence angle was affected by the skill level of the players. The winning percentage of the player who has a larger incidence angle of hitting the ball is high.

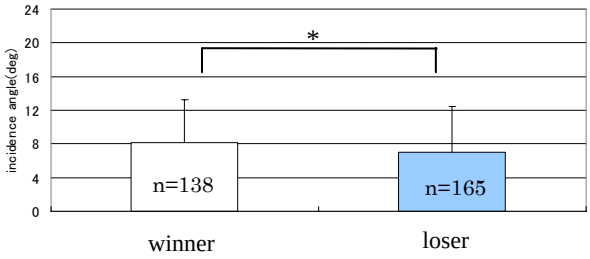

Figure 5 The average incidence angle of the hit balls in all rallies of all matches according to winners and losers

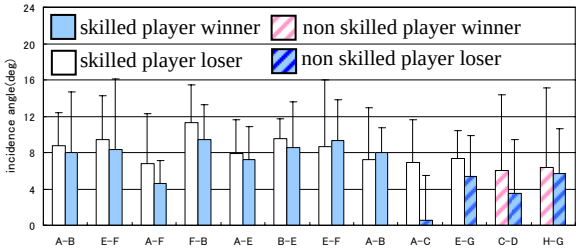

Figure 6 The average incidence angle of each match according to winners and losers

3.2 Ball speed

The ball speeds of winners and losers in all rallies of all matches are shown in Figure 7. There was no significant difference between winners and losers. However, the ball speed right above the net of the losers was faster than the winners. The average ball speed right above the net is shown in Figure 8 in each match. There was not difference of the ball speed in both winners and losers. It is expected that the players rallied at about the same ball speed in the match between the skilled players. On the other hand, in the match of skilled player and non skilled player, the speeds of the ball hit by the losers (non skilled player) were faster than the winners (skilled player). Let us take close look at the match of sub.E and sub.G. The ball speed of non skilled player sub.G was faster than that of sub.E ($p<0.05$). It is expected that non skilled players think that it is an important factor for winning to hit the ball at higher speed. It was found that the ball speed is affected by the skill levels of opponent.

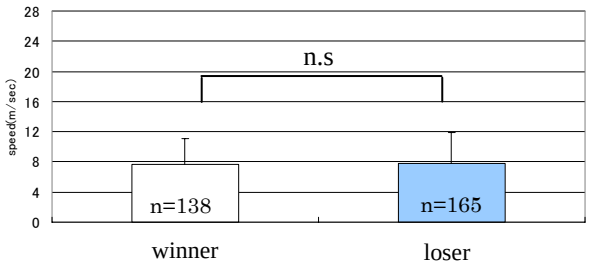

Figure 7 The average ball speed of the hit balls in all rallies of all matches according to winners and losers

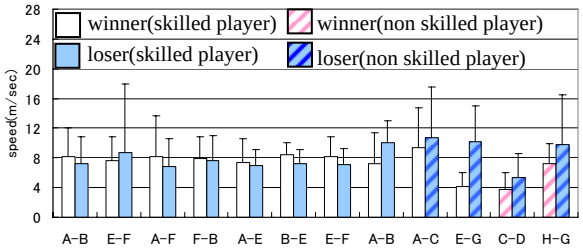

Figure 8 The average ball speed of each match according to winners and losers

3.3 Ball height right above the net

The average ball height right above the net in all rallies of all matches is shown in Figure 9 in which the results are presented for winners and losers. The average ball height right above the net in each match is indicated in Figure 10. In all skill levels, the height of balls hit by the winners was higher than that of the losers. In the match of sub.A and sub.B, the height of the ball hit by sub.A who was considered the skilled player than that of sub.B ($p<0.05$). This means that the winners hit the balls at a high position. In order to have more possibility to win the match, it is necessary to hit the balls at the higher position.

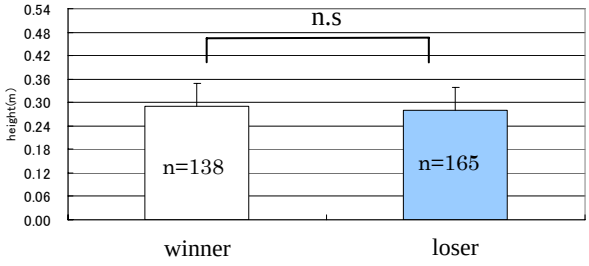

Figure 9 The average ball flight height of the hit ball in all rallies of all matches

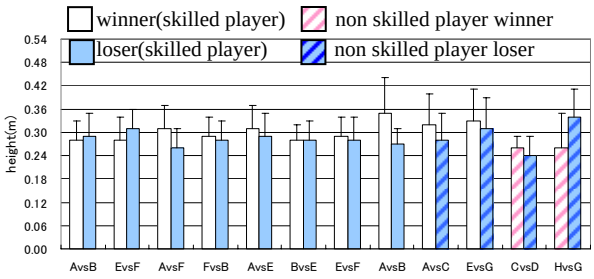

Figure 10 The average ball flight height of each match according to winners and losers

4. CONCLUSION

The results of this study are summarized as follows. Observing an incidence angle gives coaches and players the possibility to assess the skills of table tennis even in different skill levels. On the other hand, height and speed of the balls passing above the net give the possibility to evaluate the contents of matches. As a result, higher the skill levels, the higher position, speed and larger incidence angle are necessary to win the game.

5. REFERENCES

1) Takashima N, “A table tennis tactics notebook” *Table Tennis Kingdom*, pp.66, pp. 171, 2002 (in Japanese)

2) Fuji M, “Fountain of table tennis knowledge” *Table Tennis Kingdom* Table Tennis Kingdom, pp. 296, 2003 (in Japanese)

3) Tang H, Mizoguchi M, Toyoshima S, “The batted ball characteristic of the 40mm table tennis ball” *A physical fitness study*, Vol.47, No.2, pp. 155-162, 2002 (in Japanese)

4) Okabe S, Takashima N, Ashida N, Azuma T, “About a top of the batted ball line in the table tennis” *Japanese physical education association rally title* No.47, pp. 538, 1996 (in Japanese)

5) Kajiwara S, Ezaki S, Shigenaga T, Miyachi C “Development and evaluation of Volley ball evaluation system Touch Volley. *A collection of human interface society memoirs*, Vol.8, No.1, pp.1-6 (in Japanese)

Analysis of the ball fall point in table tennis game

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Abstract: During a table tennis game, coaches give players some advice, based on their experience rather than objectivity. In this research, objective data are used to analyze the advice given to players. Coordinate data of the ball fall point in a National University Table Tennis Tournament, held in April of 2008, are analyzed with the help of a video camera. Attack and defensive patterns are analyzed, allowing weak points to be clarified. This research aims to extrapolate objective advice to the advice given by the coach from experience.
Keywords: Table tennis, Sequence of pitches pattern, Strategy, Ball fall point

1. INTRODUCTION

In a table tennis game, when coaches give players advice, they often advise the players using their experience, rather than by analyzing objective data. After recording the content of a game, and doing the statistical analysis, researchers think that it is important to examine the content of the game. Especially, in American football, previous games are analyzed in order to think about strategy. However, in a table tennis game, when the coach gives the player advice, he rarely uses objective data. As a characteristic of table tennis, it is necessary to record and add up the game data fast, so it is thought that the lack of time may be a problem. However there is some research that has actually done game analysis of table tennis. From the research done by objective analysis and subjective analysis, it is said that the basic material [1][4][5][6][7] of the training project plan clearly shows information such as the ball trajectory time, distance, speed, etc. However, according to recent research, the analytical method of tactics of table tennis can not be used directly in table tennis games because there are many problems in data collection and data analysis. The present study analyzes the data collected from an official university student tournament held in April 2008. In the present study the coordinate data of the ball fall point are analyzed for the attack and defensive pattern and weak points are clarif*ied. Later, the result of data an*alysis can be added to the advice based on the coach's experience, in order to give even better advice to players.

2. MATERIALS AND METHODS

1.1 Analyzed subject: The analyzed subject was a male player from Niigata University Table Tennis Club. This player's ball fall point data in all games he performed in North Shinetsu National Championship tournament was analyzed. This player was chosen because he won his 5 games in the tournament and got the first place.

1.2 Data acquisition process: Using a video camera to record the 5 games, the following points were considered.

(1) The point to identify the fall area from a high position in the auditorium.

(2) The point for taking video from the right rear so as not to disturb the optical axis of the camera with which we take the video of the fall area as shown in Figure 1.

(3) As the flow of the game is important, there is a need to record from beginning to end without stop.

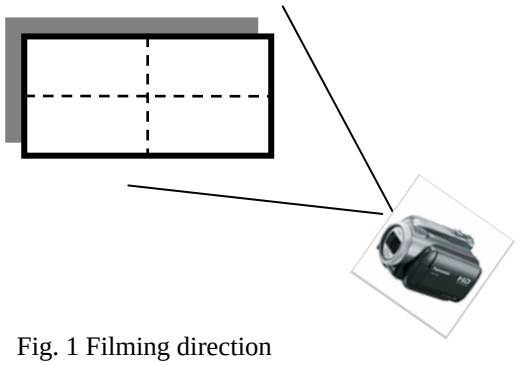

Fig. 1 Filming direction

1.3 Methods of data analysis: According to the order of the player and opponent, we use alphabet capital letters to identify them. The player is A, and the opponents from 1st to 5th games are B, C, D, E, F, respectively. Then we divide each side of the table to 9 equal parts, and so the table has 18 blocks. In a game, the data where the ball bounded were collected. Every block was designated with a number from 1 to 9 on each side of the table tennis court. The block where the ball bounced was sampled for data analysis. For example, in Fig2, the game players are A and D, the first fall point block is 7 when D serves, and the second fall point block is 5 on the other side when D serves, so the fall point block is 7 for A to receive and for B's third ball. A missed the fourth ball as a result the route of fall point is 7-5-7-7. This method is repeated in all games, and so all the player's winning and losing routes during the game can be analyzed.

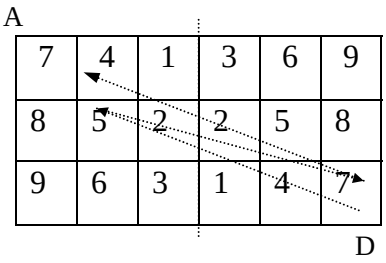

Fig. 2 Example

3. RESULTS AND DISCUSSION

At first, we analyzed the number of rallies that the player hits the ball at every play for each game. From Fig3 we can see that the play ends before or on the fourth ball on 80% of the games, which means only 20% of them have a fifth ball. According to this result, we can see that the most important part of the game is held up to the fourth ball. Table1 shows that the higher level the player has, the more plays involved in the game. The player won the championship, so this data can show us the playing characteristics of a high level Japanese college student. This research analyzed the data of correlation between the ball from service to the fourth ball and winning.

Table 1 About rally in each game

Match	Game match (game)	To forth ball	After fifth ball	Sum
AvsB	3	36	4	40
AvsC	3	39	9	48
AvsD	3	51	12	63
AvsE	3	54	8	62
AvsF	5	60	17	79
Sum	17	214	51	292

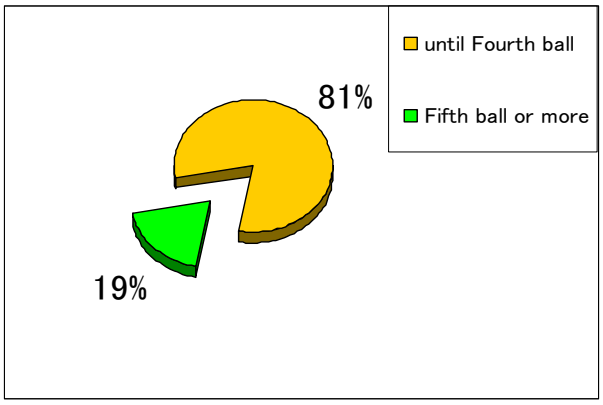

Fig.3 The rate games up to forth ball and longer then fifth ball.

3.1 Review of Player A and Player B.

Fig.4 shows there are 20 balls which A served including 8 misses when receiving by B. This is because B could not forecast the circumrotation of the ball which is served by A, and further more there is only 2 balls that can insist to the fourth ground in which A served. It also means B could not forecast the circumrotation of the ball which is served by A, even though B got the ball A served, it also a chance for A.

Fig.5 shows that in the 19 balls which B served, on only 3 he scored. In contrast, A got 19 scores from serving. All of these facts mean B's level is lower than A's. In those games, the necessity of tactical analysis is not so great.

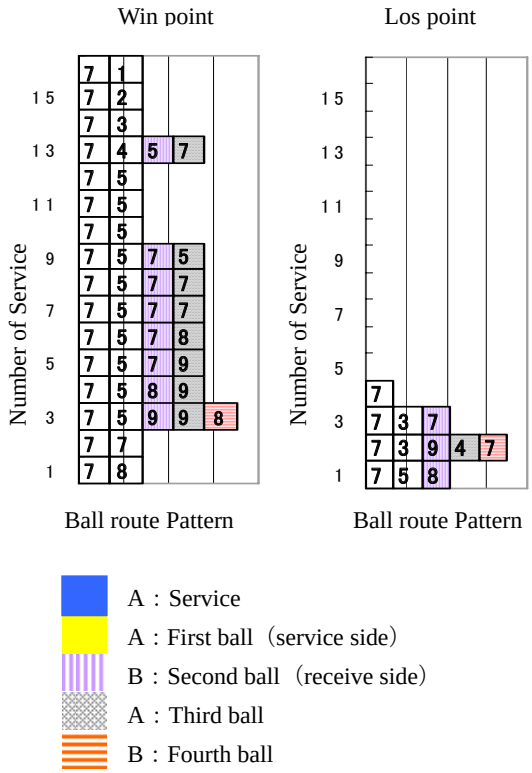

Fig. 4 Getting and Losing score when player A was at service.

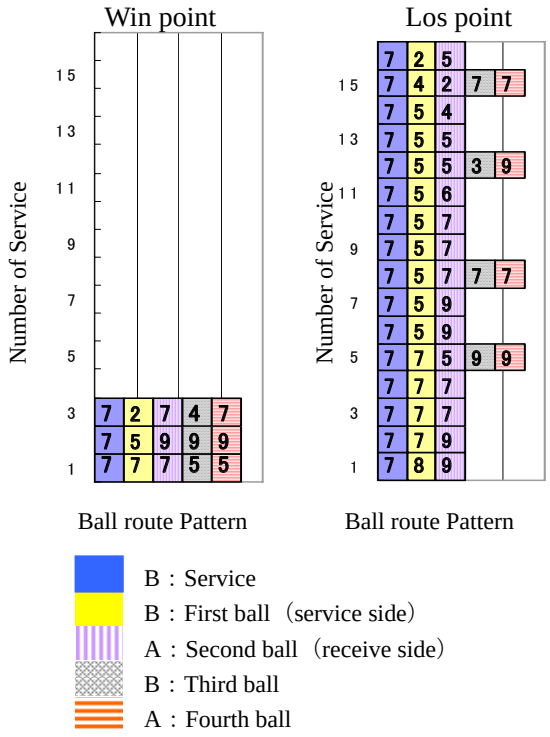

Fig.5 Getting and Losing score when player B was at service.

3.2 Review of Player A and Player C.

Fig.6 shows that A served the ball around the block 5 and 2(Fig7), and got 17 scores in all of the 23 balls. It shows player A is very preponderant in the game. Oppositely, Fig.6 shows that the fall point of C's receiving is around block 7, 8 and 9. It clearly shows that C's receiving in these blocks is a quite good for A. The way to make C have progress is to avoid receiving the ball around block7, 8 and 9.

From Fig.8 we see the fall point of the ball which was served by C is in every blocks except block 8, though block 5 got the most service and got the advantage, the other blocks didn't get any advantages except blocks 6 and 9. The above chart shows that if C could serve around the block 5, and also use block 6 and 9, he might get a advantage in the game.

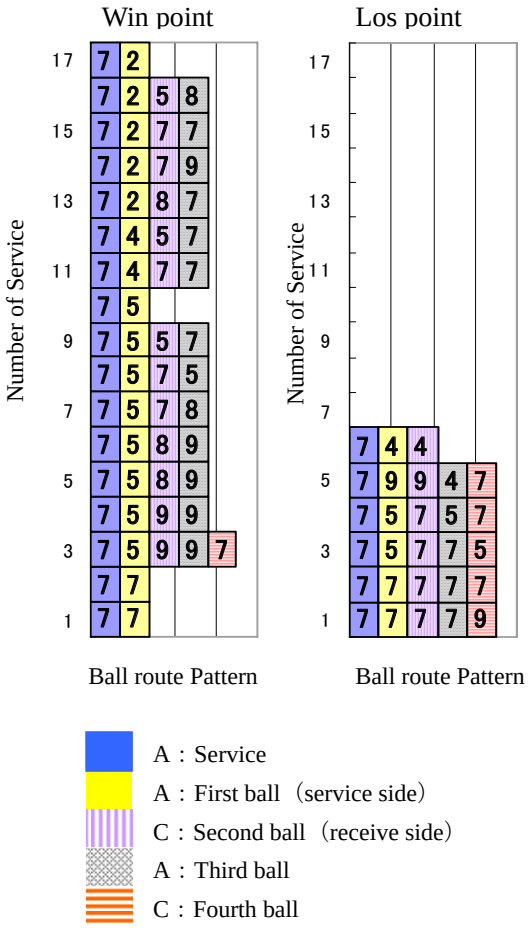

Fig. 6 Getting and Losing score when player A was at service.

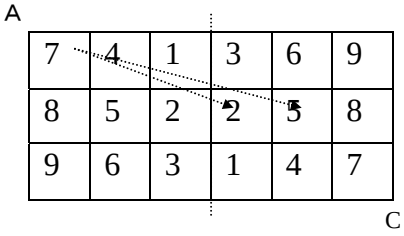

Fig. 7 Score pattern when player A was at service and got an advantage

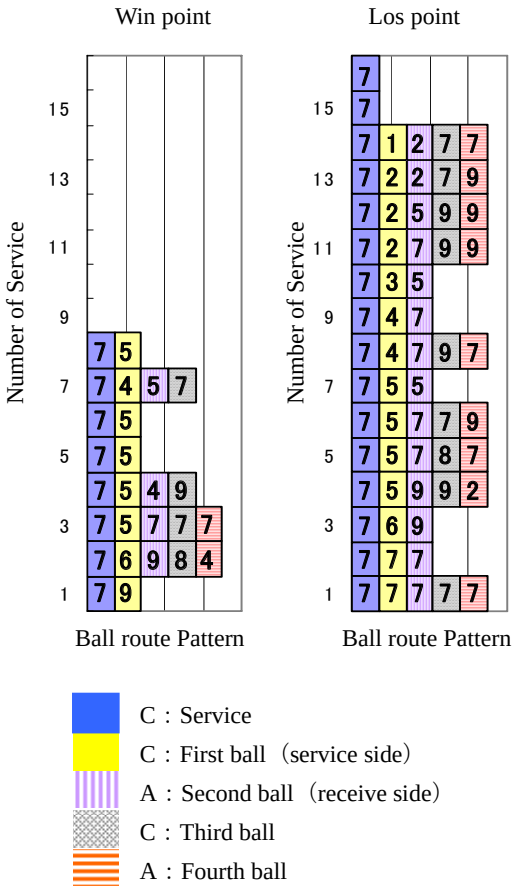

Fig. 8 Getting and Losing score when player C was at service.

3. 3 Review of Player A and Player D.

Fig.9 shows that A served 26 of the 31 balls on block 5 and took the advantage. We also see that although A didn't take advantage in route 7-5-9(Fig10), he had a great advantage in both routes 7-5-7(Fig11) and 7-5-5(Fig11), so it's good for D to use the route 7-5-9(Fig10).

From Fig.12 we can see D had a disadvantage when D served ball in block 4 and so A can use the route 7-4-7 to get an advantage. Oppositely, block 8 is an advantage for D as can be seen by the third ball of D. It is better for D to serve the ball on other blocks except block 4, or forecast the route 7-4-7 and hit the third ball onto block 8.

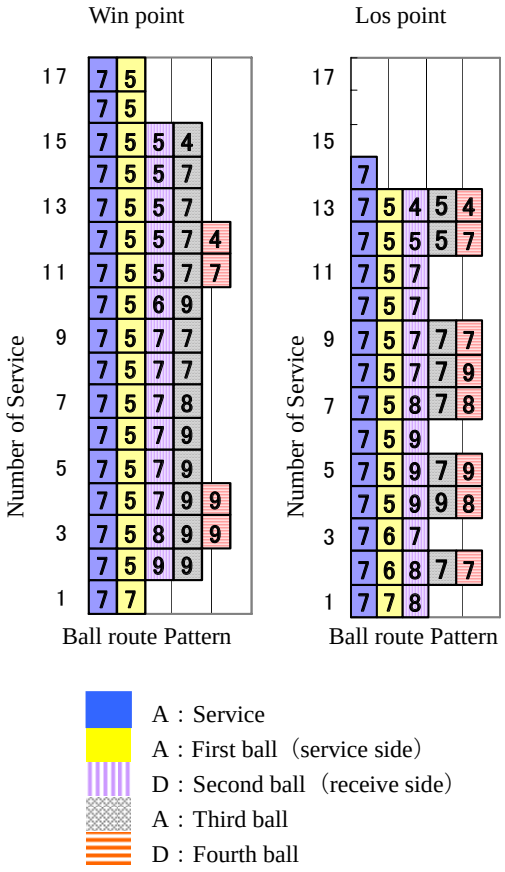

Fig. 9 Getting and Losing score when player A was at service.

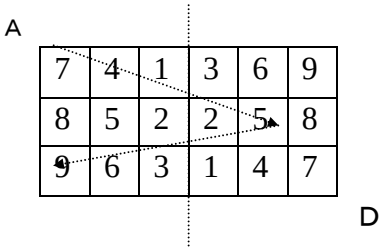

Fig. 10 This route was an advantage to D.

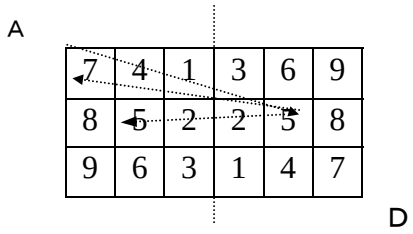

Fig. 11 This route was an advantage to A.

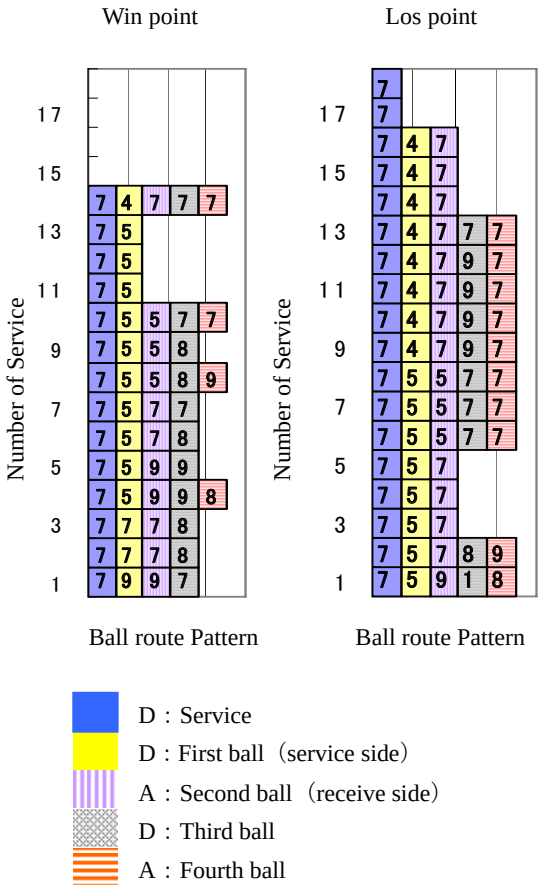

Fig. 12 Getting and Losing score when player D was at service.

3.4 Review of Player A and Player E.

Fig.13 shows that A served the ball around block 5 and took the advantage. However, he could only score once out of the 7 times at services that have fall points in block 3 or 4. Hence if A increases the fall point in block 7 and block 9, and then decreases the fall point in the block 4 and block 3, the situation would be better for A.

Fig.13 also shows that although the block 5 made A have a disadvantage, the block 9 and block 7 are good for A. In other words, E's receiving should use area around the block 5 instead of block 9 or block 7 as often as possible. Another result seen form Fig.13 is that the third ball is an advantage for A, whereas the fourth ball made by E in block 7 is a disadvantage for A. So E could take the advantage if E's receiving were around block 5, and the fourth ball are always close to block 7.

Fig.14 shows that it would be advantageous for A if E's service is in block 5 or block 7, especially use the route 7-7-9(Fig15). However, according to the third ball by E, block 8 is advantageous for A, but block 7 and 9 are not. So it is possible for E to take advantage if he can avoid to using block 7, or forecast the route 7-7-9(Fig15) and hit the third ball onto block 7 and block 9.

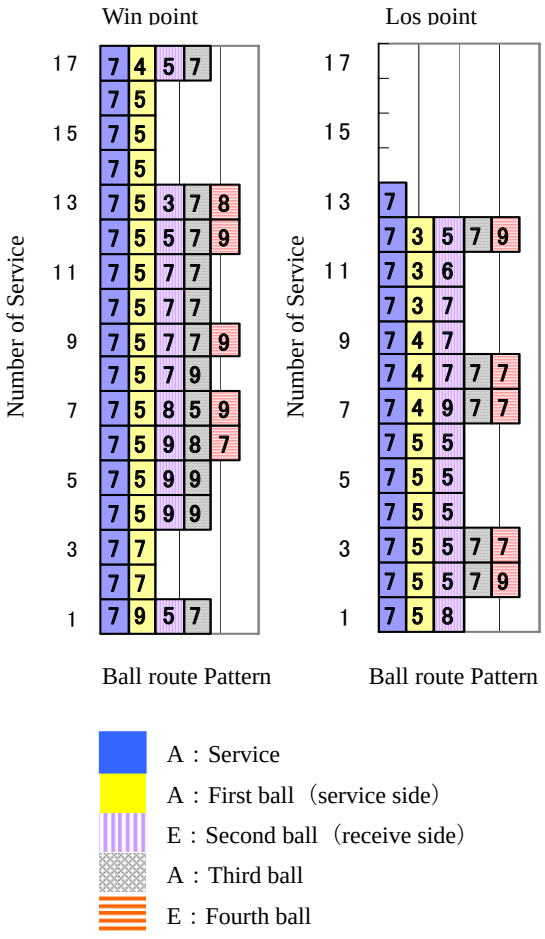

Fig. 13 Getting and Losing score when player A was at service.

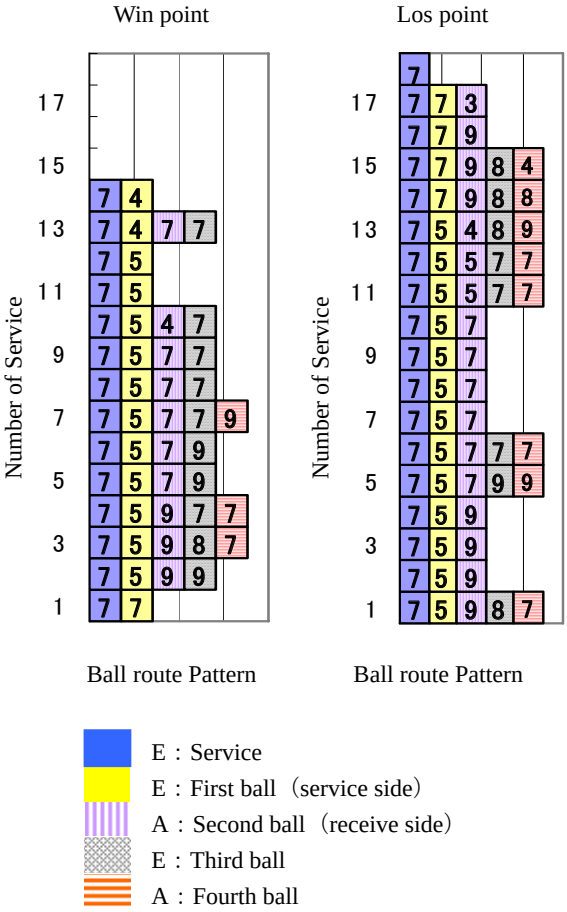

Fig. 14　Getting and Losing score when player E was at service.

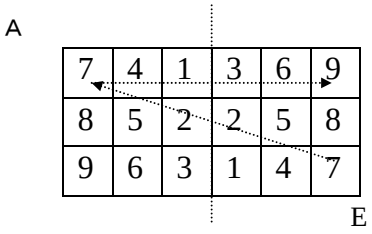

Fig. 15　This route was an advantage to A

3.5 Review of Player A and Player F

Fig.16 shows that A served the ball around the block 5, and A took advantage in route 7-5-7(Fig17), but had a disadvantage in both routes 7-5-8(Fig18) and 7-5-9(Fig18). Hence F should use the routes 7-5-8 (Fig18) and 7-5-9(Fig18) and avoid to using route 7-5-7 (Fig17) to let him take advantage.

Fig.19 shows that A received the ball around block 7 and took advantage in the game. A got most scores through route 7-7-7(Fig20) and 7-5-7(Fig21).

Fig.19 also shows that F's third ball's fall points are around block 7, 8 and 9. Although F gets the advantage in block 8 and block 9, he take disadvantage in block 7 which has most of third ball's fall point. The above results show that if F forecasted the route 7-7-7(Fig20) and 7-5-7(Fig21), and then make his third ball's fall point around the block 8 and 9, it might be advantageous for F in a game.

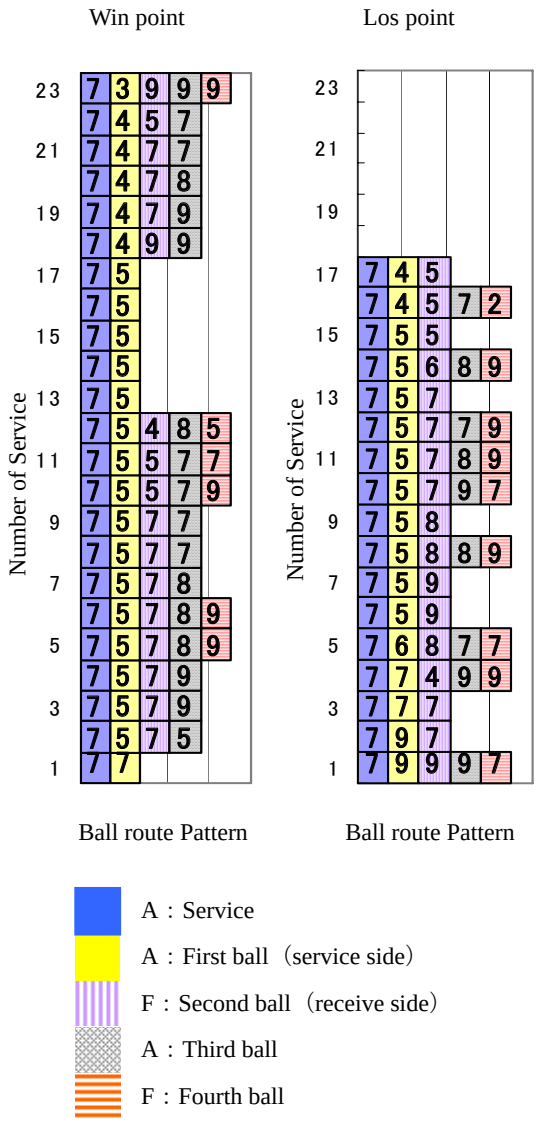

Fig.16　Getting and Losing score when player A was at service.

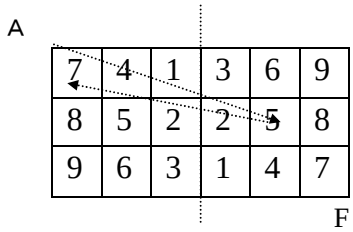

Fig. 17 This route was an advantage to A

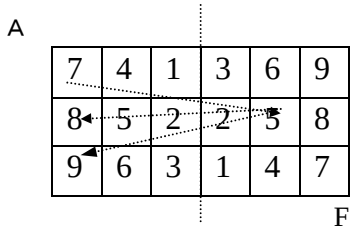

Fig. 18 This route was an advantage to F

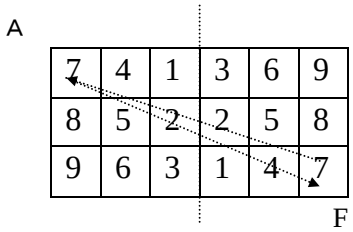

Fig. 20 This route was an advantage to A

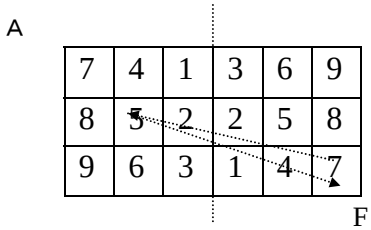

Fig. 21 This route was an advantage to A

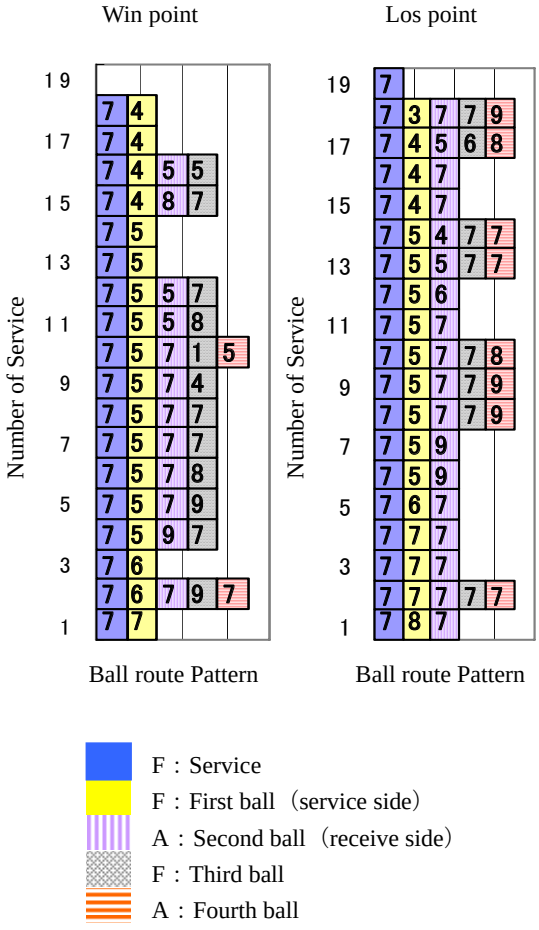

Fig. 19 Getting and Losing score when player F was at service.

4. CONCLUSION

This research concerns the routes of the ball in table tennis games. This research has college student games as an object of study. From the results we see the differences between winning score routes and loosing score routes of players. We give the possibility to use the data about getting score routes and lost score routes of players to give them correct advice. Recently, we can only focus on the analysis of the routes of whole game to help to win a game. It is also very necessary to focus on every game and do some research about practicability. Moreover, designing a practical analysis system to record the fall point instantly that can be used during the game is also necessary.

REFERENCES

[1] T. Kuraki, *Table Tennis for the Coach: III Table Tennis for Becoming a Champion.* Fumito, 1995.

[2] Y. Ushiyama, and K. Yoshida, “Computer use for Table Tennis Coaching,” *CIEC Computer & Education*, vol. 5, pp. 91–96, 1998.

[3] N. Ashida, M. Miyaki, K. Takashima, T. Azuma, T. Isomoto, and H. Turuta, “Data Accumulation

Method in Table Tennis Competition using Computer," in *Conf. Japan Society of Physical Education, Health and Sports Science,* Sep. 10, 1989, pp. 653.

[4] Z. Shi, "Rerecognization for characteristic of Table Tennis tactics," *Table Tennis World,* vol. 11, 2007.

[5] J. Kasai, and others, "Game Analysis for men's single final game in World Table Tennis Championships," in *33rd Conf. Japan Society of Physical Education, Health and Sports Science,* 1987, pp. 272.

[6] J. Kasai, and others, "Analysis of Top Table Tennis Players' Tactics," *Japan Society of Physical Education, Health and Sports Science, Science Research Report, No.2: Research on the Competition Power in Different Competition Categories*, pp. 117–121, 1989.

[7] K. Yamada, and K. Yoshida, "Difference between Subjective Evaluation of Service Receive, and Offensive of Third Ball from Service," *Sports Method Research*, vol. 13, No. 1, March, 2000.

Estimation of Energy Consumption from Heart Rates of Chinese Professional Table Tennis Players in Training Conditions

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Abstract:

Thanks to the characteristics of table tennis, different recreational players can have different aims. The movement intensity varies with such aims. It can be expected that the energy consumption in different levels will be remarkably different.

In competitive table tennis, the movement intensity varies with skill levels. For athletes at a lower skill level, it is difficult to compete continuously, and the sphere of action will be relatively limited, which consequently reduces the energy consumption. Opposite is true for the athletes at a higher skill level. So far, in order to investigate the relationship between movement intensity and energy consumption among different athletic levels, typical junior high school students and skilled university students have been tested as experimental subjects, and the energy consumption over a 60-minute table tennis practice has been surveyed. In competitive table tennis, for advancing the contestants' skill, the implementation method of the physical ability and the training should be investigated. Therefore, in this paper professionalcontestants are tested as subjects to investigate and compare a variety of pulse rates and energy consumption quantities in training conditions.

Keywords: Professional Table Tennis Player, Heart Rate, Energy Consumption.

1. Characteristics of Table Tennis Competition.

Compared with other sports, the competition characters of Table Tennis can be listed as:

It can take place relatively safely.

The motion strength of table tennis can be adjusted widely.

It can take place in the presence of a few people (but at least two) [1)].

In addition, because the speed of struck ball is quite fast, it is necessary for athletes to have balance of entire body and speed of reaction time. Furthermore, judgment and concentration is required as physical elements such as agility and dexterity. Because the equipment used in table tennis is so light in weight and the moving range is not so wide, there are not so much requirements for the young age, specific skill or purpose for the players. Body contact, accidents and injury in the midst of playing are also few. Rules of table tennis are relatively simple. It is an indoor sport which is not influenced by weather conditions. Regardless of age and sex, between different generations can enjoy the sport, seems to be widely known [2)].

2. Objective.

As for the quality of table tennis, based on the fact that it has a large population of players, it is expected that there is substantial difference even in motion strength over such a population. You stimulate fat combustion by playing table tennis. You can achieve the health maintenance, increase the physical strength, and consume excessive calories without growing tired. Contrary to what is generally supposed, playing table tennis can consume many calories. By playing table tennis periodically, therefore, you can expect substantial preventive effects against metabolic syndromes[3.4)].

In this paper change in the heart rate and change in the energy consumption during practice sessions are studied with test subjects drawn from the pool of professional players at the highest level of competition.

3. Method.

3-1. Composition of the Chinese Professional Table Tennis League Each team consists of 4 to 5 players, and is placed in the following four categories according to its strength.

The last two teams of A groups and top two teams of B ,whom winning the top two teams, upgraded to A group.

Super League: Men and women each in 10 teams (40~ 50 foreign players are included)

A League: Men and women each in 16 teams (64~ 80 players)

B League: Men and women each in 32 teams (128~160 players)

C League: Men and women each in 60 teams (240~ 300 players)

3-2. Subjects

The experimental subjects are 12 male contestants and 10 female contestants in Heilongjiang professional table tennis team (They have representatives Heilongjiang team made the top eight groups and individual achievements in the National Youth Competition.). As for the 12 male players, 4 in A League, 5 in B League, and 3 in C League, age: 16.7±1.56 year, height: 171.8±5.36cm and weight: 60.5±1.86kg, competition history 8.7±1.37 years. Each subject exercise 6 hours every day and 5 days every week.

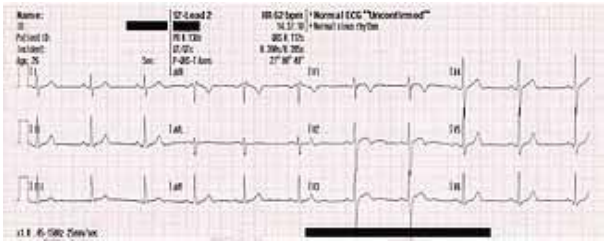
3-3 Condition of the league which subjects belong to

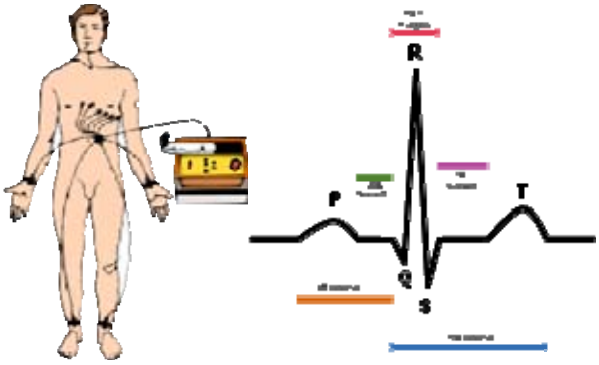
Table1: Condition of the league which subjects belong to

	Male	Female
A League	9 10 11 12	8 9 10
B League	4 5 6 7 8	4 5 6 7
C League	1 2 3	1 2 3

3-4 Equipment and method

Heart rate is surveyed by Radio electrocardiograph (heart beat meter Polar S610i,Show pictures.). The chest double pole induction electrocardiogram QRS wave is applied to survey the heart rate every 5 seconds continuously and energy consumption quantity of 60-mintutes training is surveyed by this method[5].





http://en.wikipedia.org/wiki/Electrocardiography

3-5 Practice contents

Content and practice of male players

[1] Forehand

[2] Forehand drive

[3] Forehand-backhand alternate

[4] Footwork and on loop drive-smash .

[5] Block

Content and practice of female players

[1] Forehand

[2] Forehand drive

[3] Forehand-backhand alternate

[4] Footwork and on loop drive-smash

Because male and female athletes, the physical conditions are different ， the ball and power are different, so the contents of training are not the same.

3-6 Practice times

60 minutes approximately

4. Results

Heart rate numbers to come up with a minimum value of maximum heart rate for each process . In forehand practice [1] the heart beat rate was the lowest, and the energy consumption was also the lowest. At the time of the footwork practice with drive and smash [4] the heart beat rate reached its maximum, and the energy

consumption was also the highest.

In order to improve the heart performance by playing table tennis, the footwork type practice with drive and smash [4] is considered to be the most effective training[6].

Table2 Male professional players character and results

	age	cm	kg	play	history	kcal	kcal/kg	SumIHR (bpm)	MINHR (bpm)	MAXHR (bpm)	AVGHR (bpm)	Motion Strength
sub.pm1	15	166	46	loop	7	324	7.04	6729	89	165	122	65.5%
sub.pm2	15	165	43	loop	7	288	6.70	6789	87	155	123	57.6%
sub.pm3	15	161	44	loop	8	320	7.27	6909	84	178	125	77.7%
sub.pm4	17	172	53	loop	9	335	6.32	6789	73	160	123	66.9%
sub.pm5	18	177	62	loop	10	446	7.19	7089	77	158	128	64.8%
sub.pm6	19	178	76	loop	11	593	7.80	7450	73	159	124	67.2%
sub.pm7	16	174	69	loop	8	506	7.33	7149	83	159	129	62.8%
sub.pm8	15	173	57	loop	8	472	8.28	7570	98	176	130	72.9%
sub.pm9	17	174	65	loop	9	528	8.12	7570	77	160	136	65.9%
sub.pm10	16	169	64	wse pimpled	7	626	9.78	8411	95	197	140	93.6%
sub.pm11	19	176	72	wse pimpled	10	526	7.31	7029	88	159	137	62.8%
sub.pm12	18	176	75	loop	10	741	9.88	8471	82	180	141	81.7%
Mean	16.7	171.8	60.5		8.7	475.4	7.75	7329.6	83.8	167.2	129.8	69.9%
SD.	1.56	5.36	11.86		1.4	140.16	1.11	595.84	8.04	12.76	6.97	0.10

Table3 Female professional players character and results

	age	cm	kg	play	history	kcal	kcal/kg	SumIHR (bpm)	MINHR (bpm)	MAXHR (bpm)	AVGHR (bpm)	Motion Strength
sub.pw1	15	165	57	loop	8	271	4.75	6068	71	161	111	67.2%
sub.pw2	17	167	50	loop	10	373	7.46	7149	91	145	119	48.2%
sub.pw3	15	162	55	loop	8	355	6.45	6729	83	153	112	57.4%
sub.pw4	15	166	58	loop	10	406	7.00	6969	86	143	116	47.9%
sub.pw5	16	167	54	loop	9	406	7.52	7270	84	144	121	50.0%
sub.pw6	18	163	52	loop	10	402	7.73	7390	79	157	123	63.4%
sub.pw7	19	165	51	loop	11	420	8.24	7630	89	171	127	73.2%
sub.pw8	17	165	54	loop	9	509	9.43	8171	96	156	136	56.1%
sub.pw9	15	162	51	loop	9	423	8.29	7630	104	165	127	60.4%
sub.pw10	18	166	59	loop	11	548	9.29	8111	88	185	135	85.1%
Mean	16.5	164.8	54.1		9.5	411.3	7.62	7311.7	87.1	158.0	122.7	60.9%
SD.	1.51	1.87	3.14		1.1	76.67	1.37	634.04	9.05	13.23	8.68	0.12

As for the male professional players, maximum heart rate is 167.2±12.76bpm and average heart rate is 129.8±6.97bpm; the energy consumption is 475.4±140.16kcal, the specific energy consumption (per unit body weight) is 7.75±1.11kcal/kg and motion strength is 69.9±9.99%.

After the athletes with an average weight 60.5kg have practiced table tennis for 60 minutes, the energy consumption is: 60.5 (kg) ×0.128 (kcal/kg/minute) ×60 (minutes) = 464.64 kcal.

As for the female professional players, maximum heart rate is 158.0±13.23bpm and average heart rate is 122.7±8.68bpm; the energy consumption is 411.3±76.67kcal, as for specific energy consumption is 7.62±1.37kcal/kg and motion strength is 60.9±11.86％. After the athletes with an average weight 54.1kg have practiced table tennis for 60 minutes, the energy consumption is: 54.1（kg）×0.127（kcal/kg/minute）×60（minutes）＝ 412.24 kcal.

5. Change of heart rate and energy consumption of Chinese professional Table Tennis athletes under the various modes of practice

5-1 Change of heart rate and energy consumption at fore hand practice

The two red bars show the athletes whose game type is soft. The maximum heart rate of forehand practice for male athletes is 124.3±9.5 bpm and average heart rate is 107.0±8.2bpm, average energy consumption is 30.3±9.1kcal, and specific energy consumption is 0.49±0.09 kcal per kilogram.

The maximum heart rate of forehand practice as female athletes is 129.0±12.7 bpm The maximum heart rate of male athletes is 111.8±9.5bpm, energy consumption is 28.9±5.7kcal, and specific energy consumption is 0.54±0.11kcal per kilogram.

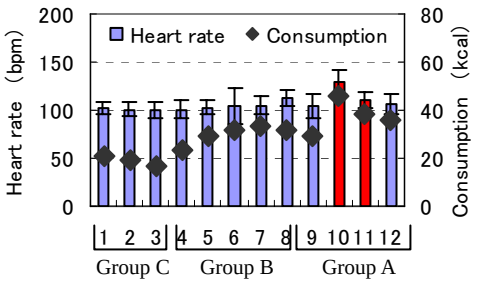


Fig. 1 Male: Heart rate and energy consumption in forehand practice.

The two red ones stand for the players who use pimpled rubber.

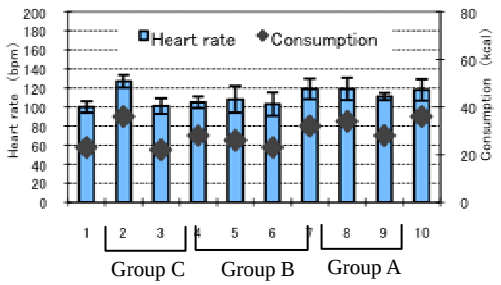


Fig. 2 Female: Heart rate and energy consumption in fore hand practice.

5-2 Change of heart rate and energy consumption at drive-counter drive practice

The maximum heart rate of male athletes at drive-counter drive practice is 152.6±11.9bpm and average heart rate is 130.1±8.2bpm, energy consumption

is 86.5±20.6kcal, specific energy consumption is 1.38±0.24kcal per kilogram. The maximum heart rate of female athletes is 141.2±14.4bpm and average heart rate is 124.5±11.9bpm, energy consumption is 72.1±13.0kcal, specific energy consumption is 0.54±0.11kcal per kilogram.

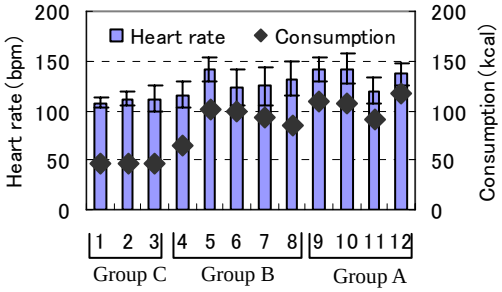


Fig.3 Male:Heart rate and energy consumption at drive-counter drive practice.

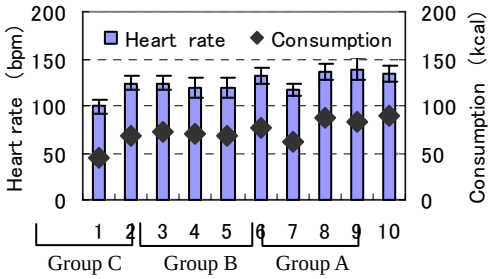


Fig. 4 Female: Heart rate and energy consumption at drive-counter drive striking practice.

5-3 Change of heart rate and energy consumption at forehand and back hand alternate practice

The maximum heart rate of male athletes at forehand and back hand alternate practice is 145.9±14.9bpm and average heart rate is 126.8±12.5bpm, energy consumption is 83.3±30.2kcal, specific energy consumption is 1.35±0.29kcal per kilogram.

The maximum heart rate of female athletes is 136.7±12.2bpm and average heart rate is 122.4±11.6bpm, energy consumption is 70.2±11.6kcal, specific energy consumption is 1.29±0.22kcal per kilogram.

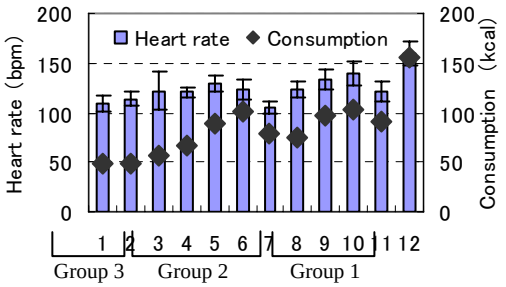


Fig. 5 Male: Heart rate and energy consumption at forehand and backhand alternate practice.

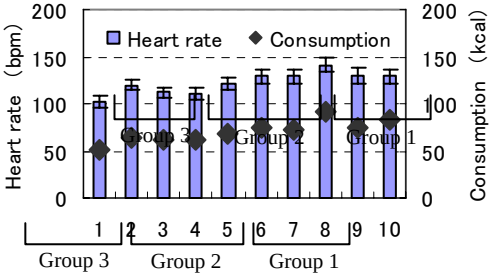


Fig. 6 Female: Heart rate and energy consumption at forehand and back hand alternate practice.

5-4 Change of heart rate and energy consumption at loop drive-smash and footwork practice

The maximum heart rate of male athletes while practicing is 167.1±14.0bpm and average heart rate is 143.8±14.3bpm, energy consumption is 105.2±31.8kcal specific energy consumption is 1.73±0.31kcal per kilogram.

The maximum heart rate of female athletes is 159.1±14.9bpm and average heart rate is 134.4±16.1bpm, energy consumption is 83.0±21.0kcal, specific energy consumption is 1.52±0.36kcal per kilogram.

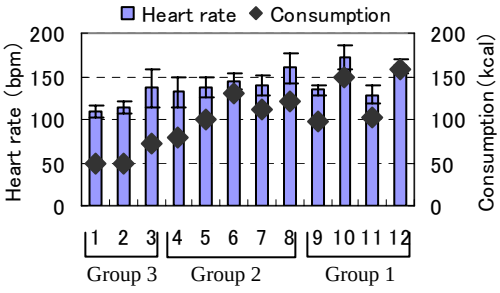


Fig. 7Male: Heart rate and energy consumption at loop drive-smash and footwork practice.

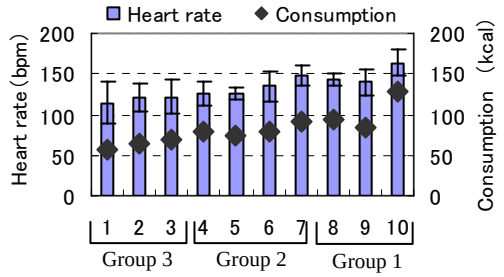


Fig. 8Female: Heart rate and energy consumption at loop drive-smash and footwork practice.

5-5 Change of heart rate and energy consumption at block practice

The maximum heart rate of male athletes at block practice. is 133.1±14.1 bpm and average heart rate is 114.5±9.0 bpm and energy consumption is 35.3±10.4 kcal, specific energy consumption is 1.14±0.17 kcal per kilogram.

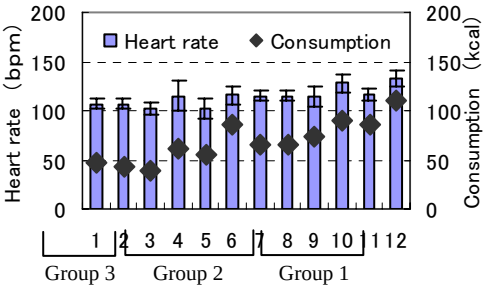


Fig. 9Male: Heart rate and energy consumption at block practice.

6.Review

As far as the prevention of recently prevalent illness caused by ill life style (metabolic syndrome) is concerned, table tennis is considered as one of the best medicine. Thus, it has become important to perform quantitative analysis of the energy consumption as a result of playing it.

“Q&A system Table Tennis sports science handbook” which has been published by the sports science committee of Japanese Table Tennis Association asserts that “table tennis is one of the typical aerobic sports which consume oxygen in the atmosphere and produce energy are all classified as “aerobic” exercises. In aerobic exercises the fat combustion is efficiently performed. Table tennis is considered as a “lifetime sport” of ideal.with it has done[3)].

There is a significant difference between the RMR disclosed to the public and the energy consumption with table tennis calculated in this paper. Energy consumption per body weight per unit time shows a range of exercise intensity: 0.050 ~ 0.083 kcal/kg/min. For example, a person with weight 70 kg who conducts medium intensity practice for an hour is estimated to consume a total energy 70 (kg) × 0.065 (kcal / kg / min) × 60 (minutes)=273kcal.

However, our results show that professional table tennis players in this experiment have consumed nearly twice more energy during their 60-minute exercise.

Some of the causes of discrepancy are the age, weight, height, sex, and history of athletic activities.

After all, what is the best index of exercise intensity?

7. Conclusion

Table tennis has been played at all levels, from the recreational level up to the professional level.

Therefore, this study examined the heart rate and energy consumption of high level professional Chinese table tennis players in training sessions. The results are as follows.

7-1. Depending on the type of exercise, energy consumption varies.

7-2. Competitive athletes at high levels tend to consume more energy in the Professional Table Tennis Player.

7-3. In the women's and men's differences competitive level energy consumption is not the same as the performance difference.

In order to enhance their strength and improve the skill levels, I think it is necessary regulate the content and practice exercises to enhance the density

8. References

1) Nishida Masahiro: "Table Tennis", pp10-11, 1985.

2) Yoshida Kazuto: "Why not change the concept art of table tennis step up?" Shizuoka Newspapers 2004

3) Japan Table Tennis Association, Sports Science Committee: Q & A format, the Handbook Table Tennis Sports Science pp.28-29, 1993.

4) "Examination of the effect of exercise on cerebral blood flow Table Tennis", was the 1996 American College of Sports Medicine Clinical Journal of the

Japan release, 1996.

5) Takushima Akira: I study the physical load on heart rate during exercise of the couple, table tennis competitions, Yatsushiro College Bulletin, No. 26, 2004.

6) Abe Kazuhiro :Competitive table tennis on the respiratory function of the circulatory system.

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A Historical Study on the Doubles Games in Table Tennis as Introduced by Dr. Yasumasa Nagayama in the Early 1930s : His Contributions and the First Step towards the Internationalization of Table Tennis in Japan

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Abstract:

The late Dr. Yasumasa Nagayama (1893-1986) was a famous psychiatrist. After World War II, he contributed to theoretical studies regarding local medical care and practice in the Osaka area. Prior to this from 1929 to 1930, he had been to Germany to conduct a rigorous study on the medical services available there. Later on the 4th World Table Tennis Championships were held in Berlin in 1930. On this occasion, Dr. Nagayama contributed valuable insight into European table tennis. He observed the knowledge and expertise that were displayed at the European table tennis competition, including the practice of the doubles games and its conformance to the international rules that prevailed at the time. Dr. Nagayama was introduced as the Japanese media's table tennis correspondent. He observed the conditions of table tennis in Europe (Germany and Switzerland) and he reported them in detail. After his return to Japan, Dr. Nagayama became Medical Director of Osaka Prefectural Empress Hospital (psychiatry, community medicine). In addition, he contributed to table tennis technical periodicals to enlighten readers about the doubles games competition method and its proliferation in table tennis. He offered guidance and advice at various classes and seminars on the doubles games competition method. In 1932, Dr. Nagayama was invited to a national doubles competition which was sponsored by the Japan Table Tennis Company. Subsequently, the competition was known by the title of Dr. Nagayama Cup of Table Tennis Doubles games. Records show that it was announced in a class held in May 1932 that it was Dr. Nagayama who had introduced the international style of the doubles games competition method. Dr. Nagayama undoubtedly had made a great contribution to the table tennis doubles games in Japan before World War II. These facts were largely unknown until now. The international competition method of the doubles games has made a stronghold in Japan today, and this is due to the introduction by Dr. Nagayama. It is essential to engrave this fact in the history of Japanese table tennis.

Keywords: table tennis, sport history, doubles games , international rules

Preface

The purpose of this study is to clarify the introduction of the doubles games in table tennis by Dr. Yasumasa Nagayama in the early 1930s, referencing his contributions and the first steps towards the internationalization of table tennis in Japan. According to historical materials, Dr. Nagayama contributed valuable insight into European table tennis competitions and introduced the international style of the doubles games competition method into Japan. We clarified the historical process and facts in the following order: 1. Table tennis competitions in Japan during the 1920s; 2. Rule changes that accompanied the competitive style of table tennis during the late 1920s in Japan; and 3. Dr. Yasumasa Nagayama introduces the doubles games in table tennis based on the international style of play in the early 1930s.

1. Table tennis competitions in Japan during the 1920s

Previously in Japan, there were many organizations formed as volunteer efforts that presided over table tennis competitions; the Japan Table Tennis Association in Prewar (*dai-nippon takkyu kyoukai*) was one of these early table tennis associations that subsequently became the umbrella organization for all others. Fittingly, there were many table tennis championship games at the national level during this period of time in the 1920s. Hence, on 2 October 1921 in Japan, the general rules titled "the All Japan Table Tennis Association Table Tennis Rules(*dai Nippon takkyu kyokai kyougi kisoku*)" were established. The rules consisted of 34 articles. Mr Kido Hisao, the so-called pioneer of table tennis competitions in Japan, made remarks in the periodical titled Journal of Table Tennis (*takkyu*) published by the Japan Table Tennis Company (*Nippon Takkyu Sha*), during the period of time in which the Japanese rules for table tennis competitions were being established. Mr Hisao Kido, who was the chairperson, compared the Japanese to the foreign table tennis competitions, which deserved consideration.

Japanese table tennis rules (*dai-nippon takkyu kyoukai seitei kisoku*) are the most progressive in the world. The Japanese should be confident in this fact. Last summer, we ordered an English table tennis rulebook from a bookstore located in London. The rulebook was in the form of a small pamphlet, which indicated that there were currently no set of unified rules in England, and two or three sentences were generally provided for the existing rules. Further, a rule of lawn tennis seems to have been applied to an actual match(May, 1926). The rules for the United States, France, Portugal and China did not provide detailed descriptions.

Accordingly, it is believed that Japanese table tennis competitions are more advanced than those of European, American and other Asian countries. The total membership for the table tennis clubs in Japan under the supervision of the umbrella organization, the Japan Table Tennis Association, was no less than 500,000 during the 1920s. This numerical value might be considered an exaggeration. However, in 1926, Japanese table tennis competitions were included among the events of nationwide athletic tournaments. Therefore, table tennis competitions advanced in the latter 1920s in Japan.

During the 1920s, table tennis competitions developed into a domestic game in Japan. In fact, this is where its style of play was devised. Originally, the method of competition was firmly established in the European countries. This originally foreign culture was then refined by the Japanese. However, these developments to the game by the Japanese are not always well received by foreign audiences.

The table tennis style of play applied in championship tournaments during this period was popularized among the masses. Players polished their skills by participating in competitions. They invented creative table tennis plays and each table tennis club played a role in supporting such competitions. In addition, the role of the umbrella organization was important because it not only allowed player participation but the means for the latter to hone their skills through these competitions.

2. Rule changes that accompanied the competitive style of table tennis during the late 1920s in Japan

Public articles attacking any element of either the service or the return of a tennis table play in accordance with the rules established early on in Japan were prohibited.

(1) You must not deliver a strong service.
(2) You must not deliver an underhanded spin serve.
(3) You must deliver the service along the centre line.
(4) You must deliver the service from within the area reserved for the service stroke.
(5) You must not deliver a strong return.
(6) You must not deliver an underhanded spin return.

These rules seemed to be commonplace in the early days. However, with time, the contents of these rules have been revised to allow such plays as tosses that exceed 16 cm and made with an open palm of the non-racket hand, and the newly permissible body hide while delivering a service. The Japanese have pushed the limits of the technical allowances provided in the rules and cultivated the technique of table tennis by continuously revising the rules. This brief outline depicts the flow of table tennis from the past to the present.

Although some changes were made to the Japanese rules of competition in table tennis from 1920 to 1934, none were significant. However, a rule change circulated among the European international federation for the game and provoked prominent changes. In 1926, from December 6 to 12, the First World Table Tennis Championships were held in London, the International Table Tennis Federation was founded, and international rules were established rules that were to become common between each European country.

3. That Dr. Yasumasa Nagayama had been introduced the doubles games in table tennis based on the international style of play in the early 1930s

An invitation, dated 8 September 1927, to participate in the world championships was dispatched by the International Table Tennis Federation to Mr Hisao Kido, who presided over Japanese table tennis at that time. Mr Hisao Kido had voluntarily been leading the efforts of the Japan Ping-Pong Cooperation (*Nippon Pin-Pong Sha*), a company dedicated to communicating information about table tennis. However, rules were already in force in Japan. Moreover, there was concern that confusion would arise by introducing the international rules established for the world championship style of playing table tennis.

The late Dr. Yasumasa Nagayama (1893-1986) was a famous psychiatrist. On 4 April 1929, Dr. Nagayama went to Germany to pursue his studies in psychiatry. During this time, he reported in detail the state of table tennis competitions in European countries such as Germany and Switzerland. Most importantly, in this information he suggests the introduction of this international, competitive style of table tennis into the Japanese doubles games. Dr. Nagayama introduced the match enforcement method of the doubles games into Japan through the European table tennis competitions that he reported on in World Ping Pong, the periodical for table tennis written in Japanese. The Fourth World Table Tennis Championships were held in Berlin in 1930, from January 22 to 27. On this occasion, Dr. Nagayama contributed valuable insight into European table tennis competitions. He observed the knowledge and expertise displayed at the European table tennis competition, including the practice sessions for the doubles games and its conformance to the prevailing international rules.

However, Dr. Nagayama returned home on 19 December 1930 and began his efforts to promote table tennis around 1931, along with the propagandists of the international rules for table tennis in doubles games. Dr. Nagayama conducted classes and lectures to introduce the international, competition method (including its rules) of the doubles games around the Osaka area; it is certain that his efforts considerably advanced the level of competition for doubles games in this area. Despite this, there is not one reference to Dr. Nagayama's contributions to the study of sports history, namely the history of Japanese table tennis. Dr. Nagayama has instead been introduced as the Japanese media's table tennis correspondent who observed the conditions of table tennis in Europe (Germany and Switzerland) an Dr. Nagayama reported on them in detail. Table.1 (The Chronological Table) points out that some of Dr Nagayama's reports and suggestions had preceded the internationalization of table tennis by the Japan Table Tennis Association in Prewar (Nippon Takkyu Kai).

The international rules for table tennis were introduced into Japan around October 1934, about eight years after the foundation of the International Table

Table.1 A Chronological Table of the Issues surrounding the Doubles Games in Table Tennis based on the International Rules reported and suggested by Dr Yasumasa Nagayama during the Early 1930s

1) February 1930
Anonym (1930), A Correspondent: Dr Nagayama Yasumasa participates in the Open Gamess at the World Championship in Berlin, Germany, from 22–27 January 1930. (World of Pingpong―Table Tennis, February 1930)

2) February 1931
Dr Nagayama Yasumasa (1931): A Report on the Situation of Table Tennis in European Countries (1). (World of Pingpong―Table Tennis, February 1931)

3) February 1931
Dr Nagayama Yasumasa (1931): The Seasons and Positions in Table Tennis in European Countries. (World of Pingpong―Table Tennis, February 1931)

4) March 1931
Dr Nagayama Yasumasa (1931): Introduction of the Table Tennis Doubles Games Championships in European Countries. (World of Pingpong―Table Tennis, March 1931)

5) March 1931
Dr Nagayama Yasumasa (1931): The First Table Tennis Doubles Games Championship in Japan (organized by Japan Ping Pong SHA). (World of Pingpong―Table Tennis, March 1931)

6) March 1931.
Dr Nagayama Yasumasa (1931): A Report on the Situation of Table Tennis in European Countries (2). (World of Pingpong―Table Tennis, March 1931)

7) April 1931
Dr Nagayama Yasumasa (1931): A Report on the Situation of Table Tennis in European Countries (3). (World of Pingpong―Table Tennis, April 1931)

8) April 1931
The Japan Table Tennis Association in Prewar (Dai-nippon Takkyu Kyoukai) (1931): The Rules for the Doubles Games in Table Tennis were instituted on 10 March 1931. (World of Pingpong―Table Tennis, April 1931)

9) April 1931
Dr Nagayama Yasumasa (1931): The Racket in Table Tennis and Bylaws of the Muenchen Table Tennis Club. (World of Pingpong―Table Tennis, April 1931)

10) August 1931
Dr Nagayama Yasumasa (1931): The Service in Table Tennis in European Countries. (World of Pingpong―Table Tennis, August 1931)

11) August 1931
Dr Nagayama Yasumasa (1931): A Report on the Situation of Table Tennis in European Countries (4). (World of Pingpong―Table Tennis, August 1931)

12) March 1932
Anonym (1932): The Doubles Games Play Styles in Table Tennis in Japan in comparison with those in European Countries. (World of Pingpong―Table Tennis, March,1932)

13) May 1932
Dr Nagayama Yasumasa (1932): A Lecture on Table Tennis and a Seminar on the Doubles Games in Table Tennis. (World of Pingpong―Table Tennis, May 1932)

14) August 1934
Dr Nagayama Yasumasa (1934): The Espoir of Constructing the New International Section of the Japan Table Tennis Association in Prewar (Nippon Takkyu Kai). (World of Pingpong―Table Tennis, August 1934)

15) October 1934
The International Rules for Table Tennis were introduced in Japan in around October 1934.
(Kido, Hisao. (1934): Revision of the Table Tennis Rules in Japan; the International Rules were added to the Japanese Style Rules in December 1934, Bulletin of Table Tennis of the Japan Table Tennis Association in Prewar (Nippon Takkyu Kai hou), December 1934)

16) December 1934
Japan Table Tennis Association in Prewar: the Authorized Rules in Japan are the same as the Japanese Style Rules in Chapter 1. The International Rules follow in Chapter 2. (December 1934)

Tennis Federation. Mr Hisao Kido publicly reported the introduction of the international rules in the periodical titled the Bulletin of Table Tennis of the Japan Ping-Pong Cooperation (*Nippon Pin-Pong Sha*) as Follows:

"Nowadays, the atmosphere surrounding table tennis in Japan is catching on worldwide. Therefore, the table tennis competitions controlled by a Japanese umbrella organization have adopted international rules. However, the Japanese style rules remain. The authorized rules in Japan remain as the Japanese style rules in Chapter 1 and the international rules follow in Chapter 2. (December, 1934)"

International style competition is considered to have begun in the latter half of the 1930s as a result of the introduction of the international style rules. Nowadays, these rules are applied to competitions throughout Japan. Table tennis competitions have grown rapidly since the adoption of the international style rules. In 1936, the first All Japan Championship based on the international rules was held. Table tennis competitions based on international rules (including doubles games) are finally the mainstream in Japan in comparison with those based on Japanese style rules that continue frugally. The Federation of Table Tennis for Collegiate Students (*Nippon Gakusei Takkyu Renmei*) converted to the international rules in 1935. It is believed that in the early days of this collegial federation, a faulty article on the prohibition on rubber-balls in table tennis was discovered in their regulations. Further, it was not until after 1936 and the adoption of the international style rules (including doubles games) that the element of technique was truly cultivated.

Dr. Nagayama became the Medical Director (psychiatry, community medicine) of Osaka Prefecture Empress Hospital upon his return to Japan. In addition, he contributed to the technical periodicals on table tennis to enlighten readers about the doubles games competition method and its proliferation in table tennis. He offered guidance and advice through numerous classes and seminars on the doubles games competition method. In 1932, Dr. Nagayama was invited to a national doubles competition, which was sponsored by the Japan Table Tennis Company (*Nipppon Takkyu Sha*). Subsequently, this competition, dated 21 March 1931, was known as the Dr. Nagayama Cup of Table Tennis Doubles games. Records from 3 April 1932 indicate that this was announced in a class lectured by Dr. Nagayama, who had introduced the international style of the doubles games into Japan. Dr. Nagayama, undoubtedly, made a great contribution to the doubles games in table tennis in Japan during the 1930s.

Conclusion

The Japan Table Tennis Association (formerly the *Nippon Takkyuu Kai*, founded in 1931) was the first unified organization for table tennis competitions in Japan, which adopted international rules in 1934. This association promoted the international style of table tennis competition by organizing the All Japan

Championship table tennis competition in 1936. Prior to this, from 1929 to the early 1930s, Dr. Nagayama introduced the match enforcement method of the doubles games into Japan through his written contributions on European table tennis competitions in World Ping Pong, the periodical on table tennis written in Japanese. Dr. Nagayama has, undoubtedly, made a great contribution to the doubles games in table tennis in Japan during the 1930s. Subsequently, in 1934, the Japan Table Tennis Association introduced international rules. This is due to the contributions of Dr. Nagayama. It is essential to engrave this fact in the history of Japanese table tennis. The preliminary efforts were accomplished by Dr. Nagayama. In the early period that followed the introduction of the international rules, personal contributions were important since the relevant organizations were chaotic. It is concluded that Dr. Nagayama's contribution was the first step to the internationalism for table tennis play in Japan. Thus, when the doubles games for table tennis competitions were first introduced in Japan, it was a medical doctor who pioneered the internationalization of the sport, including doubles games in table tennis, as reported and suggested by Dr Yasumasa Nagayama.

Acknowledgement

I would like to thank for Professor Emeritus Yasuhisa Nagayama, Osaka University, who is the 3rd son of the late Dr. Yasumasa Nagayama, for profitable suggestion to this study.

References

[1] The Japan Table Tennis Association in Prewar (dai-nippon takkyu kyoukai) (1920) the general rules entitled the All Japan Table Tennis Association Table Tennis Rules (1921) on 2 October 1921.

[2] The Japan Table Tennis Association in Prewar (dai-nippon takkyu kyoukai) (1926) The Positions of International Rules for Table Tennis, Table Tennis,May 1926.

[3] Kido, Hisao. (1928) Correspondence to International Table Tennis Federation, Bulletin of Table Tennis of the Japan Ping-Pong Cooperation (nippon pin-pong sha), January 1928.

[4] Anonym (1930) The Correspondent: Dr. Nagayama will participate in the Open Games of World Championship held at Berlin, Germany, 22-27 January, 1930, World of Pingpong—Table Tennis, February 1930.

[5] Dr. Nagayama Yasumasa(1931), The Report for Situation of Table Tennis Games in European Countries(1), World of Pingpong—Table Tennis, February 1931.

[6] Dr. Nagayama Yasumasa(1931), Table Tennis Seasons and Positions for Table Tennis in European Countries, World of Pingpong — Table Tennis, February 1931.

[7] Dr. Nagayama Yasumasa(1931), The Introduction for the Table Tennis Doubles games Championships in European Countries, World of Pingpong—Table Tennis, March 1931.

[8] Dr. Nagayama Yasumasa(1931), The First Table Tennis Doubles games Championships in Japan, World of Pingpong—Table Tennis, March 1931.

[9] Dr. Nagayama Yasumasa(1931), The Report for Situation of Table Tennis Games in European Countries(2), World of Pingpong—Table Tennis, March 1931.

[10] Dr. Nagayama Yasumasa(1931), The Report for Situation of Table Tennis Games in European Countries(3), World of Pingpong—Table Tennis, April 1931.

[11] The Japan Table Tennis Association in Prewar (dai-nippon takkyu kyoukai) (1931) The Rules for Table Tennis Doubles games on March 10, 1931, World of Pingpong—Table Tennis, April 1931.

[12] Dr. Nagayama Yasumasa(1931), The Report for Situation of Table Tennis Games in European Countries(3), World of Pingpong—Table Tennis, April 1931.

[13] Dr. Nagayama Yasumasa(1931), The Racket for Table Tennis and Bylaw of Muenchen Table Tennis Club, World of Pingpong—Table Tennis, April 1931.

[14] Dr. Nagayama Yasumasa(1931), The Service of Table Tennis Game in European Countries, World of Pingpong—Table Tennis, August 1931.

[15] Dr. Nagayama Yasumasa(1931), The Report for Situation of Table Tennis Games in European Countries(4), World of Pingpong—Table Tennis, August 1931.

[16] Anonym(1932), The Play Styles for Table Tennis Doubles games in Japan, in comparison with European Countries, World of Pingpong—Table Tennis, March 1932.

[17] Dr. Nagayama Yasumasa(1932), The Lecture for Table tennis and the Seminar for Table Tennis Doubles games, World of Pingpong—Table Tennis, May 1932.

[18] Dr. Nagayama Yasumasa(1934), The Espoir of New Construction of International section of the Japan Table Tennis Association in Prewar (dai-nippon takkyu kyoukai), World of Pingpong—Table Tennis, August 1934.

[19] Kido, H. (1934) The Revision of Table Tennis Rules in Japan: The Authorized Rules in Japan remain as the Japanese Style Rules in Chaper 1 and the International Rules follow in Chapter 2., Bulletin of Table Tennis of the Japan Table Tennis Association (nippon takkyu kai hou), December 1934.

[20] The project group for the collected literary works for the late Dr. Nagayama Yasumasa (1994), The collected literary works for the late Dr. Nagayama Yasumasa(nagayama yasumasa sensei chosakushu), Tokyo: Hitotsubasi Insatsu Co.Ltd

High-Speed Video Image Analysis of Air Flow around a Table Tennis Ball

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ABSTRACT

We tried to visualize the air flow around a flying table tennis ball and analyze the flow velocity field and vortex shedding using PIV. The images of the air flow were visualized by oil mist and a laser light sheet with a metal halide light and recoded by a CMOS type of high speed video camera at a rate of 1,000 to 10,000 fps. Our objective is to discuss from the viewpoint of fluid mechanics if a knuckle ball trajectory flickers with a zigzag motion of inward and outward curves, or not. The final goal of this study is to present scientific information about knuckle ball trajectory to table tennis players and coaches who are struggling to develop new tactics and skills.

Keywords: Visualization, Ball trajectory, Knuckle ball, Air flow, Vortex shedding

1. INTORDUCTION

The highest speed of the table tennis ball hit by the world-top player is around 40m/s (144Km/h). The highest spinning speed is around 150rps, and then the peripheral speed reaches around 19m/s. Very high spinning speed ball changes the curvature of the ball trajectory largely and causes a big change in the directions just before and after the bouncing on a table. Such changes in the trajectory makes many table tennis players feel difficult to return the spin ball.

The highest Reynolds number (Re= $Re=vd/\nu$: ball speed v =40m/s, ball diameter d=0/04m, kinetic viscosity of air $\nu=1.5\times10^{-05}m^2/s$) is estimated around 1.0×10^5, and then the air flow behind a flying ball is turbulent even in still air.

The completely no-rotating ball and/or very low spinning speed ball at a low flying speed is called “knuckle ball”. A part of players say that the trajectory of knuckle ball flickers with a zigzag motion of inward and outward curves, but other part say that it does not flicker. Here “flicker” means that the trajectory depicts first a curve to right (left) and then another curve to left (right) and moreover to right (left) repeatedly. Here we distinguish “flicker” from “ripple” due to the non-symmetry of ball shape like an elliptic ball. A part of players feel difficult to hit the flickering ball due to the unexpected change in trajectory and speed. Therefore some players use knuckle ball for the tactics in their match. To the contrary the other players do not feel difficult to hit knuckle ball because it flies at low speed without such unexpected changes. The two opinions are quite opposite.

In other sports, such as foot ball, volley ball and base ball, the flickering motion of knuckle ball can be observed [1,2,3]. The Reynolds number for foot ball and volley ball reaches a critical value of around $(3.8\sim4.0)\times10^5$, which is much higher than that for table tennis ball, and makes “flicker”. The issue of “flicker” is very interesting for researchers in the fields of fluid mechanics and sports science.

We have never found any papers which present visualized images of air flow and the velocity fields around a flying table tennis ball. In this study we try to visualize the air flow around a knuckle ball and analyze the velocity field. The objective of this paper is to discuss the trajectories of a knuckle ball focusing on “flicker” with the image analysis.

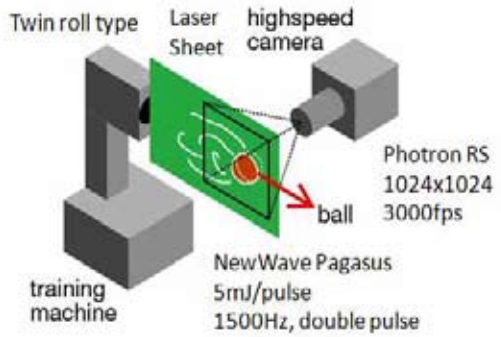

Fig.1 Experimental setup for visualizing air flow around a table tennis ball

2. EXPERIMENTAL METHOD

Fig.1 shows our experimental setup for visualizing air flow around a table tennis ball. Knuckle balls were supplied from a twin roll type of robot machine, which can control accurately both the flying speed and spinning speed with a remote controller. The camera window is fixed at the locations just before and after the ball bouncing on the table. The window size was 500mm in width.

The flying speed of the ball was around 16m/s (57Km/h), and then the Reynolds number was Re=0.43

$\times 10^5$. We put oil mist with the size of around 10μm in the air for the visualization. A laser light sheet of 2mm thickness (Yag, 200 to 300mW, green; or New Wave Pegasus, 5mJ/pulse, 1,500Hz, Double pulse) with/without two metal halide lights (250W, white) was used for the illumination. We employed a CMOS type of color high speed video camera (Photron SA1.1; or RA). The frame rate was 2,000 to 10,000fps, and the number of the pixels was 1024×1024. We took 10,000 frames of images consecutively for a trial of the test and transferred the images to a PC. We replayed the images on the PC and then necessary images were saved in a hard disc.

We could successfully capture clear images of the air flows and ball trajectories, and then applied the particle image velocimetry (PIV) to analyze the velocity fields of air flow around a flying ball with time interval of 1/000s. Our PIV algorithm was based on the brightness distribution cross-correlation technique between two consecutive images.

3. EXPERIMENTAL RESULT and DISCUSSION

Fig.2 shows a velocity map, although any post-processing procedures are not applied for removing erroneous vectors. We can recognize vortex shedding from the surface of the ball into the wake flow. This is a useful data to analyze the flow field by a computational fluid dynamics (CFD). Although we analyzed the frequency characteristics of the vortex shedding using a time-serial velocity maps, we have not obtained any sufficient results about it yet.

Fig.3 is constructed by overlapping a time-series images of a flying ball just before and after the ball bouncing on a table. We can see non-rotation of the knuckle ball before the bouncing change to top spin after the bouncing. The trajectory is very smooth and we cannot recognize any flicker from such a horizontal view. Fig.4 shows spin change from the back spin to the knuckle at the bouncing. Also the trajectory is smooth without flicker. It can be seen from Fig.5 that the longer trajectory is also a smooth parabolic curve.

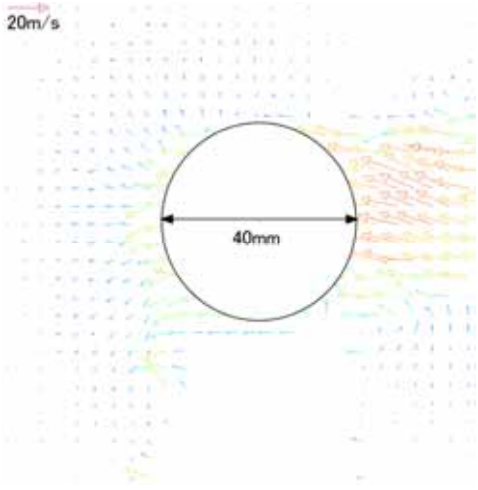

Fig.2 An example of velocity vector map of air flow around a table tennis ball.

Fig. 3 Overlapped ball images show a spin change from knuckle to top spin at bouncing on the table. The ball flies from right to left.

Fig.4 Spin change from back spin to knuckle

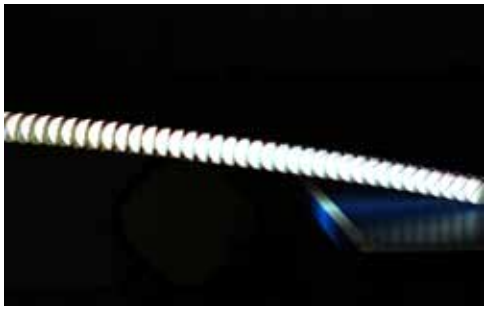

Fig. 5 Overlapped ball images show a parabolic trajectory

4. CONCLUSION

We could successfully visualize the air flow around a flying ball and could obtain the velocity field with vortex shedding using a PIV technique. As a result, we could discuss the changes in trajectory of a knuckle ball. We did not recognize any flicker at the present stage. In our future work, we will compute both values of friction coefficient and bouncing coefficient from such changes in velocities and angles at bouncing, and capture the images of ball trajectory from the vertical view to discuss the motion of “flicker”.

REFERENCES

[1] Asai, T. and Seo, K., “Secret of free kick in Soccor”, Lecture material for a citizen forum by JSME, Yokohama, Aug. 2008.
[2] Mizota, T. “Fluid mechanics of magic ball”, Science journal KAGAKU, Vol.74, No.6, pp.740-746, 2004.
[3] Wei,Q-D., Lin R-S., Liu, Z-J., “Vortex-induced dynamics on a non-spinning volleyball”, Fluid Dynamic Research, 1988.

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Differences between EMGs of Forearm Skeletal Muscles for Flick Strokes against Backspin and No-spin Services in Table Tennis

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Abstract: We have conducted an experimental study to clarify the differences between the EMGs for the forearm skeletal muscles when receiving backspin and no-spin services with a forehand flick stroke. An elite Japanese table tennis player participated as a subject in this study. A Chinese coach, acting as a server, sent a service ball and the subject returned it with a forehand flick stroke. The service ball speed was approximately 4 m/s. The receiver was informed whether the service ball had spin or not. A significant difference ($p<0.05$) between the two kinds of services was shown for the electrical discharge amount of M. extensor carpi ulnarise (Backspin: 122.06±42.10 and No-spin: 87.12±36.39microV). There were no significant differences for other muscles. It is assumed that the electrical discharge of M. extensor carpi ulnarise of the subject for 15ms just before the impact is concerned with controlling the racket surface.

Keywords: table tennis, forehand flick stroke, EMG, forearm skeletal muscle, racket control

1.Purpose

There are several techniques in table tennis for returning balls that land near the net. These techniques are considered extremely important, and closely related to competition results.

The flick stroke is an aggressive topspin return of a ball that lands near the net. The ball is flicked lightly using the wrist and a little elbow action immediately after it bounces on the receiver's court (Figure 1).

In spite of the flick stroke's importance, there have been few studies on it (Yoshida et al., 1997, 1999; Kasai et al., 1999). Therefore, the mechanism of the stroke is not well understood.

The purpose of this study was to clarify the EMGs for the forearm skeletal muscles when receiving backspin and no-spin services with a forehand flick stroke. The present report is the sequel to our previous report (Yoshida et al., 2004).

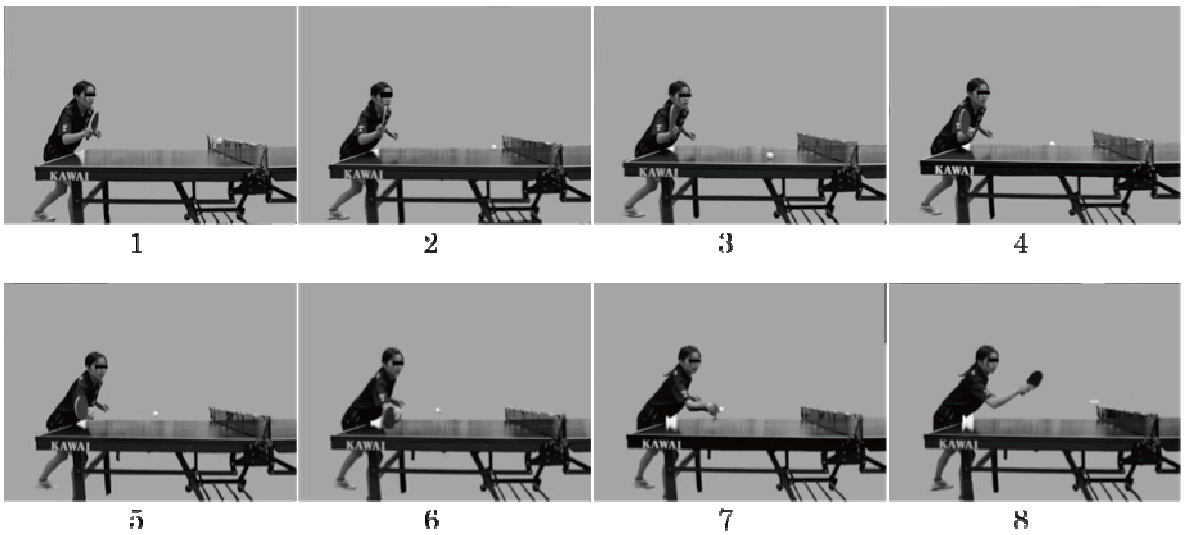

Figure 1. An example of a forehand flick stroke

These pictures show the forehand flick stroke every 0.05 s. The instant of ball contact was around 7.

2.Methods

2.1 Subject

An elite table tennis player participated as a subject in the present study. He was a finalist in the All American Open U-22 (1999) and a member of the Japanese national team of the 2001 Universiade. Table 1 shows the characteristics of the subject. We obtained his agreement to attend the experiment after explaining its purpose and safety aspects.

2.2 Experimental Procedure

A Chinese coach acting as a server sent a service ball and the subject returned it with a forehand flick stroke. The service balls were controlled to land in a circle of 20cm radius on the right half court of the receiver. The center of this circle was 50cm from the end line and 40cm from the sideline. The service ball speed was approximately 4m/s. The receiver was required to return the ball into a 25cm radius circle on the right half court of the server. The center of this circle was 95 cm from the net and 30 cm from the sideline. Two cases, backspin (B) and no-spin (N), were examined. There was little variability in service ball speed and spin. The receiver was informed whether or not the service ball would have spin before the server served. The tests were repeated for each case until the receiver succeeded in returning the ball precisely more than 5 times as required. In practice, about 10 trials were necessary for each case.

2.3 Measurement Items

Measurements of muscular activities were made for the following muscles: extensor carpi ulnaris, extensor digitorum communis, extensor carpi radialis lognus and brevis, flexor carpi radialis, and pronator teres. Muscular electrical discharge was measured by a surface dipole dielectric method. After treatment to reduce skin resistance, miniature bio-electrodes 12mm in diameter (NT-611U: Nihonkoden, Tokyo, Japan) were set at 20mm centers along the line of muscles following the Zipp method (1982). The angles of the elbow joint and wrist joint were measured by goniometers (M110, M180: Penny and Giles, Gwent, UK). The angle of the elbow joint showed flexion and extension, and the angles of the wrist joint showed flexion and extension, abduction and adduction. Acceleration sensors (AS-100HA: Kyowa Electronic Instruments, Tokyo, Japan) were installed on the table and racket to record the moment of bouncing. Using a data analyzing system (MP100WS: Biopac Systems, California, USA) and PC (iMac: Apple Computer, California, USA), all the analog signals were sampled at a sampling frequency of 1kHz and converted to digital data for further processing. Furthermore, the motion of the subject in the test was recorded by a digital video camera (DCR-TRV10: Sony, Tokyo, Japan). EMG electrodes and the goniometers set on the racket arm are shown in Figure 2.

2.4 Data Analysis and Statistical Work

The integration value was derived from the electrical discharge at each of the subject's muscles by a waveform recorded 30ms and 15ms before ball impact. The derived value was conducted (t test of Student) for the difference of the corresponding average. The

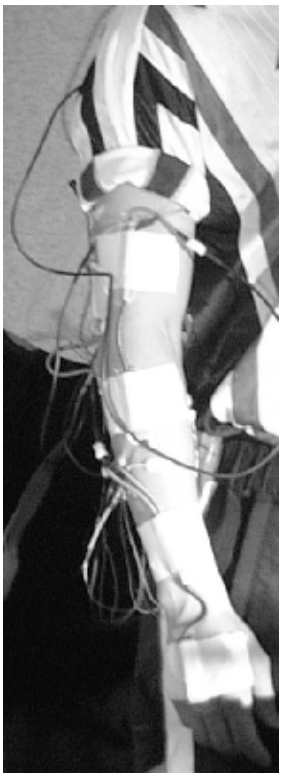

Figure 2. Setting EMG and goniometers

Table 1. Characteristics of the subject

Age	Racket Arm	Grip	Rubber	Number of competitive years
22	right	shakehand	reversed pimpled	14

significant level was $p<0.05$.

3. Results

Figure 3 shows the electrical discharge amount for each muscle for 30ms just before impact. The electrical discharge amounts for B and N were B: 254.88±62.71 and N: 226.60±76.95microV (M. extensor carpi ulnarise), 75.88±16.65 and 62.40±21.65microV (M. extensor digitorum communis), 88.46±17.23 and 76.13±19.80microV (M.extensor carpi radialis lognus and brevis), 111.99±49.15 and 74.06±42.19microV (M. flexor carpi radialis), 130.89±19.34 and 106.10±41.18microV (M.pronator teres), respectively. It was observed that the electrical discharge amounts for B for M. flexor carpi radialis was greater ($p=0.053$). However, there was no significant difference for any of the muscles.

Figure 4 shows the electrical discharge amount for each muscle for 15ms just before impact for both services. A significant difference ($p<0.05$) was shown

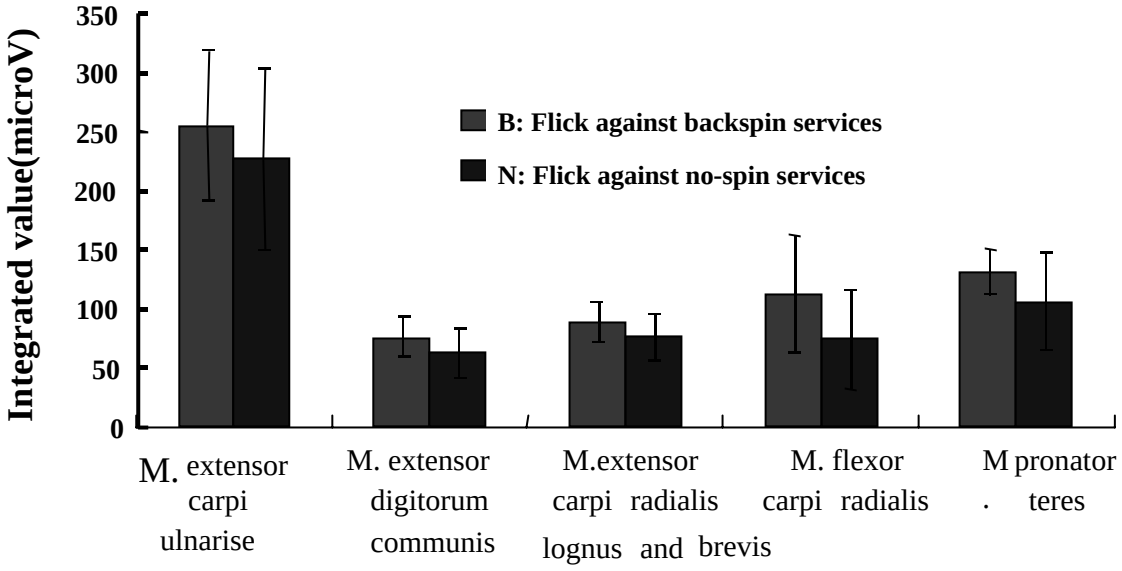

Figure 3. Integrated values for 30ms just before impact during forehand flick strokes

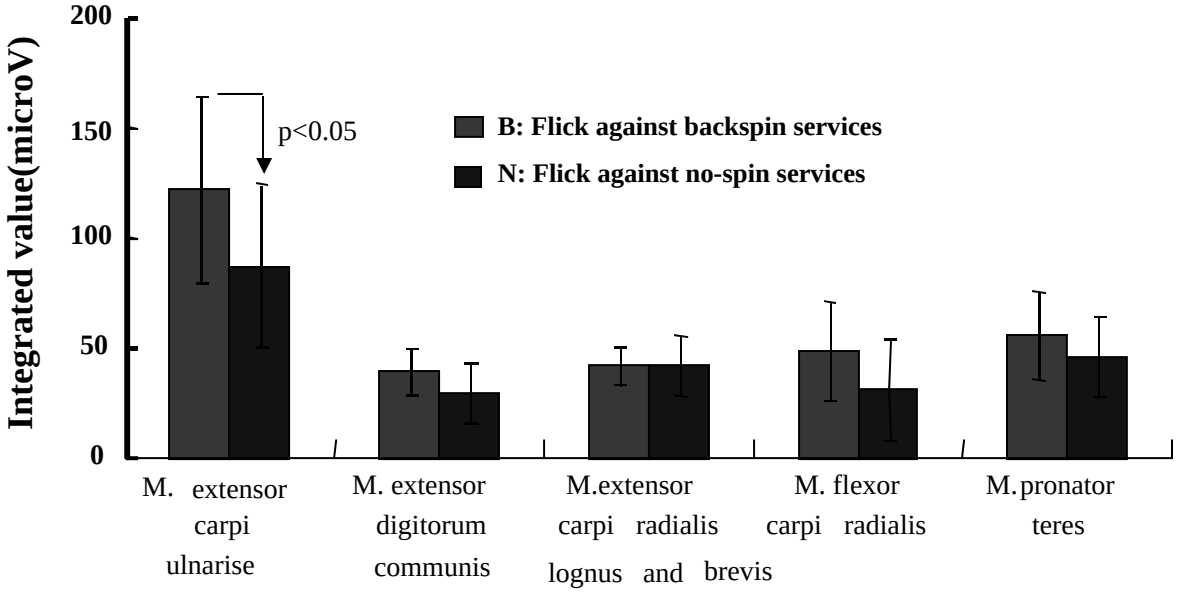

Figure 4. Integrated values for 15ms just before impact during forehand flick strokes

for the electrical discharge amount of M. extensor carpi ulnarise (B: 122.06±42.10 and N: 87.12±36.39microV). There were no significant differences for other muscles (M. extensor digitorum communis : 39.20±10.35 and 29.88±13.28microV, M.extensor carpi radialis lognus and brevis : 41.85±8.57 and 41.96±13.52microV, M. flexor carpi radialis : 48.79±22.55 and 30.98±23.37microV, M. pronator teres : 55.55±19.82 and 46.17±18.32microV).

4. Discussion and conclusion

Until now, there has been no knowledge about the relationships between EMGs for the skeletal muscles of the forearm and racket control coping with service balls with different rotations.

From the results described above, there were substantial differences in the electrical discharge amount of M. extensor carpi ulnarise for 15ms just before impact during the forehand flick stroke for the elite player for service balls with and without backspin. It was suggested that the elite player properly used the M. extensor carpi ulnarise to receive backspin and no-spin services with a forehand flick stroke.

It is said that elite table tennis players move their racket fast while controlling the racket surface just before impact to return with a forehand flick stroke. It is assumed that the electrical discharge of M. extensor carpi ulnarise of the subject for 15ms just before the impact is concerned with controlling the racket surface.

Future studies are needed to examine the characteristics of racket control when receiving against the two kinds of service spin for other elite table tennis players, classified with respect to the type of technical individual difference by movement analysis.

5. Acknowledgement

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6. References

[1] Kasai, J., IINO, Y. and KOJIMA, T. (1999) Three- dimensional analysis of a backhand flick stroke in table tennis. **Japanese Physical Fitness Society Sports Medical Sciences Annual Report NO.II Research of Developing to Athlete Ability on Events**, 22, 171-173.

[2] Yoshida, K., Murakoshi, S., Sugiyama, K., Kawai, M. and Minemura, S. (1997) Three-dimensional analysis of a forehand flick stroke in table tennis. **Biomechanics of Human Movement**, Editorial Board of the 13th Japanese Society of Biomechanics Conference, 318-323.

[3] Yoshida, K., Iimoto, Y., Hiruta, S., Ando, S., Takeuchi, T. and Yuza, N. (1999) Time analysis of In-table skills in table tennis. **Japanese Physical Fitness Society Sports Medical Sciences Annual Report NO.II Research of Developing to Athlete Ability on Events**, 22, 174-175.

[4] Yoshida, K., Murakoshi, S., Sugiyama, K., Kawai, M. and Minemura, S. (2004) The technique used to receive a rotating ball in table tennis. **Science and Racket Sports III**, 116-120.

[5] Zipp, P. (1982) Recommendations for the standardization of lead positions in surface electromyography. **Eur. J. Appl. Physiol.**, 50, 41-54.

Real-time Chart System of Table Tennis Tournaments on the Internet

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Abstract: The authors have developed a real-time tournament charts system. Owing to this system, working time and task are drastically improved and people can see the results of match immediately on the JTTA web-site. This system has been used in Japanese National Table Tennis Championships successfully since 2004. This paper describes the method and advantageous effects.

Keywords: Tournament chart, Internet, TeX

1. INTRODUCTION

In various sporting events knowing the results of the games is of importance not only to their participants but also to those who have great interests in the sports. Moreover, it can be of their vital concern to obtain the results of the games in real time.

The use of the advanced information technology syste m in sports forces us to work promptly and elaborately when entering, drawing, and calculating data. Furtherm ore, the development of computer networks which conn ect computers with each other has brought us greater op portunities to share information than ever before. Under the environment of the world wide network, the usage of computers and the quick and global deliver y of information have changed dramatically.

The users of WWW(World Wide Web) can obtain the information they want simply by clicking a mouse on a computer without recognizing where the information is stored. In other words, the demand of the Internet has increased just as it has become easy and quick to obtain any information. Though it is now popular to deliver the progress and results of the games, not all the sports are intended to apply the network technology. Only those sports for which it is considered to be potentially beneficial make use of this technology. One reason for this is that entering data requires assigning many staff, thus, increasing personnel costs.

In sporting events, many staff members and officials are involved. For example, the number of such people is a few thousand in a big event like the world table tennis championship. Some of them, for example, official scorers must be permanently stationed in order to do their job rightly. Thus, these people can directly receive the benefit from employing the computer system which we have developed in this study. Additionally, the results of the games can be delivered in real time to those who are eagerly looking forward to having the results of the games.

2. PURPOSE

The ways publishing game results differ from one sport event to another, and depend on the kind of tournaments or events of a specific sport. The purpose of this study is to evaluate the system which has been developed to draw the real-time tournament charts and to deliver them automatically based on the database for the 2004 Japanese National Table Tennis Championships. This event is hosted by the Japan Table Tennis Association and takes place once a year.

3. Japanese National Table Tennis Championships

Japanese National Table Tennis Championships is thelargest and the most prestigious tournament in Japan.. It is held for 6 days in mid January in the Tokyo Megtropolitan Gymnasium in Sendagaya, Tokyo. This tournament consists of 7 events, including “Men’s Singles,” “Womens’s Singles,” “Men’s Doubles,” “Women’s Doubles, “Mixed Doubles,” “Junior Boys” and “Junior Girls.” Managing table tennis tournaments is not an easy task due not only to the nature of this sport but also to a large number of participants playing more than 300 matches a day. When the tournament charts of 27 events are shown in a booklet, they need more than 33 pages.

Traditionally, the game charts were made by hand and therefore, that work was very laborious and time-consuming. There have been strong demand for computerization of the game charts for many years. Responding to such demands, authors’ group has been engaged in development of computer system for the purpose. Finally we succeeded in developing a real time chart system. Our computer system is quite effective in providing real-time charts and delivering them automatically.

4. METHOD

The rapid communication system for real-time information for the National Table Tennis Championships was developed at Niigata University and has been used since the 2000 National Table Tennis Championships. Entering each athlete’s name , affiliation, his/her prefecture, athlete code and match code, we can retrieve and display the results of the games immediately on the system.

By using a database, we set up the initial picture of real-time charts of the tournament. After that we r u n the computer programming for information

delivery system.

To draw tournament charts, we installed VineLinux 3.0 (Kernel Version 4.2.26-Ov115) on the PC, IBM Net Vista, connected to the Niigata University LAN. We ut ilized LaTeX to generate the charts on the PC automatic ally. Furthermore, to display the charts on JTTA's web site, we applied the PDF (Portable Document Format) format, a commonly used format to show the images on a browser.

During the tournament, Mozilla Firefox (Version 3.5.3), an application software for the internet display, was utilized to display the results of the games. In order to rewrite the HTML files after each match result was obtained, we needed to program the CGI.. In this study we chose the Perl language for CGI programming because it is suitable for CGI programming and also is independent from other types of computer and binaries.

Perl dealt with drawing the tournament charts and implemented algorithm for displaying standings and then returned the source of LaTex. After DVI File was written, it was transformed into PDF File with dvipdfmx. As for editing the data and programming the source codes, the text editor Emacsf (Version21.3) was used. The work flow in drawing tournament charts is shown in Figure 1.

5. THE DATABASE OF MATCH RESULTS AND THE FLOW CHART OF COMPUTER PROGRAMS

The conventional system which has been used in most of table tennis tournaments in Japan carried out only the delivery of match results, but the new system which we have developed deals with the draw of the tournament charts as well. The database of match results shown in Figure 2 was arranged in such a format that viewers to find the match results through a browser.

The flow chart in Figure 3 shows the programs for generating the source code of TeX file in order to draw the tournament charts.

6. PUBLICATION OF TOURNAMENT CHARTS ON THE INTERNET

A separate computer "eagle.ed.niigata-u.ac.jp" was required to draw tournament charts due to the expected high demand of access to the server www.jtta.or.jp during the tournament. The former was located at Niigata University and was needed to exchange the information with the server at JTTA in Kishi Memorial Gymnasium through the Internet. Thus, ftpmirror1.21, a software package for forwarding files, was installed in eagle to draw the charts and exchange the information with the server. Both the execution of the program for drawing the charts and the exchange of the files were done every 5 minutes through employing the cron daemon on Linux OS, a software for the auto-command function The terminals on which the results were entered were located at the tournament hall at Tokyo Metropolitan Gymnasium in Sendagaya: the open server and the computer for the tournament charts, eagle, were provided with by Niigata University. The data flow among JTTA Web Server, eagle, operator and viewers on the Internet are shown in Figure 4.

7. ACCESS COUNT FOR JTTA WEB SERVER

Access to http://www.jtta.or.jp/ in 2004 increased by 24.6% compared with that in 2003. The change in the number of hits between 2003 and 2004 is shown in Figure 5.

Apparently, the introduction of the real-time tournament chart system in 2004 resulted in an increase in the web visitor count from 2.49 up to 3.10 million or by 25%, and a similar increase in the chart viewer count from 3.31 up to 5.63 million or by 70% in a year. On the average in 2003 a visitor to the JTTA web site viewed 1.33 static tournament charts while in 2004 a single visitor to JTTA viewed 1.81 dynamic tournament charts.

8. CONCLUSIONS

The tournament charts for all events result in more than 33 pages in the booklet at the annual Japanese National Table Tennis Championships. Before the present system based on PC and network was completed in 2004, much time and laborious work was required to complete the draw procedures. It took even for experienced tournament staff dozens of working hours not only to draw the charts but also to enter the scores and other results. Those days it was out of the question to deliver tournament charts to viewers in real time. We succeeded in developing the real-time tournament charts system on the JTTA web site in 2004. Our system has now attained the following significant goals:

1. to reduce the number of the staff required to draw the charts.
2. to eliminate the time required to draw the tournament charts (30 hours to 0 hours).
3. to deliver the tournament charts immediately on the Internet (every 5 minutes)
4. to let the viewers comfortably browse the match results and the tournament charts at their convenience.

REFERENCES

1) Akimoto S, Furukawa T: CGI Kisokouza, ShoueiPublishing Co., 1999
2) ASC Editorial Dep. Henshuubu:Meikai LaTeX Reference, ASC Publishing company, 1995
3) B.W., Kernighan D.M.Ritchie :Programming Language C, Kyouritu Publishing Co, 1989
4) L. Wall, R.L. Schwartz: Programming Perl, SOFTBANK Corporation, 1993
5) Masui T: Perl Shohou, ASC Publishing company, 1993
6) Ushiysma Y, Ohtaki K, Igarashi H: The Web Site of the Japan Table Tennis Association, TABLE TENNIS SCIENCE, No.4&5, pp206-219, 2004

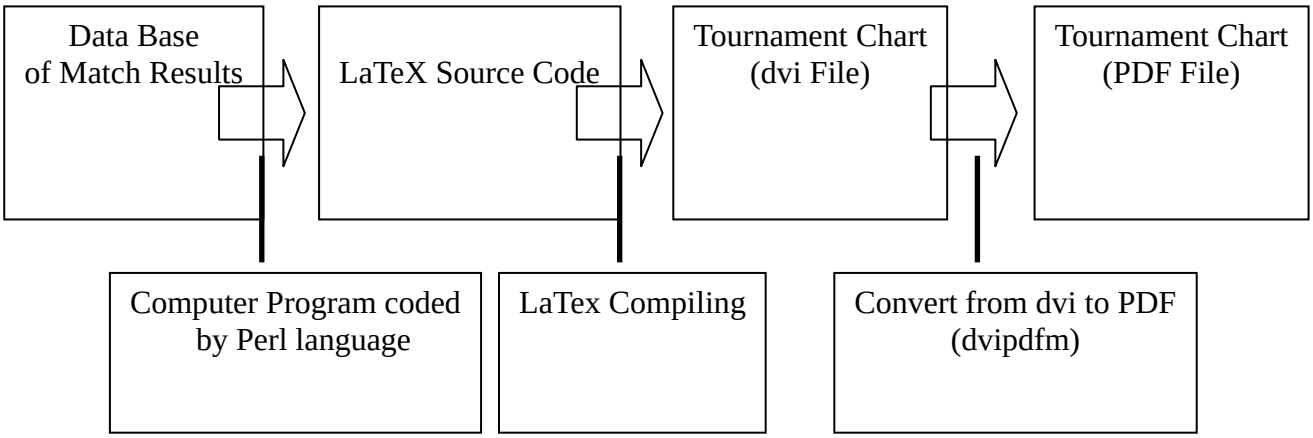
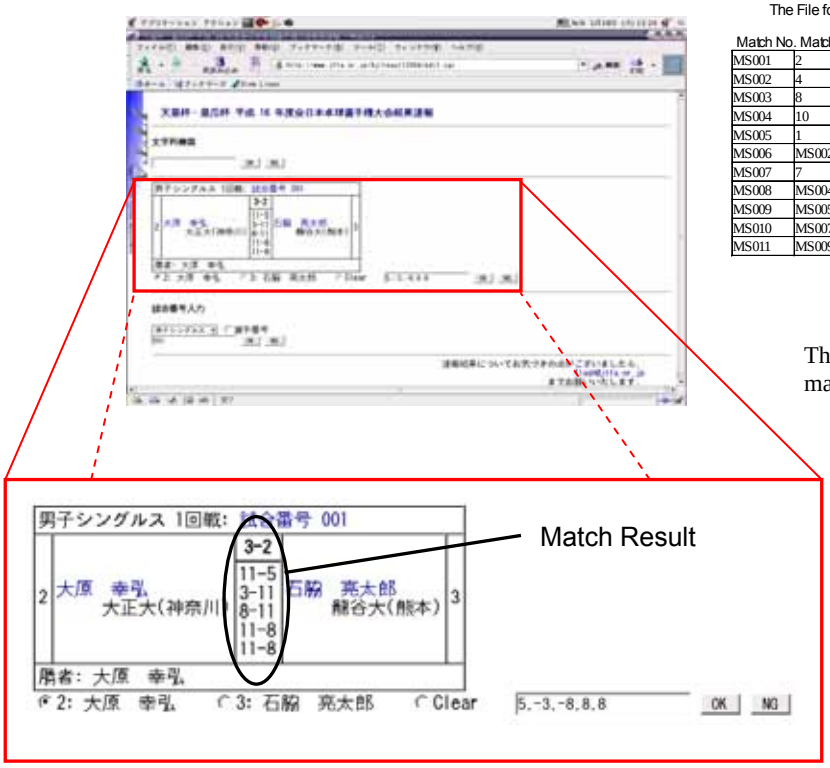


Fig.1 Flow of Drawing Tournament charts



The File format of the Data Base

Match No.	Match or Player No.	Match or Player No.	Winner	Points
MS001	2	3	0	5,-10,4,3
MS002	4	5	0	8,8,-8,-7,2
MS003	8	9	1	6,9,6
MS004	10	11		
MS005	1	MS001		
MS006	MS002	6		
MS007	7	MS003		
MS008	MS004	12		
MS009	MS005	MS006		
MS010	MS007	MS008		
MS011	MS009	MS010		

The internet server of JTTA that provides the match results shown above

Web Browser that enables viewers to obtain the match results

Fig.2 Match Results Database

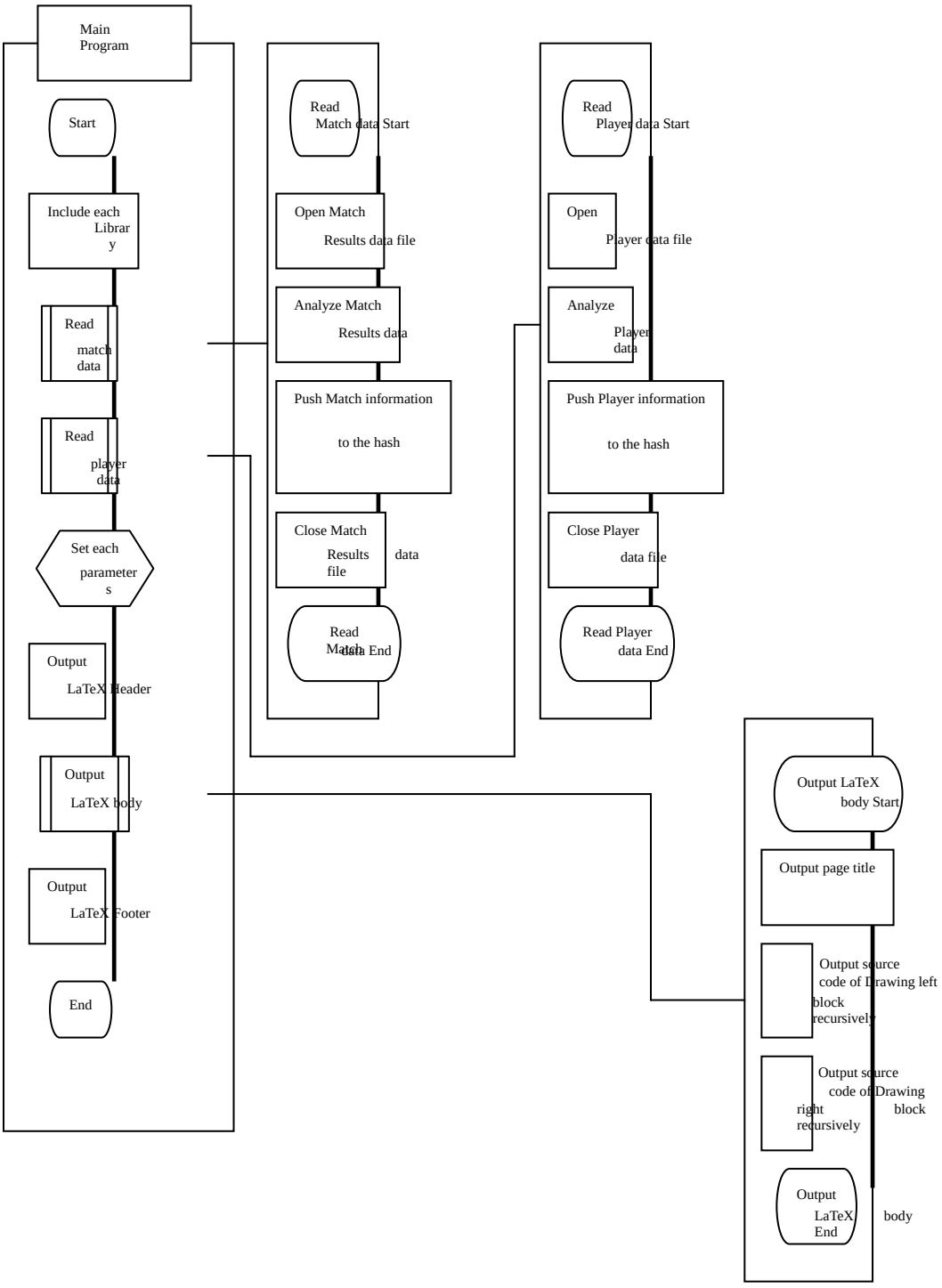


Fig.3 Flow Chart of the computer Programs

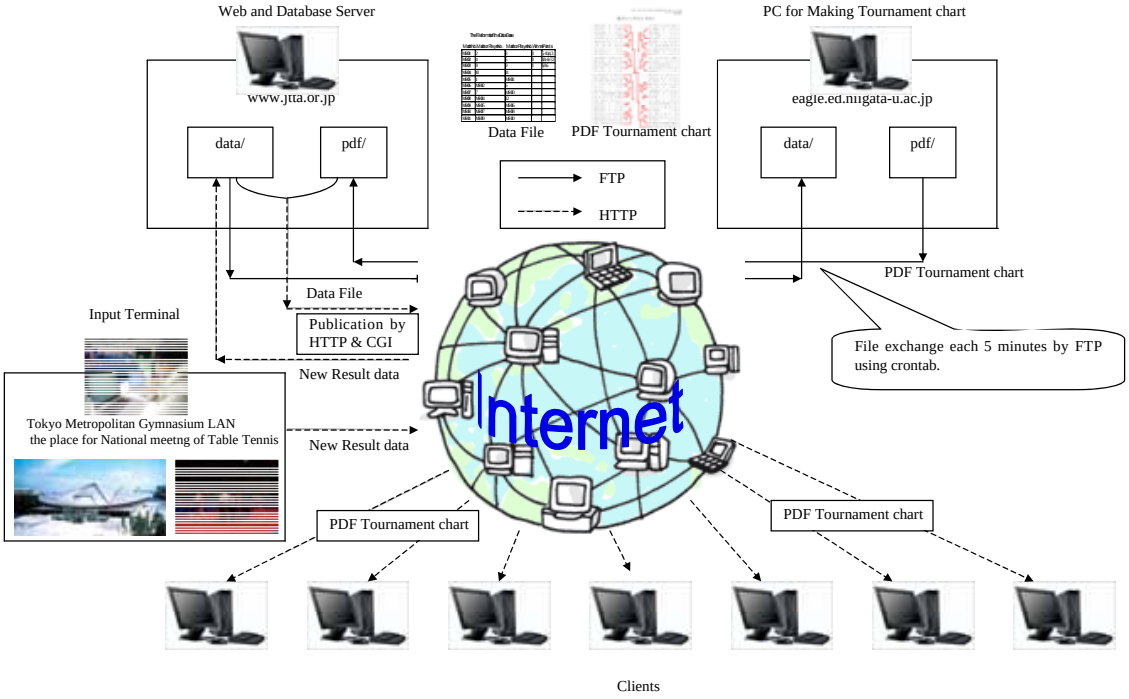
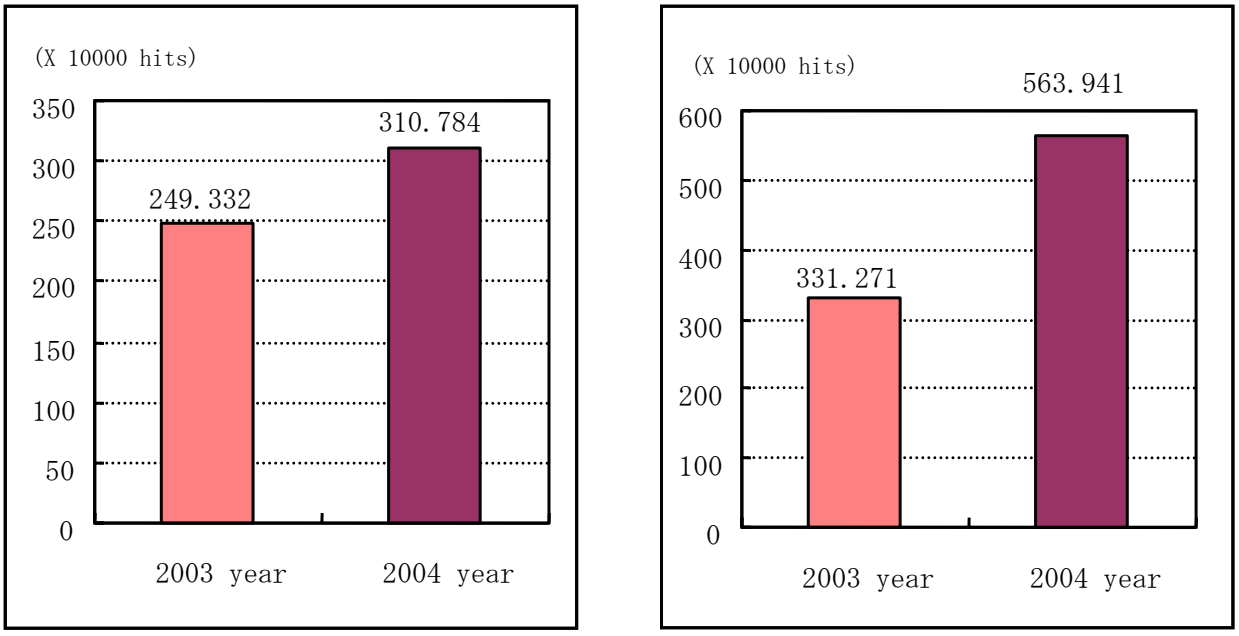


Fig.4 Data Flow on the Internet



a) Hits for web site

b) People viewing the tournament charts

Fig.5 The Difference in the Number of the Hits between 2003 and 2004
Real-time Tournament chart system was not available in 2003.

Study concerning the impact of table tennis competitions on the development of the professional table tennis in the county of Bacau-Romania

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Abstract: At present, the problem of financing different sports activities has become more and more serious, and this fact is due to the economic situation in the environment we are conducting our activity. However, accessing different financial resources can often be achieved only by means of an objective presentation of the logistics necessary for carrying out a certain sports activity.
The purpose of the study was:

- to raise the public awareness and to attract as many subjects as possible into practicing table tennis.
- to channel the participants' interest towards the values of exercise-sports-life
- to take part in the competitions organized by the federation.

Objectives of the study:

- to make table tennis more popular in the city of Bacau
- to attract a greater number of subjects into practicing table tennis individually

Duration of the project: 2005-2008, financial support from the local authorities: 11000 euro, funds raised from our own activities: 20000 euro, competitions organized: 12, number of participants: 1750, children admitted into the selection process: 245, children selected into the training groups: 42, sports associations founded in the field of table tennis: 2, a senior team promoted into the National Championship – division A.
Considering the results, we believe the objectives suggested have been achieved, the impact of the activities being a major one. Table tennis has reappeared in this area in an organized form after 15 years leading, in a relatively short period of time, to a spectacular increase in the number of people practicing it.

Keywords: Study, table competitions, development, table tennis

1. INTRODUCTION

At present, the problem of financing different sports activities has become more and more serious, and this fact is due to the economic situation in the environment we are conducting our activity. Accessing different financial resources can be achieved only by means of an objective presentation of the necessities for carrying out a certain sports activity. This analysis can be achieved only by informing the potential financers as accurately and as concisely as possible. A very important advantage is the ability of continuing the activity by means of self resources even after the financing from other parties has ceased.

1.1. Purpose:

- to raise the public awareness and to attract as many subjects as possible into practicing table tennis.
- to channel the participants' interest towards the values of exercise-sports-life
- to take part in the competitions organized by the federation.

1.2. Objectives:

- to make table tennis more popular in the city of Bacau
- the social integration and reintegration by means of sports of all the social categories included in this project;
- to attract a greater number of subjects into practicing table tennis individually

13. Duration:
2005-2008

1.4. Place:
Bacau County - Romania

2. CONTENT

In 2005, as a professor in the Sports games department at the Faculty of Movement, Sports and Health Science, University of Bacau, I drew out the project named „Sports and Health in University", having as an objective to achieve funds according to the Law no. 34/1998, the Law no. 350/2005, H.G. no. 1273/2005 and H.G. no. 49/2003 from the Local Council of Bacau city.

„Sports and Health in University" gained the competition for irredeemable financing based on projects organized by the Local Council of Bacau City and included the following activities:

- **A** "Table tennis – Methodical guide" book editing, having as an objective to make table tennis teaching easier in the centers within the city of Bacau. It has

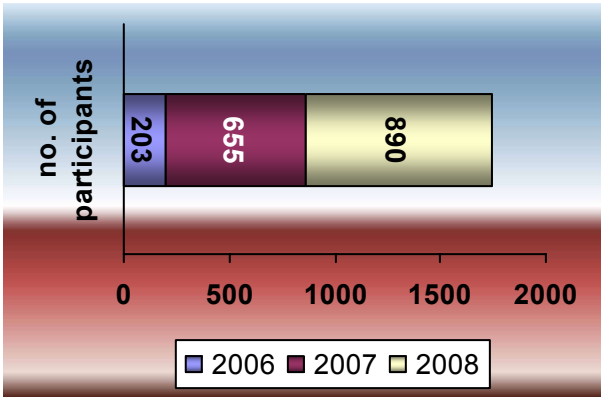
been gratuitously delivered to the schools and centers included in the „Table tennis caravan" and „Table tennis for everyone", as well as to high schools, faculties and libraries in Bacau city. **C** The Romanian Table Tennis Federation. **P** University of Bacau, Faculty of Movement, Sports and Health Science– The table tennis club.

- **A** „Table tennis for everyone", project for founding and furnishing some centers for practicing physical exercise – table tennis – in a pleasant and supervised manner. **C** The General Department for Social Assistance and Child Protection Bacau, The Public Social Assistance Service Bacau and The Students' League within the University of Bacau. **P** Within these centers.
- **A** „How" – organizing seminars and offering advice for founding private sports clubs and associations in Bacau City. **C** The County Department for Sports. **P** University of Bacau, FMSHS – Table tennis club.
- **A** The „Table tennis caravan" program for making table tennis popular and for organizing table tennis selections in the schools within Bacau city. **C** School Inspectorate of Bacau County. **P** The gyms within the schools of Bacau city.
- **A** „Table tennis demonstration" in which many present-day and former table tennis players with special national and international results took part. **C** The County Department for Sports, the ATLANTIS Sports Club Bacau. **P** The Sports Hall of Bacau City.
- **A** „Bacau Cup" in table tennis. Table tennis competition which took place from 2006 until 2008, including 9 categories. 7-10 years old; 11-14 years old, 14-18 years old and over 19 years old, men and women competitions, as well as a special section for people with disabilities. **C** The County Department for Sports, The General Department for Social Assistance and Child Protection Bacau, The Public Social Assistance Service Bacau, The Students' League within the University of Bacau, ATLANTIS Sports Club Bacau. **P** The Sports Hall of Bacau City.

Legend: A = activity,
C = collaborators
P = place

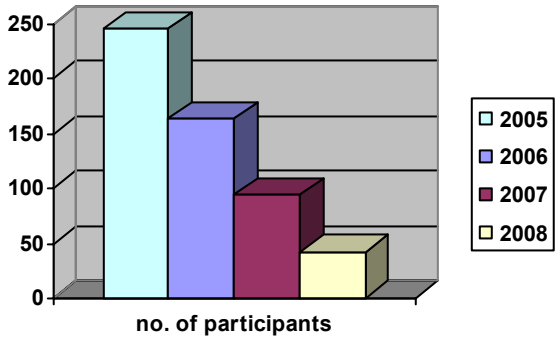
3. DATA ANALYSIS AND INTERPRETATION

In the 12 competitions carried out on a period of 3 years, the number of participants in these activities has increased by 76,96 % as compared to the first year, more exactly from 205 participants registered in 2006 to 890 registered in 2008 (graphic no.1).



Graphic no.1. Evolution of the number of participan ts in the competitions organized from 2006 to 2008

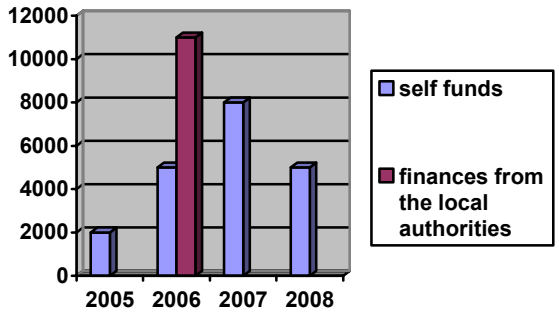
The number of children who were included in the selection process was of 245; the number of the ones who were included in the high performance groups was of 42. The losses registered during the 4 years were of 82,86% (graphic nr.2)



Graphic no.2. Evolution of the number of children included in the special training programmes

The financial situation during the 4 years (graphic no.3) was as follows: in 2005 - 2000 euro FOA, in 2006-5000 euro FOA and 11000 euro FLA, in 2007 – 8000 euro FOA and 2008 – 5000 euro FOA.

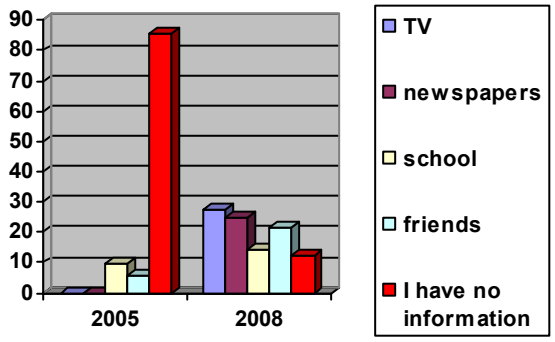
FLA – Financing achieved from the local authorities;
FOA – Funds attracted by other activities



Graphic no.3. Financial evolution and funds dispersion during the 4 years of activity

During the 4 years of activity, 2 sports associations have been founded having as a specialization table tennis, as well as a senior team (Atlantis) promoted in the National Championship Division A.

The enquiry based on a questionnaire which took place in September 2005 and June 2008, carried out on a number of 250 subjects aged between 9 and 45 chosen from different social environments from Bacau, Onesti and Moinesti has emphasized several aspects. The one which interests us the most in this paper was the answer to question number 3 „Where did you get the information concerning the table tennis activities carried out in the county of Bacau" (graphic no.4)



Graphic no.4. Evolution of the answers to question no.3 in 2005 as compared to 2008

The data achieved by means of the questionnaire showed a substantial increase in the amount of information concerning the table tennis activities offered by mass-media (from 0 to 27,2 % in television and from 0 to 24,8 % in newspapers). School is still the most constant area concerning the sports information and indirectly concerning the information about table tennis (from 9,7% to 14,3%). A significant and also beneficial increase is the one noticed in the information offered by acquaintances and friends, which increased almost 4 times (from 5,7% to 21,7%). The most important result is the one concerning the number of people who have no information about this phenomenon (table tennis), number which has decreased the most. While in September 2005 85, 6% of the people questioned had no information about the table tennis activities carried out in Bacau county, in June 2008 their number decreases up to 12%.

4. CONCLUSIONS

15 years ago, the city of Bacau had a table tennis championship including 8 teams with at least 200 sportsmen; due to the activities carried out, we have brought this sports branch to the attention of the local community once again and we have revived it.

By founding the centers destined for the practice of table tennis in a constant and organized manner, the data concerning this initiative during the years to come will be monitored and analyzed.

We believe that all the actions which had table tennis as a main subject have had a special impact on the citizens of Bacau county.

The Table Tennis Shoulder

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Abstract: The paper is based upon more than three decades of personnel experience of the authors as the medical doctors of a table tennis national team. This was a quite reliable period to notice that the most of the problems are related to overuse injuries of the shoulder region. Introduction of new materials as well as spin stroke contributed to the development of degenerative condition of the tendon fibers that attach to the bony prominence of the shoulder blade. The tendons involved are responsible for anchoring the muscle that perform movement of the shoulder girdle. The article explains the common cause of the table tennis shoulder, symptoms and diagnostic procedures, treatment and possible prevention measures

Keywords: table tennis, shoulder, overuse injuries .

1. INTRODUCTION

What most people call the shoulder is really several joints that combine with tendons and muscles to allow a wide range of motion to the arm, from scratching your back to perfect spin stroke in table tennis.

Most shoulder problems involve the soft tissues, muscles, ligaments, and the tendon rather than bones and fall into three major categories;

tendinitis/bursitis
injury
arthritis

In the case of professional or recreational activities the tissue is related to repetitive strain injury also called cummulative trauma disorder, overuse syndrome or enthesopathy. As with many other hand and arm conditions, very limited scientific support has been observed. The tendon as a cord connects a muscle to a bone or other tissue and most tendinitis are the result of of the wearing process that takes place over a period of time.

-acute/subacute tendinitis following some overuse excessive activities chronic

- tendinitis resulting from degenerative diseases or repetative movements

- the spliting and tearing of the tendons of the rotator cuff,(that is an arragement of muscles and their tendons that provides the shoulder motion and stability).

2. ETIOLOGY

The aim of the paper is to explain the most common cause of *table tennis shoulder,* symptoms and diagnostic procedures as well as possible measures. The pathophysiology of enthesopathy is related to the levator scapular muscle attachment on the upper medial corner of the scapular blade. Non-inflammatory, chronic degenerative changes are identified in surgical pathology specimens. This muscle has small origin and does not transmit large forces through its tendon during repetative nature of hitting thousands and thousands of balls which leads to tyny tears in the tissue. This most often is seen at the muscular tendinous junction by direct palpalation.

3. SYMPTOMS

The most often complain is severe, burning pain of the upper medial aspect of the scapular blade and neck which gradually worsens over the time. The motion contracture under such circumstances is a rule. If the player is right handed it has to be pointed out that the symptoms are predominant on contralateral left shoulder. X-rays may show some bone in the muscle origin and on MR images fluid may be seen in tissue defect.

4. DISCUSSION

This paper is based on the authors' experience of more than 30 years as the national team medical doctors. During these decades,development of the game was in feed-back relation to big innovations in blade, rubber and glue manufacture.In modern table tennis most competitors favor the forehand top spine as the most attacking stroke.

Technically,adequate performance of top spin strike is dependable of knowledge,motor abilities but can not be executed without a proper kinetic chain of the shoulder girdle. It means that in case of the right handed player, impact of the ball to the racket can be realised only if the left scapular blade is elevated in the upper plane in relation to the right one.

The levator scapular muscle is responsible for obtaining this kinematic synchronization and repetative contractions, keeping repeating microtrauma lead to overuse syndrome on the tendon attachment. This type of enthesopathy is unique for the table tennis and should be regarded as a separate notion as well as tennis elbow.

5. CONCLUSION

According to the updated knowledge and experience, soft tissue therapy should be conducted by

decompressing the area around the repetitive stress injury thus enhancing circulation and promotion of healing. Biofeedbacks can be used to reduce stress related muscle tension in the muscles of the neck and shoulders. As the prevention active release tecniques are effective in reducing symptoms by realising the tension of the muscles and nerves of the injuried area.

REFERENCES

[1] Rene Caillet, "Soft Tissue Pain and Disability, " F.A.Davies Company, 1980.

[2] Nahit ES,Pritchard CM,Cherry NM, Silman AJ,Macfarlane GJ, "The Influence of Work Related Psychosocial Factors and Psychological Distress on Regional Musculoskeletal Pain,".,J.Rhe. 28(6)1378-84.,(2001)

[3] Ratzlaff,CR.,Gillies,MW.,Koehoor," Work –related Repetitive Strain Injury and Leisure-Time Physical Activity," Arthritis& Rheumatism 57(3),495-500, 2007.

[4] Van Tulder M.,Malmivaara A.,Koes B ; "Repetitive Strain Injury", .Lancet 369(9575).,2007

Physiological demands and testing in table tennis

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Abstract: The purpose of this review was to support table tennis experts and scientists with up to date science research regarding physiological measurement of table tennis players. We have noticed that some authors use obsolete references when comparing data in their research.

Literature available all over the world has been consulted to unify the findings involving measurement of physiological characteristics among table tennis players. In the past ten years, we have encountered a lack of quantitative data regarding the evaluation of training intensity and physiological load capacity of table tennis players in training and competition. From this point of view the judgement on the quantity of sports load depended only on one's observation and experience, a situation which, unfortunately, lacked a scientific basis. In order to scientifically improve the training of table tennis players and support table tennis researchers with newer findings, it is necessary to put forward objective evaluation indices for the training intensity and physiological loads of table tennis players and to support scientists with the results of extant research.

Key words: table tennis, testing, physiology

1.0 INTRODUCTION

Table tennis is known around the world as the fastest ball game. With the development of table tennis equipment, rule changes and player techniques, ball speed and spin have increased greatly, which shortens the rallies for each point. This is not what table tennis was in the past. In order to increase the attractiveness of table tennis, the International Table Tennis Federation (ITTF) has carried out reforms, such as having different combination rubbers on each side of the racket, the co-existence of the white and yellow ball, regulations on service, a 40-mm ball, a shorter point system and lately the prohibition of glues containing harmful volatile compounds (VCs). This includes glues with organic and inorganic volatile compounds excluding water.

Table tennis has a major competitive aspect and is widely popular, especially in the Asian and some selected European areas; recently it has also become popular in Africa and America. But even though ITTF is one of the sport's greatest association (on November 2008 ITTF had exactly 205 members), this is not obvious in the scientific research about table tennis. Moreover, despite its popularity, little is known of the characteristics and competencies of high class table tennis. Because of its complex nature, it is not easy for scientists to provide measurements, e.g., at the World championships or the Continental championships, to collect the necessary data for presentation to coaches and athletes.

In talking with many coaches around the world, we see that there are few coaches who pay attention to the aerobic endurance factor. This is understandable, because most coaches think that table tennis training should be highly specific, and endurance is frequently not recognized as important in this sport. So the question is, why waste valuable training time if the result is not an improved performance which means achieving better results at table tennis competitions? But is this the truth? Table tennis, in common with other non-endurance sports activities, does indeed have an endurance, or aerobic, component. For example, if you do multi ball practice, you might fail to recognize the importance of cardiorespiratory endurance as part of a total training program. With a high aerobic endurance level, one can maintain stroke quality throughout the training session or the game and still remain fresh for the next game in the tournament. To improve endurance performance, the athlete must work specific muscles or organ systems at an increased resistance.

The same is true for the importance of including resistance training as part of the total table tennis training program: table tennis does not demand high levels of strength. Most coaches are afraid that strength would do damage to the basic motor movement – i.e. the sense for a good stroke. Yet, athletes in all sports do some resistance training to increase, or at least maintain basic strength levels. Winning the match in table tennis requires not only excellent technique, tactics and psychology, but great physical strength, as well.

A professional table tennis player requires high level physical capacity, technical skills and tactical competence. The purpose of a table tennis player's basic training is to reduce stress on the body imposed by exercise, so that any level of workouts can be carried out more comfortably and an increase in the maximum number of workouts can be achieved. The aim of this report is to give an overview of the characteristics and physiological demands of table tennis match-play from the physiological point of view. Most scientists all over the world agree that table tennis is an aerobic metabolism sport requiring great endurance, which often alternates with intense anaerobic metabolism over short periods.

Characteristics of the table tennis game

Demands of the game

During the match a table tennis player should exactly analyse changes in the tactics and techniques of the opponent. His cerebral cortex during play is in a tense state and his attention quite focused. He has only 0.2 to 0.4 seconds to analyse the approaching ball and to react. A world competition often lasts for a week, and a ranked player will attend many games. The load is heavy, and it always brings various effects such as a busy schedule, strong opponents, changes in diet and sleeping habits, a new environment and time difference [12]. It is therefore necessary for a player to be in good physical shape and mental condition. Still, however, skill is the decisive factor in a table tennis match.

Match characteristics of the table tennis game

During the last eight years, rules of table tennis have been changed enormously. Since the introduction of a bigger ball and a shorter point system, matches differ considerably from the physiological demands point of view from matches before the rules changes.

The old 38mm ball

On the basis of Weber's [26] conclusions, the energy during ball exchanges is supplied mainly by alactic anaerobic metabolism. It has to be pointed out that in his research real play lasted only 35.9% of total game time, - and games lasted on average 6:06 minutes - where the ball was in play for only 3.8 seconds. Epstein [9] reports 23.1% of total real play, and the ball was in play for 3.1 seconds, with 10.3 seconds of rest between single points. According to Yuza et al [21], a table tennis match (best of 3, 38mm ball, 21 points) lasts 28:40min. ± 7:35min.

The new 40mm ball

According to Katsikatedils et al [14] real play time at the Olympic Games in Athens in 2004 oscillated from 3:7 min. to 6:6 min. in total. The mean duration of games was increased at the development of organisation up to the quarterfinals. Men's pure play time ranged from 3:8 min. to 4:4 min. and women's from 3:7 min. to 6:6 min. Means of matches are 22:5 min. and 26:3 min. Djokić [7] analysed the differences between play with the 38mm ball till 21 points and the actual system and found that rally per point (without service) increased from 3:52 min. to 4:02 min.

Physiological characteristics

Mitchell et al [18] classified sports activities based on the static component, dynamic component and energy system involved, where table tennis falls into the low-moderate group of sports, together with baseball, softball, volleyball and tennis (doubles). From that point of view, table tennis requires significant energy from both the anaerobic and aerobic energy systems.

The most important ability for table tennis player is undoubtedly endurance. Top players usually have higher levels of endurance [27, 26]. Endurance is a term that describes two separate but related concepts: muscular endurance and cardiorespiratory endurance [24]. Each makes a unique contribution to the player's performance, so each differs in importance to different players. For a table tennis player, endurance is the quality that allows him to sustain a high speed over the couple of top spin strokes with high rotation of the ball. This quality is muscle endurance, the ability of the shoulder muscle group to sustain high-intensity, repetitive movement. The resulting fatigue is confined to a specific muscle group (the shoulder girdle), and the activity's duration is usually very short. Muscular endurance is highly related to muscular strength and anaerobic development [24].

On the other hand, cardiorespiratory endurance relates to the body as a whole. For a table tennis player, it means the ability to sustain prolonged activity in long table tennis competitions. Cardiorespiratory endurance is related to the development of the cardiovascular and respiratory systems and thus aerobic development. This is why the term aerobic endurance is used to represent cardiorespiratory endurance [24].

Most sports scientists regard VO_2max, representing aerobic power, as the best objective laboratory measure of maximal cardiorespiratory endurance capacity. VO_2max is defined as the highest rate of oxygen consumption attainable during maximal or exhaustive exercise. In table tennis these conditions arise only during training sessions and occasionally during long rallies – particularly when playing against a defensive player. DeVries [4] pointed out that measurement of maximal O_2 consumption has some serious problems. Although the measurement of VO_2 max has come to be the criterion against which all other PWC (physical working capacity) test procedures are evaluated, there are at least four grounds for criticism of those measurements. First, the subject must be taken to a

state of exhaustion; second, the results of the test vary considerably with test method and protocol; third, the results are couched in chemical terms, when the physical educator or coach is working with physical parameters of work and power, and fourth, the test requires an expensive laboratory and considerable testing time.

We can speak of three recognizable phases during the transition from low to maximal exercise level. The first phase of low intensity exercise mainly involves aerobic metabolism, characterized by small increases in ventilation and blood lactate levels similar to resting values (1-1.5 mmol). The second phase, or Aerobic Threshold (AerT – eg. [20]), is characterized by slight hyperventilation and increased lactate levels of approximately 2 mmol/l. As the level of exercise increases further, ventilation rises considerably, and there is a steady increase in blood lactate levels to approximately 4 mmol/l. This third phase is termed the Anaerobic Threshold (AnT).

Physiological testing

Djokic [6] pointed out that testing and measurement are the means of collecting information upon which subsequent performance evaluations and decisions are made. Effective functional diagnosis of athletes means success for the training program.

The battery of tests designed for the study by Melero Romero et al [17] included impedanciometry, sanguine analytic and field tests, with lactate determinations in capillary blood, and control of heart rate frequency. The data obtained from these tests reveal a better picture of the elite player's physical condition in relation to the other two groups of inferior sport category, and also a direct correlation among the variables considered, such as indicators of good physical condition, and the sport yield evidenced through the results of the field test.

In season 2002/2003 Djokić [5] reported increasing heart rates as the game unfolded. The average values of the heart rate during 6 official competition matches were from 162 to 172 beats.min^{-1}. During table tennis training the approximate value of the heart rate was 142 beats.min^{-1}. In purely tactical training when stress is placed on the precision of performing and returning the serve, the average values of the heart rate were 152-156 beats.min^{-1}. Weber reached the same conclusion [25] – the loud parameter heart rate in setback play becomes especially meaningful when the psychological factor in stress can be eliminated by the use of approved exercise and trainings. During interval training, the values vary from 98 to 115 beats.min^{-1} at the beginning and between 144 to 192 beats.min^{-1} at the end of an interval. In speed training (maximum intensity) where a series of 4-5 balls were projected rapidly followed by a short rest of 1-1.25 min, the heart rate at the beginning was 110-115 beats.min^{-1}, while at the end it was 168-192 beats.min^{-1}. Like many other authors [21, 26, 13], Djokić pointed out that heart rate depended on the type of training, but more demanding training yielded heart rates in excess of those found in competition.

Wang Xin [23] has put forward objective evaluation indices in fixed quantity for the training intensity and physiological load of adolescent table tennis players so as to scientifically improve the training of table tennis players. He measured 24 person-time experiments related to various sports loads on eight subjects. The data showed that the average heart rate was as follows: 27/10 seconds for heavy load, 24/10 seconds for medium load and 22/10 seconds for low load. So the heart rate can be considered as the main evaluation index for the training intensity of table tennis training.

The object of the study by Kasai et al [13] was to clarify cardiorespiratory response during practises and games and to obtain basic information on the best method for evaluating the cardiorespiratory function of a table tennis player. They measured oxygen consumption, ventilation, heart rate and blood lactate concentration during practices and games. Data showed that oxygen consumption, ventilation, heart rate and blood lactate during games are lower than during training. The main values in games were 30.7 ml/kg/min for ventilation, 142b/min mean for heart rate and 1.17mmol/l for blood lactate.

Using a 6 different practices and regular games, Watanabe et al [22] measured program of table tennis involving heart rate, blood lactate concentration and rating of perceived exertion (RPE) between Chinese national class players and Japanese university class players. All subjects performed a maximal exercise test, using a bicycle ergometer in the laboratory before the table tennis programme. As an expressed percentage of maximal O2, the exercise intensity of table tennis practice was 56-73% and 56-7% VO2max in the Chinese and Japans players, respectively. Chinese players showed lower exercise intensity than Japanese players in 5 practices out of 6. RPE showed a higher scale than physiological parameters. Throughout the program of table tennis, blood lactate had no changes in both groups.

Allen [2] reports on the physiological characteristics of elite Australian table tennis athletes and their responses to high level competition. A maximum oxygen uptake test using the Åstrand protocol on the treadmill and a Wingate test of anaerobic power were used for laboratory assessment, and at least four games were used for field evaluation where heart rate was measured and blood lactate levels were taken from each player. Values of maximum oxygen uptake vary from 2.55 l/min^{-1} in females to 4.13 l/min^{-1} in males. The anaerobic capacities recorded on the Wingate at peak power vary from 7.68

watts/kg^{-1} in females to 9.89 watts/kg^{-1} in males. It should be stressed that these measurements were carried out with the smaller ball.

In his experiment Ellwood [8] sought to establish whether VO_2 measured during a game of table tennis was consistent with the level predicted by a progressive sub-maximal treadmill test for equivalent heart rates. According to the results, it is suggested that a steady state treadmill test is not suitable for predicting oxygen uptake during table tennis games.

In order to compare some results with the previous smaller ball, here are the results from Weber's research [26]. In 30 minutes of competitive training, eight Bundesliga players had an average of 159 beats. min^{-1} in a 2 game match and for the rest of the time, 164 beats.min^{-1}. The lactate concentration in the arterialised blood was 1.99, (first game), 1.85 (second game) and 1.92 mmol (at the end of training). Preuß [19], too, tested the energy consumption during one typical "bundesliga" tennis training session and during one simulated training competition. During training, the concentration of lactate in the substance rose from 1.1±0,1mmol/l during rest to 2.6±1,0mmol/l after the load, while the rise during competition from 1.0±0,1mmol/l during rest to 2.0±0,7mmol/l after the load was not that high. Preuβ also compared this data to that from multiball training and found that there is significantly higher lactate present in blood – from 1.1±0,2mmol/l during rest to 4.3±1,9mmol/l during training. These obvious by increased values are probably based on the special load structure of the training form. Epstein [9] reports of 1.29mmol/l to 1.56±0,53mmol/l in training and 1.24mmol/l to 1.84mmol/l in competitive games where the heart rate gets over 190 beats.min^{-1}.

Lundin (in Preuβ [19]) reported in 1972 that during a single table tennis play the heart rate lies between 160-180 beats.min^{-1}. Because the rests between two games usually last a maximum of one minute, thi results in accumulated fatigue. At the constant pulse frequency of 160-180 beats.min^{-1}, this means that the player is constantly at the edge of preservation of anaerobic ability. Because of the high intensity, accumulation of lactic acid in blood is present. A top player should have a maximum oxygen uptake of at least 60ml/kg, and the anaerobic threshold should be 70-80% of this value. Research on the Swedish table tennis team between 1970-1972 showed that values for maximum oxygen consumption during the game were 65 ml.kg^{-1}.min.

For table tennis purposes (exercise prescription), we are really more interested in the level of performance that can be maintained without fatigue, rather than the aerobic power (VO_2max) available at the point of exhaustion.

The findings of Lu Yunxia (in Lin, [16]) indicate that China's coaches often attach great importance to skills and training tactics but pay scanty attention to training for physical strength, since they believe player achievement to be relatively unrelated to their physique.

Unfortunately, we do not have enough information about and access to the results of research by Chinese scientists that should lead us to better understanding of why Chinese players – especially women – are so superior in their games.

Physiological testing and players with disabilities

Abe et al [1] studied the fluctuation of salivary cortisol and urinary 17-ketosteroid of table tennis players during exercise. There was no increase in cortisol levels and no decrease in 17-ketosteroide levels in anyone's sample after 3-hours of table tennis exercise, which means that no one suffered from excessive stress during that time.

The present level of table tennis games in people with disabilities gives no more space for practice without physical training. It may be inconvenient for the individuals to have a disability, but this does not mean that they cannot improve their lives with high performance sports results.

Physiological testing and physical preparation as injury prevention in table tennis and health-related fitness

Furjan Mandić et al [10] reports on the possibility of implementing slide aerobics into the program of a table tennis player to avoid injury to the muscles of the lower extremities (e.c. abductor and adductor) and to strengthen leg muscles. On the other hand, since a slide aerobics programme is performed with music at an optimal tempo between 100 and 138 BPM, techniques specific to table tennis may be practised at a particular rhythm and a certain tempo, which means that we could also use a slide board for endurance testing of table tennis players. Nordic walking (Furjan- Mandić et al [11]) is another of the sports disciplines that can be implemented in fitness training for table tennis players. Nordic Walking is an effective method of walking with poles where the swing of the arms and the powerful placement of the pole influence the length of strides and requests from the player to activate the shoulder girdle muscles, which should be strengthened for better performance of spin strokes in table tennis.

Kobayashi et al [15] investigated the relationship of habitual physical activity to various components of health-related fitness as well as bone density in middle-aged women. Results of the measurements indicate that muscle activity during table tennis may not place sufficient stress on the bone to maintain a high level of bone mass. In addition, plasma HDL cholesterol

concentrations tended to be higher in table tennis groups than in sedentary groups. These results may indicate that habitual table tennis activity is beneficial to maintaining a high level of aerobic fitness as well as in reducing the risk of coronary heart disease.

2.0 CONCLUSIONS

We have discussed general trends in the adaptations that occur in response to training. However, we must always remember that we are talking about adaptations of individual table tennis players and that everyone does not respond in the same manner. Several factors that can affect player response to aerobic and anaerobic training must be considered. Based on a sample of international research, we can conclude that modern table tennis is a sport that requires both sub-maximal and maximal work and this puts pressure on both the anaerobic and aerobic systems.

Even though much work has been done, there is still a remarkable amount of information needed before comprehensive knowledge of table tennis can be claimed. In this paper we have focused only on the table tennis player's physiology.

Sport scientists have demonstrated the importance of endurance training for table tennis players. Nothing but great stamina enables players to bring their skills and tactics into full play. After competition table tennis players are often not only physically exhausted, but also highly tense in the mind, so great endurance performance is the most important factor in their success.

3.0 REFERENCES

[1] Abe, K., Kawakamii, Y., Ohuchii, M., Watanabe, Y., Shibataz, Y., & Takahashi-Abbe, S. (2002). Biochemical and physiological examination of intellectually disabled table tennis players. *International Journal of Table Tennis Sciences*, No.4&5. Pp. 61-67.

[2] Allen, G.D. (1991). Physiological characteristics of elite Australian table tennis athletes and their responses to high level competition. *Journal of Human Movement Studies* 20(3): 133-147.

[3] Baron, R., Petschnig, R., Bachl, N., Raberger, G., Smekal, G., & Kastner, P. (1992). Catecholamine excretion and heart rate as factors of psychophysical stress in table tennis. *International Journal of Sports Medicine*. 13(7):501-505.

[4] DeVries, H.A. (1986). *Physiology of Exercise*. Dobuque, Iowa: Wm. C. Brown Publisher

[5] Djokić, Z. (2004). Heart rate monitoring of table tennis players. In: Lees, A., Kahn, J.F. & Maynard, W.: Science and Racket Sports III. *The proceedings of the Eighth International Table Tennis Federation Sports Science Congress and The Third World Congress of Science and Racket Sports*. (p. 21-22). London and New York: Routledge.

[6] Djokić, Z. (2007). ITTF scored a goal (changes of rules in table tennis during 2000-2003). In: Kondrič, M., Furjan-Mandić, G. (ed). *Proceedings book. 10th International Table Tennis Sports Science Congress* (p. 168-174). Zagreb: Faculty of Kinesiology, CTTA, ITTF.

[7] Djokić, Z. (2007). ITTF scored a goal (changes of rules in table tennis during 2000-2003). In: Kondrič, M., Furjan-Mandić, G. (ed). *Proceedings book.10th International Table Tennis Sports Science Congress* (p. 336-341). Zagreb: Faculty of Kinesiology, CTTA, ITTF.

[8] Ellwood, J.D. (1992). Is the Sub-maximal Treadmill Test an Accurate Predictor of Oxygen Uptake in Table Tennis? *International Journal of Table Tennis Sciences*, 1:33-39.

[9] Epstein, S. (1992). Hämodynamische und metabolische Veränderungen im Tischtennis bei Weltklassespielern. [Haemodynamic and metabolic changes at the top players in table tennis]. Köln: DSHS.

[10] Furjan-Mandić, G., Kondrič, M., Rausavljević, N., & Metikoš, B. (2002). Slide aerobics in the physical preparation of table tennis players. *International Journal of Table Tennis Sciences*, No.4&5. Pp. 91-95.

[11] Furjan-Mandić, G. Kondrič, M., & Alikalfić, V. (2006). Nordic walking in the physical preparation of racket sports players = Nordic walking en la preparacíon física de los jugadores de deportes de raqueta. V: *[IV World congress of science and racket sports : 21-23 de Septiembre de 2006, Madrid]*, (Cultura, ciencia y deporte, Suplemento, Vol. 2,no. 4, ano 3). Guadalupe: Universidad católica San Antonio.

[12] Guan, Y. (1992). Functional Evaluation for Table Tennis Players. *International Journal of Table Tennis Sciences*, No.1. pp. 95-97..

[13] Kasai, J., Dal Monte, A., Faccini, P., & Rossi, D. (1994). Oxygen consumption during practice and game in table tennis. *International Journal of Table Tennis Sciences*, No.2, pp.120-121.

[14] Katsikadelis, M., Pilianidis, T. & Vasilogambrou, A. (2007). Real play time in table tennis matches in the XXVIII Olympic games «Athens 2004». In: Kondrič, M., Furjan-Mandić, G. (ed). Proceedings *book. 10th International Table Tennis Sports Science Congress* (p.94-98). Zagreb: Faculty of Kinesiology, CTTA, ITTF.

[15] Kobayashi, Y., Hososi, T., Takeuchi, T., & Okuda, N. (1996). Effects of long-term recreational table tennis on health related fitness, plasma lipids and bone density in middle-aged woman. *International Journal of Table Tennis Sciences*, 3:67-78.

[16] Lin, X.B. (2007). A feasibility study of interval hypoxic training of table tennis players. In: Zhang,

X.P., Xiao, D.D. & Dong, Y.: *The proceedings of the Ninth International Table Tennis Federation Sports Science Congress*. (p. 374-379). Beijing: People's Sports Publishing House in China.

[17] Melero Romero, C., Pradas de la Fuente, F., Sanchez Arjon, C., & Vargas Corzo, C. (2005). Physiological course to apply in table tennis. *MD revista científica en Medicina del Deporte.* p.p. 17-24.

[18] Mittchel, J.H., Haskell, W.L., & Raven, P.B. (1994). Classification of sports. Medicine and Science in Sports and Exercise 26(10-supplement), 242-245.

[19] Preuβ, A. (1988). Die Energiebereitstellung im Tischtennis in Wettkampf- und verschiedenen Trainingsbelastungen. [Supply of Energy at Table Tennis – during Competition Loads and during Different Training Loads] Diplomarbeit. Köln: Deutsche Sporthochschule.

[20] Skinner, J.S. & McLellan, T.H. (1980). Transition from aerobic to anaerobic metabolism. *Research Quarterly for Exercise and Sport (RQES)*, 51(1), 234 - 248.

[21] Yuza, N., Sasaoka, K., Nishioka, N., Matsui, Y., Yamanaka, N., Ogimura, I., Takashima, N., & Miyashita, M. (1992). Game Analysis of Table Tennis in Top Japanese Players of Different Playing Styles. *International Journal of Table Tennis Sciences*, No.1, pp. 79-89.

[22] Watanabe, M., Kitahara, T., Shu, J.Z., & Nagata, M. (1994). Exercise intensity of table tennis practice and games by heart rate, blood lactate concentration, and RPE. *International Journal of Table Tennis Sciences*, No.2, pp.121.

[23] Wang, X. (1994). The Evaluation of the Training Intensity and Physiological Load. *International Journal of Table Tennis Sciences*, No.2, pp.61 – 63.

[24] Willmore, J.H. & Costill, D.L. (2004). Physiology of sport and exercise. Champaign, Il:Human Kinetics.

[25] Weber, K. (1982). Analyse der körperlichen Beanspruchung in den verschiedenen Rückschlagspielen unter dem Aspekt der Präventiv- und Leistungsmedizin. In: Andersen/Hagedorn: Training im Sportspiel. 4. Int. Sportspielsymposium. Ahrensburg. Pp. 111-133.

[26] Weber, K. (1985). Reaktion und Adaptionen im Tennissport – eine sportmedizinische Analyse. [Reaction and adaptation in tennis – a sports medicine analysis]. Köln: DSHS.

[27] Weber, K. & Hollmann, W. (1984). Neue Methoden zur Diagnostik und Trainingssteuerung der tennisspezifischen Ausdauerleistungs-fähigkeit. [New methods on diagnostic and workout plan of tennis specific endurance abilities]. In: Gabler, H., Zein, B. (ed). Talentsuche und Talentförderung im Tennis. Ahrensberg: Czwalina. Pp. 186 – 209.

Where is it? A simple guide to table tennis information

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Abstract: The purpose of this paper was to support table tennis experts and scientists with up to date information regarding table tennis issues. Accessing information about table tennis today can be very easy due to the internet access but on the other hand also very complicated The growth of the web and different services has decreased the need of table tennis experts, players and scientists to visit libraries to locate relevant books, journals or conference papers.

This paper would like to outline the need and availability of table tennis information through the web and database. Literature around the world has been checked out in order to collect information on different fields of table tennis game in one place. In order to increase the sports attractiveness of table tennis, the International Table Tennis Federation (ITTF) has carried out reforms such as having differently combined rubbers on the two sides of the racket, the co-existence of the white and yellow ball, regulations on service, 40-mm ball, shorter sets and lately players have to cease using glues containing harmful volatile compounds (VCs). With the development of table tennis equipment, rules change and players' techniques, the need to get up-to-date information has grown in all fields of table tennis training and game.

Key words: table tennis, literature, literature search

1.0 INTRODUCTION

The World Wide Web has revolutionized the way people access information, and has opened up new possibilities in areas such as digital libraries, general and scientific information dissemination and retrieval, education, commerce, entertainment, government, health care and sport. Thus, the web is a useful research tool but it is no substitute for a library. Library services have been greatly improved by computer automation and use of the web, but the web cannot replace all of the services offered by a good library.

There are many ways of improvement of the Web; for example, in the areas of locating and organizing information. Libraries are increasingly moving away from collecting information to providing gateways to electronic information. Today, most information is found by utilizing search engines. A search engine is a software program that uses web robots to query millions of pages on the Internet and creates an index of those web pages. Users can then search that index quickly and easily to find the information they may be looking for. Current techniques for access to both general and scientific information on the Web provide much room for improvement; search engines do not provide comprehensive indices of the Web and have difficulty in accurately ranking the relevance of results. Some indexes and databases on the web provide free access to text or at least allow one to search their holdings.

Scientific findings, also in table tennis, spread very quickly. New findings supersede old ones which is why a scientist or a coach has to keep up with novelties in the international literature and search for the latest findings so as to maximise the planning and proficiency of his or her work. It is sometimes difficult to keep up with the novelties in the professional and scientific literature on table tennis due to the vast number of professional and scientific magazines published worldwide. Nowadays, the Web enables fast communication between people around the globe and facilitates the search for and exchange of information. However, the problem of the dispersion of new professional and scientific findings remains since many professional magazines are not published on the Web.

Are we wasting our valuable time endlessly searching the Web for an answer? There are several glaring problems with the notion of the web as a "gigantic digital library". First, the web is an uncatalogued mess and, despite what any search engine claims to do, none of them searches the entire web. Imagine a librarian telling you that there are 60 books on your subject, but he is only going to let you look at 12 of them [2].

The aim of this paper is to describe the possibility of using search engines and computer software when searching for table tennis databases. Using the Web and TT Knowledge Base programme, table tennis scientists, coaches, PE students and others can regularly follow published table tennis and table tennis research work from all over the world.

2.0 METHODS

Instrument

The basic elements for data collections were Web search engines, SPORTDiscus and Table Tennis Knowledge Base (TTKB).

Procedure

For obtaining and completing analysis of table tennis investigation the total volume of table tennis references was collected.

3.0 RESULTS AND DISCUSSION

Unfortunately, most documents on search engines we found in the Web were either lists of hyperlinks without any comments, or discussions about how many documents are in the database of particular contents and what method of counting of the number of documents was used. No word about the efficiency, i.e. how many documents on some subject I can find using this search engine, especially in comparison to the other ones (Table 1).

Table 1 Search results with different search engines (access: 28.02.2009)

	GOOGLE	YAHOO	ALTAVISTA
equipment "table tennis balls"	35.500	203,000	203,000
how to get info about table tennis.	6.440.000	144,000,000	144,000,000
international table tennis rules	288.000	8,350,000	8,450,000
international table tennis rules and regulation	78.100	2,040,000	2,060,000
table tennis	17.300.000	143,000,000	143,000,000
table tennis balls	436.000	12,700,000	12,700,000
table tennis champion	2.970.000	24,900,000	24,900,000
table tennis equipment	347.000	22,200,000	22,200,000
table tennis game	4.910.000	1,170,000	1,170,000
table tennis history	266.000	27,900,000	28,000,000
table tennis learning	2.040.000	30,400,000	30,400,000
table tennis players	4.280.000	32,000,000	32,100,000
table tennis racket	386.000	4,360,000	4,500,000
table tennis rules	305.000	26,500,000	26,900,000
table tennis science	1.400.000	25,100,000	25,100,000
table tennis technique	782.000	12,600,000	12,600,000
table tennis tips	269.000	19,900,000	19,900,000
table tennis trainer	627.000	28,400,000	28,500,000
table tennis trainers	792.000	28,400,000	28,400,000
table tennis training	2.180.000	28,300,000	28,600,000

Search engines such as Google (www.google.com), Yahoo (www.yahoo.com), AltaVista (www.altavista.com), etc. should be utilised to locate table tennis information published on websites, e.g. research and conference papers, contents pages, references lists, etc. It should be noted that these search engines do not search inside some professional databases (e.g. Pub Med).

In addition we have search SPORTDiscus and TTKB for references about table tennis. A total of 1926 (till February 2009) references were registered in SPORTDiscus. But we have to take into account that both elements for data collection have limitations. Namely in some cases authors don't define appropriate key words in their manuscripts which can be an aspect that can generate difficulties and put limits to the search possibilities [4]. On the other side, it is possible that some references are incompletely listed or there can be a lack of information in their search fields [1].

Table 2 Search results with SPORTDiscus and TTKB

	SPORTdiscus	TTKB
table tennis	1926	923
table tennis balls	4	65
table tennis champion	4	12
table tennis equipment	11	4
table tennis game	3	24
table tennis history	0	0
table tennis learning	0	23
table tennis players	30	114
table tennis racquet	2	27
table tennis rules	5	10
table tennis science	1	8
table tennis spin	2	22
table tennis technique	7	41
table tennis trainers	1	2
table tennis training	13	94

Before you start your search, you should be aware of the completeness and the sort of information you can find in the Net. Lebedev [3] did an informal study called 'Best search engines for finding scientific information on the web' in 1996, which describes the functionality of selected search engines using the number of documents returned as the primary parameter for a good search engine. He states: "My estimates show that the maximum number of documents which can be found in the net is less than 10% of the number that can be (found) using a good scientific database like INSPEC or CAS. Thus, the bigger is the database of a search engine, the higher are chances that you won't miss something important". (Lebedey 1996, 33)

Databases remain the primary method of locating quality sports and table tennis information. Listed below are several databases available through the web that can assist you. The following two most wanted databases you can find in the Hochschulnetz (University web):

- **SPORT Discus** ("Weltdatenbank des Sports"/Worlddatabase of Sport), is issued by Sport Information Resource Centre (SIRC) in Canada. Besides numerous documents in English it also contains the databases Heracles, Atlantes and the catalogue of "Musée Olympique". This is the most comprehensive database covering table tennis information needed by scientists and coaches.
- **HERACLES** (French Database of Sport Science) of the Institut National du Sport et de l'Éducation Physique (INSEP), Atlantes (Spanish database) and the catalogue of "Musée Olympique". These three databases are a part of Sport Discus.

Here you can find some more information about the free access to some sports databases in the web:

- **Spolit** (Dokumentation sportwissenschaftlicher Literatur, Erfassungszeitraum ab 1970)/Dokumentation of the Sport Science Literature, collected since 1970), published by the German „Bundesinstitut für Sportwissenschaft".
- **Spofor** (Dokumentation sportwissenschaftlicher Forschungsprojekte, Forschungsarbeiten der letzten 12 Jahre/Dokumentation of Sport Science Research Projects, research projects of the last 12 years), published by the German „Bundesinstitut für Sportwissenschaft".
- **Spomedia** (Dokumentation von AV-Medien im Sport/ Dokumentation of the AV-media in sport), published by the German „Bundesinstitut für Sportwissenschaft".
- **SPOWIS** (database "Sportwissenschaft") from „Institut für Angewandte Trainingswissenschaft (IAT)" in Leipzig, mainly Dokuments for the German speaking countries and for Easteurope, completed in 1995.
- **Heracles** (French, sports science database), published by the SPORT-DOC.
- **Sponet** (web-sources for Sport and Sport Science – Emphasis on Training Science).
- **SportScan database** (Australian Recherche database of the National Sport Information Centre. Once known as Sports journal update database).
- **Altis** (database of the University of Birmingham with information and links to health, spare time, sport and tourism).
- **Coaching science abstracts** (abstract-database by Brent S. Rushall, San Diego State University regarding the topic training).
- **Digital Library d. World Anti-Doping Agency WADA/AMA** – contains up-to-date anti-doping-publications of the WADA/AMA-member states.
- Etc.

Useful features of the database include links to full text articles, journal browsing, marking references and saving search strategies for future use (cubby future).

Faculty of Sport at the University of Ljubljana has developed one of the largest table tennis literature database collections in the world known as Table Tennis Knowledge Base (TTKB) [5]. This collection has been developed to service the information needs of table tennis scientists and professionals around the world. The TTKB is designed to deliver the latest sports science information to sports practitioners including coaches, participants, physical educators and practitioners in table tennis area with sports focus. The basic idea of the information system in TTKB is to enable any user interested in these topics to access the database and enter the latest information regarding table tennis. The data entry is controlled by the software, meaning that the same article cannot be entered in the database more than once. The data entry system ensures the uniqueness of each individual reference.

For unregistered users the data entry consists of two phases; in the first phase the unregistered user can enter an article and add it to the waiting list to be reviewed and confirmed by the database administrators. In the second phase, the article is incorporated in the database. This method helps to prevent any malicious entering of nonsense data in the database (i.e. spam). When an individual contributes a certain number of articles in the database she or he becomes a registered user. Registered users are trustworthy individuals who are granted the right to make direct entries in the database without adding their entry to the waiting list. In exchange for their contributions, they are granted access to all the data in the central database.

It is in table tennis experts' interest to enter information which is still lacking in the database. Thus the database of professional and scientific articles, authors, test descriptions etc. grows daily, while any individual can acquire the status of a registered user by contributing a number of entries. As mentioned earlier, registered users can enter new articles directly into the database while at the same time retrieving articles and other information from the database without limitations. This system involves mutual dependency between its administrators and users.

We believe the 'Table Tennis Knowledge Base' information system will be very useful for table tennis coaches and researchers as it will enable fast access to data on articles from various countries. The system is designed in such a way as to motivate every individual to contribute to the central database. Thus, the most relevant data on table tennis will be available in the one place which will save a lot of time and help in keeping track of novelties from various fields of expertise. Currently there are over 1000 data entries.

4.0 CONCLUSIONS

At the end, the idea that the web can be a replacement for a library ignores the most important characteristics of a library. A library is not just a collection of books, or some vast warehouse of words, books, and journals; it is part of our cultural, historical and scientific memory. With the advent of the web, libraries are now connecting and sharing their collections and resources with each other. Thus an individual academic or public library can be the access point for scientists and people

to explore their world and their history, and to enlist the aid of information professionals to help guide them through their contents.

We also believe that the situation with scientific documents in table tennis will improve soon because many editors of scientific journals start to publish contents of their editions, and sometimes the full papers in the Internet. Low frequency of updating of databases of search engines and imperfect algorithms for locating and adding new URLs into these databases is now becoming the problem. In our analysis of the contents of URLs we saw many links to interesting scientific documents that were not indexed by most search engines.

In recent years there has been a decline in the publishing of printed conference proceedings and a move to publishing these proceedings on the Web or on the CD-s and DVD-s.

5.0 REFERENCES

[1] Carrasco Páez L., Pradas de la Fuente F. & Godoy-Izquierdo D. (2007). Actual state of table tennis research throughout sport discus database Analysis. In: Kondrič, M., & Furjan-Mandić, G. (ed). *Proceedings book.10th International Table tennis Sports Science Congress* (p. 463-469). Zagreb:Faculty of Kinesiology, CTTA, ITTF.

[2] Herring, M. (2001). 10 reasons why the Internet is no substitute for a library. *Am. Libraries* 32, 76-78.

[3] Lebedev, A. (1996) *Best search engines for finding scientific information on the Web*. http://scon155.phys.msu.su/~swan/comparison.html (access: 28.02.2009)

[4] Lepowski, F.J.(1991). Sport Discus CD-ROM: Access to Sport Information. *CD-ROM Librarian*. 6-(8), 41-44.

[5] Štihec J., Kondrič M., Karpljuk D. & Videmšek M. (2007). Development of database system "knowledge base" in table tennis. In: Kondrič, M., & Furjan-Mandić, G. (ed). *Proceedings book.10th International Table tennis Sports Science Congress* (p. 470-476). Zagreb:Faculty of Kinesiology, CTTA, ITTF.

Somatotype and Body Composition of Young Top-level Table Tennis Players

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Abstract: **Introduction.** The aim of this study was to analyze the anthropometric profile of young top-level table tennis players belonging to Spanish table Tennis National Team. A total of 63 players (38 males and 25 females), aged between 10 and 13 years were evaluated with the sex as a factor. **Methods.** Different body measurements were recorded following the guidelines proposed by the ISAK: body mass, height, skinfolds (biceps, triceps, subscapular, suprailiac, supraspinale, abdominal, anterior thigh, and medial calf), girths (arm flexed and relaxed; arm flexed and tensed, thigh, and calf) and breadths (biepicondylar of the humerus, bistyloid, and biepicondylar of the femur). In addition to anthropometric analysis, body composition and somatotype of participants have been assessed. A t- test for independent samples was performed to examine statistical differences between sex groups and a Pearson's coefficient was applied to evaluate the correlation between variables. **Results.** A mesomorph – endomorph somatotype was registered for the entire group. Analysis, taking into account the sex factor, revealed a balanced mesomorph somatotype for males and a mesomorph - endomorph somatotype for females. Data corresponding to body composition contrasted by sex showed higher body fat percentage in females than in males. **Conclusions.** Within the tested age interval, range body fat content in female players is higher than in male players. Although these differences may be the consequence of a normal growth, it is advisable to integrate educational and nutritional strategies in order to maintain an adequate body fat content.

Keywords: Table Tennis, Body Composition, Somatotype, Young Players.

1. INTRODUCTION

Table tennis is an acyclic sport in which work and rest time periods are continuously alternated. Also, the intensity developed during the match makes it mixed activity, taking into account the energetic metabolism [1].

The most important physical capacities of the players are endurance and velocity, due to the short time high intensity periods under anaerobic metabolism that characterize the match: Players need velocity training while the capacity to face match duration mainly depends of endurance training [2]. However, strength, coordination and flexibility may also have a key role in this sport [3].

Although it is evident that the physical training is an important factor to reach sport success, several studies demonstrated that, at the same training level, the best performances are obtained by athletes with more compatible anatomic conditions [4].

These structure relationships have been studied through observational investigations revealing how athletes with the same sport performances presented similar anthropometric parameters and body composition [5].

Nowadays, the study of human form is a useful tool for both early talent selection and for evaluating the efficacy of a training program. A good number of investigators agree on the importance of early discovering the most capacitated subjects, selecting them and carrying out a monitoring process to facilitate maximal development of young athletes in any sport [6].

In this way, and taking into account 1. the importance of early sport talents detection, 2. biotype influence in sport performance, and 3. lack of definition of suitable morphology of table tennis players, it is necessary to perform analysis that may provide a specific anthropometric reference for this sport.

Thus, the aim of this study was to determine the morphologic profile of young top-level table tennis players, assessing their somatotype and body composition.

2. METHODS

Subjects.

A total of 63 table tennis players (38 males and 25 females), aged between 10 and 13 participated in this study. All players were members of the National Sport Technification Program developed by the Spanish Table Tennis Federation at the moment of the study.

A written informed consent was obtained from parents or tutors of all subjects prior to participation in this study that was also approved by the *Ethic Committee* of the University of Seville, Spain.

Anthropometric measurements, somatotype and body composition assessment.

Different body measurements were registered following the guidelines proposed by the International Society for the Advancement of Kinanthropometry (ISAK): body mass, height, skinfolds (biceps, triceps, subscapular, suprailiac, supraspinale, abdominal, anterior thigh, and medial calf), girths (arm flexed and relaxed; arm flexed and tensed, thigh, and calf) and breadths (biepicondylar of the humerus, bistyloid, and biepicondylar of the femur).

Somatotype was calculated according to the method proposed by Heath and Carter (1967) [7]. Moreover, De Rose and Guimaraes equations [8] were used in the determination of body composition for both males and females table tennis players.

Statistical analyses.

Standard statistical methods were used for calculating mean values and standard deviations (SD). The Kolmogorov-Smirnov test was applied to determine the nature of data distribution. Since a normal distribution was confirmed, a t- test for independent samples was performed to examine statistical differences between sex groups. In any case, a 95% confidence interval was assumed.

3. RESULTS

General characteristics of table tennis players are summarized in Table 1. There were no statistical differences in any of parameters considered.

Table 1. General characteristics of the subjects.

	Age (years)	Body mass (kg)	Height (cm)	Body mass index ($Kg \cdot m^{-2}$)
Males (n=38)	11.32±1.82	41.61±1.84	149.1±12.16	18.36±2.51
Females (n=25)	11.56±1.94	44.36±11.21	150.6±10.89	19.25±3.22
Total (n=63)	11.41±1.85	42.70±11.58	149.7±11.60	18.71±2.82

Data are expressed as mean ± SD.

Figure 2 shows body composition parameters expressed in percentage with respect to the total body mass. Bone mass and residual mass were higher in males than in females ($p \leq 0.05$), whereas female players showed higher fat mass values ($p \leq 0.001$). There were no statistical differences for muscle mass.

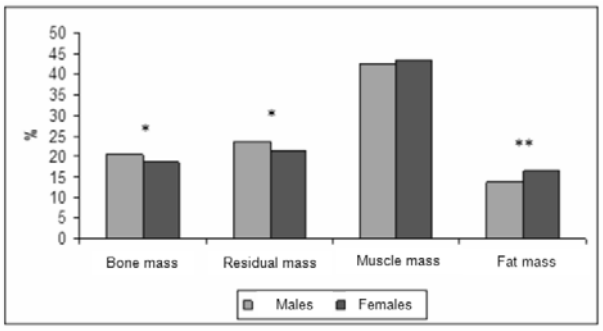

Figure 1. Body composition of table tennis players. *p≤0.05; **≤p0.001

Mean male players' somatotype was classified as balanced mesomorphy, while a mesomorph - endomorph somatotype was registered for female players and the total group. Mesomorphy component was higher in males than in females ($p \leq 0.001$) and endomorphy component was higher in females than in males ($p \leq 0.001$) (see Table 2 and Figure 2).

Table 2. Somatotype components and somatochart coordinates.

	Somatotype components			Somatochart	
	Endomorphy	Mesomorphy	Ectomorphy	X	Y
Males (n=38)	3.62±1.41	4.64±0.74**	3.28±1.18	-0.3	2.3
Females (n=25)	4.41±1.49**	4.10±1.24	2.92±1.39	-1.4	0.8
Total (n=63)	3.93±1.48	4.42±0.99	3.14±1.27	-0.7	1.7

Data are expressed as mean ± SD. **p≤0.001

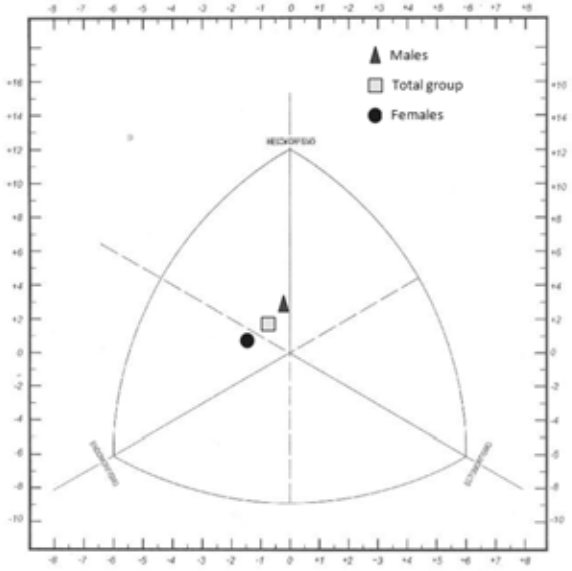

Figure 2. Somatochart.

4. CONCLUSIONS

The aim of this study was to determine body composition and somatotype of young top-level table

tennis players. Although the influence of anthropometric characteristics on table tennis performance is not clear yet, it seems obvious that a mesomorphic predominance can play a decisive role in any sport, including this one [9]. Indeed, several investigations carried out with table tennis players demonstrated a superior muscular development in lower extremities [10].

On the other hand, high levels of body fat could have a negative effect on sport performance, since body mass improvments are not correlated with the capacity of generating muscular strength. Furthermore, and considering that acceleration is directly proportional to the strength production, but inversely proportional to body mass, fat excess could reduce global or segmental velocity in any sport skill, increasing the energy cost at the same time [11].

In the present study, focused on young top-level table tennis players, a greater body fat mass was observed in female players than in male players. Bone mass and residual mass were higher in male players than in female players, something that was expected because De Rose and Guimaraes equations [8] contain constant coefficients that are different by sex. Nevertheless, muscle mass showed no statistical differences between male and female players.

Regarding to somatotype assessment, mesomorphy was the most important component in male players. In female players a remarkable endomorphic component was observed thus, mesomorph–endomorph somatotype was defined for them and when the total group was considered. In this sense, it is important to note that the age of the players analyzed correspond to the prepuberal phase in which muscles are underdeveloped and fat content can be prominent.

Data from investigations carried out using different athletes of the same age, reported similar results [12, 13]. Moreover, in a recent study, de Hoyo et al. [14] found a greater incidence of overweight in young volleyball players than in sedentary age-matched people. Taken into account these results, it is easy to conclude that anthropometric analyses and body composition evaluation may not represent a valid tool for selecting young talents in sports.

It can be concluded that at this age range body fat content in female players are higher than in male players. Although these differences are consequence of a normal growth, it is necessary to integrate educational and nutritional strategies in order to maintain an adequate body fat content.

REFERENCES

[1] Faccini P, Faina M, Scarpellini E, and Dal-Monte A. “Il costo energetico nel tennistavolo”. (Energy cost in table tennis.) *Scuola dello sport*, No. 17, pp.38-42, 1989.

[2] Bagur JC, and Serra JR. “Clasificación de la actividad física y de los deportes más comunes en función del trabajo que requieren”. In: Serra, J.R. *Prescripción de ejercicio físico para la salud*, Paidotribo, Barcelona, 1996.

[3] Bermejo JL, Quintano J, Ramos M, and Dongping Z. *Tenis de mesa*, Comité Olímpico Español, Madrid, 1991.

[4] Esparza F. *Manual de cineantropometría*, GREC-FEMEDE, Pamplona, 1993.

[5] Zatsiorski V. *Metrología deportiva*, Planeta, Moscú, 1989.

[6] Bompa T. “La selección de atletas con talento”, *Revista de Entrenamiento Deportivo*, Vol. 1, No. 2, pp. 46-54, 1987.

[7] Carter JEL, and Heath BH, *Somatotyping. Development and applications*, Cambridge University Press, Cambridge, 1990.

[8] de Rose EH, and Guimaraes AC. “A model for optimization of somatotype in young athletes”. In: Ostin M, Buenen G, Simons J: *Kinanthropometry II*, University Park Press, Baltimore, 1980.

[9] Pradas F, Carrasco L, Martínez E, and Herrero R. “Anthropometric profile, somatotype, and body composition of young table tennis players”, *Revista Internacional de Ciencias del Deporte*, Vol. 3, No. 7, pp. 11-23, 2007.

[10] Matytsin OV. “The role of personal characteristics of the table tennis player in providing efficiency and stability during competitions”, *International Journal of Table Tennis Sciences*, 2, pp. 55-60, 1994.

[11] Shephard K, and Astrand P. *La resistencia en el deporte*, Paidotribo, Barcelona, 1998.

[12] Carrasco L, Martínez E, and Nadal C. “Perfil antropométrico, somatotipo y composición corporal de jóvenes piragüistas”. *Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte*, Nº. 20, 2005.

[13] de Hoyo M, and Sañudo B. “Composición corporal y actividad física como parámetros de salud en niños de una población rural de Sevilla”. *Int J Sport Sci*, Vol. 3, No. 6, pp. 52-62, 2007.

[14] de Hoyo M, Sañudo B, and Carrasco L. “Assessment of somatotype in young volleyball players: validity as criteria to select young sports talents”, *Rev Bras Cineantropom Desempenho Hum*, Vol. 10, No. 3, pp.255-260, 2008.

Muscular Power of Leg Extensor Muscles in Young Top-level Table Tennis Players

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Abstract: **Introduction.** Table tennis is an individual and asymmetric sport in which a great number of shots are performed at high speed developing high levels of muscular power. The aim of this study was to determine the power of leg extensor muscles in young top-level table tennis players. **Methods.** A total of 63 players (38 males and 25 females), aged between 10 and 13 years and members of Spanish National Team have been included in the study. After 15-min of easy cycling (cycloergometer Monark 810) subjects randomly carried out three attempts on SJ test and three more on CMJ test (Newtest® contact map). A rest period of two minutes was established between attempts. The test was executed for both jumps following the original protocol. The measured variables were jump height (cm), flight time (ms), power (W), and elasticity index. A t-test for independent samples was performed to examine statistical differences between sex groups. **Results**. All variables measured on SJ and CMJ tests showed higher values in female than in male players (with exception of the flight time). Also, data related to CMJ were higher than those registered in SJ, independently from the sex factor (see table below). The elasticity index was higher in female players than in male players. **Conclusions.** Although within the tested age interval, sex differences in generating muscle power are not clear, higher values in female players have been registered for all variables measured, with exception of the elasticity index.

Keywords: Table Tennis, Muscular Power, Leg Extensor Muscles, Young Players.

1. INTRODUCTION

Table tennis is an individual and asymmetric sport in which a great number of shots are performed at high velocity developing high levels of muscular power.

Although the end of the shot implies an important shoulder, arm and wrist muscles activation, it starts at the lower limbs level, where the action of extensor muscles plays a key role.

Moreover, players develop a great number of quick displacements and changes of direction during the match generating high levels of mechanical power with lower limb extensor muscles. For this reason, muscular power or mechanical power are essential variables for assessing performance in table tennis.

Jump test have been frequently use to evaluate peak power output from this muscles [1]. Indeed, several authors have registered data concerning vertical jump parameters in senior table tennis players, reaching to establish differences between offensive and defensive players [2].

However, there is a lack of information about mechanical power generated by leg extensor muscles of young table tennis players. These data may serve as criteria for young players' selection and for evaluating muscular strength development during training process.

Thas, the aim of this study was to evaluate the muscular power of leg extensor muscles in young top-level table tennis players considering sex as a factor.

2. METHODS

Subjects.

A total of 63 table tennis players (38 males and 25 females), aged between 10 and 13 participated in this study. All players were members of the National Sport Technification Program developed by the Spanish Table Tennis Federation at the moment of the study.

A written informed consent was obtained from parents or tutors of all subject prior to participation in this study that was also approved by the *Ethic Commite* of the University of Seville, Spain. The general characteristics of subjects are summarized in Table 1.

Table 1. General characteristics of the subjects.

	Age (years)	Body mass (kg)	Height (cm)	Body mass index ($Kg \cdot m^{-2}$)
Males (n=38)	11.32±1.82	41.61±1.84	149.1±12.16	18.36±2.51
Females (n=25)	11.56±1.94	44.36±11.21	150.6±10.89	19.25±3.22
Total (n=63)	11.41±1.85	42.70±11.58	149.7±11.60	18.71±2.82

Data are expressed as mean ± standard deviation (SD).

Test procedure

After 15-min of easy cycling (cycloergometer Monark 810®, Stockholm, Sweden) three squat jumps (SJ) and three counter movement jumps (CMJ) were performed in random order on a jumping mat connected to an electronic timer (Newtest Oy® - Powertimer®, Oulu, Finland). Two min rest period between attempts

was established. Test was executed following the original protocol for both jumps [1]. In any case, the best attempt (highest jump) was registered. In both SJ and CMJ, variables measured were jump height (JH; cm), flight time (FT; ms), power (W), and elasticity index (CMJ – SJ *100 / SJ) [1].

Statistical analyses.

Standard statistical methods were used for calculating mean values and standard deviations (SD). The Kolmogorov-Smirnov test was applied to determine the nature of data distribution. Since a normal distribution was confirmed, a t- test for independent samples was performed to examine statistical differences between sex groups. The confidence interval was established at 95%.

3. RESULTS

As it can be seen in Table 2, both JH and FT variables were higher in female players than in male players ($p \leq 0.05$).

Table 2. Data from vertical jump test.

	SJ		CMJ	
	JH (cm)	FT (ms)	JH (cm)	FT (ms)
Males (n=38)	15.8±4.2	357.2±44.4	16.9±4.8	369.0±49.9
Females (n=25)	19.4±6.7*	395.5±52.1*	21.0±6.1*	423.0±50.1*
Total (n=63)	17.6±5.0	377.0±49.3	19.0±5.2	394.8±49.9

*$p \leq 0.05$ (t-test between sex groups).

Similarly, female players were able to generate higher mechanical power than male players (822.0 ± 268.7 W and 759.3 ± 465.6 W for female and male players, respectively) (Figure 1).

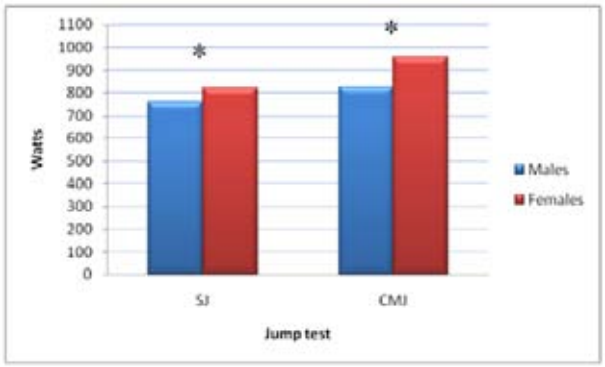

Figure 1. Mechanical power of leg extensor muscles developed in jump test. *$p \leq 0.05$ (t-test between sex groups).

On the other hand, elasticity index assessed in both groups revealed a no statistical differences, but approached statistical significance (7.1 ± 3.2 and 8.2 ± 2.8 for male and female players, respectively; $p=0.063$) (Figure 2).

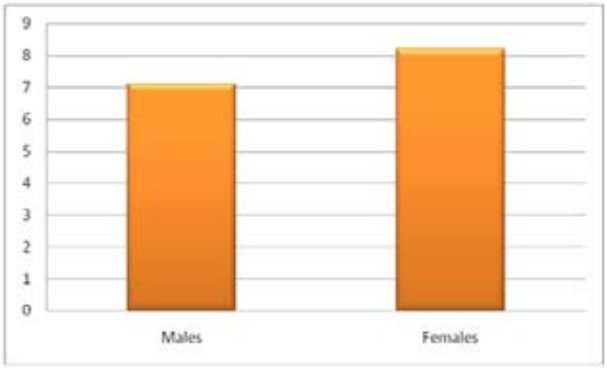

Figure 2. Elasticity Index

4. CONCLUSIONS

The most relevant result found in this study is related to the differences between male and female young table tennis players regarding jump capacity. This led to higher JH and FT in SJ and CMJ for female players. Although there is no evidence one cam speculate that withim the tested age range, females can exhibit higher madurative state than males. Moreover, sex differences in segmental coordination can play an important role in vertical jump performance, a factor not considered in this study.

In general, values related to JH are in consonance with the results of González et al. [4] who registered mean JH for SJ and CMJ of 18.3 cm and 21.6 cm, respectively, for students of both sex and ages between 10 and 12 years. In this sense, Pérez-Gómez et al. [5] found JH for SJ and CMJ of 18.8 and 22.4 cm, respectively, in female gymnasts aged 10-11. By sex, these authors found JH of 17.7 cm in SJ and 20.5 cm in CMJ for female students and 19.0 and 22.8 for male student. Data of males are higher than those found in the present study, where male table tennis players only reached JH of 15.8 cm in SJ and 16.9 cm in CMJ. Lack of control in testing protocol and differences in knee flexion angles at the start of SJ and at the end of eccentric phase of CMJ can be decisive factors for explaining these differences [6].

Mechanical power was higher in female than in male table tennis players, according to higher JH and FT for this sex group. Also, female players showed higher body mass values than males, resulting in higher levels of mechanic power.

Regarding to elasticity index, there are no statistical differences between sex groups. Nevertheless, we found high values (7.1 and 8.2 for male and female players), especially when they are compared with those registered

by Gonzalez et al. [4] who reported indexes of 3.3 in students aged between 10 to 12. These differences can be originated by the above-mentioned factors by a little countermovement in SJ performance.

In any case, the real efficacy of these muscular tests for selecting young sport talents can be questioned considering the results obtained by Castillo et al. [7] who found similar SJ and CMJ between young soccer players and age-matched students, and taking into account the difficulties for to carry out SJ and CMJ test in the correct form.

Although at this age range sex differences in muscle power generation are not clear, we registered higher values in female players for all variables measured, with exception of elasticity index.

REFERENCES

[1] A. Lara, M.L. Alegre, J. Abián, L. Jiménez, A. Ureña, X. Aguado, “The selection of a method for estimating power output from jump performance”, *Journal of Human Movement Studies,* Vol. 50, pp. 399-410, 2006.

[2] F. Pradas, C. de Teresa and M.C. Vargas, “Evaluation of the explosive strength and explosive elastic forces of the legs in high level table tennis players”, *Sport Science Research,* No. 3, pp. 80-86, 2005.

[3] C. Bosco. *La valoración de la fuerza con el Test de Bosco*, Paidotribo, Barcelona, 1994.

[4] J.L. González, N. Díaz, L. García, J. Mora, J. Castro, and M. Facio. Jumping capacity and elasticity index at primary scholar age. *Rev Int Med Cienc Act Fís Deporte,* Vol. 7, No. 28, pp. 359-373, 2007.

[5] J. Pérez-González, G. Vicente-Rodríguez, I. Ara, R. Arteaga, J.A.L. Calbet, and C. Dorado, “Capacidad de salto en niñas prepúberes que practican gimnasia rítmica”, in *IV Congreso de la Asociación Española de Ciencias del Deporte; Book of Abstracts*, Asociación Española de Ciencias del Deporte, Pontevedra, 2006.

[6] F. M. Bobbert and L. J. Richard, “Is the effect of a countermovement of jump height due to active state development?”, *Medicine and Science in Sports and Exercise*, Vol. 37, No. 3, pp. 440-446, 2005.

[7] A. Castillo, J. Canalejo, E. Martínez, A.M. Muñoz, G. Bermejo, J.M. Garrido Jiménez, and E. Armada, “Estudio comparativo sobre la capacidad de salto, flexibilidad y resistencia entre futbolistas y escolares de 13 años de la ciudad de Cartagena”, In: *Actas IV Congreso Internacional de Fútbol Base / XI Jornadas Nacionales de Fútbol*, Ayuntamiento de Cartagena, Cartagena, 2005.

Design and Development of an Observational Tool for Evaluating Table Tennis Singles Matches

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Abstract: **Introduction.** In the field of high level sport performance, evaluation of game actions during competition is a matter of great interest. Systematic assessment of table tennis matches represents a basic method to understand this sport, its physical training as well as its strategy and behavioral techniques. During a table tennis match, we can observe a high number of technical actions in a short decision time between one set and the following one. Due to this complexity, a systematic evaluation model of table tennis game actions is necessary to understand the strategy of each player, possibly improving their performance. The aim of this study was that of developing an observational tool for analyzing the different variables that characterize a table tennis singles matches. **Methods.** An observational method was applied for analyzing each match. The development of this tool was accomplished in different steps: 1. Design of the procedure for match video recording; 2. Development of an observational protocol; 3. Design of a database to organize and store the results; 4. Validation of the tool assessing its reliability. **Results.** The informatic tool provided data recording: the match time structure, the playing technique, the ball touching area on the table, the effectiveness of the playing technique in terms of performance. Data evaluation gave the possibility of predicting the player's game strategy as well as his effectiveness in terms of wining and loosing points, through the analysis of frequencies and delays. **Discussion.** The systematic evaluation of the data provided by the informatic tool represents a basic method to understand table tennis. Moreover, this tool allows identifying the physical, tactical and technical profile of the players. **Conclusions.** The informatic tool described in this study allows knowing which single technical-tactical elements led to the final result. The knowledge of these data may help the player and the coach to focus on the weak points and to understand what aspects of the training planning have to be improved or changed. In this way, the training process may be modified in the attempt of reaching the highest level sport performance.

Keywords: Informatic tool, Timing structure, Technical actions, Prediction levels, Notational Analysis.

1. INTRODUCTION

In the field of high level racket sport performance, evaluation of game actions during competition is a matter of great interest in scientific writings [1-4]. Systematic assessment of table tennis matches represents a basic method to understand this sport, its physical requirements as well as its strategy and behavioral techniques [5-7]. Considering this, observational methodology can be a valid scientific tool to describe the player's actions in the sport scene [8,9].

Single modern table tennis competition, and other racquet sports such as tennis, squash and badminton, takes place in an area of motor function in which two athletes carry out different conducts following a logical contrary interaction [10,11].

In each match we can see an important number of elements, all of them constituting the motoric body of table tennis: different techniques decided upon and executed within a short period of time and with a rapid succession from one action to the other. This complexity makes very difficult to study the sequences of motor interactions, so it is of great importance to establish a game's action systematic assessment model, that will provide knowledge of each player's strategy, and improve his/hers sport performance**.**

Thus, the aim of this investigation was that of creating a computerized instrument for observing, coding and analyzing every one of the different elements that take place in the single table tennis competition.

2. METHODS

An *ad hoc* observational instrument, made up by a combination of an organised system of categories and events has been designed to assess game actions in single table tennis competition. This taxonomic system has been made following the observational methodology rules [12,13]. All categories included in every observational criteria, are exhaustive and mutually excluded.

The development of this instrument was done in

consecutive phases:

1. Designing a competition recording procedure.
2. Designing an observational protocol for each match.
3. Designing a database to save and organize the observational results.
4. Verifying the instrument's validity, reliability and accuracy.

2.1 Taxonomic system

Interactions of the techniques that are used in single's table tennis competition have been taken into consideration when developing the system of categories. In a sequenced manner we have defined the variety of events in different levels. The point establishes the moment the ball is being played, as well as the moment that it is out of the game.

The situations we assess in this investigation are those in which the ball is being played, but we also consider those in which it is not being played, to later analyze the temporal structure of the whole match. The instrument that sequentially describes the players conduct interaction is made up by seven categories: start, end, player, racquet grip, strike, technique and bounce area.

Start category is made up by 4 events: PART, TANT, JUE, T_MU.

Start category	
PART	Match start
TANT	Point start
JUE	Game start
T_MU	Time out

End category is made up by 7 events: T_1, T_0, J_1, J_0, PA_1, PA_0, T_NUL.

End category	
T_1	The player wins the point
T_0	The player loses the point
J_1	The player wins the game
J_0	The player loses the game
PA_1	The player wins the match
PA_0	The player loses the match
T_NUL	Invalid point

Player category is made up by 2 events: JUG1, JUG2.

Player category	
JUG1	Player that starts serving
JUG2	Player that starts returning the service

Racquet grip category is made up by 2 events: ASIA, EUR.

Racquet grip category	
ASIA	Asian racquet grip
EUR	European racquet grip

Stroke category is made up by 2 events: DCHA, REVS.

Stroke category	
DCHA	Forehand
REVS	Backhand

Technique category is made up by 5 events: SERV, SPIN, CORT, SIN, OTRA.

Technique category	
SERV	Service
SPIN	Topspin
CORT	Backspin
SIN	No spin
OTRA	Not classifie

Bounce area category is made up by 6 events: Z_1, Z_2, Z_3, Z_4, Z_5, Z_6 (Figure 1).

Bounce area category	
Z_1	Left square close to the net
Z_2	Right square close to the net
Z_3	Left square on the middle of the table
Z_4	Right square on the middle of the table
Z_5	Left square back on the table
Z_6	Right square back on the table

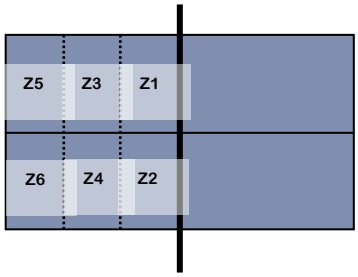

Fig. 1 Court area divisions.

2.2 Participants

To create this observational method high level matches belonging to the the Spanish elite division "la Superdivison", The Champions league, Spanish senior championships and the International Top12 ENEBE have been evaluated.

2.3 Materials

We used two cameras fixed in a lateral-superior angle in order to code each match. Each camera registered one half of the table (Figure 2).

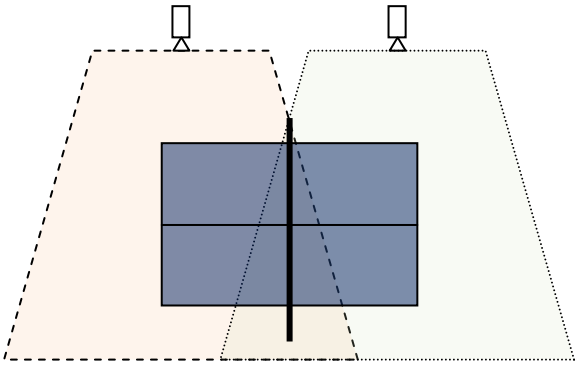

Fig. 2 Location of the recording spaces in the court area.

A total of 4 cameras (Panasonic NV-GA15), 4 telescopic supports 3 metres high (Manfrotto model 007U), 25 metres of cables, one staircase, 200 miniDV tapes and the computer program Match Vision Studio v. 3.0® were used to register and code the information (Figure 3).

Fig. 3 Example of computerized analysis using Match Vision Studio v. 3.0®.

2.4 Experimental design

The information has been coded and registered in a continuous and sequenced manner, two observers have been trained, using a protocol of observation, registering the matches at different times during the day. The analysis of the information is approached from two perspectives: one qualitative, where the concordance derives from a consensus between experts in table tennis, and the other is from a quantitative point of view, where we estimate correlations, concordances and the possibility of generalising the information from the different observations and between observers.

3. RESULTS

The results regarding the quality of the information are satisfactory. The numbers for validity and viability between observers and within each observer gave an error percentage under 5% (Table 1 and 2).

Table 1. Frequencies recorded for each category and observation.

	% Error intra-observer Observer A	% Error intra-observer Observer B	% Error inter-observer Observer A	% Error inter-observer Observer B
Set time 1	0.0	0.5	0.3	0.1
Set time 2	0.0	0.0	0.0	0.0
Set time 3	0.0	0.0	0.0	0.0
Set time 4	0.0	0.0	0.0	0.0
Match time	0.0	0.0	0.0	0.0
Play time set 1	1.8	3.6	2.7	1.8
Play time set 2	0.0	2.5	4.1	2.8
Play time set 3	1.4	2.7	4.6	2.6
Play time set 4	0.0	1.8	2.7	0.0
All play time	0.4	0.4	3.7	2.2
Rest time set 1	0.6	0.6	0.7	0.7
Rest time set 2	0.4	0.9	1.2	1.0
Rest time set 3	0.4	0.9	1.4	0.8
Rest time set 4	0.0	0.6	0.8	0.1
Rest time between set 1 y 2	0.0	0.0	0.6	0.2
Rest time between set 2 y 3	0.0	0.0	0.0	0.0
Rest time between set 3 y 4	0.0	0.0	0.1	0.4
All rest time	0.0	0.0	0.1	0.1

The instrument and its system of evaluation describe and analyze the strategic conducts developed by the players during the competition (Table 3), giving relevant information regarding the:

- Temporal structure of single game.
- Techniques used by the players.
- Areas of contact between ball and table.
- Efficiency-levels in the rendition of the techniques used.

Table 2. Reliability of scoring, stroke, technique and bounce area categories (Cohen's coefficient kappa).

Categories	Intra-observer A	Intra-observer B	Inter-observer A-B
Scoring	0.889	0.665	0.935
Stroke	0.986	0.967	0.987
Technique	0.959	0.919	0.896
Bounce area	0.858	0.890	0.790

Table 3. Summary of all the variables under study when performing one observational analysis.

Time							
Match time	54'13"						
Set time	4'06"	5'46"	5'08"	6'03"	6'10"	10'23"	9'11"
Rally length	52"	58"	1'02"	1´13"	1'07"	2'36"	2'05"
Inter-point time	3'21"	4'50"	4'05"	5'21"	4'58"	8'26"	7'06"
Inter-set time	1'46"	2'	1'55"	1'58"	2'15"	2'08"	-
Points							
Win and lost points in each set (player A)							
Winner	6	4	2	3	1	5	4
Loser	1	4	3	4	4	6	5
Win and lost points in each set (player B)							
Winner	3	4	8	2	7	6	6
Loser	5	7	3	8	7	5	5
Strokes							
Total strokes	56	65	76	76	77	119	99
Total forehand strokes	39	43	47	49	45	75	59
Total backhand strokes	17	22	29	27	32	44	40
Total services	17	20	17	18	20	24	22
Total spin strokes	21	26	28	31	28	47	39
Total backspin strokes	5	10	6	11	10	12	11
Total strokes without effect	13	9	25	16	19	36	27
Number of bounces areas for each set							
Total in Z_1	2	4	2	4	5	5	3
Total in Z_2	3	1	4	7	2	7	11
Total in Z_3	14	14	20	12	12	33	14
Total in Z_4	12	21	18	15	20	26	21
Total in Z_5	6	4	10	15	9	13	15
Total in Z_6	5	7	10	10	11	19	17

When registered and processed in the appropriate manner, all this information provides a way to evaluate tendencies and preferences of the player in motor conduct, that is, establishing predicaments in the tactics used by the player, based on the analysis of frequencies and delays, and its efficiency shown in the production of winners and losers.

4. CONCLUSIONS

The systematic study of information gathered with this method, constitutes a basic method for enhancing the knowledge of table tennis. Assessment of the obtained information provides a picture of the physical profile needed in modern table tennis, because it studies the temporal structure of actions during the game. It is an objective and quantitative evaluation of the techniques and tactics used, together with the efficiency and performance of them.

This designed system may determine with precision and exactitude the elements of the game that determined a given result. All these data allow the athlete and the trainer to see the patterns of conduct (an essential information in recognizing the players weak areas and strong areas).

This instrument is useful for analyzing the athlete's structure of play. It gives immediate feedback as to how to improve aspects related to training and to the process of teaching-learning.

Definitively, the various practical applications derived from this study are relevant, as they will provide knowledge of the player's conducts in competition as well as their levels of efficiency.

For later studies it is necessary to amplify the criteria in the diversification of sample, including competition type and level, and also athletes gender to be able to explore the behaviour links that occurs during the evolution of the game.

REFERENCES

[1] M. Hughes, "Computerised notation of racket sports". In: T. Reilly, M. Hughes and A. Lees, *Science and racket sports*, E&FN SPON, London, 1995.

[2] M. Hughes, "The application of notational analysis to racket sports". In: A. Lees, I. Mainard, M. Hughes and T. Reilly, *Science and racket sports II*, E&FN SPON, London, 1998.

[3] P. O'Donoghue, "Match analysis in racket sports". In: A. Lees, J.-F. Kahn and I. W. Mainard, *Science and racket sports III*, Routledge, London, 2004.

[4] M. D. Hughes, M. T. Hughes and H. Behan, "Computerized notational analysis and performance profiling in racket sports". In: A. Lees, D. Cabello and G. Torres, *Science and racket sports IV*, Routledge, London, 2009.

[5] I. M. Franks and D. Goodman, "A systematic approach to analyzing sports performance", *Journal of Sports Sciences*, No. 4, pp. 49-59, 1986.

[6] I. M. franks and P. Nagelkerke, "The use of computer interactive video in sport analysis", *Ergonomics*, Vol. 31, No. 11, pp. 1593-1603, 1988.

[7] I. M. Franks, G. E. Wilson and D. Goodman, "Analyzing a team sport with the aid of computers", *Canadian journal of Sports Sciences*, No. 12, pp-120-125, 1987.

[8] J. Castellano and A. Hernández, "El análisis de coordenadas polares para la estimación de relaciones en la interacción motriz en el fútbol", *Psicothema*, Vol. 15, No. 4, pp. 569-574, 2003.

[9] P. O'Donoghue and B. Ingram, "A notational analysis of elite tennis strategy", *Journal of Sports Sciences*, No. 19, pp. 107-115, 2001.

[10] G. Gorospe, A. Hernández, M. T. Anguera and R. Martínez, "Desarrollo y optimización de una herramienta observacional en el tenis de individuales", *Psicothema*, Vol. 17, No. 1, pp. 123-127, 2005.

[11] M. Blomqvist, P. Luhtanen and L. Laakso, "Validation of a notational analysis system in badminton", *Journal of Human Movement Studies*, Vol. 3, No 35, pp. 137-150, 1998.

[12] F. H. Sanderson, "A notation system for analyzing squash matches", *Physical Education Revue*, Vol. 6,

No. 1, pp. 18-23, 1983.

[13] J. Arnau, M. T. Anguera and J. Gómez, *Metodología de la investigación en ciencias del comportamiento*, Universidad de Murcia, Murcia, 1990.

[14] M. T. Anguera, A. Blanco, J. L. Losada and A. Hernández, "La metodología observacional en el deporte: conceptos básicos", *Lecturas: EF y deportes. Revista Digital*, 24 de agosto, http://www.efdeportes.com/efd24b/obs.htm, 2000.

Energy Expenditure and Cardiorespiratory Responses during Training and Simulated Table Tennis Match

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Abstract:
Objectives: To investigate the energy expenditure and cardiorespiratory responses during training and simulated table tennis match. Sixty university male table tennis players from Division A (thirty, elite player) and Division B (thirty, amateur player) performed both laboratory test and simulated table tennis match. Bruce protocol were used to evaluate their maximum oxygen uptake ($\dot{V}o^2max$) and Cortex Metalyzer 3B were used to evaluate their peak oxygen uptake ($\dot{V}o^2_{peak}$) during simulated table tennis match . The results demonstrated that 1. The mean Vo^2max for all players were 42.1±6.4 ml/kg/min±6.4, the maximum value was 48.5 ml/kg/min, and the minimum value was 37.2 ml/kg/min ; 2. During practice session and simulation match, group A player's oxygen consumption rate during practice session and simulating competition were 29.8±7.2ml/kg/min and 36.8±13.2ml/kg/min, respectively. There were no differences between heart rate and oxygen uptake during practice session and forehand and backhand practice; 3. Group B player's Vo^2max during practice session and simulating competition were 33.5±7.5 ml/kg/min and 35.6±18.4ml/kg/min, respectively, no differences between heart rate and oxygen uptake during practice or forehand and backhand practice sessions.4. In this experiment the players of oxygen ability and good endurance that will be better exercise performance.5. During practice session an average METS to be 8.51 ± 1.0 METS ; the simulation match METS to be 8.51 ± 1.0 METS, It belongs to extremely heavy degree of sportses to carry on the intensity of movement that table tennis trains according to this research. The intensity of simulation match is fierce sports, the energy that the competition needs to consume is much higher than to training.

Key word : 40mm table tennis ball, eleven points, oxygen uptake

INTRODUCTION

Background

In 2000, the diameter of table tennis balls was regulated to change from 38 mm to 40 mm. By doing so, it maximizes the chances for players to play back and forth more in a game so as to draw larger audience (Xu, 2004). As the ball gets bigger, it is less subject to the drag force and Maguns force than the smaller ball (Chou,2001). Hence, owing to the fact that bigger balls have less velocity and don't spin as much as smaller balls, the number of games in a match will increase, and the players will hence be trained more to endure greater energy consumption in a match.

Table tennis is one of the sports whose matches last longer. During a practice or a match, if both players are more equivalent, the competition gets more intense. As a result, players consume more physical vigor. According to previous research, the energy that a world-class table tennis player requires in a world-class match amounts to the energy required for wave racket 5,400 times or running 8,100 meters in a day. For the purpose of winning, players need to be equipped with staunch will and perseverance to overcome extreme fatigue.

The action of hitting in table tennis demands enormous accuracy. Trainees must practice repetitively to acquire the hitting skills. Therefore, it is hard to get rid of those mechanical trainings. For players to finish the monotonous training requires strong wills.

In March, 2000, the International Table Tennis Federation (ITTF) made an announcement that starting October in the same year, the diameter of table tennis balls was to change from 38 mm to 40 mm. This small change not only led to a revolution in skills, tactics, and players' mindset and physical strength, but also to an adjustment in how the players should be trained. Research points out that the new-sized ball have less velocity and doesn't spin and bounce as much as the old-sized ball, reserve hits back more easily, and this maximizes the chances for players to play back and forth more in a game. Players have greater psychological （Chen, 2000；Krohne & Hindel, 1988）and physical burdens.

Based on PENG (1993), the training of table tennis focuses on the training on players' velocity, endurance, and explosive force, in other words, on players. The source of energy required for playing a 38mm-diameter ball comes from 60% of anaerobic, 20% of AT, and 20% of aerobic (LIN, 1986). Although a 40mm-diameter ball spins 23% less and has 13% less velocity, the increase in size requires a change in physical trainings. Nevertheless, previous studies focus more on the smaller ball and on the old match system; a scientific study on the energy consumption and on field assessment in a match with bigger balls has not been done and reported. It is probably due to the difficulty in measuring the complicate movements in a table tennis match with delicate apparatus.

Taiwan's performance in international matches has improved, but to maintain and expedite that

improvement needs the intervention of sports science. Systematically doing research on the evaluation of players' energy expenditure (EE) in a new match system with a new-sized ball is the most important of all. With the efficient research and development on cortex metamax 3B in recent years, the weight and quality of the apparatus are lighter and more reliable respectively, which results in more research on EE and field assessment conducted successively. Previous literature provides no report as to EE and field assessment in a table tennis match with a bigger ball, so this hopes to be a pioneer. Two Cortex Metalyzer 3B are used to conduct field assessment in a simulated table tennis match with a new match system and a larger ball. Players' Hr, Hr Max, gas exchange including $\dot{V}O2/kg$, $\dot{V}CO2/kg$, AT, $\dot{V}O2/HR$, $\dot{V}O2HRmax$, etc. will be analyzed breath by breath. By doing so, we expect to establish players' Energy Expenditure index that provides our national table tennis athletes with reliable training parameters. If the method and result of this experiment are proven valid, more studies on martial arts, Tai Chi, badminton, and so on can be conducted likewise so as to enrich the literature.

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Purpose

This study used Cortex Metalyzer 3B to conduct field assessment in a simulated table tennis match with a new match system and a larger ball. Variables of players' Hr, Hr Max, gas exchange including $\dot{V}O2/kg$, $\dot{V}CO2/kg$, AT, $\dot{V}O2/HR$, $\dot{V}O2HRmax$, etc. were analyzed breath by breath. The main purposes of this study are: 1. to establish players' Energy Expenditure index; 2. to point out the difference in Energy Expenditure index between players from Division A and those from Division B.

Methods

The subjects of this experiment came from 30 male players from Division A and 30 males players from Division B. Pre- and post-match EE and field assessment in a match with a new match system and a bigger ball were evaluated with Cortex Metalyzer 3B. players' Hr, Hr Max and gas exchange were analyzed breath by breath.

Table 1 subjects' age, height and weight (N=60).

value	Mean	SD	MAX	min
age	22.6	2.58	27	19
Height(cm)	172.1	4.43	180	165
Weight (kg)	64.3	7.34	84	55

Experimental apparatus

CORTEX MetaMax 3B

CORTEX Biophysik MetaMax 3B portable CPX system (Cortex, Leipzig, Germany) analyzes subjects' HR, gas exchange, and ventilation breath by breath. Its accuracy was proved by Schulz, Helle and Heck (1997).

PROCEDURE

Cortex Metalyzer 3B was used for monitoring. Each player did warm-up and training to get adjusted to the equipment for 10 minutes with Cortex Metalyzer 3B on them. All the data were collected. When their heart rate returned to normal range, they started the competition. Each player underwent measurement twice on their Hr, Hr Max, gas exchange including $\dot{V}O2/kg$, $\dot{V}CO2/kg$, AT, $\dot{V}O2/HR$, $\dot{V}O2HRmax$, etc. to establish Energy Expenditure index.

All the data were analyzed via Microsoft Excel and SPSS softwares.

Results

Maximum oxygen uptake represents how well the body uses oxygen, which helps us understand how well a player restores from fatigue after physical training. If a player has higher values, he/she has better cardiorespiratory ability.

Totally there were 60 subjects: 30 male players from Division A and 30 male players from Division B. All confirmed before experiment that no previous history of heart-related diseases.

$\dot{V}o^2max$ represents the uptake of oxygen; it shows the ability of recovery from fatigue in physical training of players. The higher $\dot{V}o^2max$ represents the better cardiorespiratory ability. This research demonstrated the measurement of the oxygen uptake and the energy expenditure from 60 male table tennis players' during practice sessions and simulated competition by CORTEX MetaMax 3B.

This experiment included 60 male players divided into A (elite players for 30) and B(secondary players for 30) groups. For the security during the experiment, all players were ensured to be in a healthy status by filling in a form about self-health examination.

The mean of the oxygen uptake from players in Group A during practice sessions was about 29.8±7.2 $ml \cdot kg^{-1} \cdot min^{-1}$ and was about 36.8±13.2 $ml \cdot kg^{-1} \cdot min^{-1}$ during the simulated competitions. The heart rate and oxygen consumption did not rise apparently in practice sessions (including forehand /backhand practice) until the players started to take continuous attacks. Players group A who has better aerobic ability and endurance also gets better performance during the simulated competitions.

The mean of the oxygen uptake of players in Group B during practice sessions was about 33.5±7.5

$ml \cdot kg^{-1} \cdot min^{-1}$ and was about 35.6±18.4 $ml \cdot kg^{-1} \cdot min^{-1}$ during the simulated competitions. The heart rate and oxygen consumption did not rise apparently in practice sessions (including forehand /backhand practice) until the practice time was over 5 minutes. The longer of the practice sessions and competitions last, the more of the heart rate rose up. These measurements indicates that players in group B get worse aerobic ability and endurance.

This research divided all kinds of sport into five degree by intensity based on ACSM (1997) as follow:

The mean of METS from group A during practice sessions was 8.51 ± 1.0 METS and was 10.5± 1.0 METS during simulated competitions. The mean of METS from group B during practice sessions was 9.57± 1.0 METS and was 10.1± 1.0 METS during simulated competitions. According to the measurements above, the practice sessions and simulated competitions could be classified as below:

Division A training METS

$$METs = \dot{V}O2(ml/min/kg) \div 3.5\ ml/min/kg$$

$$= 29.8 \div 3.5\ ml/min/kg$$

$$= 8.51$$

Division A simulated match METS

$$METs = \dot{V}O2(ml/min/kg) \div 3.5\ ml/min/kg$$

$$= 36.8 \div 3.5\ ml/min/kg$$

$$= 10.5$$

Division B training METS

$$METs = \dot{V}O2(ml/min/kg) \div 3.5\ ml/min/kg$$

$$= 33.5(ml/min/kg) \div 3.5\ ml/min/kg$$

$$= 9.57$$

Division B simulated match METS

$$METs = \dot{V}O2(ml/min/kg) \div 3.5\ ml/min/kg$$

$$= 35.6(ml/min/kg) \div 3.5\ ml/min/kg$$

$$= 10.1$$

This research revealed that the oxygen uptake rose slowly in the first two rounds, and got rapid increase from the third round to the middle of the forth round. After this, most players star`ted to appear exhausted. The aerobic ability and endurance of table tennis players should be enhanced for better performances

It takes much more intensity to give continuous attack during new 11-scored competition. Some indexes also indicate` an apparent decline of physical capability in the final round. These indexes may be critical to the result of competition.

By wearing CORTEX MetaMax 3B, table tennis players usually feel difficult to reveal their skills. Documents for table tennis are also deficient in instantaneous energy measurements.

REFERENCES

[1] Chen, X. & Huan L. (1999). Stroke rhythm and skills of table tennis. *Journal of Wuhan Institute of Physical Education.* 33(4). 43-44.

[2] Li, Y. (1994). Review of the 1993 mational junior table tennis competition. *Chinese Sports Science and Technology.* 30, (7). 29-31.

[3] Su, Piren. (1996). *A discussion of penhold grip fast attact play. Journal of Beijijg University of Physical Education*. 19, (1), 76-81.

[4] Wang, J. Wang, X. (1994). A study on the method of evolution with 100 stroks in table tennis. *International Journal of Table Tennis Sciences.* 2. 84-85.

[5] Billat, V. L., Hamard, L. , & Koralsztein, J. P. (2002) The influence of exercise duration at VO2 max on the off-transient pulmonary oxygen uptake phase during high intensity running activity. *Arch Physiol Biochem.* 110(5):383-92.

[6] Chen, X., & Huang, L. (1993) Stroke and skills of table tennis. *Journal of Wuhan Instute of Physical Education*.3(4.)43-44.

[7] Dobrosielski, D. A., P. H. Brubaker, M.J. Berry, M. Ayabe, H.S. Miller.(2002) The metabolic demand of golf in patients with heart disease and in healthy adults. *J Cardiopulm Rehabil.* 22(2) 96-104.

[8] Doyon, K.H., S. Perrey, D. Abe, RL. Hughson. (2001) Field testing of VO2peak in Cross-country skiers with portable breath-by-breath system. *Can J Appl Physiol.* 2001 Feb;26(1):1-11.

[9] Doyon, P, Abe D. & Hughson RL Field. testing of VO2peak in cross-country skiers with portable breath by breath system. *Can J Appl Physiology*. 1-11.

[10] Krohne, H.W., & Hindel, C,. (1998) Trait anxiety,state and coping behavior as predictors of athletic performance. *Anxiety Research*, 1(3),225-234.

[11] Parkkari, J., Natri, A. Kannus, P. Manttari, M. Laukkanen, R. Haapasalo, A. A. Nenonen, M. Pasanen, P. Oja, I. Vuori. (2000) A controlled trial of the health benefits of regular walking on a golf course. *Am J Med.* 109(2):102-8.

[12] Schabort, E.J., J.A. Hawley, W.G. Hopkins, H. Blum. (1999). High reliability of performance of well-trained rowers on a rowing ergometer. *J Sports Sci*. (8):627-29.

[13] Su P. (1996). A discussion of penhold grip fast attact play. Journal of Beijijg University of Physical Education. 19, (1), 76-81.

[14] Wang J., Wang X. (1994). A study on the method

of evolution with 100 stroks in table tennis. *International Journal of Table Tennis Sciences*. 2. 84-85.

[15] Wu X., Y. Zhang.(1993). Adaptability of table tennis players. *Journal of Beijing University of Physical Education*. 16(2). 74-77.

[16] Chen X., Haung L. Stroke and skills of table tennis. *Journal of Wuhan Institute of Physical Education*. 1999;3(4). 43-44.

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How to Harness the Characteristics of the 11-Point Scoring System for Winning a Table Tennis Match

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Abstract: In 2000, the International Table Tennis Federation (ITTF) changed from a 21 to an 11 point scoring system to make games more fast-paced and exciting. For coaches and athletes, it is crucial to understand the nature of the 11 point scoring system, thus controlling the tempo and the key features of the game. Particularly, coaches need to design systematic training plans for group and individual athletes to prepare for the fast-paced matches.

Keywords:11 point scoring system, winning formula, training preparation

1. INTRODUCTION

The core of a coach's work is efficient training. The athlete's winning performance in matches is the touchstone for a coach's training performance. What is to be trained? How to carry out training? How much training do we need? These have been the important topics for coaches. Regarding to the training contents, a coach needs to focus on the training quality and increase the intensity of training, thus proving the necessary technical and tactical capacities that athletes can depend upon and thrive.

Regarding training approaches and measures, a coach should pay attention to the cruel nature of matches and competition. The training plan needs to include competitive simulation games with diversified playing styles. By doing so, elite athletes will accumulate competition experience and increase their psychological capacity. This is particularly true when a fast-paced 11-point game is on the line. Athletes need to quickly respond to different psychological pressures at different phases of scores and under the circumstances when they are ahead of, behind, or tied with the opponent in the competition. Because a typical 11-point game only lasts for less than 10 minutes (in a situation where no timeout is called), a coach should help athletes prepare themselves with the mentality to react to different situations and execute the game plan without hesitation.

Every competitive sport has its features. It is critical for coaches and athletes to study and comprehend the competitive features inherent in the 11-point scoring system. Understanding and taking advantage of the competitive features in the 11-point scoring system is the foundation for coaches to organize successful training programs for a team and/or individual athletes. A systematic understanding of the competitive features of the 11-point game will enable athletes to strive for better match performance.

2. METHOD

This paper adopts the approach of documentary studying [please see references 1 to 12] and uses a review as well as report style of writing to include information from the Chinese national table-tennis training program. Personal contacts and interviews were conducted to make possible of integrating opinions of how to combine the routine practice with the in-game strategy to prepare for the fast-paced, 11-point games.

3. RESULTS

Here, we summarize seven points in the 11-point scoring system: the developing trend (3.1), winning patterns (3.2), competitive features (3.3), key points in technical and tactical training (3.4), enhancing the psychological capacity to undertake match pressures (3.5), increasing the proportion of physical training (3.6), and the application of match simulation training (3.7)

3.1 The world's trend in table tennis competition

Top-spin shots are the most effective means to generate winners (points) of today's world-level table tennis matches. Thus, how to effectively create offensive

strokes with fast top-spins is the core technique that a player should develop in practice. Based on this concept, a player should build up his or her ability to connect defensive and offensive strokes in the routine training program. In addition, an elite table-tennis player should be capable of making high-quality close-table and middle-table strokes, generating balanced transition between forehand and backhand strokes, and having the awareness of changing from a defense situation into opportunities for top-spin shots. Particularly, in today's short 11-point games, winners of the international competitions typically carry proactive manners, outstanding offensive strokes (some with a unique fashion), all-around techniques, fierce and relentless acts in the rally, and well-connected and balanced offensive and defensive skills. Overall, the winning formula is to aggressively create shots with fast speed and tight spin in combination with an adaptable strategy based on in-game situations [11].

3.2 The winning pattern for the 11-point scoring system

The winning pattern for the fast-paced, 11-point scoring system is to: 1) quickly adjust and control opponent's playing style, 2) avoid opponent's control of your playing style, 3) actively create opportunities for winner shots in the first three strokes, and 4) prepare multiple game plans, in advance, to counter measure opponent's tactics. Particularly, scouting reports would play a key role in providing information of opponent's tendency to help coaches in structuring the training program to prepare for important competitions.

3.3 The competitive features of the 11-point games

The competitive features and requirements for training matches in 11-point scoring system are described below. First, the competitive features of 11-point scoring system include: quickly starting competition, fast exchange of drives, rapidly-changing rhythm, swiftly altering tactics, quick switch between attack and defense, high fluctuation in scores, highly physical consumption, high psychological pressures, highly decisive service, and higher sudden-death chance with the winning shot. In the 11-point scoring system, the requirements set for an athlete in both training and in matches are: the first five shots shall be accurate and skilled; the service shall combine speed with aggressiveness; the return of service shall combine control with aggressiveness; recognition that each score is the match point; comprehension of proper timing for pause; the athlete shall be rich in his/her competition experience, capacity of controlling the game, capacity of controlling game rhythm, capability to adjust and control the mental conditions during a game, variation and adaptability in competition tactics.

3.4 Important aspects for the technical and tactical trainings

3.4.1 Guidelines for the technical and tactical trainings

In the routine practice, it would be beneficial for coaches to help athletes in gaining the awareness of actively creating offensive strokes. Particularly, there are three aspects of the game that require more attention – attack after service, fast attack upon return of opponent's service, and finding opportunities to attack in a prolonged rally. A good training program should also help athletes to acquire:

1) All-around skills: having variable types of service, variable strokes in return of service, and a variety of attack and defense capacities.

2) Outstanding aptitudes: having unique style of techniques, remarkable features of personal styles of play, and the featuring winning type of shot.

3) Variable tactics: having the capacity of tactically changing and adapting to different opponents, different styles of play and varying competition context.

3.4.2 Key points in technical training

3.4.2.1 Technical analysis

Technical analysis of today's table tennis skills should include: 1) the latest trend of each techniques, 2) introduction of new techniques and stroke styles, and 3) diagnosis of individual players. While analyzing athletes' skills, coaches should make extra efforts to rank and categorize opponents' repertoire of different services, returns of services, and strokes. Advanced analysis should cover the percentage of different strokes used, combinations of strokes, wining shots used, uniqueness, and tendency. A SWOT (strengths, weaknesses, opportunities, and threats) analysis of ourselves and our opponents will provide valuable information in decision making in both pre-game preparation and in-game response against the fast-paced 11-point games.

3.4.2.2 Content of technical training

The following are primary skills should be included in the technical training program: 1) the first three shots, 2) the return of service to connect the locations and spins of the second and forth strokes, and 3) our attack after service by effectively generating top-spin offensive strokes at the

third and fifth stroke. Secondary skills should include: engagement of prolonged rally, loop strokes for winners or for transition, and footwork around the table. Additional areas of technical training should include: 1) helping players to streamline individual strokes, 2) single- and multi-ball training, and 3) simulative matches of doubles and singles.

3.4.3 Key points in tactical training

3.4.3.1 How to improve athletes' tactics for wining matches of 11-point games

To help athletes in gaining edges by using in-game tactics, coaches should routinely analyze the latest game plans used by the world-level players to enrich athlete's tactical capacity. Particularly, a customized strategy designed by the coach will be very helpful for players to respond and adjust for different situations in the 11-point game. For example, the strategy may include short-shot tactic to control opponent's first attack, forehand breakthrough shots for overpowering fitness, control-type of players, and big-angle, two-corner loop shots against short players. In addition, tactics can also be arranged based on combinations of strokes, such as attack after service, changing strokes while returning the service, rally strokes for counter-attack, back-spin chop strokes against smash shots, and high-angle loop strokes for slow but spiny shots against chop players. Overall, world-level athletes typically understand and apply the "8 factors" of tactics [3] (strength, speed, spin, landing point, arc, trajectory, rhythm, and variation) in their 11-point games more so in comparison to the old 21-point games. Why? This is because designing tactics is not an inherent ability for all players. Well-prepared or well-coached players tend to adjust faster in the 11-point games against players who need time to fit in when situations arise.

3.4.3.2 How to improve the tactical capacity of an athlete

The guidance to improve athlete's tactical capacity should include:

3.4.3.2.1 Tactics based on landing point and trajectory

This includes the consciousness of changing the landing points, landing-point control, major trajectory, active change in the direction of shots, use of short-shot landing point, two-winged attack, and use of deep-shot trajectory (including cross shots, middle shots, and straight shots).

3.4.3.2.2 Tactics based on finding opponent's tactical weakness

Shot selections should always include probe shots to test opponent's game plan as well as his or her in-game adjustment to our strategy. The key is to use a systematically approach to figure out opponent's weakness for gaining our advantage in a tight match.

3.4.3.2.3 Tactics based on different phases of the game

This should include the strokes in 3 phases for each point of score, i.e. the tactical styles of play for attack after service, return of service, and prolonged rally; the strokes in 3 phases in each game, i.e. the styles of play and practice during the game start, middle, and the end of game; the styles of play and practice for the first three shots and the first five strokes, as well as during prolonged rally and opponent's capability to control the match situation. Especially, winning the first game is crucial to the victory of a 5-game match. Also, the player should consider the styles of strokes and shots in the second game, the middle games, and the final game and create or find the opportunity to use particular styles and surprise shots at decisive moments.

3.4.3.2.4 Tactics based on shot angles

Different shot angles can be created based on the distance between the player and table. Thus, tactics adopted during a match needs to include in-table, close-table, medium-table, and deep-table oppositions against opponent's range. In addition, different types of strokes as well as forehand and backhand oppositions, such as forehand versus forehand, backhand versus backhand, and side-step forehand versus backhand will create different match-ups because of different shot angles.

3.4.3.2.5 Tactical consideration based on rhythm and tendency

This includes fast against slow, fast against aggressive, prolonged rally tactics, and big-angle/fast-speed forehand ball location against aggressive players who have a tendency to use side-step forehand shots instead of the normal backhand shots.

3.4.3.2.6 Tactical consideration based on shot selections

This includes fast-changing reverse tactics, especially at critical shot and critical set; emphasize forehand or backhand, and flexibly switch according to actual circumstances; alter tactics between the first three shots and prolonged rally, which can also be fast against

fast or slow against slow, controlling rhythm and speed changes.

3.4.3.2.7 Control the timing and mental condition for reversing the situation

Active movement and attacks are required to reverse the situation when the athlete is stuck in a difficult circumstance or behind the opponent since he/she could not exert his/her tactics; control the timing of pause; control the timing of toweling.

3.5 Enhancing the psychological capacity to overcome match pressures

In a match adopting 11-point scoring system, each point is critical. The shots at the beginning, in the middle, at the end, and the critical point of a game are the four key sectors in one single game, and are also the four key points in daily psychological training. At the start of game, the athlete is required to be quickly, psychologically ready for competition so as to exert his/her scoring skills and gain control. As the game progresses, elite players typically can quickly adjust strokes and shots to react to or counter-measure opponent's strength. At the end of game, players need to do appropriate decision making based on available in-game information to apply aggressive or steady style of play for better results. At the critical point, the shot must be resolute and aggressive, and take advantage of coming opportunity, avoiding any worthless mistake. Finally, properly control the timing of toweling and pause to strive for reverse and the final victory.

Integrated capacity to review the match: The athlete shall accumulate experience from various matches, experiencing the taste of both victory and defeat, feeling both nervousness and excitement, so that he/she could grasp the close relationship between mental and physical conditions as well as understand the feeling that mental conditions are affecting the exertion of skills and tactics in a match, and feel the ups and downs of his/her competitive performance.

The key points lie in the mental preparation, mental state and the plans of skills and tactics before match commences. The hinge goes to the psychological adjustment and control on emotion, confidence and will. The shot, variation, and reaction at critical point shall be determined. A post-match review is always an important measure for an athlete to improve his/her competition experience and intellectual capability.

3.6 Increasing the proportion of physical training

Skills are an extension of athletes' physical capacity. An athlete's physical condition does affect the exertion and stability of his/her competitive skills and capacity. It is an important measure to improve the skills and capacity by enhancing the athlete's physical capability in both aerobic metabolism for comfortable to brisk activity in the presence of oxygen in the bloodstream and anaerobic metabolism for short bursts of strenuous activity in the absence of oxygen in the bloodstream [2]. Physical training allows an athlete to strengthen his or her will power. Increasing at specific physical part the speed, agility and explosive power is the basis to improve step movement and positioning, and is also the key to improve the speed in skill connections and combination, as well as the guarantee of improving technical quality of a shot and the threat of the athlete's tactics. Therefore, increasing the proportion of physical training in the training program is important for athletes to achieve excellent performance.

Because the 11-point matches emphasize more on aggressive plays of power and speed, there is a trend of today's top players, particular on the men's competition, to become stronger and faster in comparison to the top players ten years ago of the 21-point matches . It remains a field under development about how to incorporate physical training in athlete's routine program to improve muscle strength for better strokes. Nonetheless, the decision of ITTF to use the 40-mm big ball (instead of the 38-mm small ball) and the 11-point scoring system leads to the direction where physical conditions play an important role in today's competition.

3.7 Trainings based on simulative matches

The tempo of 11-point matches is fast, and the fluctuating scores can, and will, influence athlete's performance through his or her mental state and exertion of tactics. Therefore, it is important for an athlete to get familiar with different environments and atmospheres under different score situations and pressures. This can be done by playing organized simulative matches in the camp or participating small tournaments as training matches for big, important cup/medal tournaments. With high attention paid on the exercise on the athlete's competitive psychological capacity, the athlete can be more easily adapting to the high pressures in actual matches, so that he/she could fully exert the skills and tactics that would lead him/her to the best performance.

The format of simulative matches can include: 1) training matches for the first four points at the beginning of a game, 2) 6-point games, 3) one-sided games (such as

starting at 0:4 or 4:8), 4) simulations of critical points (such as starting at 8:9 or 10:10), 5) one-game matches, 6) one-point matches, 7) final matches, 8) team-confronting matches, 9) single elimination matches, and 10) round robins.

4. CONCLUSION

This paper summarizes seven important aspects of the 11-point scoring system – (1) the developing trend, (2) winning patterns, (3) competitive features, (4) key points in technical and tactical training, (5) enhancing the psychological capacity to undertake match pressures, (6) increasing the proportion of physical training, and (7) the application of match simulation training – as the guidelines for the scientific training and match preparation of coaches and athletes coping with 11-point scoring system, so as to improve the efficiency and effect in table tennis training and the chance of winning matches.

REFERENCES

[1] Compiled by Xie Ya Long and others, *"Special Study on Winning Patterns and China's Competition Advantages"*, People's Sports Publishing House, 1992.

[2] Peng, Leung Cheuk-fai, *"Junior Table Tennis players aerobic and anaerobic metabolic capacity study of the characteristics"*, page 24, the Guangzhou Institute of Physical Education Master's thesis, 1993.

[3] Wu De-cheng, *"Table tennis technical report"*, pages 54-59, Taiwan's National Institute of Physical Education Master's thesis, 1998.

[4] Compiled by Li Fu Rong and others,*" What is training for? How to carry out training? How much training do we need? "*, P184, Sports Training Division, China Sport Science Society, 1999.

[5] Compiled by Dong Yang and others , *"Analysis on Tactics of Major Athletes in China's Table Tennis Team with the 11-Point Scoring System"*, Page 40~42, Vol.1, China Sports Coaches,2003.

[6] Su Pi Ren, *"Modern Table Tennis Teaching and Training"*, People's Sports Publishing House, 2003.

[7] Zhang Xiao Peng, "*Rational Diagnosis Method and Practical Effect on Tactical Training Level of China's Table Tennis Team*", Dissertation for PhD Degree, Beijing sport University, 2004.

[8] Table Tennis, *"Textbook for Chinese Sports Coach Service Education"*, People's Sports Publishing House, 2005.

[9] Liu Guo Liang, *"Table Tennis World"*, Vol. 1~12, People's Sports Publishing House, 2006.

[10] Wu Jing Ping, "*Training for Table Tennis Shots with Penholder-Grip and Inward Pimpled Rubber*", People's Sports Publishing House, 2008.

[11] Li Xiao Dong, *"Practices on Fast, Sturdiness, Variation"*, Table Tennis World, Page 64, Vol. 1, People's Sports Publishing House, 2009.

[12] Cai Zhen Hua, *"A Sense of Urgency, An Improvement of Quality"*, Table Tennis World, Page 32~34, Vol. 1, People's Sports Publishing House, 2009.

How to Coach World-Class Athletes of Table Tennis

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Abstract: The success of world-class table tennis players heavily relies on the training program provided by their coaches. Although there are unique characters of individual athletes, in this study we summarize the common experience of their coaches in training preparation. We targeted Chinese top coaches and researchers of the sport science of table tennis to understand their philosophy and methodology to help talented players become successful as well as maintain the performance of world-class athletes at the highest level.

Keywords: top table-tennis coach, coaching philosophy, successful experience

1. INTRODUCTION

The success of world-class table tennis players heavily relies on the training program provided by their coaches. Although there are unique characters of individual athletes, in this study we summarize the common experience of their coaches in training preparation. We targeted Chinese top coaches and researchers of the sport science of table tennis to understand their philosophy and methodology to help talented players become successful as well as maintain the performance of world-class athletes at the highest level.

2. METHOD

China's 20 best table tennis coaches and research and development personnel are the main subject of investigation by this thesis, which adopts the approach of induction as the method of study.

3. RESULT

3.1 Liang Zhuo Hui

He is one of China's first generation table tennis athletes and the coach for China's first world champions. He had changed Mainland China's table tennis team from a second-class one into a formidable team in the world. In order to catch up with European teams and surpass Japanese teams, he told his athletes, "Some foreigners looked down upon us because we are not strong enough to defeat them. We ought to earn respect for ourselves, try real hard and catch up; when they take one step forward, we must take two or more steps!"
He studied every styles of play of foreign players and compiled a book on styles of play and features of each athlete in the world's top ten table tennis teams, and he led his athletes to study and discuss this book. He ordered athletes to exert themselves in basic trainings so as to challenge the world's top players. With high recognition in scientific exploration, he recorded in detail the training program, match performance, styles of play and draw backs of each athlete and tried to make improvements accordingly. He was prudent and willing to learn from others; he was a thinker. With beneficial experiences learnt from matches, he summarized efficient types of shots and tactics such as cross-lift straight shot, center shot and quick against slow, close against deep, distract the opponent and gain control, etc.
In his opinion, three qualities are required for an excelle nt player to reach the top level in the world: precise and admirable in his/her scoring type of shot; steady, strong and sturdy in skills; capable of adapting to various style s of play.

3.2 Liang You Neng

He coached master choppers such as Zhang Xie Lin, Lin Hui Qing, Zheng Min Zhi, Wang Jun, Huang Liang, Lu Yuan Sheng and Chen Xin Hua, as well as fast attackers such as Hu Yu Lan, Shi Zhi Hao and Fan Chang Mao.
He pointed out the principle behind bettering skills: mistakes, hard work, and improvement; and more mistakes, harder work, and further improvement. In his opinion, an excellent coach will not only coach athletes who inherit his/her own style of play, but also coach athletes who differ a lot from his/her style of play; he believed the coach should, besides teaching an athlete everything, teach in accordance with the athlete's aptitude, offering pertinent and foreseeing coaching.
He emphasized subliming and abstracting theories wit h long-term accumulation of experiences, taking positio n arrangement in matches into serious consideration and prudently planning training programs in each year and seeking innovations. He warned young players that "nev er fight for worthless vanity, keep your feet on the groun d."

3.3 Zhuang Ze Dong

Behind a world champion are the coach's proper training and vision. As the saying goes, "the heart of military forces is the general, and the heart of the

general goes to strategies," he believed that it allows athletes to avoid detours and take the right path by taking guidance from highly qualified coaches and proper guidance and corrections in technical moves, training practice, development orientation, as well as in thinking and accomplishments, hence acquire advantages. His training practice was highly focused on the concept of speeding and stopping – the "3 fast moves" of fast stepping, fast stopping and fast returning to position. He selected athletes by expression in their eyes and their capability of reaction and balance as well as flexibility and agility. He believed that a coach should be courageous and innovative, capable of integrating advantages from various styles of play and form his/her own style. The training for table tennis athletes draws from a wide range of physical, technical, intellectual and mental practices instead of merely physical activities. Training requires specific architecture and structure as well as various methods, studies and artistic practices. An athlete is required to be well trained in his/her physical skills, as well as enriched in his/her character.

3.4 Xu Yin Sheng

Based on the history of table tennis and experience from his own practice, Xu Yin Sheng suggested three qualities for "how to be an excellent coach": perceptive insight on the trends of table tennis; good at capturing his/her inspirations; innovative.

3.5 Zhuang Jia Fu

Two key points in table tennis training: training guidelines shall be specific, and differences among training focuses shall be distinguished.

Training guideline: The training for primary skills shall be more active; the scoring tactics shall be emphasized; the adaptability to various styles of play shall be more rounded, and; the tactics shall be diverse.

Differences among training focuses:

For young players, step practice and the basic training of primary skills shall be of highly importance, and solutions shall be found in three aspects: 1. To enhance the judgment on spin, judgment and reflection on direction, and to comprehend patterns therein. 2. To combine speed and strength. 3. To coordinate steps and strokes, especially to ensure agile and swift steps.

For national teams, the objective of training is for an athlete to be the world's top player, especially in his/her high loop shots and the ability to cope with loops: 1. Try to gain control within the first three strokes. 2. Gain control with advantages in speed and angle. 3. Improve the time and stroke against loops, and distinguish the protracted rally and zone of counterattack.

3.6 Wu Huan Qun

A researcher of China Institute of Sport Science. In his cooperation with China's national table tennis team, he had found solutions to numerous difficulties in training practice, such as pen-hold backhand attack with reverse surface, study on doubles game, 3-phase index training approach, etc.

He pointed out that three relationships shall be noted during table tennis training:

Relationship between outstanding primary, scoring tactics and rounded skills.

Relationship between basics and application in single-item training, integrated training, multiple-ball training and competition training.

Relationship among winning factors during tactical training.

In addition, his experience in the combination of single-ball training and competition practice is summarized as the following: flexible training for fixed approaches; step exercises along with stroke practices; keep the right in mind when practicing on the left; keep middle table zone in mind during close-table practices; find chances to exert strength during slowed movement practice; implement practices according to patterns commonly seen during matches.

3.7 Li Ping Zhi

Good at offer trainings according to the physical characteristics and featuring skills of each athlete. Always hold a preparation meeting before match, and provide reviews after match, learning advantages of other teams to improve from drawbacks of his own team. He liked to encourage athletes to earn respect and honor for the country with supreme skills, strong will and robust physical conditions as well as overcoming overconfidence.

He pointed out issues to be noted during training:

1.Unaltered and flexible training practices.
2.Reflection and variation.
3.First three strokes and protracted rally.
4.Primary skills and ordinary skills.
5.Active attack and active defense.
6.Fast and aggressive, and steady and accurate.
7.Single line and multiple lines.
8.Fixed point and alterable points.
9.Strokes and steps.
10.Coach and trial horse.

3.8 Yang Guang Yan

He summarized the emphases in the training of Cai Zhen Hua's provincial team:

Compete with burden, which is a psychological training for athletes to adapt to competition with pressure. Winning was required and different requirements were assigned according to various opponents.

1.Physical training was emphasized.

2.Training requirements were specified for the first three strokes, emphasizing rhythm, dropping point and spin.

3.Training methods: trial horse being teammates, trial horse being coach (frequent), trial horse at both sides,

and 2 vs. 1.

3.9 Cai Zhen Hua

The head coach who led China's men's team to the peak once again from the valley in the 1990s. His primary focus in building the team was to enhance their confidence and morale; one of the reasons for his success was his trust in the coach team, which was consisted of young, motivated coaches with the assistance of highly comprehended theoretical knowledge; he had the courage to employ capable new coaches; innovation was emphasized, and the trends and current circumstances in the world of table tennis were timely comprehended; he matched new players with experienced athletes; player deployment and position arrangement was of highly focus; he changed the approaches for training and in-team matches, increasing new players' experience of overseas competition; disciplines were strictly executed, and; scientific research and other assistance were adopted for his strategy, leading the team back to the world championship within 6 years. In his opinion, Mainland China has an absolute advantage in women's team, whilst men's team is short of advantage in technical department; however, the latter shared the advantage in sufficient preparation, high pertinence and in psychological advantages. He has a strong sense of urgency.

3.10 Lu Yuan Sheng

He focused on the talent and the cultivation of character of athletes. He coached Ding Song with the style of chopping attack, which emphasized attack while keeping both attack and defense feasible. He emphasized enhancing forehand attacks on the basis of backhand spin variation, and the service training was intensified, especially the short service. He required perfection in techniques and proper confidence, helping Ding Song to overcome self-contempt by inviting senior athletes like Xu Yin Sheng and Li Fu Rong for encouraging talks and arranging opponents that Ding Song was most afraid of for competition practice – by such, his confidence and capability to undertake pressure were improved, providing him with a psychological foundation for matches. He used to tell extremely nervous athletes to hop along, which helped them to relax. He also instruct athlete to forget about match scores and keep on attack and attack, removing their psychological barriers and leading them to win.

3.11 Li Xiao Dong

Former head of training and researching team in China Men's Table Tennis Team.

He believed that in local or national competitions, a better return of service would help athletes, taking advantage of protracted rally, achieve better performance in matches within China. He requested in national team improved recognition on theories for technical issues such as steps, active attacks and attack from protracted rally. When new issues were found, he often had athletes pointing out the issue for joint discussion; he never forced athletes to obey his opinions, instead, he encouraged them to spontaneously accept new circumstances during their own practice. His emphasis in his guidance for athletes is reflected in the toughness of his athletes against any opponent.

3.12 Yin Xiao

Former head of training and researching team in China Women's Table Tennis Team. He believed that certain process is required for innovation, and the team would be hopeless if they adopt the existing styles of play. In 1991, he put all her endeavor in finding the solution for several technical difficulties in pen-hold backhand attack with reverse surface: backspin high lift, left large-angle return of service, and topspin push-and-block with flick shot – with which Liu Guo Liang won over the world's reputation overnight. He realized that, during the consummation of new techniques, an athlete's basics and overall skill should reach a world-class level before he/she plays the leading role.

3.13 Zhang Xie Lin

"28 Qualities" required in a coach:

Moral character:

1. Loyal to his/her country.
2. Filial to his/her parents and the elderly.
3. Compassionate to public services.
4. Forgiving in daily life.
5. Honest toward the others.
6. Responsible for his/her own career.
7. Never seek filthy lucre.

Management and disciplines:

1. Regretful for his/her mistakes and demerits.
2. Patient and persuasive for repeating mistakes of teammates.
3. Influential for solutions to conflicts among athletes.
4. Understandin for different opinions among athletes.
5. Just for incident solutions, overseas assignment decisions and competition event participant decisions.

Training:

1. Undivided during training.
2. Prudent in preparation training.
3. Curious towards new things and innovative technologies.
4. Considerate in program and tactic planning.
5. Calm before competition.
6. Confident before match begins.
7. Ambitious to challenge strong opponents.
8. Prudent and careful when dealing with weaker opponents.
9. Never let down his/her guard when in lead.
10. Never be discouraged when falling behind.
11. Persevering during protracted rally.

12. Decisive at critical moments.
13. Enduring when facing difficulties.
14. Modest towards victory.
15. Open-minded towards defeat.
16. Stick together to accomplish tasks.

3.14 Zhou Lan Sun

He coached best players such as Zhang De Ying, Cao Yan Hua, Qi Bao Xiang and Tong Fei Ming; he believed that the most importance quality for table tennis was tenacity – as long as you keep on practicing, you will achieve better performance. His training methods include: firstly, free-hand practice, in which a movement is to be repeated for hundreds of thousands times; secondly, contemplation, which is to imagine a fierce competition and the opponent is using certain style of play, requiring certain tactics and countermeasures to win over the game…etc. He was self taught in technical trainings, and he believed that roads are made from exploration at places where no roads existed, and that the more difficult is the condition, the more improving it is. He suggested athletes to learn, both obviously and secretly.

3.15 Ma Jin Bao

During 20 years of coaching in Mainland China's women's team, he found that women players share common characteristics including: lack of confidence, lower receptivity, and spends more time in training. He believed that an athlete should be ambitious, and feasible objectives should be made for further encouragement and performance review; critical issues shall be comprehended and explained in detail, so that the athlete could understand and communicated, and; all the endeavor shall be exerted so as to ensure the quality of training. An athlete's primary scoring tactics shall be recognized, and the disagreement between the coach and the athlete shall be properly coped with. The coach shall be responsible and understanding to the mental state of his/her athletes, hence ensure a rewarding efficiency in his/her guidance.

Technically, the coordination between the arc and timing of a stroke shall be recognized; with the principle of joint force, guide the direction of forces from each body part to stay in accordance with the direction of outgoing ball; the strength shall be properly controlled, determined, from observation, according to the strength exerted by the opponent; the relationship between body parts with leading force and the dropping point of incoming ball shall be noted, in which the player shall properly determine which body parts to exert, such as fingers, wrists, forearm, upper arm, waist, hip, thighs, shanks or forefoot, as well as the amount of strength to be exerted. In said case, strength exerted from the fingers may produce the following effects: hard to return the spin, easily increasing spin, sudden change in stroke, easily produce the ideal arc, etc.

3.16 Wang Lian Fang

Cao Yan Hua's first coach.

She believed that, for elite athlete, the training shall be stricter, and more exercise and more joint practices with male athletes are required. During competition, the athlete is required to think more and response according to circumstances, gaining the capability to cope with various types of shots and spontaneously, fully exert his/her potentials. She taught her athletes to cherish every minute in training course, try to make every stroke the best stroke, complete preparation before training commences and never spend too much time in preparation. A coach should try his/her best, exert all the strength, passion and love to coach a best athlete.

3.17 Liu Guo Liang

Head coach of China's National Men's Team

With the emphasis on personalized training, he gradually adjusted the proportion between routine training and personalized training; provide solutions in accordance with issues newly emerged in details and sessions during matches; he thinks highly of the competition system for event participant selection, hence arranges diverse and highly-demanding simulation matches based on the 11-point scoring system so as to exercise the mental and intellectual capacity of athletes. Said simulation matches include Round Robin Rankings, Promotion Tournaments, Championships, Point Spreads, 6-Point and Sudden Deaths. The guidelines adopted during his coaching from 2004 to 2008 for Beijing Olympics include: technical innovation, competition system, physical enhancement and strict management.

3.18 Shi Zhi Hao

Head coach of China's National Women's Team.

He believed that technical advantage is more important than the short-lived scores, and it is a sure path for women's table tennis technique to become similar to that of men's in order to reach the leading position in the world.

The guidelines adopted during his coaching from 2004 to 2008 for Beijing Olympics include: difficulty-oriented training; pertinent confronting training; partial zone control training; unexpected circumstances training; integrated training; calmness training; primary tactics training. The training reviews during Olympics include: new tactics, new concepts and new contents; solutions to large age and education difference among team members; improvement in communication between the national team and local teams; enhance coaching for talent reserves.

3.19 Wu Jing Ping

He is the coach assigned for Ma Lin and Wang Hao.

He believed that the major key to his success is the innovation in multi-ball training combined with

confronting competition games. Trainings are arranged in accordance with the level of an athlete. Young players are mostly trained with multi-ball training program, which is to efficiently increase the intensity and consistency of training, focusing on establishing the scoring tactics according to the characteristics of an athlete; high-level players are mostly trained with single-ball program that efficiently increases the intensity and difficulty of training, focusing on providing tactic-integrated trainings according to tactics required for the athlete in matches.

3.20 Qin Zhi Qu

He is the coach assigned for Ma Long and Xu Xin.

He believed that the key in training is all-round management. A coach shall focus on finding drawbacks of an athlete in matches and help them find the solution of found problems accordingly, which are also the problem needed to be solved during training. The coach shall apprehend information on major competitors and the growth of young, elite athletes in teams overseas, hence analyze their featuring tactics and drawbacks. The athlete shall be taught to acquire his/her own long-term goals and the objective in the near future, increase his/her recognition of honor and accomplish goals through fierce competition.

4. CONCLUSION

Although they have their very own opinions and visions, the 20 well-known coaches and research personnel described above share a profound comprehension of the rules to victory in the world of table tennis, as well as that all of them have been concerning the new circumstances in the development of table tennis (sharing highly capable insights), teaching athletes (not only with focus on training for athletes' skills, tactics, physical and psychological conditions, but also emphasize on intellectual education and continuously improve their moral character and will power), and they share a strong sense of innovation.

REFERENCES

[1] Zhuang Jia Fu, *"Two Existing Key Issues in China's Table Tennis Training"*, Table Tennis World, P11, Vol. 2, People's Sports Publishing House, 1982.

[2] Wu Huan Qun, *"Brief Discussion on Three Relationships in Table Tennis Training"*, Table Tennis World, Page 17, Vol. 2, People's Sports Publishing House, 1982.

[3] Liang Zhuo Hui, *"All Flowers Blooming, Variety Booming"*, Table Tennis World, Page 10, Vol. 2, People's Sports Publishing House, 1983

[4] Xu Yin Sheng, *"Thoughts"*, Table Tennis World, p11, Vol. 4, People's Sports Publishing House, 1991.

[5] Yin Xiao, *"Technique and Application of Penholder-Grip Backhand Shots"*, Table Tennis World, p42,Vol. 3, People's Sports Publishing House, 1992.

[6] Li Xiao Dong, *"Preliminary Study on Table Tennis Training"*, Table Tennis World, Page 35, Vol. 2, People's Sports Publishing House, 1993.

[7] Su Pi Ren, *"Chinese Sport Technology – Study on Long-lived National Sport"*, Page 9~17, 1997.

[8] Lu Yuan Sheng, "Discussion on Chop Shots", Table Tennis World, P29, Vol. 3, People's Sports Publishing House, 2000.

[9] Su Pi Ren,*"Modern Table Tennis Teaching and Training"*, People's Sports Publishing House, 2003.

[10] Wu De Cheng, *"Strategic Research on Development of Table Tennis as a Competitive Sport in Taiwan"*, Dissertation for PhD Degree, Page 63~68, Beijing sport University, 2003.

[11] Wu Jing Ping, *"Training for Table Tennis Shots with Penholder-Grip and Inward Pimpled Rubber"*, People's Sports Publishing House, 2008.

[12] Liu Guo Liang,*"Build Up Personality, Coach a Winner"*, Table Tennis World, Page 68, Vol. 1, People's Sports Publishing House, 2009.

[13] Shi Zhi Hao,*"In 2009, Everyone Back to Where It Started"*, Table Tennis World, Page 70, Vol. 1, People's Sports Publishing House,2009.

A Study on Table Tennis Players' Psychological Skills, Sport Injuries, and Tournament Satisfaction at the 49th World Championship

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Abstract: The purpose of this study was to: 1) to investigate the psychological skills that players used during the 49th World Championship; 2) to survey the sport injuries sustained; and 3) to survey the satisfaction of the players in order to better understand the tournament context for them. 102 participants who came from 23 countries were surveyed during the tournament. 55% of the participants sought help from sport psychologists, while the average consulting time was 1.7 hours. During tournaments, psychological consultations came from the coaches, athletes, physiotherapists, psychologists, team physicians, and nutritionists. Psychological problems encountered in training and competitions included lack of concentration, lack of self-confidence, too much pressure, lack of motivation, and recurrence of previous injury. Motivation for participating in the championship stemmed from the desire to attain higher achievements, rewards and prizes; gain more experience, and accomplish personal goals. In regard to tournament injuries, participants' injuries were at the waist, shoulders, knees, thigh, back, legs, arms, and neck areas. Causes of injury included overtraining, insufficient warm-up, incorrect posture, emotional instability, lack of concentration, and previous injuries. Injuries were owing to forceful ball saving, smashing, and driving. In the satisfaction survey the highest score went to 'transportation arrangement', followed by 'event organizers' and 'tournament equipment'. 'Food supply' recevied the lowest satisfaction score, followed by 'awards and prizes', and then the tournament's 'procedures/arrangements'.

Keywords: table tennis, psychological skills, sport injury, satisfaction

1.Purpose

The Wheel of Excellence is a model that has been supported by many applied studies and extensive consultation of elite performers (Orlick, 1980, 1990, 2000, 2002; Orlick & Partington, 1988; Burke & Orlick, 2003). Orlick (2000) describes seven "keys to success", in which four elements form the outer circle (positive images, mental readiness, distraction control and ongoing learning), and three elements form the inner core of the wheel (commitment, focused connection, and confidence).

In Orlick's theory, focus is highlighted as the center of the wheel and the center of excellence. Coleman and Orlick (2006) state that a strong focused connection involves loving what you are doing, the ability to remain calm when performing even when faced with extreme consequences for failure, and acting on valuable lessons from personal experiences. These success elements have the potential to guide the positive development of performers in many sports as well as areas of life.

Besides personality and approach, the acquired environment and external factors also play significant roles. These include the counsel of the coach, overload training, mental and physical exhaustion, stress and anxiety, audience/spectators, sport injuries, and the expectations of significant others. Sport injuries in particular may affect the athlete's mental and physical status.

Evidence from prior research supports an association between psychological skills and sport performance. Sports psychology helps athletes develop confidence and focus skills as they master the technical aspects of the game (Cohn, 2008). In fact, using psychological skills allows for mental readiness. Orlick and Partington (1988) consider mental readiness an extremely influential factor in an athlete's performance. Mental readiness is a sense of complete preparation prior to performance. It includes the athletes' mental, physical, and technical-mental readiness. Mental readying is derived from a number of learned mental skills which must be continually practiced and refined for an athlete to perform at full potential on a consistent basis.

The purpose of this study was to: 1) investigate the psychological skills used; 2) survey sports injuries sustained by players; and 3) survey the satisfaction with the 49th World Table Tennis Championship in order to understand the real tournament context encountered by athletes.

2.Methods

Participants

The participants in this study were 102 elite table tennis players (Mean age = 23.4, SD = 4.7; Mean sport years = 15.2, SD = 5.0), from 23 countries, surveyed during the 49th World Table Tennis Championship.

Procedure

a) The questionnaire was designed by the authors. Items from this questionnaire were discussed and modified by professional sport psychologists. The questionnaire included three parts: utilization of psychological skill, sports injury and satisfaction with tournament context.
b) The questionnaire were brought to the places of the games and completed.
c) We explained and with the consent of coaches and athletes to fill in the questionnaire.

Table 1. Demographic data of the participants

Variable	Mean	SD
Height (cm)	170.4	9.2
Weight (kg)	63.8	10.4
Attending world championship (times)	3.8	6.9
Attending continental championship (times)	3.6	3.8

Statistical analysis

Data were compiled using SPSS 12 version package software to calculate different variables in this questionnaire.

3.Results

1. Table 1 shows the demographic data of the participants in this study.

2. In regard to the athletes' psychological skills, 55% of the participants sought help from sport psychologists, while the average consulting time was 1.7 hours. During tournaments, psychological consultations came from the coach, athletes, physiotherapist, psychologist, team physician, and nutritionist. Psychological problems encountered in training and competitions included lack of concentration, lack of self-confidence, too much pressure, lack of motivation, and recurrence of old injury. Motivations for participating in the championship were to: attain higher achievements, obtain rewards and prizes, gain experience, and accomplish personal goals.

3. With regard to sport injuries, participants had been previously injured at the waists, shoulders, knees, thighs, backs, legs arms, and neck areas. Causes of injury were overtraining, insufficient warm-up, incorrect posture, emotional instability, lack of concentration, and previous injuries. Injuries were owing to forceful ball saving, smashing, and driving.

4. As to the satisfaction of the tournament context, the higher scores were in transportation arrangement, event organization, and tournament equipment. The lower scores went to food supply, awards and prizes, and the tournament's procedure/arrangement.

4.Discussion and conclusion

From the results, we found that athletes need sport psychologists to consult their psychological skills as per the norm. However, during tournaments athletes require more help from coaches than psychologists for support and instruction. Orlick (2002) mentioned that successful coaches are genuinely committed to their athletes and to doing what is best for them. They care about their athletes as people and performers, challenging them to keep pushing their limits and supporting athletes every step of the way, especially through challenges, injuries and setbacks. Truly great coaches have mastered the art of coaching largely because they mastered their capacity to: Listen, Respect, Challenge, Believe, Care and Support. Successful coaches give athletes reasons to believe in themselves, their team and their capacity. They seize opportunities to enhance confidence, and are careful to avoid speaking or acting in ways which undermine confidence, challenging athletes to push their limits in positive rather than negative ways. Through these methods, the coach can alleviate most of an athlete's psychological problems, including: lack of concentration, lack of self-confidence, too much pressure, and lack of motivation.

Concerning sports injuries, most of the athletes had been injured from overtraining. Coaches should know how to prevent this. Support staff should have athletic trainers to take cake of them, preventing injuries from occurring. During competition, the athletic trainer should release the athlete's stress and pain, both mentally and physically. Most importantly, the athletic trainer and coach should build good relationships based on trust and resolve the problem together with the injured athlete.

Orlick (2002) tells a particular anecdote about how at the 2002 Olympics, one of the world's best ling track speed skaters who was factored to win faltered in both his Olympic races, finishing far off the podium. In a subsequent qorld cup race shortly after the Olympics he

was back on tract as a world leader. What was different? He returned to familiar territory, and followed the patterns of thinking, focusing and doing that worked best for him. Orlick supposes that a great athlete is often determined by two factors: how prepared he feels to accept challenges, and the extent to which he is able to remain positive and fully absorbed in the process of engaging himself in the experience or performance. Excelling in the tournament context is almost entirely dependent on perspective and focus. In order to perform one's best as a competitor, one of the first things that must be done after being momentarily stunned by the environment or feeling somewhat intimidated, is to take control.

When athletes do not perform to their potential in competition it is not because the performance demands are different, but because they have not been prepared to deal effectively with the tournament environment, in even areas such as their diet, and many other distractions surrounding their performance. Those who do perform to their capacity are able to plan their own ideal path, commit themselves to staying positive through the many challenges, and focus fully on executing their own best performance.

An elite athlete utilizes his psychological skills to fulfill his mental readiness before competition. No matter what challenges they encounter, it is possible to get through them and achieve the set goal. The role of the coach and staff should be to remain positive, calm, and confident, besting order to support and help their athletes to gain honor and recognition for their efforts.

With regard to the 49th World Table Tennis Championship context, most of the athletes were satisfied with the transportation system, and disliked the supplied food. However, it is not easy to supply appetizing and nutritious food for athletes who come from different countries.

5. Acknowledgement

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6.References

[1] Burke, S., & Orlick, T. (2003). Mental strategies of elite Mount Everest climbers. **Journal of Excellence**, 8, 42-58.

[2] Cohn, P. J. (2008). **How can sports psychology help athletes?** Retrieved from http://www.topendsports.com/psychology/performance-maximizing.htm

[3] Coleman J. & Orlick, T. (2006). Success Elements of Elite Performers in High Risk Sport: Big Mountain Free Skiers. **Journal of Excellence**, (11). Retrieved from http://www.zoneofexcellence.com/

[4] Orlick, T. (1980, 1990, 2000). **In pursuit of excellence: How to win in sport and life through mental training.** Champaign, IL, Human Kinetics.

[5] Orlick, T. (2002). Excelling in the Olympic context. **Journal of Excellence**, (6). Retrieved from http://www.zoneofexcellence.com/.

[6] Orlick, T., & Partington, J. (1988). Mental links to excellence. **The Sport Psychologist**, (2), 105-130.

A Study In Taiwan College Table Tennis Players' Competition Confidence and Its Inference

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Abstract: The purpose of this study was to investigate the relationship between the competition confidence and the career development of college table tennis players in Taiwan. A total of 360 players (256 males and 104 females) were surveyed. The competition confidences of different categories are described. The findings include the career exploration, career orientation, career decision and environmental exploration are presented in contrast with the competitor confidence scale. With the positive correlation of competitor confidence and careers development,but player's academic record with negative correlation.

Keywords: Career exploration,Career orientation,Career decision,Environmental exploration

1. INTRODUCTION

1.1 Research motivation and background

An outstanding athlete must go through a number of factors before he achieve his goal! Behind the outstanding performance of an athlete, he needs a long hard training and disbursement, the coach's professional guidance and sacrifice, and the support of the educational administrative units. The physical and technical condition can be detected and distinguished from the appearance while psychological condition is obscure. Exercise factors on psychological differences are subtle and not easily detectable (Zhu-min Liao, 1993). Especially in the tight match with the opponent at the close technical level, an athlete lacking of the self-confidence before the game can lose the game for constant errors. In the short-range, fast and strong confrontational table tennis games, the self-confidence is an important factor in performance. Many studies have pointed out that the self-confidence put the most direct impact on the performance of athletes among the psychological factors (Landers & Petruzzello, 1994; Feltz, 1988; Vealey, 1986; Ying-Che Huang, 1994, Weinberg & Gould, 2003). And Brewer, VanRaalte, and Linder & VanRaalte (1991) explored the performance of athletes in the best psychological perception and found that there are five main factors: 1. a high degree of confidence; 2. a clear focus on paying attention; 3. non-concerned about the outcome of competition; 4. changes in consciousness; 5. there is no feeling of effort. Loehr (1984) interviewed 100 athletes to survey on their feelings and mental process when in their peak performance. As a result, some results are summarized as following: 1. high activity (such as challenges, determination); 2, fun and happy feelings; 3, there is no pressure (low-anxiety state); 4, mental calmness and certainty; 5, a high degree of self-confidence; 6, completely focused. Today, the rules of the table tennis change into 11 points system. It is predictable that players' psychological aspect is important in the table tennis game. Therefore, an athlete's goal is to control his own mental process in a tight game of table tennis. Self-confidence becomes the key to victory to a table tennis player.

Table tennis players' training at the initial inputs are the beginning of primary stage, cognitive development is not yet ripe, the fewer questions to consider his career, almost to win success as a major objective. Until the high middle para participated easement after the large and small game, are beginning to realize the choice of further education or employment planning issues, in particular, access to tertiary institutions began planning for their future career in thinking to do. Young athletes are the most valuable training ground in the sport, most players pay for the training time, and loss of other skills or academic study of the learning opportunities, can be adjusted by purchase. Should the players did not do a good job in college career planning period, likely to face a great graduation means unemployment dilemma. Individual career development planning better, the future well-being of a higher index (Prapavessiis, 2000; Terry & Lane, 2000). As coaches and educators who can stand in the position of counseling to address the needs of key players, table tennis players to strengthen the understanding of the current status of career planning to table tennis players to have a more sound development, to attract more players are involved in ongoing training incentives, so players will be able to solve the problem of the source of faults and Taiwan billiard player development, and providing information to relevant bodies to promote table tennis, table tennis player can be assisted on the career development, which are worth exploring with the important subject of study.

Tertiary institutions in the table tennis players will retire after the use of the past in the field of table tennis competition of the sport self-confidence? The representative of China's scramble for the licensing of

billiard players, most still are students of identity, therefore, table tennis players confidence for tertiary institutions will affect sports performance? Or players, such as career development-oriented topics are topics I want to explore in order to enact the development of Taiwan billiard sports.

In Taiwan as a coach must pass everything, except the game is responsible for the progress of players, but also served as Health, psychological counselors, such as the important role players in the athletes after the end of his career, but also hope to have the ability to help players find a job, If you can in the school's stage, first seek to understand the career development of the situation, and then given to career planning guidance and assistance, whether it can have better opportunities and to change the arrangement? Pearson & Petitpas (1990) study indicated that, for the majority of university athletes, the most challenging career change into the athletes are from non-athletes. Facing a time when retirement began to take into account their own future, then I do not know what to do, there is a sound career planning, time can only select between the low-skilled labor and high high-nature to replace the non-technical categories of occupational shelter (纪俊 Kyrgyzstan,苏慧慈, 2006). Athletes after retirement to go to different areas of development, is really hard not to be easy, do a good job in his career before retirement planning, retirement will not be generated because the role of being lost and maladjustment problems. Therefore, table tennis players for tertiary institutions exercise self-confidence and career development whether they have relevance? Players sport their own self-confidence will affect sports performance? Or players, such as career development-oriented issues, the questions are worth exploring. Terry & Slade (1995), Terry & Lane (2000), Beedie (2000), Prapavessis (2000) study shows, such as athlete's overall emotional status, emotional regulation is good or not, will affect the performance of sport. At the same time also shows a positive mood before the game, it is essential to peak performance sports a psychological quality. Increasingly sophisticated technology today, using the results of scientific research to exclude factors that affect the performance of exercise in order to have competition in the most perfect performances are every coach, player by the goal of hope. So of our tertiary institutions to do table tennis players of psychological research, is essential.

1.2 Research purposes

1.2.1To understand the characteristics of table tennis players' background in Taiwan.

1.2.2To understand the relationship between table tennis players' different background variables and self-confidence.

1.2.3To understand the relationship between table tennis players' self-confidence and career development.

1.3 Research questions

1.3.1 What are the characteristics of the background which adapt to the table tennis players in Taiwan?

1.3.2 Does different characteristics of the background of the table tennis plays affect their self-confidence?

1.3.3 What is the relationship between table tennis players' self-confidence and career development in Taiwan?

1.4 Operational definition of the terms

1.4.1 Career development

Career development is a lifelong process; according to individual age, state of physical and mental development, it may differ when we choose and take the role of educational, vocational and other important roles. (Hsin-Tai Lin, Hsiu-Lan Tien, Hsio-fong Chiang, and Der-Chon Chiang, 2003). This study focus on self-confidence and career development in College Group A and B table tennis players, through four dimensions, including "environment exploration," "career exploration", "career orientation" and "career decision".

2. RESEARCH METHODS

The purpose of this study was to explore the college table tennis players of the sport self-confidence and career development. Table tennis player in college for the study sample, using a questionnaire survey method for data collection.

2.1 The Study Subject

In this study, college table tennis players to study the parent group, study ways to facilitate the sampling (convenience sampling) way to collect relevant information, testing time for the July 5, 2007 to July 25, 2007, conducted a questionnaire survey Total payment of 375 copies, 364 were recovered, one of 4 copies of the questionnaire deduction is invalid, 360 valid questionnaires were effective recovery rate of 96%.

Second, research tools

2.1.1 Exercise self-confidence scale

The department cited Scale Vealey (1986) trait self-esteem scale of the exercise (TSCI) of the Chinese version of trait sport confidence scale (Zhuo Guo-hung, 2003) was modeled, and then based on this study need to be amended 『adaptation table tennis players exercise self-confidence 』Scale, Scale Points Scale Mining liker five ways, such as design, were very much agree with the general, agree, somewhat agree, very much do not agree with, respectively, to give the 5,4,3,2,1 Score.

2.1.2 Career Development Scale

The main use of this scale Li Xin Jing (2006), Wang Wenke (2004), such as the establishment of a blueprint, and then based on this study need to be amended into college table tennis players from『』career development questionnaire, five liker scale mining Points Scale means, such as design, were very much agree with the general, agree, somewhat agree, very much do not agree

with, respectively, given the scores of 5,4,3,2,1. Table on behalf of subjects scoring higher on the career development of the more excellent; scored lower on behalf of their career development worse.

2.2. Scale discrimination and reliability analysis

2.2.1 Identification Scale Analysis

1. exercise self-confidence scale

Juice valid questionnaires of this study, in the "exercise self-confidence scale," a total of 13 topics, samples recovered after item analysis data, delete the value of less than 3 and the determination to achieve a significant level of the subject, and its scale by the above-mentioned pretests Ways to be two kinds of tests and found that a high degree of identification, the preparation of 13 topics are the subject effectively.

2. Career Development Scale

"Career Development Scale" A total of 23 topics, samples recovered after item analysis data, delete the value of less than 3 and the determination to achieve a significant level of the subject, and its scale as the pretest method of the above-mentioned two kinds of tests, found the establishment of 23 topic title apart from the seventeenth, eighteenth title, title XIX, the twenty-second title, the twenty-third extraneous topics are valid.

2.2.2 Scale Reliability test

Scale of this study is to test its reliability coefficient of internal consistency Cronbach α values measured by the Tests of whether the content tended to be consistency and stability reliability coefficient above 0.7 with the reliability, it is an acceptable standard; if less than 0.35 must be rejected (Nunnally, 1978).

1. exercise self-confidence scale
   Table tennis players exercise their self-confidence Scale total table Cronbach α coefficient of .9346.
2. Career Development Scale
   Table tennis player career development scale, the test results of total α coefficient table Tatsu .894; while the dimensions of the α coefficients were: .764, .764, .758, .713. Shows that the scale of good internal consistency can be said to have good reliability.

2.3 Data processing

In this study, questionnaires recovered, and collate all the information coding, omissions answer incomplete volumes of waste, the use of SPSS for Window 12.0 version statistical data processing software, and p =. 05 for the significant level.

3. RESULT AND DISCUSSION

3.1 Taiwan table tennis players of the background characteristics of the situation

Table tennis players in the Taiwan region for the subjects after the questionnaire survey in different background variables, demographic characteristics, in order to describe the frequency distribution and percentage, as shown

in table 1:

Table1 The characteristics of subjects billiard table

Variance	Category	Amount of people	Percentage
Gender	Male	256	71.1
	Female	104	28.9
Year	Freshman	110	30.6
	Sophomore	101	28.1
	Junior	64	17.8
	Senior	46	12.8
	Institute	39	10.8
Group Categories Tertiary	College A	110	30.6
	College B	250	69.4
Academic Performance	More than 90 points	24	6.7
	More than 85 points	66	18.3
	More than 80 points	107	29.7
	More than 70 points	116	32.2
	More than 60 points	42	11.7
	Failure	5	1.4
Scholarship	Yes	77	21.4
	No	283	78.6

3.2 compare the characteristics of table tennis players of different backgrounds confidence difference

3.2.1table tennis players of different gender differences in self-confidence in the comparison exercise

The results from Table 2 that the Taiwan table tennis players of different gender in the "exercise self-confidence scale" different scores, with independent samples t test results showed that subjects of different gender, self-confidence in the sport has yet to reach significant differences. The results of this study with Zhang language Chambers (2002),Wu Su-Quing(2002) study different possible causes for the Billiards Sports Net belong to the following, and a stronger emphasis should be placed on the skills of sport, and Zhang language Chambers (2002) , Wu Su-Quing (2002) object separately Taekwondo and soccer for the project, the research object in the game in the phenomenon of physical contact, and for high school athletes may be gender personality differences still maturity. Billiard sports organizations and the nature of organizational culture, and other ball games than different, leading to male, female other in the "exercise self-confidence" and no significant difference.

Table 2 Table tennis players of different gender self-confidence of the exercise of independent samples t test summary table

Sample Name	Gender	Average	Standard Dviation	t value	p value

Exercise	**male**	**72.89**	**14.99**	**-1.383**	**.268**
Self-Confidence	**female**	**77.15**	**16.89**		

3.2.2table tennis players at different levels in the comparison of differences in exercise self-confidence

Table 3 was informed by the Taiwan table tennis players at different levels in different sports self-esteem scale scores by one-way ANOVA results showed that table tennis players of different levels of exercise self-confidence does not meet the significant differences. Reason may lie in universities and research institutes in the table tennis players score in sports performance has tended to be relatively stable stage, because of table tennis technical maturity also around at the university stage, and Khan University Institute for players in age and mental period also are more sophisticated, so universities and research institutes in the table tennis players in the mental maturity is also tend to mature stage, so the exercise of self-confidence may also have better performance and stability.

Table 3 Different grades in the exercise self-confidence one-way ANOVA summary table

Sample Name	Variance	Average	Standard Deviation	Variance Analysis					
				Variance Source	SS	Degree of Freedom	MS	F Value	p Value
Exercise	Freshman	72.15	15.58	Between	2118.862	4	529.7	2.284	.064
Self-Confidence	Sophomore	77.06	15.95	Group	30842.913	133	16		
	Junior	74.00	14.87	Within	32961.775	137	231.9		
	Senior	66.37	14.66	Group			02		
	Institute	79.71	13.94	Total					

3.2.3different categories table tennis players in the comparison of differences in exercise self-confidence

Table 4 from the Taiwan area was informed that the table tennis players of different categories in different sports self-esteem scale scores by one-way ANOVA results showed that different categories of sport table tennis player does not meet the significant differences in self-confidence. Although the meaning of different technical standards level, but the performance of self-confidence in sports are not. The results of this study with Weinderg & Gould (2003), Jones & Hardy (1990) do not conform. Weinderg & Gould (2003), Jones & Hardy (1990) of the 63 most outstanding athletes of the sports interviews, found that nearly 90% of the athletes that he has very high self-confidence, self-confidence so exercise will directly affect the athletes The exercise performance, and relative technical score of outstanding sports players will have a higher exercise self-confidence, because the subjects were college students in groups A and B of table tennis players in the performance of subjects may not score Weinderg & Gould (2003), Jones & Hardy (1990) study referred to the most outstanding athletes of various sports items, so the result has been different. By comparison of the different categories does not make table tennis players have different self-confidence sports exist.

Table 4 Table tennis players of different gender self-confidence of the exercise of independent samples t test summary table

Sample Name	Gender	Average	Standard Deviation	t Value	p Value
Exercise	Male	72.48	16.35	-.838	.401
Self-Confidence	Female	74.77	15.01		

3.2.4 table tennis players of different academic self-confidence in sports compare differences

From Table 5 that table tennis players of different academic self-confidence in sports scores, with one-way ANOVA results showed that different grades of table tennis players in the sport to achieve significant differences in self-confidence by the Scheffe method (Scheffe 's method) compared to later that academic performance of more than 85 points higher than the exercise self-confidence more than 80 players, with the results of this study Weinderg & Gould (2003) coincides, Weinderg & Gould (2003) of 63 the most outstanding athletes of various sports interviews, found that nearly 90% of the athletes that he has very high self-confidence, self-confidence so exercise will directly affect the performance of athletes of the sport, and the relative academic performance good players will have more high exercise self-confidence, academic subjects of this study for 85 hours or more table tennis players have a higher self-confidence of the performance of sport.

Table 5 Different academic exercise self-confidence in one-way ANOVA summary table

Sample Name	Variance	Average	Standard Deviation	Variance Analysis						
				Variance Source	SS	Degree of Freedom	MS	F Value	p Value	Unplanned Comparison
Exercise Self-Confidence	Freshman	72.86	10.69	Between Group	2857.873	5	571.575	2.506	.033*	b>e
	Sophomore	82.87	18.69							
	Junior	69.66	13.54	Within Group	30103.903	132	228.060			
	Senior	73.78	13.39							
	Institute	75.94	17.68	Total	32961.775	137				
		6.8	32.53							

* P<.05 a. More than 90 points ; b. More than 90 points ; c. More than 90 points ; d. More than 90 points ; e. More than 90 points ; f. Fail

3.2.5 Scholarships table tennis players in the comparison of differences in exercise self-confidence

Table 6 from the Taiwan area was informed that the table tennis players table tennis players in the sport scholarships confidence different scoring scale, with one-way ANOVA found that whether there is a scholarship sport of table tennis player was no significant difference between self-confidence, express Billiards players will not see if they have received scholarships because of their self-confidence have a different sport. Scholarships may be due to the Taiwan table tennis players, it is added value, not the main purpose of the availability of scholarships and thus self-confidence of the players do not have a significant impact on performance.

Table 6 Table tennis players of sports scholarships

confidence independent samples t test summary table[e]

Sample Name	Scholarship	Average	Standard Deviation	t Value	p Value
Exercise	Yes	72.27	17.99	-.596	.283
Self-Confidence	No	74.29	14.94		

3.3 Comparison table tennis players of the difference in career development

Taiwan college career, the development of table tennis players of the current situation such as shown in table 7, post-secondary career development of table tennis players of the subscale average scores were "career exploration" 3.57; "environment to explore," 3.52; "career orientation" 2.43 . Scores are in moderate circumstances, show that Taiwan's college career, the development of table tennis players generally good situation. In career development factors, the "career exploration" factor scores higher than the "environment to explore" possible for college table tennis players for their future career development has a certain degree of awareness and understanding, so in the "career exploration" factor for the case of higher scores.

Table 7 College table tennis player in the career development of all dimensions of the scoring summary table

Factor Orientations	Questionnaire No.	Average	Standard Deviation
Career Exploration	12，13，14，2，21	3.57	.47
Environmental Exploration	15，16，1，17	3.52	.41
Career Orientation	3，9，4，20，8	2.96	.59
Career Decision Making	10，11，5，6	2.43	.45

3.4 To understand Taiwan's table tennis players self-confidence and the relationship between career development

From Table 8 we can see that, Pearson product-moment correlation analysis of the exercise of outstanding table tennis players confidence and career development of the relevant circumstances, "to explore the environment" and exercise self-confidence; "career orientation", "career decision" and "career exploration"; "career decision" and "career orientation" are showing a significant positive relationship exist. Table tennis player so the higher exercise self-confidence to explore the environment they are, the more good, career-oriented while the more good the better career exploration, career decision making, the better are the more excellent career exploration and career decision making career orientation is the more the better good.

Table 8 Table tennis players exercise self-confidence and career development of product-moment correlation

	Self-Confidence	Career Exploration	Environment Exploration	Career Oriented	Career Decision
Self-Confidence	1.00				
Career Exploration	.016	1.00			
Environment Exploration	.433**	.085	1.00		
Career Oriented	-.086	.524**	-.087	1.00	
Career Decision	-.054	.530**	.052	.600**	1.00

4. CONCLUSIONS AND SUGGESTIONS

4.1 The conclusion

Weinberg et al. (1999) study indicated that self-confidence will trust their own athletes, and make themselves believe they have the ability to complete work or goals, through the statistical description and analysis, this study was caused by the following major empirical dis-covery:

4.1.1

table tennis player in Taiwan's background characteristics, in addition to whether a scholarship from an outside, its no special gap.

4.1.2

table tennis player in Taiwan's background characteristics, the academic performance of the confidence in the sport, reaching a significant correlation; and more than 85 points than 80 points above the academic achievement of the table tennis players have a higher confidence exercise heart orientation, the remaining background variables related to the development of sport self-confidence, are not significantly related.

4.1.3

exercise self-confidence and "to explore the environment"; "career decision" and "career orientation" were significant positive correlation.

4.2 SUGGESTIONS

4.2.1 Research applications

Table tennis coaches and players in the planning of training prescription, the player can keep abreast of the psychological state, such as can suit the remedy to even be able to reach a multiplier effect, a player to engage in intense exercise, have to dry entry from the basic moves to start to develop, successive Jin-Sheng, and finally to the sophisticated skills and tactics, training, performance has outstanding score, which complete the entire training process, if they do not have any good and firm support to do sport psychology, it is difficult for the continued training of one of the difficult burden, then Do not go on even more excited to talk about demands a more active driving force for progress. These mental activities are easy to match teams have a favorable and unfavorable effects of an outstanding outstanding coaches, should be like an experienced psychology as team members can keep abreast of the psychological state, such as to prescribe the right remedy, the players adjust emotions and state of competition in order to maintain the smooth conduct of competition and play, it is recommended the coach of China's table tennis players can be found in the light of this study with

psychological guidance.

4.2.2 Follow-up research proposals

Researchers think table tennis players of sport self-confidence and other factors affect each other, so for the above-mentioned factors can be quite in depth to explore the West, must have access to more complete skills, should enable the study of the depth of better.

REFERENCES

[1] 洪聰敏（2003）運動員的生涯轉換。2002學生運動員生涯規畫輔導人員研討會（70）。運動心理學會。嘉義縣: 國立中正大學運動與休閒教育所/體育中心。

[2] 黃英哲、季力 康（1994）：運動動機氣候與自覺能 力 對賽前狀態 焦慮和滿足感之相關研究。體育學報，18，321-332頁。

[3] 陳聖芳（1997）。走在挑戰極限的路上 - 我國運動員的生活、學業和出路問題。國立台灣大新聞研究所碩士論文，未出版，台北市。

[4] 李韻如（2002）。一個優秀運動員的養成模式。國立交通大學工業工程研究所碩士論文，未出版，新竹市。

[5] 行政院體育委員會（2000）。中華民國體育白皮書。台北市：作者。

[6] 金樹人、林清山、田秀蘭（1989）。我國大專學生生涯發展定向之研究教育心理學報，31，23-64。

[7] 卓國雄(2003)：特質性運動自信心量表之修訂研究。南師體育，10期，106-112。

[8] 張語庭（2002）：跆拳道選手目標取向、知覺運動動機氣候與運動自信心之相關研究，國立體育學院研究所碩士論文。

[9] 吳素卿（2002）：足球選手目標取向、知覺運動動機氣候與運動自信心來源之相關研究，國立體育學院研究所碩士論文。

[10] 李詠秋（2001）。原住民大學生生涯發展狀況、生涯自我效能與其生涯阻隔因素之相關研究。國立新竹師範學院國民教育研究所碩士論文，未出版，新竹市。

[11] 楊智馨（1997）。大學生生涯發展狀況與自我認定狀態之相關研究。國立台灣師範大學教育心理與輔導研究所碩士論文，未出版，台北市。

[12] 陳欣怡（2000）。依附關係與生涯探索、生涯不確定源、生涯定向狀態之相關研究---以大學三四年級學生為例。國立彰化師範大學輔導與諮商學系碩士論文，未出版，彰化縣。

[13] 黎天生（2006）。中等學校桌球選手生涯發展與運動動機之研究。國立台北體育學院研究所碩士論文，未出版，台北市。

[14] 徐耀輝（1992）。大學運動員運動社會化之性別差異。國立台灣師範大學體育研究所碩士論文，未出版，台北市。

[15] 施茂進（2004）。影響體育院校學生的職業選擇相關因素之調查研究。台北市立體育學院研究所碩士論文，未出版，台北市。

[16] 林正洲（2004）。臺北市高中體育班學生生涯信念與生涯發展之研究。台北市立體育學院研究所碩士論文，未出版，台北市。

[17] Barnes, M. W., Sime, W., Dienstbier, R., & Plake, B. (1986). A test of construct validity of the CSAI-2 questionnaire on male elite swimmers. *International Journal of Sport Psychology, 7*,364-374.

[18] Beedie, C. J., Terry, P. C., & Lane, A. M. (2000). The profile of moodstates and athletic perdormance: Two meta-analyses. *Journal of Applied Sport Psychology, 12*, 49-68.

[19] Blustein, D. L. (1989). The of career exploration in the career decision making of college student. Journal of

College Student Development, 30, 111-117.
[20] Blustein, D. L., & Phillips, S. D. (1988). Individual and contextual factors in career exploration. Journal of Vacational Behavior, 33, 203-216.
[21] B r ewer , B . W . , Va n R aa lte , J. L ., L i nder , D , E. , & Va nR aal te, N. S . (1 991) . Pea kperf orma nce a nd the per i l s of retrospectiveinospction . *Jo urna l of Sp ort an d E x erci se P s y c ho logy , 8* , 227-238.
[22] Feltz, D. L. (1988). Self-confidence and Sport perforance. In K. B. Pandolf(Ed), Exercise and Sport Sciences Review (PP.423-457). *New York: MacMillan*.
[23] Gould,D ., Pe tli chof f , L .,& W e inber g , R .S.(1 98 4). A n tece dent s o f te pora lc h ang e s in a nd relationsh i ps between C S A I -2 co mponent s. *Journa l of Sp or t Psychology , 6* , 289-304.
[24] Greenhaus, J. H., & Sklarew, N. D. (1981). Some sources and consequences of career exploration. Journal of Vocational Behavior, 18, 1-12.
[25] Jones, C., & Hardy, L. (1990) . I ntensity and derection dimensions of competitive state anxiety and relationships wish performance. *Joural of sports Sciences, 11*,533-542.
[26] Landers, D. M.., Han, M. W., Salazar, W., Petruzzello, S. J., Kubitz, K. A., & Gannon, T. L. (1994). Effects of learning on electroencephalographic and electrocardiographic patterns in novice archers. *International Journal of Sport Psychology, 25*, 313-330.
[27] Loehr , J.E. (1 98 4). Ho w t o over c ome s t re ss and p l ay at y o u r pe a k a ll the time . *T e nnis, March* , 66-76.
[28] Pearson & Petitpas (1990)
[29] P r apa v es si s, H . (2 00 0). T h e POM S an d s por ts perfor m ance : A review . *J ournal of a pplied Sport Psy c holog y, 12*, 34-48.
[30] Ter ry &Slad e(1995)
[31] T e rr y , P. C. , & L a ne , A. M. (200 0). Norma t ive values f o r the profile of moo d sta t e s f o r use w i t h a t h l e t icsa m p le s. *J ournal of Applie d Sport Psy c holog y, 12*, 93-109.
[32] T e rr y , P. C. , & S l ade , A. (1995). Di scr i m i na nt effectiveness of psycholo gical st ate meas uresin predicting performance outcome i n karate co mpe t it ion. *Percep t u a l an d Motor Skills, 81*, 275-286.
[33] Ve a l e y , R . S. (1986) . F u t u re direc tio ns i n ps y c holog ica l sk il ls training . *The Sport Psy c holog ist, 2*, 318-336
[34] Weinberg et al. (1999) . G o al se tt ing and perf orma nce in s por t an d e x erci se se tt ing : A s y nthes i s an d c r i t i que. *Med i c i ne and Science in Sports and Ex ercise ,26*, 469-477.
[35] Weinberg, R., & Gould, D. (2003). *Foundations of sport and exercise psychology* (3rd
[36] Nevil , Super (1988)
[37] Nunnally, J. C. (1978),*Psychometric theory*. New York, Ny: McGraw-Hill.

The training satisfaction of table tennis players and the influence it has on team support, team commitment, and the intention to leave: A study of university general group table tennis players

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Abstract: This study focuses mainly on the correlation between the training factors involved in university table tennis and team support, team commitment, and a tendency to quit the team. The subjects in this study include 257 general group table tennis players. Evaluating tools include: the table tennis players' training satisfaction scale, team commitment scale, team support scale, and intention to leave scale. The data obtained from these evaluating tools was analyzed using Pearson correlation and multiple regressions. According to the analysis results, training satisfaction is proportional to team support. Among the factors contributing to training satisfaction, sports performance, place and equipment, teammate relationships, training control, and sports devotion can effectively predict team support; while sports performance, teammate relationships, coach professionalism, and place and equipment can effectively predict team commitment. In addition, coach professionalism and team welfare can be used to effectively predict a tendency to quit the team. This study can serve as a reference for schools, players and coaches, and for subsequent research.

Keywords: training satisfaction, team support, team commitment, intention to leave

1. INTRODUCTION

1.1 Research background

The main task of group training in university sports teams is to promote school athletics. However, each sports representative comes from a different background and has his/her own unique mindset. Top players tend to think that they have already achieved the stage target of the discipline, which is required for university entrance; therefore most of them do not wish to participate in training again. Also, most players join a team because of recreational interests and do not like the idea of having to strengthen their training. Consequently, the University may face difficulties in recruiting and/or keeping players. Most coaches serve two roles: the role of the physical education teacher and the part-time representative team coach. This dual task may result in increased stress when teaching, studying and heavy training are all being carried out. Chien (2006) has observed that within a sports team, the role of the coach is to be the team leader and key person, and this idea has been accepted by the public. In all matters pertaining to team player relationships, team cohesion and sports performance, the coach plays a very significant role. According to Hsu (1989), a coach has an influence on an athlete that surpasses the influence of teachers. The most respected teacher or friend of a team player is usually not a class teacher, but a past sports coach. Chelladurai (1984) has argued that increasing the training satisfaction of players is the primary factor in maintaining their interest in sports training. Chelladurai (1990, 1993) has stated that satisfaction with the coach influences not only the level of acceptance of sports training, but also the coach's leadership behavior, as players and coaches influence each other. If the coach knows the player's level of satisfaction with training, this knowledge is helpful in adjusting his/her leadership style and discipline so as to obtain the respect, trust and approbation from players that is required to make training successful.

Eisenberger, Huntington, Hutchison and Sowa (1986) have proposed the concept of perceived organizational support (POS). POS means that each employee will develop a conviction to evaluate the importance that his/her organization attaches to employee contribution and welfare. Wayne, Shore Bommer and Tetrick (2002), Yang (2004), and Chen (2008) have determined that there is a significant positive correlation between employee POS and work performance. Rhoades and Eisenberger (2002) have compiled POS related literature and concluded that POS has a significant positive correlation with many employee attitudes (including work satisfaction, organization commitment, etc.) and behavioral results (including in-role and extra-role behavior, rate of absence, etc.). Two mechanisms are primarily responsible for these findings: the principle of reciprocation and the perception of socio-emotional needs. When employees feel a high POS, this triggers their willingness to repay the organization by exhibiting a positive work attitude along with good behavior. In addition, a high POS satisfies employees' needs for social approbation and emotional support, thus

promoting a happier work feeling, which reduces stress and results in a higher level of performance (Rhoades, Eisenberger & Aemeli, 2001). When employees perceive the support of their organization, this provokes feelings of obligation toward the organization, which in turn impels them to fulfill their obligations through behavior that supports the organization's goals. Thus, Eisenberger et al. (1986) has maintained that employee performance is based on the principle of reciprocation. Extending these findings to team sports, it is possible to conclude that players who receive the full support of their team will do their best to reward the team with good results. By understanding the relation between team support and training satisfaction, coaches can be better equipped to train and construct their teams.

Kanter (1968) has defined organizational commitment as a personal willingness to demonstrate the behavior and attitudes that will serve the organization most effectively, and to continue this work ethic over a long term. Morries and Sherman (1981) have stated that organizational commitment can predict the likelihood of job-quitting as well as employee performance. Organizational commitment has already become an important factor that managers take into consideration in hiring. Therefore, the influence of training satisfaction on organizational commitment is a subject that deserves further research.

Lai (2004) has pointed out that when students attend a school team and accept the training, they usually, but not always, have a strong interest in a particular sport. (Sometimes the motivation comes from a classmate or other person whom the student deems important.) However, sports team training is different from after class PE activities. It demands that players devote considerable time and energy to training, which is more than most students do. During the training period, players may be thinking of quitting the team due to stress (which can come from a variety of sources, including parents) or interpersonal relationship issues. Studying the factors that contribute to training satisfaction has as its goal the continuation of a player's participation in sports team training.

1.2 Study objectives

1.2.1 To understand the correlation between factors that contribute to training satisfaction within a general group of university table tennis players and team support, team commitment, and intention to leave.

1.2.2 To determine whether factors which contribute to training satisfaction can effectively predict team support.

1.2.3 To determine whether factors which contribute to training satisfaction can effectively predict team commitment.

1.2.4 To determine whether factors which contribute to training satisfaction can effectively predict an intention to leave the team.

2. RESEARCH METHOD

2.1 Research subjects

The subjects in this study were drawn from participants of the Tamkang University Table Tennis Invitational Tournament, which extended from October 20th to 21st, 2007. Included were 49 teams from 30 universities and colleges, totaling 466 players. 300 players were randomly sampled. After deducting the invalid questionnaires, the total number of respondents was 257: 166 male players, 91 female players, and a recovery rate of 86%.

2.2 Research tools

2.2.1 Table tennis players' training satisfaction scale

This scale was constructed to reflect the needs of the university's general group of table tennis players, as determined by Chien (2006), Wang, Tang and Chen (2006), Lee (2003), and Huang (2000). Seven factors were initially designed, including: teammate relations, coach professionalism, team atmosphere, training control, place and equipment, team welfare, and technical performance. A five-point Likert scale was adopted (very satisfied = 5, satisfied = 4, neutral = 3, dissatisfied = 2, and very dissatisfied = 1), consisting of 36 questions in total. Through item analysis, it was determined that the discrimination index of these 36 questions was within 0.83-1.66 and the critical ratio (CR) was between 5.52-14.92, $p<0.05$. According to Ebel (1979) and Wolman (1989), the discriminate index should be higher than 0.4, and the critical ratio higher than 3, which indicates that the scale scores well on these categories. Next, R2 indicated that the questions were all correlated with training satisfaction. Finally, the R1 value of the questions was consistently above 0.4, indicating that these questions have met the medium-high correlation criteria and that the scale has a good reliability. The next step was to conduct factor analysis by principal factor analysis (PFA) and oblique rotation. A total of 7 factors were extracted: coach professionalism (12 questions), technical performance (5 questions), team welfare (4 questions), place and equipment (4 questions), training control (4 questions), team atmosphere (4 questions), and teammate relation (3 questions). The factor burden of each question was above 0.4. Ultimately, the cumulative percentage of variance within the whole scale was 65.41%. In terms of reliability testing, the Cronbach α value of teammate relation, coach professionalism, team atmosphere, training control, place and equipment, team welfare, and technical performance were: .93, .82, .86, .80, and .79, respectively. These results indicate that the scale has acceptable reliability and validity.

2.2.2 Team commitment scale

This research adopted the short-type scale of organizational commitment designed by Lai and Wang (2002), and based on Mowday, Steers and Poter (1979). A five-point Likert scale was used (very satisfied = 5, satisfied = 4, neutral = 3, dissatisfied = 2, very

dissatisfied = 1), consisting of 7 questions in total. Through item analysis, it was determined that the discrimination index of these 7 questions was within 1.06-1.52 and the CR was between 8.91-13.92, $p<0.05$, which indicates that the scale scores well on these categories. Next, R2 indicated that the questions were all correlated with team commitment. Finally, the R1 value of the questions was consistently above 0.4, indicating that these questions have met the medium-high correlation criteria and that the scale has a good reliability. The next step was to conduct factor analysis by principal factor analysis (PFA) and oblique rotation. One factor was extracted. The factor burden of each question was above 0.4. Ultimately, the cumulative percentage of variance within the whole scale was 59.49%. In terms of reliability testing, the Cronbach α value was .88. These results indicate that the scale has acceptable reliability and validity.

2.2.3 Team support scale

This research adopted the short-type scale of organizational support designed by Lai and Wang (2002) with reference to Eisenberger (1986). A five-point Likert scale was used (very satisfied = 5, satisfied = 4, neutral = 3, dissatisfied = 2, very dissatisfied = 1), consisting of 4 questions in total. Through item analysis, it was determined that the discrimination index of these 4 questions was within 1.08-1.38 and the CR was between 7.07-10.53, $p<0.05$, which indicates that the scale scores well on these categories. Next, R2 indicated that the questions were all correlated with team support. Finally, the R1 value of the questions was consistently above 0.4, indicating that these questions have met the medium-high correlation criteria and that the scale has a good reliability. The next step was to conduct factor analysis by principal factor analysis (PFA) and oblique rotation. One factor was extracted. The factor burden of each question was above 0.4. Ultimately, the cumulative percentage variance within the whole scale was 66.48%. In terms of reliability testing, the Cronbach α value was .83. These results indicate that the scale has acceptable reliability and validity.

2.2.4 Intention to leave scale

This research adopted the scale of intention to leave designed by Lai (2004). A five-point Likert scale was used (very satisfied = 5, satisfied = 4, neutral = 3, dissatisfied = 2, very dissatisfied = 1), consisting of 2 questions in total. Through item analysis, it was determined that the discrimination index of these 2 questions was within 0.49-0.59, and the CR was between 3.02-3.07, $p<0.05$, indicting that this research tool has a possible discrimination. Next, R2 indicated that all the questions have a significant correlation. Finally, the R1 value of all questions was between 0.21-0.25, which is marginally above the 0.2 low correlation criteria. This shows that the scale has a relatively low reliability. The next step was to conduct factor analysis by principal factor analysis (PFA) and oblique rotation. One factor was extracted. The factor burden of each question was above 0.4. Ultimately, the cumulative percentage of variance within the whole scale was 81.37%. In terms of reliability testing, the Cronbach α value was .77. The above results indicate that the scale has passable reliability and validity.

2.3 Data analysis

This research used Pearson Correlation to analyze the correlation between training satisfaction and team support, team commitment and intention to leave. Also, multiple regressions were used to analyze the predicted situation between training satisfaction and team support, team commitment and the intention to leave, respectively. The level of significance of the various statistical tests in this research was set at $\alpha = .05$.

3. RESULT

3.1 The influence of training satisfaction on team support

Table 1 shows the correlation matrix between the players' training satisfaction and team support. It was found that a positive correlation exists between team support and coach professionalism, training control, sports performance, team welfare, sports devotion, place and equipment, and teammate relations. Among these factors, sports performance has the highest correlation with team support. Table 2 indicates that of the 7 prediction variables of training satisfaction, Sports Performance, Place and Equipments, Teammate Relation, Training Control and Sports Devotion are significant predictors of team support (F values are 149.74, 97.09, 70.74, 57.15, and 47.77, respectively). Sports Performance's predictive role on team support is 48.9%. The second predictive variable is Place and Equipment. Its cumulative coefficient of determination is 53.9%. The third predictive variable is Teammate Relation. Its cumulative coefficient of determination is 55.6%. The fourth predictive variable is Training Control. Its cumulative coefficient of determination is 57.1%. The fifth predictive variable is Sports Devotion. Its cumulative coefficient of determination is 58%. The total variation of team support explained by the predictive variables is 58%. It can be seen from the plus or minus sign of the regression coefficient that the greater the number of scores in Sports Performance, Place and Equipment, Teammate Relation, Training Control and Sports Devotion, the higher the Team Support.

Table 1: Correlation matrix of players' training satisfaction vs. team support

Variable		1	2	3	4	5	6	7	8
Team Support	1	1.00							
Coach Professionalism	2	0.38*	1.00						
Training Control	3	0.35*	0.24*	1.00					
Sport Performance	4	0.49*	0.58*	0.38*	1.00				
Team Welfare	5	0.29*	0.27*	0.37*	0.37*	1.00			
Sports Devotion	6	0.35*	0.40*	0.29*	0.42*	0.39*	1.00		
Place & Equipment	7	0.46*	0.44*	0.43*	0.55*	0.21*	0.34*	1.00	
Teammate Relations	8	0.40*	0.44*	0.17*	0.46*	0.14*	0.28*	0.47*	1.00

*P<.05

Table 2: Multiple stepwise regression analysis summary of team support

Select sequence	Predict. variable	B	β	R^2 Cum.	R^2	$R^2\Delta$	F
1	Sports Perform.	0.25	0.23	0.489	0.239	0.239	149.74*
2	Place & Equip.	0.17	0.16	0.539	0.290	0.051	97.09*
3	Teammate Relations	0.18	0.17	0.556	0.309	0.019	70.74*
4	Training Control	0.14	0.13	0.571	0.326	0.017	57.15*
5	Sports Devotion	0.11	0.11	0.580	0.336	0.010	47.77*
	Intercept	0.53					

*P<.05

3.2 The influence of training satisfaction on team commitment

Table 3 shows the correlation matrix between the players' training satisfaction and team commitment. It was found that a positive correlation exists between team commitment and coach professionalism, training control, sports performance, team welfare, sports devotion, place and equipment, and teammate relations. Among these factors, sports performance has the highest correlation with team commitment. Table 4 indicates that of the 7 prediction variables of training satisfaction, Sports Performance, Teammate Relation, Coach Professionalism, and Place & Equipment are significant predictors of team commitment (F values are 202.81, 148.07, 115.82, and 96.14, respectively). Sports Performance's predictive role on team commitment is 55%. The second predictive variable is Teammate Relation. Its cumulative coefficient of determination is 62%. The third predictive variable is Coach Professionalism. Its cumulative coefficient of determination is 65%. The fourth predictive variable is Place and Equipment. Its cumulative coefficient of determination is 67%. The total variation of team commitment explained by the predictive variables is 67%. It can be seen from the plus or minus sign of the regression coefficient that the greater the number of scores in Sports Performance, Teammate Relation, Coach Professionalism, and Place and Equipment, the higher the Team Commitment.

Table 3: Correlation matrix of players' training satisfaction vs. team commitment

Variable		1	2	3	4	5	6	7	8
Team Commitment	1	1.00							
Coach Professionalism	2	0.53*	1.00						
Training Control	3	0.23*	0.24*	1.00					
Sports Performance	4	0.55*	0.58*	0.38*	1.00				
Team Welfare	5	0.17*	0.27*	0.37*	0.37*	1.00			
Sports Devotion	6	0.34*	0.40*	0.29*	0.42*	0.39*	1.00		
Place & Equipment	7	0.52*	0.44*	0.43*	0.55*	0.21*	0.34*	1.00	
Teammate Relations	8	0.51*	0.44*	0.17*	0.46*	0.14*	0.28*	0.47*	1.00

*P<.05

Table 4: Multiple stepwise regression analysis summary of team commitment

Select sequence	Predict variable	B	β	R^2 Cum.	R^2	$R^2\Delta$	F
1	Sports Performance	0.20	0.20	0.55	0.30	0.30	202.81*
2	Teammate Relations	0.22	0.23	0.62	0.38	0.09	148.07*
3	Coach Professionalism	0.22	0.23	0.65	0.42	0.04	115.82*
4	Place & Equipment	0.19	0.20	0.67	0.45	0.03	96.14*
	Intercept	0.72					

*P<.05

3.3 The influence of training satisfaction on the intention to leave

Table 5 shows the correlation matrix between the players' training satisfaction and intention to leave. It was found that a negative correlation exists between the intention to leave and coach professionalism, sports performance, sports devotion, place and equipment, and teammate relations. Among these factors, coach professionalism has the highest correlation with the intention to leave. In addition, training control and team welfare are positively correlated with intention to leave, team welfare having a higher correlation than training control. According to Table 6, among the 7 prediction variables of training satisfaction, coach professionalism

and team welfare are the most significant predictors of the intention to leave (F values are 35.91 and 28.46, respectively). The predictive power of coach professionalism on the intention to leave is 26%. The second predictive variable is team welfare. Its cumulative coefficient of determination is 33%. The total variation of the intention to leave explained by the predictive variables is 33%. It can be seen by the plus or minus sign of the regression coefficient that the greater the number of scores for coach professionalism, the lower the intention to leave, whereas higher scores for team welfare correlate with a higher intention to leave.

Table 5: Correlation matrix of players' training satisfaction vs. intention to leave

Variable		1	2	3	4	5	6	7	8
Leave Team	1	1.00							
Coach Professionalism	2	-0.26＊	1.00						
Training Control	3	0.06	0.24＊	1.00					
Sports Performance	4	-0.12＊	0.58＊	0.38＊	1.00				
Team Welfare	5	0.11＊	0.27＊	0.37＊	0.37＊	1.00			
Sports Devotion	6	-0.03	0.40＊	0.29＊	0.42＊	0.39＊	1.00		
Place & Equipment	7	-0.17＊	0.44＊	0.43＊	0.55＊	0.21＊	0.34＊	1.00	
Teammate Relations	8	-0.14＊	0.44＊	0.17＊	0.46＊	0.14＊	0.28＊	0.47＊	1.00

*P<.05

Table 6: Multiple stepwise regression analysis summary of the intention to leave

Select sequence	Predict variable	B	β	R^2 Cum.	R^2	$R^2\Delta$	F
1	Coach Profession.	-0.47	-0.32	0.26	0.07	0.07	35.91＊
2	Team Welfare	0.27	0.20	0.33	0.11	0.04	28.46＊
	Intercept	3.24					

*P<.05

4. DISCUSSION

4.1 Training satisfaction vs. team support

Anderson and Sullivan (1993) maintained that customer satisfaction is important for the success of an enterprise. However, on a good sports team, the training satisfaction of players is reflected not only in the success of the team, but in the enthusiasm of the team players, the team's operations, etc. According to the results of this research, sports performance is the strongest predictor of team support. It follows that a coach's priority should be to upgrade sports performance. In addition, coaches should aim to improve the quality of training places and equipment, promote interaction, support and trust among players, and reduce tedious training. The best way to enhance training is to develop interesting and creative ways of managing control, which will allow players to engage in training voluntarily. According to Rhoades and Eisenberrger (2002), who conducted meta-analysis on 70 subjects, there is a significant positive correlation between awareness of organizational support and work results, a finding corroborated by Chen (2008). It follows that increasing the training satisfaction of players will positively influence team support.

4.2 Training satisfaction vs. team promise

According to the research of Huang (2002) and Currivan (1999), a player's satisfaction significantly influences his/her commitment to the team; the higher the player satisfaction, the higher the team commitment. This finding correlates with the research conducted on work satisfaction in the industry field and its impact on organizational commitment. Esienberger (1986) found that when employees feel a satisfactory level of organizational support, they feel an obligation towards the organization, which they demonstrate by behavior and attitudes that support organizational goals. With regard to the training satisfaction of the university's general group of table tennis players, the results of this study show that sports performance has the strongest predictive influence on team support and commitment. Coaches should therefore focus on upgrading performance, while also building good teammate relations, enhancing self professionalism, and striving for better training places and equipment, as all of these factors positively influence team commitment.

4.3 Training satisfaction vs. intention to leave

Price (1997) maintains that a high level of work satisfaction reduces the leaving rate of employees. However, Lai (2004) maintains that of the 7 predictive variables on training satisfaction, only coach professionalism and team welfare can predict the intention to leave. This study would seem to reflect both views. Coach professionalism and team welfare are not the only predictors of the intention to leave, but they are the most important predictors; the higher the scores for coach professionalism, the lower the intention to leave, whereas higher scores for team welfare correlate with a higher intention to leave. According to these findings, it is important to have an intelligent coach with good judgment. Dong, Han, Jiang and Liu (2006) have indicated that coaches should have knowledge of the main sciences (sports physiology, sports psychology, sports biomechanics), the concept of applied sciences (sports coaching, physical training, management), the design of exercise prescription, and an understanding of player selection.

Cheng and Fang (1994) and Chen (1995) maintained that a coach's duties extend to issues that are seemingly unrelated to training, such as promoting the players and acting as a love advisor and mental health counselor. Evidently, a coach who can meet all these requirements will have diversified skills. Although a

good or bad sports team cannot be the sole responsibility of the coach, there is no doubt that a successful coach can improve team performance and not only by knowing how to play the game. A professional coach will have a significant impact on players, whether they stay on the team and continue with training, or not.

When a team acquires more welfare, which may mean more resources, a resource allocation inequity sometimes results. Adams (1965) has indicated that an individual in a state of inequality pertaining to reputation or remuneration, typically reacts by re-adjusting his/her physical or mental state; substituting the current object of comparison for one that reflects his/her current state; or leaving this realm (i.e., giving up). Many team players would choose the first option: lower their own performance to match the reward they get. Some would combine this with the second option: choose a player who performs less well as a comparative object. Finally, there are those who would opt out; therefore, a coach should be aware that excessive welfare will not necessarily influence the team positively. On the contrary, it may have a significantly negative impact. Coaches should consider this possibility, and manage team welfare carefully to prevent any negative reactions.

5. CONCLUSION

5.1 Main purpose and recommendations

The main purpose of this study was to understand the relationship between training satisfaction and team support, team commitment and the intention to leave. After analysis via multiple regression, the following recommendations emerged:

5.1.1 The university's general group of table tennis players should make sports performance their primary mission. This requires team support, which is enhanced by a high-quality training place and equipment, positive team relationships, and training control conducted in joyful and creative ways to encourage players to actively devote themselves to training.

5.1.2 The university's general group of table tennis players should focus on improving performance by strengthening team commitment. This is accomplished by establishing good teammate relationships, continuously enhancing professionalism, and building better places for training and better equipment.

5.1.3. Tennis coaches should be especially aware of the importance of professionalism, since a high level of professionalism correlates negatively and significantly with the intention of players to leave the team. Coaches should also be aware that implementing team welfare may increase the intention to leave. Therefore, coaches should carefully manage team welfare to avoid negative reactions from players.

5.2 Further Suggestions

5.2.1 Research result application

For most table tennis players who belong to a university group, it is no longer attractive to require long-term painstaking training in order to obtain a good performance. Players tend to be more interested in enhancing their social skills through table tennis than in training; they are also focused on obtaining employment after graduation. It is suggested that coaches establish a social interaction network between the team's graduate alumni and the school players. For example, alumni activity can be held periodically to provide current players with assistance in their studies and employment through an exchange in jobs and in the stadium. In addition, coaches should enhance their sports-related professional knowledge. It is also suggested that coaches study the principles of team construction and group dynamics to enhance the process of sports training and to teach players how to communicate effectively, how to build relationships of trust, improve their decision-making and problem-solving abilities, compete and cooperate with others, and deal with frustration, etc. Only then can they guide the players systematically during the period of training to practically apply and transfer what they have learned on the school team to other domains.

5.2.2 Future research suggestions

There is a definite correlation between the training satisfaction of players and team support and commitment. The latent mediator variables are worth studying. Positive mood might be taken as an example of a latent mediator variable. According to the theory of attribution, a person in a positive mood tends to impute failure to environmental influences. No doubt, there are other latent mediator variables that wait to be discovered.

In the future, researchers interested in conducting studies on the intention to leave might consider closely their selection of research subjects. The study subjects in this research were contestants of a competition. Basically, these are players with a low intention to leave; therefore, they cannot represent with any degree of accuracy the intention of general team players. Nevertheless, it is very difficult and impractical to obtain as study subjects players who are thinking of leaving or have just left the team. In view of this difficulty, it might be useful to conduct an in-depth interview with each team's coach prior to the selection of research subjects.

References

「1」 Adams, J. S. (1965). Inequity in social exchange. *Advances in Experimental Social Psychology, 2*, 267-299.

「2」 Anderson, E. W. & Sullivan, M. W. (1993). The antecedents and consequences of customer satisfaction for firms. *Marketing Science, 12*, 125-143.

「3」 Chelladurai, P. (1984). Discrepancy between preferences and preferred leadership behavior and satisfaction of athletics in varying sports. *Journal of Sport Psychology, 6*, 27-41.

「4」Chelladurai, P. (1990). Leadership in sport: A review. *International Journal of Sport Psychology, 21*, 328-354.

「5」Chelladurai, P. (1993). Leadership in R. N. Singer, Murphey, & L. K. Tennant (Eds.). *Handbook of research on sport psychology*. New York: Macmillan.

「6」Chelladurai, P., & Riemer, H. A. (1997). A classification of facets of athlete satisfaction. *Journal of Sport Management, 11*, 133-159.

「7」Chen, Y. J. (1995). The interrelationship between swim coaches, leadership and swimmers, performance as well as satisfaction in Taiwan. Unpublished master's thesis. *National Taiwan Normal University*: Taipei City.

「8」Chen, C. C. (2008). Test of a mediating model linking perceived organizational support and job performance. *Journal of Management, 25(3),* 309-331.

「9」Currivan, D. B. (1999). The causal order of job satisfaction and organizational commitment in models of employee turnover. *Human Resources Management Review, 9*(4), 495-524.

「10」Doong, J. L., Han, D., Chiang, C. J. & Liu, S. Y. (2006). Perception and satisfaction of volleyball players on coaches' leadership. *Journal of Nanya, 26*, 241-255.

「11」Eisenberger, R., R. Huntington, S. Hutchison, & D. Sowa, (1986). Perceived supervisor support. *Journal of Applied Psychology, 71*, 500-507.

「12」Huang, Y. H. (2002). A study of job satisfaction model on fitness instructor and satisfaction model on fitness club member. *Physical Education Journal,* 33, 155-163.

「13」Chien, J. Y. (2006). The effects of perceived coach leadership behaviors on sport participation motivation and training satisfaction for collegiate tennis players. *Psychological bulletin for Sport and Experience Psychology of Taiwan, 8*, 65-86.

「14」Kanter, R. M. (1968). Commitment and social organization: A study of commitment mechanisms in Utopian communities. *America Sociological Review, 33*, 499-517.

「15」Lai, S. S. & Wang, K. W. (2002). The effect of mentor leadership, class support on class commitment, class cohesion, and achievement performance. *Journal of Physical Education in Higher Education, 4*(2)，45-54.

「16」Lai, S. S. (2004). Intention to leave and practice performance: A case study on division II swimming athletes. *Journal of Physical Education in Higher Education, 6*(2), 119-130.

「17」Li, C. P. (2003). A study of training satisfaction of universities' excellent tennis players. *Physical Education Journal,* 34, 149-160.

「18」Morris. J. H., & Sherman, J. D. (1981). Generalize ability of an organization commitment model. *Academy of management Journal, 24*, 512-526.

「19」Mowday, R. T., Steers, R. M., & L. W. Poter, (1979). The measurement of organizational commitment. Journal of Vocational Behavior, 14(2), 224-247.

「20」Price, J. L. (1997). *Handbook of organizational measurement*. Bradford, UK: MCB University Press.

「21」Rhoades, L., R. Eisenberger, & S. Aemeli, (2001). Affective commitment to the organization: The contribution of perceived organization support. *Journal of Applied Psychology, 86*, 825-836.

「22」Rhoades, L., R. Eisenberger, (2002). Perceived organization support: A review of the literature. *Journal of Applied Psychology, 87*, 698-714.

「23」Huang, S. K. (2000). A study of training satisfaction of division I baseball players in Taiwan. Unpublished master's thesis. *Chinese Cultural University*, Taipei City.

「24」Wang, S. C., Tang, C. C., & Chen, Y. F. (2006). A study of coach's leadership behavior perception and player's satisfaction of participation: case of B division collegiate table tennis athletes. *Journal of National Huwei University of Science & Technology, 25*(4), 97-106.

「25」Wayne, S. J., L. M. Shore, W. H. Bommer, & L. E. Tetrick, (2002). The role of fair treatment and rewards in preventions of organization support and leader-member exchange. *Journal of Applied Psychology, 87*, 590-598.

「26」Wu, K. H. (2000). A competitive study of collegiate coaches' leadership behavior in Taiwan. *Physical Education Journal, 28*, 59-68.

「27」Hsu, I. H. (1989). The role of coaches from the standpoint of humanism. *The Quarterly of Chinese Athletics*, *11*, 60-62.

「28」Yang, B., G. (2004). The effects of perceived organizational support and leader-member exchange on organizational citizenship behavior. *Taiwan Academy of Management Journal, 4*(2), 141-160.

「27」Cheng, C. F. & Fang, M. Y. (1994). A study of the leadership behavior of the university soccer coaches. Taipei: Written Chinese Book Company.

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The training satisfaction of the university table tennis players of general Group

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Abstract: The study is aimed to study the satisfactory level and difference of university general Group plays. The subjects are 257 table tennis players attending the table tennis competition held in Tamkang University. The statistical analysis included description, factory analysis, t-test and one-way ANOVA. It found 7 factors related to satisfaction including the professional competence of coaches, skill performance, team welfare, venue facility, training supervision, and team morale and teammate relationship. The descending rank of players' satisfactory factors is teammate relationship, professional competence of coaches, team morale, training supervision, venue and facility, players' welfare, and team performance. The satisfaction of Male players is significantly higher than female ones in the factors of the professional competence of coaches, venue facility, and training supervision. The performance of players with longer playing span is significantly better than those with shorter experience. The players have no achievement in competition is significantly higher in satisfaction with the professional competence of coaches than those ranked higher. Compared to the players with shorter training sessions, those who trained longer are more satisfied with the three factors of the professional competence of coaches, training supervision, and teammate relationship. Under the guidance of the coach with professional background, the player has significant satisfaction with the professional competence of coaches and teammate relationship.

Keyword：Table tennis, Table tennis players, training satisfaction

1. INTRODUCTION

1.1 Background

Table tennis is one the widely practiced programs of university physical education. It is also a common leisure activity for students. Table tennis has beneficial effects on overall health with the advantages in easy access of venue and facility, simple game rules, safety for intensity self adjusted, and full of diversity (Wen et al., 2005). Besides, table tennis is an indoor exercise without the effect of weather and with high feasibility (Xu, 1986). Table tennis is very popular in the university students. According the statistic report from the official website of university sports competition (2007) documented table tennis had the most attendants in all the competing events. However, table tennis training often confronted much inadequacy in raising funding, recruiting or maintaining players (Lai, 2004). The motivation of students to join in the team can be intense interest, peer affect. The team players bear pressure from family and/or university since they have to balance the time spending in study and training. Locke (1976) defined satisfaction as the happiness or positive sensation resulted from personal judgment of certain experience. Chelladurai and Riemer (1997) suggested that athlete satisfaction is the positive sensation or perception after self-judgment when experiencing exercise- related organization, implement, and outcomes. Coaches who had had absolute authority in the past have being experiences the role changing to training player-centered. The satisfaction of players greatly influences individuals' enthusiasm, motivation, morale, and achievement as well as team performance. The study of players' satisfaction with the team can reflect the effectiveness of team management so as to form insight to the need of players and status quo of ball team. The current study addressed the player's satisfaction to their team.

1.2 Research purpose

The study aims at the following investigation:

1.2.1 the satisfactory condition of general Group players.
1.2.2 the satisfaction difference in players' gender.
1.2.3 the satisfaction difference in players' playing span.
1.2.4 the satisfaction difference in players' performance.
1.2.5 the satisfaction difference in players' training session.
1.2.6 the satisfaction difference in the professional background of coaches. .
1.2.7 the suggestion for coaches, athletes and future study.

2. RESEARCH METHOD

2.1 Subjects

The total number of subject is 257 (male = 166, female = 91), and randomized chosen from 499 table tennis players from 30 universities attending the competition held in Tamkang University on October, 20-21. The response rate is 86%. Table 1 showed the biographic information of subjects.

Table 1 Biographic information

Variable		Number
gender	male	166
	female	91
Playing span	1-5 year	158
	6-10 year	80
	11 year above	19
best result	1~2	20
Nationwide rank	3~4	14

	5~8	41
	9~16	29
	No rank	153
training session	<=3 hour	50
	3~6 hour	125
	6~9 hour	60
	>=9 hour	22

2.2 Measurements

The research applied a 5-point Likert scale (Chien, 2006, Wang, Tang, Chen, 2006, Lee, 2003, Huang, 2000), ranged from very satisfied to extremely dissatisfied.

2.3 Reliability and validity

Factor analysis found DP ranged from .83 to 1.66, CR value form 5.52 to 14.92, P<.05. According to Ebel (1979) and Wolman (1989), the questionnaire had satisfying discriminate power when DP > .04 and CR > 3. The score of R2 indicated that all the items were significantly correlated with each others. And the reliability is satisfactory with R1> 0.4. As table 3 showed, the final factor structure differentiated among 7 subscales and subsequently labeled as: 'the professional competence of coaches' accounted for 31.40%, consisted of item 12, 10, 9, 6, 11, 4, 7, 5, 8, 3, 28, and 27; 'performance' with the variance percentage of 10.47%, was consisted of item 16, 18, 1, 17, and 2; 'ball team welfare' with the variance percentage of 6.80%, was consisted of item 34, 33, 36, and 35; 'venue facility' consisted of item 30,31,32, and 29, accounting for 5.39% of variance; 'training supervision' is consisted of item 26, 23, 24, and 25, accounting for 4.45 % of variance; 'ball team morale' is consisted of item 19, 22, 20, and 21, accounting for 3.54% variance; and 'teammate' is consisted of item 13, 14, and 15, accounting for 3.35%. The reliability coefficients of the above factors were 0.93, 0.82, 0.86, 0.80, 0.86, 0.80, and 0.79 respectively.

Table 2 The content of scale items

Questions	DP	CR	R1	R2
1 My feeling to my performance in the games of last year	0.88	5.71	0.42	0.38
2. My feeling of my improvement in skill in the games of last year	0.97	6.45	0.42	0.37
3. My feeling to coach attitude to players	1.42	10.3	0.59	0.55
4. My feeling to the way that coach deal with team affaire	1.42	12.28	0.62	0.58
5 My feeling to the way that coach trains me	1.39	11.71	0.64	0.61
6.My feeling to the coach' s caring to me	1.66	14.92	0.71	0.68
7. My feeling to my relationship with the coach	1.39	12.15	0.62	0.58
8. My feeling to the professional background of the coach	1.28	10.76	0.58	0.55
9.My feeling to the coach' s arrangement of player sequence	1.41	12.54	0.66	0.63
10. My feeling to the coach' s strategy for games.	1.38	10.88	0.62	0.58
11.My feeling to the coach' s conclusion for games	1.33	11.16	0.62	0.58
12. My feeling to the coach' s guidance to me	1.41	13.00	0.67	0.65
13 My feeling to my relationship with other team members	0.97	7.16	0.48	0.45
14. My feeling to the guidance from my team members	0.86	8.01	0.50	0.47
15.My feeling to the relationship between the older players and the younger	0.92	6.91	0.46	0.42
16. My feeling to my attacking performance in the games of recent one year	1.06	6.86	0.47	0.42
17.My feeling to my defending performance in the games of recent one year	0.88	5.98	0.42	0.38
18. My feeling to my strategies applied in the games of recent one year	1.00	6.87	0.48	0.43
19.My feeling to the team morale	1.22	9.59	0.52	0.49
20.My feeling to the training attendance of team members	1.00	7.30	0.50	0.46
21.My feeling to the team member' s contribution to the team	1.02	7.45	0.54	0.50
22.My feeling to the training atmosphere	1.23	9.75	0.58	0.55
23.My feeling to the training hours per time	1.13	9.77	0.60	0.57
24.My feeling to the training sessions per week	1.33	12.26	0.65	0.62
25.My feeling to the arrangement of training and break	1.20	11.41	0.66	0.63
26. My feeling to the training time controlling	1.25	10.61	0.60	0.56
27.My feeling to the coach' s psychological guidance	1.25	10.61	0.63	0.60
28.My feeling to the coach' s skill guidance	1.48	13.10	0.69	0.66
29.My feeling to the quality of training venue	1.33	7.91	0.49	0.44
30.My feeling to the quality and quantity of campus facility of weight training	1.28	10.05	0.53	0.49
31.My feeling to the quality and quantity of training facility of the ball team	1.25	8.38	0.54	0.50
32.My feeling to the provision of facility and medicine for treating exercise-induced jury	1.11	7.31	0.50	0.46
33.My feeling to the team' s funding	0.89	5.52	0.40	0.35
34.My feeling to the quality and quantity of player' s equipment	0.89	6.07	0.45	0.41
35.My feeling to the allocation of team' s funding	0.83	6.75	0.46	0.42
36. My feeling to the team welfare (tourism, bonus, awards, etc.)	1.03	6.97	0.48	0.43

Table 3 The outcomes of factor analysis

Topic number	coach professional	technique performance	team welfare	place equipment	train control	team atmosphere	teammate relation
12	0.79	0.10	0.05	0.10	0.18	0.04	0.07
10	0.78	0.02	0.16	-0.04	0.10	0.12	0.02
9	0.78	0.06	0.12	0.01	0.09	0.18	0.07
6	0.77	0.07	0.00	0.20	0.16	0.12	0.13
11	0.77	0.14	0.13	0.04	0.00	0.01	0.11
4	0.76	-0.03	0.00	0.18	0.14	0.13	-0.03
7	0.75	0.05	-0.05	0.15	0.06	0.10	0.13
5	0.75	0.04	0.11	0.05	0.11	0.26	-0.06
8	0.72	0.01	-0.01	0.12	0.13	-0.08	0.29
3	0.70	-0.01	-0.04	0.12	0.07	0.22	0.12
28	0.67	0.10	0.09	0.18	0.22	0.10	0.18
29	0.62	0.23	0.15	0.11	0.20	-0.07	0.12

16	0.06	0.79	0.08	0.16	0.05	0.10	0.10
18	0.14	0.74	0.14	0.04	0.00	0.18	0.05
1	0.04	0.72	0.22	0.04	0.07	0.15	-0.01
17	0.04	0.71	0.11	0.07	0.13	0.17	-0.04
2	0.10	0.67	0.03	0.09	0.18	0.03	0.03
34	0.02	0.16	0.81	0.21	0.15	0.01	0.05
33	0.06	0.12	0.80	0.15	0.07	0.05	-0.10
36	0.14	0.16	0.80	0.11	0.04	0.03	0.11
35	0.12	0.12	0.80	0.08	0.10	0.10	0.02
30	0.16	0.12	0.06	0.82	0.12	0.08	0.14
31	0.16	0.13	0.16	0.78	0.10	0.17	0.02
32	0.13	0.07	0.30	0.69	0.13	0.09	0.01
29	0.23	0.09	0.10	0.67	0.05	0.01	0.10
26	0.29	0.11	0.04	0.15	0.74	0.07	0.17
23	0.20	0.18	0.11	0.08	0.73	0.23	0.13
24	0.24	0.19	0.19	0.17	0.73	0.18	0.12
25	0.32	0.09	0.17	0.10	0.68	0.28	0.13
19	0.18	0.17	0.06	0.10	0.08	0.74	0.15
22	0.21	0.15	0.01	0.20	0.14	0.71	0.25
20.	0.09	0.29	0.04	-0.01	0.27	0.71	0.05
21	0.21	0.15	0.11	0.10	0.18	0.58	0.15
13	0.22	0.09	0.01	0.06	0.13	0.15	0.83
14	0.27	-0.01	0.03	0.11	0.21	0.12	0.76
15	0.14	0.03	0.03	0.09	0.11	0.36	0.67
Eigenvalue	11.30	3.77	2.45	1.94	1.60	1.28	1.21
Explained variability	31.40	10.47	6.80	5.39	4.45	3.54	3.35
General Explained variability	31.40	41.87	48.67	54.07	58.52	62.06	65.41
General scale Crobach α=.93	.93	.82	.86	.80	.86	.80	.79

2.3 Data analytical

This research adopts SPSS 13.0 for date analysis including description, mean, SD and t-test.

3. Result

3.1 Result

3.1.1 The description of satisfaction

Table 4 show the description of university players' satisfaction with the 7 factors

Table 4 The descriptions of players' satisfaction

Factor	Number people	Average	Standard Deviation	Rank
teammate relationship	257	4.03	0.66	1
coach professional competence	257	3.87	0.65	2
ball team morale	257	3.62	0.67	3
Training Supervision	257	3.61	0.65	4
Venue facility	257	3.48	0.77	5
ball team welfare	257	3.23	0.75	6
performance	257	3.14	0.68	7

3.1.2 The satisfaction difference in gender

In comparison with female players, male ones have the higher satisfaction in the factors of the professional competence of coaches, venue facility, training supervision ($p<.05$).

Table 5 The satisfaction difference in gender

Factor	sex	Number people	Average	Standard Deviation	T Value	P Value
coach professional competence	male	166	3.97	0.65	3.58*	0.001
	female	91	3.67	0.61		
performance	male	166	3.19	0.65	1.70	0.090
	female	91	3.04	0.72		
ball team welfare	male	166	3.29	0.72	1.79	0.075
	female	91	3.11	0.80		
Venue facility	male	166	3.55	0.72	2.20*	0.029
	female	91	3.34	0.84		
Training supervision	male	166	3.67	0.65	2.19*	0.029
	female	91	3.49	0.64		
ball team morale	male	166	3.68	0.69	1.73	0.085
	female	91	3.52	0.64		
teammate relationship	male	166	4.03	0.66	0.01	0.996
	female	91	4.03	0.65		

*p<.05

3.1.3 The satisfaction difference in playing span

Table 6 showed that the players with playing span of 5 years shows the obvious dissatisfaction with the performance compared the ones with 6-10 years and more than 11 years. ($p<.05$).

Table 6 The satisfaction difference in playing span

Factor	year	Number people	Average	Standard Deviation	F Value	P Value	Significant difference
coach professional competence	1-5	158	3.83	0.68	0.91	0.403	
	6-10	80	3.95	0.59			
	11 above	19	3.86	0.63			
performance	1-5	158	3.01	0.66	8.32*	0.001	1＜2,3
	6-10	80	3.29	0.67			
	11 above	19	3.53	0.63			
ball team welfare	1-5	158	3.20	0.70	0.46	0.632	
	6-10	80	3.24	0.79			
	11 above	19	3.37	0.98			

Venue facility	1-5	158	3.49	0.77	0.54	0.585
	6-10	80	3.42	0.75		
	11 above	19	3.62	0.88		
Training Supervision	1-5	158	3.58	0.66	0.35	0.702
	6-10	80	3.65	0.63		
	11 above	19	3.63	0.69		
ball team morale	1-5	158	3.57	0.64	1.72	0.181
	6-10	80	3.74	0.74		
	11 above	19	3.54	0.65		
teammate relationship	1-5	158	3.99	0.68	0.93	0.398
	6-10	80	4.11	0.61		
	11 above	19	3.96	0.64		
ball team morale	9~16	29	3.65	0.52		
	No rank	153	3.61	0.70		
	1~2	20	3.94	0.66	1.87	0.117
	3~4	14	3.38	0.69		
	5~8	41	3.53	0.65		
	9~16	29	3.56	0.58		
	No rank	153	3.64	0.69		
teammate relationship	1~2	20	4.07	0.75	0.84	0.498
	3~4	14	3.88	0.84		
	5~8	41	3.95	0.60		
	9~16	29	3.90	0.61		
	No rank	153	4.08	0.65		

＊p<.05

3.1.4 The satisfaction difference in performance

As table 7 showed, the players who ever had ranked No. one to two in the national competitions had lower satisfaction with the professional competency of coaches compared to those who ranked No. three to four (p <.05).

Table 7 The satisfaction difference in performance

Factor	Country results	Number people	Average	Standard Deviation	F Value	P Value	Significant difference
coach professional competence	1~2	20	3.36	0.64	6.49＊	0.001	1<3,5
	3~4	14	3.40	0.64			2<5
	5~8	41	3.93	0.54			
	9~16	29	3.79	0.64			
	No rank	153	3.97	0.64			
performance	1~2	20	3.35	0.78	2.49	0.044	
	3~4	14	3.39	0.66			
	5~8	41	3.22	0.60			
	9~16	29	3.30	0.63			
	No rank	153	3.03	0.69			
ball team welfare	1~2	20	3.33	0.78	2.97	0.020	
	3~4	14	3.66	0.56			
	5~8	41	3.03	0.88			
	9~16	29	3.47	0.68			
	No rank	153	3.18	0.72			
Venue facility	1~2	20	3.65	0.65	2.58	0.038	
	3~4	14	3.11	1.12			
	5~8	41	3.23	0.72			
	9~16	29	3.49	0.87			
	No rank	153	3.55	0.72			
Training supervision	1~2	20	3.79	0.57	0.97	0.423	
	3~4	14	3.38	0.78			
	5~8	41	3.54	0.55			

＊p<.05

3.1.5 Satisfaction difference in training sessions

Table 8 presented that in terms of the satisfaction with the professional competence of coaches, training controlling, and teammate relationship, the players who had the training time more than 9 hours gave higher scores than those who trained less than 3 hours, 3-6 hours, and 6-9 hours. It indicates that more training sessions can lead to higher satisfaction in the professional competence of coaches, training controlling, and teammate relationship (P<.05).

Table 8 The satisfaction difference in training sessions

Factor	hour	Number people	Average	Standard Deviation	F Value	P Value	Significant difference
coach professional competence	<3 hour	50	3.66	0.70	5.84＊	0.001	
	3~6 hour	125	3.94	0.56			2＞1
	6~9 hour	60	3.75	0.72			
	9 hour above	22	4.26	0.62			4＞1,2,3
technique performance	<3 hours	50	3.14	0.67	0.20	0.893	
	3~6 hour	125	3.15	0.67			
	6~9 hour	60	3.09	0.73			
	9 hour above	22	3.22	0.67			
ball team welfare	<3 hour	50	3.29	0.86	0.14	0.935	
	3~6 hour	125	3.21	0.78			
	6~9 hour	60	3.22	0.68			
	9 hour above	22	3.18	0.51			
Venue facility	3 hour following	50	3.49	0.88	1.75	0.158	
	3~6 hour	125	3.47	0.71			
	6~9 hour	60	3.36	0.79			
	9 hour above	22	3.80	0.73			
train supervision	<3 hour	50	3.43	0.67	5.88＊	0.001	4＞1,2,3
	3~6 hour	125	3.58	0.59			

	6~9 hour	60	3.63	0.67			
	9 hour above	22	4.10	0.70			
	<3 hour	50	3.54	0.77	2.73	0.045	
ball team morale	3~6 hour	125	3.61	0.65			
	6~9 hour	60	3.58	0.60			
	9 hour above	22	4.00	0.69			
	<3 hour	50	3.93	0.72	6.62＊	0.001	4＞1,2,3
teammate relationship	3~6 hour	125	4.01	0.59			
	6~9 hour	60	3.93	0.68			
	9 hour above	22	4.59	0.54			
relationship	non-PE	17	3.69	0.85			
	never	39	3.79	0.74			

＊p<.05

3.1.6 Coach's professional background

Table 9 showed the difference of satisfaction resulted in the professional background of coaches (p<.05). It is indicated that the coaches with professional background would receive more satisfaction from players who were also more satisfied with teammate relationship than the players without awareness of coach's background or under the guidance of unprofessional coaches. The players have the highest scores in the factors of teammate relationship and the professional competence of coaches.

Table 9 The satisfaction difference in coach background

Factor	coach background	Number people	Average	Standard Deviation	F Value	P Value	Significant difference
coach professional competence	PE	201	3.94	0.63	6.35＊	0.002	1>2,3
	non-PE	17	3.52	0.71			
	never	39	3.64	0.66			
technique performance	PE	201	3.17	0.68	1.26	0.285	
	non-PE	17	2.95	0.49			
	never	39	3.04	0.73			
ball team welfare	PE	201	3.23	0.78	0.05	0.954	
	non-PE	17	3.18	0.68			
	never	39	3.24	0.64			
venue facility	PE	201	3.49	0.78	0.17	0.840	
	non-PE	17	3.47	0.74			
	never	39	3.41	0.72			
Training supervision	PE	201	3.66	0.65	3.97	0.020	
	non-PE	17	3.31	0.65			
	never	39	3.44	0.62			
ball team morale	PE	201	3.65	0.66	1.09	0.338	
	non-PE	17	3.43	0.95			
	never	39	3.56	0.58			
teammate	PE	201	4.10	0.61	6.43＊	0.002	1>2,3

4. Discuss

4.1 The training satisfaction

The study shows the score of training satisfaction is 133.13, 73.69% of the total score indicating the medium level. The results is little higher than that of the adult group A of baseball (63.79%) in the research conducted by sick Huang in 2000 and university elite tennis players 68.62% suggested by Li (2003). The subscales of teammate relationship and professional competence of coaches have the highest satisfactory score, whereas the lowest score in team welfare and performance. The finding supports with the highest score in teammate relationship in the study of Huang (2000) and the most satisfactory aspects of personal relationship and coach behavior in the study of king, Tang, Chen (2006). The players' highest satisfaction with teammate relationship suggests that the general Group players are voluntary to attend the training without being forced by university departments. The good relationship is developed in the process of training requiring players' efforts and adherence. The second higher score in the factor of the professional competence of coaches indicates that the general acceptance of coaches' performance. As for the dissatisfaction with team welfare, it suggests that the gap between the expectancy of players and the provision of university. The lowest score in team performance demonstrates that fierce competition among various teams resulting in unsatisfactory achievement out of the expectation.

4.2 The analysis of satisfaction difference

4.2.1 Gender

In comparison with female players, male ones have the higher satisfaction in the factors of the professional competence of coaches, venue facility, training supervision, which is inconsistent with the findings of the studies of Lee, and Liao(2004), Chen(1995) indicating that the perception in satisfaction is not affected by gender. And it is also contradicting with the findings of Hong (2007) and Wang (2007) showing that female athletes have higher satisfaction in personal relationship than male athletes. The possible explanation is the achievement obtained by male groups largely depended on professional competence of coaches, provision of training venue and arrangement of training time so as to guarantee the competency.

4.2.2 Playing span

The players with playing span of 5 years shows the obvious dissatisfaction with the performance compared the ones with 6-10 years and more than 11 years. The finding is different from the study of Wang (2006) that there is no correlation between the training satisfaction degrees and playing span. In addition, Lee and Shi (2003) showed that the players with the playing span of 1-5 years had higher score than those with 6-10 year playing

in training satisfaction. And Huang (2000) suggested that the players with playing span of 1-3 years were the most satisfied with the training and those with playing span of more than 10 years showed the lowest satisfaction. The two studies also contradict with the finding in the current study. The potential reason is that in group A the players with shorter playing span have higher expectancy and learning efficacy so that they have higher satisfaction in training. However, the players of general Group are not professional athlete but amateur, so their motivation is originated from their interest. Their training time is limited, even for the basic skills, which results in their lower satisfaction with the performance. But some of these amateur players had the training at younger age or relatively longer training span, so they do well in grasping the skills and strategies.

4.2.3 Performance

The players who ever had ranked No. one to two in the national competitions had lower satisfaction with the professional competency of coaches compared to those who ranked No. three to four. In other words, there is the higher achievement the players have, the lower satisfaction expressed to coaches' competency. The finding is consistent with the observation of Zheng (2001), Wang (2006) and Liao (2004). It is likely due to less experience of the players who have less chance to compare various coaches. Besides, the players inadequate in skills rely largely on the coaches for improvement. More feedback from coaches could lead to higher players' satisfaction. The study of Hong (2007) pointed out that the players with very high rank have mature skill so they did not show profound response to the factors.

4.2.4 Training sessions

As for the satisfaction with the professional competence of coaches, training controlling, and teammate relationship, the players who had the training time more than 9 hours gave higher scores than those who trained less than 3 hours, 3-6 hours, and 6-9 hours. It indicates that more training sessions can lead to higher satisfaction in the professional competence of coaches, training controlling, and teammate relationship. The finding is not consistent with that of Wu's research (2002). The players who participate in more training sessions due to their strong interest in table tennis have higher expectancy to coach guidance so that they are more satisfied with the professional competence of coaches. In addition, the lack of scientific training arrangement can have negative effect to training and ultimately lead to the feeling of boredom and fruitlessness. Fortunately, most of present university coaches are competent in training controlling and reach the expectancy of the players. What's more, more training sessions lead to more interaction between coachers and players, which cultivate the value and cohesion of the group.

4.2.5 Coach

It is indicated that the coaches with professional background would receive more satisfaction from players who were also more satisfied with teammate relationship than the players without awareness of coach's background or under the guidance of unprofessional coaches. Jiang (1997) suggests that there are multiple factors effecting training achievement, but the front-line coaches are determinant. Zheng (1991) also points out that the role of coach is crucial, who is the leader of the group as well as develop and maintain the harmonious relationship among players. Besides, the study of Zheng (1997) finds that a coach acts as not only skill guide but also manager, consultant, and role model. the study and performance of player are closely related to coach's training method (Kao & Chen,2006). Wu (2002) and Wu (2000) demonstrate that compared with the athlete of group A, general Group is more cohesive. On the other hand, general Group is generally from the spontaneity of player so that the corporative spirit is very high. Therefore, the quality of coach is very important. The incumbent university coaches has the background of elite athletes and the degree of master or higher degree, who are experienced to build good teammate relationship.

5. Conclusion and recommendation

5.1 Conclusions

The study is concluded as below:

5.1.1 The descending rank of players' satisfactory factors is teammate relationship, professional competence of coaches, team morale, training supervision, venue and facility, players' welfare, and team performance.

5.1.2 The satisfaction of Male players is significantly higher than female ones in the factors of the professional competence of coaches, venue facility, and training supervision

5.1.3 The performance of players with longer playing span is significantly better than those with shorter experience.

5.1.4 The players have no achievement in competition is significantly higher in satisfaction with the professional competence of coaches than those ranked higher.

5.1.5 Compared to the players with shorter training sessions, those who trained longer are more satisfied with the three factors of the professional competence of coaches, training supervision, and teammate relationship.

5.1.6 Under the guidance of the coach with professional background, the players has significant satisfaction with the professional competence of coaches and teammate relationship.

5.2 Recommendation

5.2.1 General Group players are less satisfied with the factors of venue facility and team welfare. It is suggested that the aspects have not reached the expectation of players such as the training budget, environment, and related facilities. It is helpful to make students aware of university's status quo in the resource. On the other hand, universities can

appeal to sponsorship from alumnus by holding regular competition to raise the fund for team uniform, facility, competition outlay, coach, and hardware of venues.

5.2.2 Besides the promotion of the skills and strategies, it is vital for players to cultivate good teammate relationship and stress the importance of personal interaction to future success in occupation .

5.2.3 The players have the highest scores in the factors of teammate relationship and the professional competence of coaches. It indicates the importance of teammate interaction. The cultivation of team members' interaction and cooperation can lead to the construction of team spirit and ultimately be beneficial to future development in society. The confirmation to coaches' professional performance suggests the selection addresses the professional background and encourages in-service training of coaches.

5.2.4 Further study can address the construction of teammate relationship, such as team quality, leadership, management and motivation.

References

「1」Chen, Y., G. (1995). The leadership behavior of the swimming coach of Taiwanese region and player's result expresses and the research with satisfaction relation. Do not publish Master's thesis, the national Normal University in Taiwan: Taipei City.

「2」Chelladurai, P., & Riemer, H. A. (1997). A classification of facets of athlete satisfaction. *Journal of Sport Management,* 11, 133-159.

「3」Ebel, R. L. (1979). Essential of educational measurement. (3rd,ed.). Englewood Cliffs, N. J.: Prentice-Hall.

「4」Hong, G., T. (2007). University table tennis representative's contestant consciousness the coach leads behavior and participate satisfaction of research. Aletheia University exercises knowledge college journal. 164-173.

「5」In 2007 national official website of the hospital sports games in the university school. 2008.07.15, Draw from a Taipei Physical Education College, Web address: http://2007niag.tpec.edu.tw/public/rbook/RBook_4.aspx?id=C

「6」Jiang, J., S. (1997). Cultivate to talk my country practices training from the international exercise coach system of improvement. *National Sports Quarterly*. *26*(4), 45-51.

「7」Jian, R., Y. (2006). The university tennis player's consciousness coach leadership behavior is to the influence that exercises to participate in motive and training satisfaction. *Taiwan exercises mental college journal, 8*, 65-86.

「8」Kao, S., F. & Chen, Y., F. (2006). Exercising the coach teaches the case study of exercise team of the leadership-senior high school。The university athletics learns to publish, *8*(1)，97-111.

「9」Li, J., P. (2003). The university excellent tennis player's trains the research with satisfaction. *Physical Education Journal,* 34, 149-160.

「10」Liao, Q., F. (2004). University bowling representatives the coach behavior of the contestant consciousness with participate satisfaction of research. Do not publish Master's thesis, Fu Jen Catholic University: Taipei City.

「11」Lai, S., S. (2004). The athlete satisfaction, team support coagulates power and leaves the influence of team tendency and practice performance to the team commitment, team-with the university general set swim player's for example. The university athletics learns to publish, *6*(2), 119-130.

「12」Lock, E. A. (1976). *The nature and causes of job satisfaction*. In M. D. unknotted(ed.).Handbook of industrial and organization psychology. 1297-1349.

「13」Wang, S., Q. (2000). *My country A constitutes the research that baseball member trains satisfaction.* DO not publish Master's thesis, Chinese cultural university, Taipei City.

「14」Wang, S., J.、Tang, G., J. & Chen, Y., F. (2006). The consciousness coach leads behavior and participate the research of satisfaction-with the university General Group table tennis member of team for example. *National tiger tail science and technology university college journal, 25*(4), 97-106.

「15」Wen,C.T. & Kong, J.C, & L, S. L.(2005).Relationship between depth of involvement in leisure and leisure benefit of playing table tennis. The 9th ITTF Sports Science Congress.

「16」Wolman, B. B. (1989). Dictionary of Behavioral Science. United Kingdom Edition Published by Academic Press, Inc. Chicago: Rand-McNally.

「17」Wu, G., C. (2000). My Country University and college exercise the coach lead a behavior comparison a research. *Physical Education Journal, 28*, 59-68.

「18」Wu, H., Q. (2002). Hospital table tennis contestant satisfaction in the university school and team coagulate the research with power relation. *Chengkong University The athletics research gathers, 7*, 61-72.

「19」Wu, M., L. (2005). SPSS and covariance apply analysis Taipei: Five south book incorporated company.

「20」Xu, S., Y. (1986). Exercise technique guidance principle. Taipei: Help into the book limited

company.
「21」 Yang, C., B. (1998). The coach leadership behavior relates to satisfaction with the team atmosphere and coach — contestant of influence. DO not publish Master's thesis. national Taiwanese athletics university in Taiwan: Taoyuan City.
「22」 Zheng, M., X. (1992). *The university and college coach's leadership's behavior and athlete satisfaction's feeling relates to it a research.* DO not publish Master's thesis. National Normal University in Taiwan: Taipei City.
「23」 Zheng, Z., F. (1997). *Exercise coach leadership the behavior study*. Taipei: Normal University Book Company.
「24」 Zheng, S., Y.(2001). *The leadership behavior and contestant satisfaction of the senior high school volleyball coach in Taiwan relates to it a research*. DO not publish Master's thesis. National Taipei educates university in Taiwan: Taipei City.

A Study of Athletes' Satisfaction for Participating 2008 National Collegiate Teacher's Table-tennis Tournament in Taiwan

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Abstract: The purpose of this study was to determine the athletes' satisfaction for participating 2008 national collegiate teacher's table-tennis tournament in Taiwan. Subjects for this study were consisted of 121 players. The instrument of this study was by using "Questionnaire of management and administration for 2008 national collegiate teacher's table-tennis tournament" (return rate 91.67%). Data analysis was by descriptive statistic, t-test and one-way analysis of variance. The results of this study indicated that: (1) There are significant differences of athletes' satisfaction among athletes with different personal attributes for sub-scales "planning of event", "administration of competition" and "service of event". (2) Athletes have the highest satisfaction on "facility and equipment" in sub-scale "service of event" and followed by the factor is "service of officers". (3) Athletes have the highest satisfaction on "administration of registration" in sub-scale "planning of event" and followed by the factor is "administration of opening ceremony". (4) Athletes have the highest satisfaction on "announcement" in sub-scale "administration of competition" and followed by the factor is "competition results bulletin".

Keywords: Table-tennis, Satisfaction, Management of Sports Event

1. INTRODUCTION

Today, the sport playing a central role in our lives, the sports events or programs may motivate individuals to engage in lifelong physical activities, and helping individuals involve in lifetime physical and recreational activities which is the objective of physical education and sports development. On the other hand, the management of sports events not only focus on the competitive skills performance and event management skills, but also offer knowledge, business, sport marketing, sports media and communications, lifelong physical activities, fitness-oriented activities and leisure activities to enter sports management areas. The purpose of this study was to determine the athletes' satisfaction for participating 2008 national collegiate teacher's table-tennis tournament in Taiwan.

2. METHODS

Subjects for this study consisted of 121 players by randomly from 7 category of 2008 national collegiate teacher's table-tennis tournament (102 male and 19 female), sends out 131 questionnaires, recycling effective questionnaire 121, the effective returns-ratio is 91.67%. The instrument for this study was by using "Investigation and satisfaction for participating in table-tennis of collegiate teacher's questionnaires" to determine subjects' personal attributes and participation in this game. The data analyzed by descriptive statistics, t-test and one-way analysis of variance by SPSS 12.0 for Windows.

3. RESULTS

Researchers assigned 131 questionnaires and retrieved 121 from subjects in the players, odds of validation questionnaire retrieved are 91.67%. The results of data analyzed are as the following:

(1) The result show the athletes have the highest satisfaction on "facility and equipment" (M=3.33) in sub-scale "service of event" and followed by the factor is "service of officers"(3.28), on "administration of registration"(M=3.02) in sub-scale "planning of event" and followed by the factor is "administration of opening ceremony" (M=3.18), on "announcement" (M=3.35) in sub-scale "administration of competition" and followed by the factor is "competition result bulletin"(M=3.29) see table 1.

Table 1. The satisfaction in service of event, planning of event, administration of competition

Number of factor	Topic in questionnaires	Mean	MD
Facility and equipment (M=3.33)	Question 41	3.36	.530
	Question 42	3.32	.622
	Question 43	3.30	.572
Service of officers (M=3.28)	Question 40	3.30	.542
	Question 39	3.27	.548
	Question 38	3.27	.563
Administration of registration (M=3.20)	Question 2	3.21	.520
	Question 1	3.19	.505
	Question 3	3.19	.610
A dministration of opening ceremony (M=3.18)	Question 12	3.25	.567
	Question 11	3.16	.548
	Question 10	3.12	.566
Announcement (M=3.35)	Question 16	3.42	.574
	Question 17	3.33	.638
	Question 18	3.29	.584
Competition results bulletin (M=3.29)	Question 26	3.30	.527
	Question 25	3.29	.539
	Question 27	3.28	.520

(2) There are significant differences among difference experience for sub-scale administration of competition (P<.001). (see table 2)

Table2. Personal attitude and perspective for 2008 national collegiate teacher's table-tennis tournament

	Personal attributes	n	M	*p*
Experience	1	7	53.8571	.001**
	2-3	19	51.5263	
	4-5	28	47.3214	
	More than 6	67	48.3134	

$^{**}p <$ .01

(3) There are significant differences among martial status for sub-scale service of event (p<.001). (see table 3)

Table3. Personal attitude and perspective for 2008 national collegiate teacher's table-tennis tournament

	Personal attributes	n	M	*p*
Martial status	Unmarried	6	62.1667	.001**
	Married	115	61.2435	

$^{**}p <$ .01

(4) The satisfaction for result in differences personal attributes in service of event. We can see the result in the gender and experience and marital status there have significant difference in service of event (see table 4).

Table 4. The different personal attributes satisfaction in service of event

	Gender	Age	Education level	Attend the category	Experience	Marital status	Work period of service
Service of Event	-	-	-	-	-	-	-
Planning of Event	-	-	-	-	**	-	-
Planning of Event	-	-	-	-	-	**	-

$^{*}p <$ .05 ; $^{**}p <$ .01

4. DISCUSSION

Cheng (2004) states that the difference in the research design, provides has potency and so on rest and recreation, sightseeing amusement and rest, economic development, political diplomacy movements and the related type of event, achieves the preparation organization to decide the goal in order to. The results show the significant differences among difference experience for sub-scale administration of competition ($p<.001$), the mean score shows that the more participates experience players significant higher then few participates experience players, the result is same to Chang's (2007) research, the research finding shows that the difference personal attributes is significant to administration of competition, specially in the difference participate experience. Significant differences among martial status for sub-scale service of event ($p<.001$), the result shows that unmarried participates have higher significant then married participates. The research of study provides us for the sport event management information to that organization the planning of event, administration of competition and service of event is most important to the event.

5. CONCLUSION

The conclusion of study as follows:

1. There are significant differences of athletes' satisfaction among athletes with different personal attributes for sub-scales "planning of event", "administration of competition" and "service of event"
2. There are significant differences among difference experience for sub-scale administration of competition($P<.001$).
3. There are significant differences among martial status for sub-scale service of event ($p<.001$).
4. There are not significant differences among the other personal attributes.
5. This research is by discusses in 2008 national collegiate teacher's table-tennis tournament, by the investigation, expected that can promote the congress to conduct the standard. And will provide by this findings takes in the future execution of reference the inquisition related competition.
6. This object of study only send the questionnaire by 2008 national collegiate teacher's table-tennis tournament's players, Take collects the contestant to fill in answers the material to do basis of as the analysis competition degree of satisfaction. May aim at each team staff members and so on team group leader, training and trainer research on the future, includes the object of study, permeable by different face will conduct the deep research and the discussion, the time obtains a more perfect effective result to prepare the reference for the future.

6. REFERENCES

1. Cheng, S, T. (2004). *Principle and practice of sport management*. Taipei :Yang-Chih Press.
2. Chang, C, Y. (2007).*A study of athletes' satisfaction for participating 2008 national collegiate athletic game*.. Unpublished master's thesis, National Changhua University of Education, Changhua, Taiwan.

A Study on the Impeding Factors of Disability Participate in Table Tennis in Taiwan

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Abstract：The purposes of this study were to investigate current situation and impeding factors of disability participate in table tennis. The research tools adopted is questionnaire. Means of statistics in use in this research include: Descriptive Statistics, t-test and One-way Anova. To analysis different of impeding factors by background variables and disability classification of disability individual who participate in table tennis. Results of this research are as follows:

1.Disability who participate in table tennis almost 80% were male, more than 60% married, more than 50% childless, more than 60% were 40 to 49 years old, 40% education were high school, occupation were military, civil servant and teacher close 35%, about 23% earn less 20,000NTD per month.

2.Different disability classification of disability who participate in table tennis were, more than 75% were polio, acquired were close 90%, Disability classification of ITTC were more than 50% on TT4 and TT5. Use walking stick help to walk was 34.12% and useless any thing to help walking was 31.76%.

3.Among the background variables, gender, married, child, age, education, occupation, income per month show no significant variance for impeding factors to participate in table tennis.

4.Among the inherent or acquired and classification of disability show significant variance for impeding factors to participate in table tennis.

Keywords: Disability, impeding factors, table tennis

1 Historical Background

In 2000's Special Olympics held at Sydney, there were a total of one gold, two silver and four bronze medals awarded; and in table tennis alone, Taiwan had won two silver and two bronze medals. Back in 2004's Athens Special Olympics, our nation was awarded with two gold, two silver and two bronze each; table tennis awards accounted for one silver and two bronze awards. This researcher has been involved in promoting table tennis for years. In addition, this researcher also witnesses that the exercise itself would be vital, in the sense of leisure life, to those who are disabled. It not only can pace both mind and body with enhancement noted in physical fitness, but also get to know friends of the same aspirations during exercise sessions, culminated with a sense of achievement.

At the time, table tennis is one of the many athletic items with ardent participation by the bodily disabled in Taiwan. There are at least 20 tournaments for bodily disable athletes held annually both domestic and abroad. These contests not only provide the bodily disabled with opportunities of participating to these activities, but also motivate their participation to the sport of table tennis. Hence, for these table tennis participants, while engaging in the sports of table tennis, the conditions developed as well as impediments derived from the participation, motivated this author in this research.

The purpose of this research is to understand the impediment factors for bodily disabled athletes in participating to table tennis here in Taiwan. And based on research findings, suggestions will be made to training organizations, the coaches as well as to bodily disabled athletes. Additionally, it would provide relevant organizations for reference as to enhance and rid off the impediment factors for bodily disabled athletes in participation to table tennis. Furthermore, it would enhance the passion and motivation for the bodily disabled to participate table tennis, ensued with the upgrade of living qualities for bodily disable persons.

The main purpose for this research:

(1) Understand the current status for those who disabled in the participation with table tennis in Taiwan.

(2) Compare and locate the impediment factors for those disabled in participating to table tennis here in Taiwan.

(3) Analyze the different variables as well as differences of impediment factors between different levels in disability for the disabled in general, while participating to table tennis sport.

2 Research methodology

The subjects under this study were those who registered to the participation for 2005 Postal service and life insurance cup dedicated to nation's disabled tennis athletes. And these athletes originated from the bodily disabled persons, a total of 94.

The questionnaire for this research was the primary survey tool. The contents for questionnaire included for parts. The first part was the survey for table tennis participation status. The contents of survey included the number of days, time and duration, transportation, time spent on traffic, participation location, any fees paid, any

available coaching, any actual contest entered, ever served as athletes representing our country and years of the athletic experience in table tennis. The second part was the measurement chart this research adopted for questionnaire for the impediment factors for participating table tennis, originated from referencing Tsai, Hui-Chun's (2003) "Survey query for impediment factors of adults participating leisure athletic events" in addition to compliant to bodily disabled special configuration, and these were compiled into 18 questionnaires as result. The third part was primarily the survey tables for bodily disabled information acquisition. This questionnaire was to reference Kuan, Te-Tsai (2003) compiled "Survey for orientation of leisure exercise for bodily disabled". And the questionnaire included type of disability, born with disability, classification level and the auxiliaries to assist walking, etc. The fourth part was primarily personal information. The questionnaire included filling out basic information (including gender, marital status, siblings, age, education background, profession and income, etc). Please reference the following (Fig. 1)

(Fig. 1)

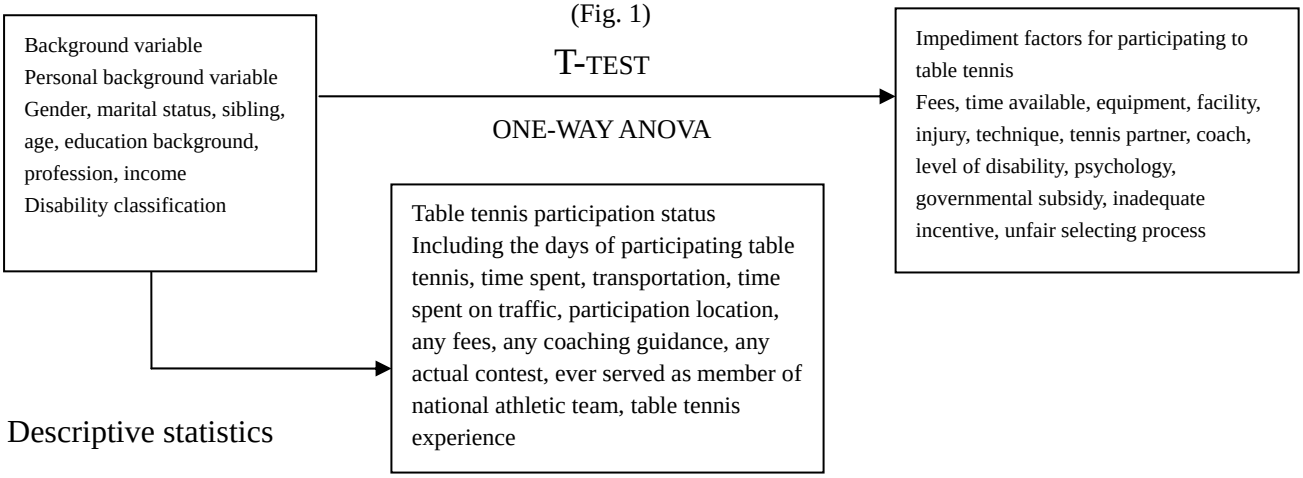

Table1. Itemized analysis summary for "Athletic impediment factor chart for bodily disabled to participate to table tennis"

# of quiz		CR,Critical Ratio	Relevancy with the measurement chart's total scoring	Notes
6	I felt like that I was frequently injured after	2.801*	0.371	Deleted
7	I felt that every time when I participated to table tennis game, I was always in high	2.401*	-0.195	Deleted
8	I felt that I frequently got physically exhausted which led to further weakening	2.140*	0.306	Deleted
9	I felt that there was less time than I would have spent with my family members.	0.951	0.186	Deleted
11	I could not participate with table tennis	1.830	0.302	Deleted
23	I felt that there were too few subsidies from local government to the bodily disabled	2.584*	0.339	Deleted

*p<.05

(1) Compilation for the questionnaire .

The research tools were carefully tested after compilation by professionals, and they were modified and finalized with some of the question updates and minor wording corrections in compliance to finished pre-questionnaire requirements. In filling out the measurement chart, this research adopted the so called "five-point Likert item". Since the reactions to this Likert scale are the most distinct with sufficient differentiation, therefore, under most circumstances, the five-point Likert measurement chart is the most reliable design (Chiu, Yung-Chiao, 2005;). In the five-point Likert item, the format for rating is:1. "Strongly disagree"; 2. "Disagree"; 3. "Neither agree or disagree"; 4. "Agree"; ; 5. "Strongly Agree"

(2) Item analysis

After filing away the collected survey query sheets, we applied the criterion of internal consistency which sequenced the summarized scores for all the participants' measurement chart conducted in the bathroom facility, then, arranged for those who scored the top 27% as the high-score team and the bottom 27% as the low-score team. By applying t-test for the participants under the same question posed, we arrived with the value of "critical ratio" for each query . Then, followed with correlation analysis to compute the product-moment correlation between each item and total scores. If the related coefficient did not exceed the standard .40, this would signify that this question item could not distinguish the reaction level for the participant under test (i.e. having no distinguishing effect), and it should be crossed out or deleted. As long as the distinguishing capability could match to the level of the question posed, it could then be selected as the official question. (Wang, Chun-Ming, 1999)

1.Within the original 23 questions of "Athletic impediment factor chart for bodily disabled to participate to table tennis", the 9th and the 11th questions were deleted because they did not reach the significance level. Other than these, the significance

levels for the 6th, 7th, 8th and 23rd questions opposed to the measurement chart's total scoring respectively were less than .40, thus, these were also deleted. 17 out of the 23 questions were retained as result. (Table 1)

(3)Factor analysis

The factor analysis for this research primarily adopts "Principal component analysis" to analyze the common factors, which adopts "Varimax" to sample the factor's characteristic value greater than 1.0. In this research survey, the impediment factor portion for the bodily disable participating to table tennis sport was sampled for four factors with each Eigen value separately as 32.215, 11.907, 9.387 and 8.000, and the accumulated interpreted variance was 61.51, like depicted in Table 2:

Table 2. Summary table for factor "Athletic impediment factor chart for bodily disabled to participate to table tennis"

Item No.	Question	Factor 1	Factor 2	Factor 3	Factor 4
17	I felt frustrated because I frequently needed to handle wheelchair.	0.828			
18	I felt I was severely disabled therefore I was afraid of participating.	0.748			
10	I felt that every time I finished off playing, and I was sweating all over and felt uncomfortable thus I did not want to participate.	0.716			
20	I felt unable to get to know the friends whom I wanted to associate with.	0.667			
19	I felt there were too many players during activity and there were few tables available.	0.608			
13	I felt not to join because my family members were against this.	0.608			
14	I felt that I was not skilled enough and also lack of practicing companions therefore I did not want to participate.		0.778		
12	I felt there was lack of coaching, therefore I did not want to participate.		0.753		
16	I felt that I was unable to find an opponent player or coach therefore I lost interest.		0.751		
15	I felt that I was not able to upgrade my playing skill and felt bored, therefore I did not want to participate.		0.746		
2	I felt I spent too much on the equipments.			0.751	
4	I felt that, by participating to table tennis, it made me have less financial income.			0.739	
1	I felt that the participation to table tennis wasted too much time in transit.			0.716	
22	I felt that Chinese Taipei Paralympics Committee was into unfair practice in the selecting for national athletic team members as well as coaching staffs, and this prompted me with resignation from participation.				0.838
21	I felt there was not enough national incentive or encouragement to the disabled, which discouraged my motivation to participate to table tennis.				0.699
3	I felt there was too few or none Barrier-Free Facilities and this was rather inconvenient to me.				0.607
5	I felt that the installation and equipments were not up to par, and usually felt that I would get hurt.				0.561
Characteristic Value		5.476	2.024	1.596	1.360
Eigen value%		32.215	11.907	9.387	8.000
Accumulated Eigen value%		32.215	44.122	53.509	61.508

(4)Factor contents and nomenclatures

The first factor is primarily concerned with psychological self which contains frustration regarding wheelchair transport, level of disability led to afraid to participate, body stickiness preventing from participation, too many players without available table to practice and family member's objections to participate, etc. Therefore it is named as "Self rejection factor". The second factor contents include lack of practicing partners, lack of coaching guidance, unable to acquire encouragement and unable to upgrade playing skills, etc. Therefore it is named as "skill and coaching factor". The third factor contents include too expensive, less economical income, too much time wasted in traffic. Therefore it is named as "economical and traffic factor". The fourth factor contents include unfair selection process, inadequate incentive, unable to acquire encouragement, very few Barrier-Free Facilities and poor playing facilities, etc. Therefore, it is named as "policy and installation factor".

(5) Reliability for measurement chart

According to a measurement chart or survey with good reliability coefficients must have its reliability coefficients for the total measurement chart above 0.80, coefficients between 0.70 and 0.80, are still acceptable. For sub-measurement chart, reliability coefficients are better off above 0.70, coefficients between 0.60 and 0.70, are still acceptable. From the above, we can learn that, this measurement chart's reliability is still in good range (Table 3).

Table 3. The summarized reliability analysis for "Athletic impediment factor chart for bodily disabled to participate to table tennis"

Name of	No. of question	Cronbach's α
Self rejection	10、13、17、18、19、	0.833
Technique	12、14、15、16	0.830
Economic and	1、2、4	0.685
Policy and	3、5、21、22	0.693
Total		0.856

(6) Validity for measurement chart

The compilation for this research's measurement chart references the compiled measurement charts by Tsai, Hui-Chun (2003) and Kuan, Te-Tsai (2003). In addition, it accommodates the characteristics of table tennis sport for the disabled with modifications ensued with careful review by both the scholars and professionals. Factor analysis methodology is thus conducted to certify the construct validity for measurement chart.

(7) Official measurement chart

This research's "Athletic status and impediment factor survey for bodily disabled to participate to table tennis" was completed after test trial for survey sheet, item analysis and factor analysis. The survey can be decomposed into four parts:

(A) Table tennis participation status:

1.How many days in a week do you play table tennis?
2.How long do you play table tennis each time you engage in this sport?
3.What are the primary transportations when you go to play table tennis？
4.How long does it take in a round trip to get to the location for table tennis?
5.What are the locations where you play table tennis？
6.Do you have to pay for the location you play or the organization which it is affiliated to on regular basis？
7.Is there any coaching available at the location where you play table tennis？
8.Have you ever participated with any table tennis tournament dedicated for the bodily disabled?
9.Have you ever been selected as the athlete who represented our nation for bodily disabled table tennis tournament?
10.How long have you being participated in table tennis?

(B) Athletic impediment factor chart for participating to table tennis

1.I felt that my family members are against it therefore I don't want to participate.
2.I felt that every time I finished off playing, and I was sweating all over and felt uncomfortable thus I did not want to participate.
3.I felt frustrated because I had to carry and transport the wheelchair every time I went to the game.
4.I felt since I was severely disabled and was afraid of going to the game.
5.I felt that there were too many players onsite and lack of table to play.
6.I felt that I could not get to know the friends I desired.
7.I felt that the lack of coaching diminished my desire to participate.
8.I felt that I was not proficient enough to play as well as lack of partner to practice, therefore I did not want to participate.
9.I felt that it was also impossible to upgrade my playing skills and got frustrated, therefore I did not want to participate.
10.I felt that I couldn't get the encouragement from either other players or coaches, therefore I was not motivated.
11.I felt that too much time spent on traffic while attending the table tennis sport.
12.I felt the equipments were too costly.
13.I felt that my income tended to be less and less while participating to the game of table tennis.
14.I felt that there were too few Barrier-Free Facilities or it was simply nonexistent which would be inconvenient.
15.I felt the facilities were rather lacking and constantly worried that I could get hurt.
16.I felt that there wasn't enough national incentives provided to the bodily disabled, which tended to lower my motivation to participate to table tennis sport.
17.I felt that Chinese Taipei Paralympics Committee was into unfair practice in selecting national athletic team members as well as coaching staffs, and this prompted me with resignation from participation.

(C) Bodily disabled information

1.What is the your bodily disabled category？
2.Is the disability congenital or postnatal？
3.What is the category of table tennis that you are classified as？
4.What kind of assistant equipment do you use while walking？

(D) Personal information

1.Gender
2.Marital status
3.Any kids?
4.Age
5.Educational background
6.Profession
7.Average monthly income

3.Findings and discussions

(1) Current status for the bodily disabled with different background variables participating to table tennis sport

According to the information available, those who are bodily disabled participating to table tennis sport are predominantly male (78.82%). In the marital status portion, most of them are married with 64.71%. And 52.94% of the persons being interviewed have no kids. As for the age category, predominant group is between the age of 40~49, which accounts for 64.71% of the interviewed. As for the portion for highest educational background, they are high (vocational) school (40.00%), junior college (23.5%), university (18.82%), junior high

(11.76%), above graduate school (4.71%) and others (1.18%).

In the area of profession, 34.12% of the participants under test are military, civil servant and teaching. Then it is followed by commerce (12.94%), labor (9.41%) and (1.18%) in agriculture, lumber, fishing, animal and stock-raising related professions. In the average monthly income, those who have less than 20,000NTD belong to the predominant group, accounting for 23.53% in the total persons under test. Then followed by monthly income between 40001~50000 NTD (18.82%). The rest are respectively with monthly income in the range of 20001~30000 NTD (17.65％), 30001~40000 NTD (16.47%), 50001~60000 NTD (11.76%), 90001 NTD and above (4.71％), 60001~70000 NTD (3.53％), 70001~80000NTD(2.35%),80001~90000NTD which is in the group with least participants under test with only 1.18%.

(2) Current status for attending the table tennis sports from bodily disabled with different level of disability

According to our information, in the category of bodily disabled protion, there is 3.53% suffering Cerebral Palsy, 75.29% with polio, 15.29% with spinal chord injury, 2.35% with limb amputation and 3.53% in multiple disabilities. As for whether the disability is congenital or postnatal, the former accounts for 10.59% of the persons under test and the latter with 89.41%.

As for what kind of category in table tennis: For those who under test are categorized in TT1 accounts for 4.71% of the total; 0.00% in TT2, 10.59% in TT3, 27.06% in TT4, 23.53% in TT5, 2.35% in TT6, 2.35% in TT7, 16.47% in TT8, 5.88% in TT9 and 7.06% in TT10.

As for what kind of assisting equipments being used while walking, 17.65% using wheelchair, 34.12% with walking sticks, 31.76% without any assisting equipments, and others accounted for 16.47%.

(3) In the portion of what kind of assistant equipment being used during walking, there are 17.65% of the persons under test who use wheelchair, 34.12% using walking stick, and 31.76% not using any assistant equipments at all, and others accounted for 16.47% of the total under test.

According to information, for those who bodily disabled with different background variables, gender, marital status, whether having kids, age, educational background, profession and monthly income, etc, did not attain the significance level in four of the profiles for impediment factors participating table tennis. And these four profiles were “self-rejection”, “technique and training”, “economy and transportation” and “policy and installation”.

(4) Analyze to determine whether there exists significant difference for the athletic impediment factors of those who are bodily disabled with different level of disability in participating to table tennis

According to information, for those who are congenital disabled or postnatal disabled of bodily disabled persons, there were significant differences in the profile of “policy and installation” (p-value = .048: p<.05). And this could be attributed to the fact that those who disabled did show the reaction to the policy as well as the gap between anticipation and reality in using the facilities, entailing with performance of difference between the timeframe of prior to and after the occurrence of bodily disability. For those who are congenitally disabled, from birth up to growing up, they are already used to the feeling from the policy as well as the usage of facilities, therefore, there are some differences. Detailed as follow (Table 4)

Table 4 : t-test for athletic impediment factors for those who either congenitally disabled or postnatally diabled persons in participating to table tennis sports

Name of	Congenital		t Value	
Self-rejection	Congenital	8	-1.09	0.281
	postnatal	76		
Technique	Congenital	8	-0.67	0.507
	postnatal	76		
Economy and	Congenital	8	0.92	0.361
	Postnatal	76		
Policy and	Congenital	8	2.01	0.048*
	postnatal	76		

*p<.05

The “self-rejection” profile in the classification for different disability level on table tennis (F value is 2.44, p<.05) and the profile of “policy and installation” (F value is 2.48, p<.05) have significant differences. Moreover, if applying Scheffe’s posteri, in the profile of “self-rejection”, it did not show any significant difference. In the “policy and installation”, TT6 class was more significant than that of TT7 class. This could be attributed to the fact that for those who were classified in TT6 of bodily disabled were much more severe than those classified in TT7, therefore, in the feeling from policy as well as the usage of installation, the former had much stronger experiences than the latter. For the impediment factors of other classifications of bodily disabled who participated to table tennis, they did not reach the level of significance in four of the profiles for impediment factors in participating to table tennis: “self-rejection”, “technique and training”, “economy and transportation” and “policy and installation”

4.Conclusions

1.Disability participate in table tennis almost 80% were male, more than 60% married, more than 50% childless, more than 60% were 40 to 49 years old, 40% education were high school, occupation were military, civil servant and teacher close 35%, about 23% earn less 20,000 NTD per month.

2.Different disability classification of disability who participate in table tennis were, more than 75% were

polio, acquired were close 90%, Disability classification of ITTC were more than 50% on TT4 and TT5. Use walking stick help to walk was 34.12% and useless any thing to help walking was 31.76%.

3.Among the background variables, sex, married, child, age, education, occupation, income per month show no significant variance for impeding factors to participate in table tennis.

4.Among the inherent or acquired and classification of disability show significant variance for impeding factors to participate in table tennis.

References

[1] Chiu,Yung-Chiao , " A Study of the Effects of Organizational culture and Work Value on Job Involvement – Taking Junior High School Physical Education Teachers of Taipei City as an example ," *Department of Physical education.Fu Jen Catholic University Master's Thesis*.2005

[2] Der-Jiang Guan , "Participation in Recreational Sport for People with Physical Disabilities," *National Taiwan College of Physical Education Master's Thesis*.2003.

[3] Tsai, Hui-Chun's, "Comstraints to Recreational Sport Participation Amomg Adults-Taking Feng-Shan City in Kaohsiung for example," *Taipei Physical Education College Graduate Institute of Exercise and sport Science Master's Thesis*.2003

[4]Wang, Chun-Ming,, "The point of veiw about the PE performance evaluation, "*Bulletin of University Physical Education and Sports*.,Vol. 4(1), No. 14, pp. 1999.

Survey analysis for the current utilization status of wheelchair table tennis athletic equipments

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Abstract：This article adopted the research subjects from those who participated in the 2008 Postal Insurance Cup for national bodily and mentally disabled athletes who represented this country. And these athletes participated to the points-accumulated contests for wheelchair teams of the first to fifth levels were of 45 men and 16 women athletes with a total of 61. Research methodologies like documentations, survey queries and mathematical statistics were used to conduct analyses in regards to issues like athletic populations for current Taiwan bodily and mentally disabled wheelchair table tennis players, and current equipment utilization status. And the following are the findings:

1. In the arena of wheelchair table tennis population development, male athletes accounted for 45 persons (74%): 28 persons (62%) of High levels TT4, TT5, 12 (27%) of middle level TT3, and 5 persons (11%) of low level TT1 and TT2. Female athletes accounted for 16 persons (29%)： 10 persons (63%) of TT4 and TT5 levels, 5 persons (31%) of TT3 middle level and 1 person (1%) of low level TT1 and TT2.
2. In paddle grip, the male wheelchair athletes adopted right hand grip with 42 persons (93%), and those with left hand grip were 3 persons (7%). And the female athletes adopted right hand grip were 15 persons (91%) with one in left hand grip (9%). The male wheelchair athletes had 38 persons (84%) adopting handshake grip, 7 persons (19%) adopting pen-hold grip. Female wheelchair athletes had 16 persons (100%) adopting handshake grip.
3. In the area of pad rubber, 31 (69%) of the male athletes adopted pimpled rubber pad, and 14(31%) of them adopted the smooth surface pad. For female wheelchair athletes, there were 12 persons (75%) adopting pimpled pad and only 4 persons (25%) adopting smooth surface pad.
4. In the wheelchair control method and usage, 25 (56%) of the male athletes adopted the unlock mechanism with only 9 persons (20%) adopting the wheelchair locked approach, and 11 persons (24%) semi-locked. 6 persons (38%) of the female athletes adopted unlock mechanism, only 4 persons (24%) adopting locked mechanism and 6 persons (38%) with semi-locked.
5. In the wheelchair seat preparation and usage, 33 persons (73%) of the male athletes adopted parallel stance and only 12 (27%) adopted sideways. 8 persons (57%) of the female athletes adopted the parallel stance with only 6 (43%) adopting sideways.

Handshake grip has been the mainstream for Taiwan table tennis sport. Still, the pen-hold has the tactical characteristics in technique. The pad rubber can be pimpled which has the characteristics of enabling the spin with varieties; it allows the player with either the attack or defense, slow or fast maneuvers. And this approach is adopted by most wheelchair players. For those middle and high levels wheelchair athletes, they tend to adopt unlock or semi-locked control of wheelchair, which can enhance the agility of wheelchair control.

Key Word：Wheelchair, Table tennis sport, bodily and mentally disabled

1 INTRODUCTION

The wheelchair control technique and the seating arrangement are just important as normal person's stance by the table as well as footwork. Each type of seating arrangement dictates the playing type and the mainstream tactics, therefore the coach must base upon the athlete's condition to provide wheelchair athlete with suitable seating and preparation so as to facilitate their readiness for both the technique and tactics.

In view of this, this report intends to illustrate the wheelchair for the wheelchair athletes, the pad, etc, in addition to issues like its current usage status so as to conduct analysis. It includes discussions for the importance of wheelchair maneuvering technique and seating arrangement, and comparison for the characteristics and limiting factors for each method. And it proposes individual findings as well as things to look out for, with the expectation that it would be of assistance in promoting the research atmosphere conducive to the promotion of Taiwan wheelchair table tennis sports.

2 Research subject and methodology

2.1 Research methodology

This article adopted the research subjects from those who participated in the 2008 Postal Insurance Cup for national bodily and mentally disabled athletes who represented this country. And these athletes participated to the points-accumulated contests for wheelchair teams of the first and fifth levels were of 45 men and 16 women athletes with a total of 61. They were the subjects under study. Survey query was conducted on

all 61 athletes with 61 copies of survey sheets disseminated and the returned ratio reaching 100%, effectiveness ratio 100% as well. In addition, mathematical statistics approaches were employed to sort out and compile survey information.

2.2 Operational definition for key words

2.2.1 Disabled table tennis

(1)One to five levels of wheelchair team： Those who have to play in wheelchair. (Lin, Kuang-Hua 1994; International Paralympic Committee, 1995)

2.2.2 Rubber surface for table tennis pad

(1)Pimpled surface (rubber)： Its rubber surface has pellet-like shape with ripples on the pellet surface. Ping pong ball spinning capability is less than that of rubber pad with flat surface.

(2) Flat surface (rubber)： The rubber surface is flat and even, which can produce highly spinning movement.

2.2.3 Controlling and maneuvering for the wheelchair

(1)Unlock style：The brakes for all the wheels of wheelchair are released with high agility in moving around.

(2)Locked style：The brakes for all wheels of the wheelchair are locked and fixated with less agility but more stabilized.

(3)Semi-locked style：The playing-hand side of the wheelchair with its wheel locked allows the other hand free to control the playing-side wheel.

2.2.4 The preparation for wheelchair seating

(1)Parallel：The body of the athlete and the frontal region of the wheelchair are parallel with the edge of the table (edge line).

(2) Sideways：The body of the athlete and the frontal of wheelchair are in an intersection angle with the edge of table (edge line), the sideways angle is approximately 20~45 degrees.

3 Findings and discussions

3.1 Findings

Table 1. The dexterity in paddle grips for the male and female wheelchair team from levels one to five

	Male		Female	
class	Right-handed	Left-handed	Right-handed	Left-handed
TT1	2			
TT2	3		1	
TT3	12		4	1
TT4	16	1	6	
TT5	9	2	4	
Total (%)	42(93%)	3(7%)	15(91%)	1(9%)

From the statistics result in Table 1, we learned that in the dexterity for paddle grip of male contenders in wheelchair sports, the ratios between right-handed and left-handed were 93:7, which were 42 right-handed persons and 3 left-handed. The female wheelchair athletes had the right-handed vs. left-handed ratio of 91:9 with 15 persons in right-handed and one in left-handed.

Table 2. The paddle grip inclinations for the male and female wheelchair team from levels one to five

	Male		Female	
	Handshake	Pen-hold	Handshake	Pen-hold
TT1	2			
TT2	3		1	
TT3	12		5	
TT4	12	5	6	
TT5	9	2	4	
Total (%)	38(84%)	7(16%)	16(100%)	0%

From the statistical findings in Table 2, we learned that in the paddle grip scenario, the ratio between handshake and pen-hold grip for male wheelchair sports athletes was 84:16 with 7 persons in pen-hold and 38 in handshake. For the female counterpart, the ratio between handshake and pen-hold was 100:0 with 16 persons in handshake and none in pen-hold.

Table 3. The paddle rubber use for male and female wheelchair teams of one to five levels

	Male		Female	
	Pimpled	Flat surfaced	Pimpled	Flat surfaced
TT1		2		
TT2	3		1	
TT3	9	3	2	3
TT4	12	5	5	1
TT5	7	4	4	
Total(%)	31(69%)	14(31%)	12(75%)	4(25%)

From findings in Table 3, we learned that in the paddle rubber usage, the pimpled and flat surfaced rubber for male athletes had ratio of 69:31 with 31 in pimpled and 14 in flat surfaced. For the female counterpart, the ratio was 75:25 with 12 in pimpled and 4 in flat surfaced.

Table 4. The wheelchair maneuvering style for male and female wheelchair teams of one to five levels

	Male			Female		
	unlocked	Locked	Semi- Locked	unlocked	Locked	Semi- Locked
TT1		2				
TT2		1	2		1	
TT3	7	2	3	3	1	1
TT4	10	2	5		2	4
TT5	8	2	1	3		1
Total(%)	25(56%)	9(20%)	11(24%)	6(38%)	4(24%)	6(38%)

From the findings of Table 4, we learned that in the wheelchair maneuvering, the ratio for wheelchair unlocked, locked and semi-locked athletes in this contest was 56:20:24 with 25 persons in unlocked, 9 persons in locked and 11 persons in semi-locked. For the female counterparts, the ratios were 38:24:38 with 6 in unlocked, 4 in locked and 6 in semi-locked

Table 5. The wheelchair seat preparation style for male and female wheelchair teams of one to five levels

	Male		Female	
	Parallel	Sideways	Parallel	Sideways
TT1	2			
TT2	3			1
TT3	9	3	4	1
TT4	12	5	3	3
TT5	7	4	1	1
Total (%)	33(73%)	12(27%)	8(57%)	6(43%)

From the findings in Table 5, we learned that in the wheelchair preparation, the athletes for this contest adopted the parallel and sideways style with the ratio of 73:27, entailing 33 persons in parallel and 12 persons in sideways. The female counterparts of the same categories had 57:43 ratios with 8 persons in parallel and 6 in sideways.

3.2 Discussions

3.2.1 Discussions for paddle grip dexterity

From the findings in Table 1, we learned that there was extreme difference in ratio for the left-handed and right-handed approach (Male 93:7; Female 94:6). And this phenomenon attracted our attention entailing an urgent need to cultivate a group of players in left-handed approach. Since there are plenty of globally high quality players playing with left hand; therefore if we do not cultivate a definite amount of players in left-handed approach, then we expect that Taiwan players would have a difficult time to adapt themselves to the reality needs in global contests.

3.2.2 Discussion for paddle grip

From the statistical findings in Table 2, there was a dead-set ratio (84:16) for pen-hold grip in Taiwan wheelchair athletes, and this can be attributed as something good. Multiple styles of paddle grip can facilitate the formation of tactics and can also reach the demanded tactical characteristics. Nonetheless, the female counterparts of wheelchair athletes were trained with pen-hold tactics through handshake grip. Since the female is bounded by physiological characteristics, their instantaneously bursting energy was conspicuously less than that for the male counterpart. Thus, the female pen-hold grip for the wheelchair tactics was not encouraged nor recommended.

For the wheelchair athletes who tend to adopt handshake grip, the techniques like backhand push, cut, serve and flick are quite common. If the athlete adopts the twiddle-gripped and still be adroit like those handshake grip player using the pen-hold backhand push, cut, serve and flick, then, the performances would be amazing. From the characteristics of the overall pen-hold backhand, for the incoming ball of the backhand direction, it would be convenient to counteract with pen-hold backhand for the athlete.

Recently, experts in this field pointed out that, any technique of backhand pen-hold grip can be converted into techniques for backhand backside. This illustration indicates that the potential for backhand backside is not limited to a few items that we have commanded, and there are more new techniques to be developed and unearthed. (Lee Chia, Dan Tau, 2006)

3.2 .3 Paddle rubber discussion

From the findings in Table 3, we learned that the ratio for adopting pimpled paddle surface was pretty high in Taiwan male and female wheelchair athletes (i.e. Male 69：31; female 75:25). Within this, it includes long pimple, mid and long pimple, short pimple to complement pen-hold flat-in approach. And this tactics utilizes the characteristics for the slow speed of pimpled as well as the anti-spin, which would effectively buffer the wheelchair team characteristics of high speed for the ball due to the seating closer to the table. In addition, with mix of flat-in tactics, it can allow the tactics of timely spin with arcs, thus, the tactics would be unpredictable.

(1) Flat-in

Nowadays, domestic usage of flat-in foam rubber for the athletes is quite predominant. Flat-in foam rubber's characteristics is that the rubber has greater glutinous capability which facilitates the serve, counter the serve, spin and arcs which produce the spin. Since the surface of the rubber is both flat and even, therefore, in the counter-serve, the form changes for both the foam and rubber would be relatively small. Hence, the hand feeling would be stable and easy to control the paddle.

(2) The short pimple of the foam rubber is OUT

The main characteristics for foam rubber with the short pimple out are： Since there is less rubber surface viscosity, the ball would spend less time on the surface of the paddle. The rebound would be faster, the counter-drive would be faster with lower arc produced. The serve with cut would also be faster which can be beneficial to the control for fast, low and short serve. During the serve, the foam rubber viscosity would be less than that for flat-in. Nonetheless, in serve, the wheelchair athletes can adjust to the angle entailing with good cut and spin, and serve-strength concentration with stronger spin serve. According to the functions of flat-in foam rubber paddle, under the premise of desired serve speed and landing spot in accommodating the spin variations resulted from the speed and agility of the wrist movement as well as the variations of the paddle, and this is exactly the characteristics for the flat-in foam rubber paddle.

(3) Long pimpled and semi-long pimples paddle

The characteristics for both the long and semi-long pimpled paddle are： The pimple is thin, long and soft, and it tends to react in sideways when impacted with the ball. When the pimple resumes its original shape and it would produce a counteract force which would result with counter-spin of the ball. Thus, using the long pimple paddle would create a different feeling than others. And using the long pimpled paddle, it tends to be using less tactics of attack serve and flip; instead, it would be primarily using the techniques of cut, spin and block.

Therefore, wheelchair athletes should base on the counter-serve characteristics of long pimpled and semi-long pimpled paddle to correctly select the paddle's rubber with appropriate pimples so as to match the tactics and techniques. This way, it would create psychological panic at the opponent with induced mistakes and finally the effect of surprise to win the game. (Cao, Ben, 2004)

3.2.4 Discussions for wheelchair maneuvering style

From the findings of Table 4, we learned that the wheelchair athletes of both male and female can adopt the unlock, locked and semi-lock, with the ratios (Male 56:20:24; Female 38:24:38), which showed that most were in unlock, next followed by semi- lock and the least of them in locked.

(1) Unlock style

This method is suitable to those with good waist strength like male team of TT4 and TT5 levels, female team of TT5 level. Those with less waist strength should not adopt this method. The characteristics and effects are： This is a kind of seating maneuvering with high techniques in the wheelchair table tennis sport, with the characteristics primarily focusing on the maneuverability of the wheelchair in both the front and back direction. As for the complementing serve tactics, it possesses conspicuous advantages which allow wider area for forehand attack, easy to control the attack timing and greater capability to lunge forward to save the wide-angled serve with faster position-shifting.

(2) Locked style

For the male team of TT1,2,3 levels and female team with less waist strength as well as those who with less hand maneuverability, this is the preferred seating. Its characteristics and effects are： This is the commonly seen seating arrangements in table tennis sport for medium skill level or the beginners. And it is known with adoption by most users with characteristics like the stabilized gravity center of wheelchair, powerful serve and counter-serve, better ball control and high safety reasons.

(3) Semi-locked style

It is suitable to male team of TT4, TT5 and female team of TT5 with better waist strength as well as tactics of fast attack. Characteristics and effects：It is one of the seating arrangements suitable to attack mode athletes. Its characteristics lies primarily at more stabilized gravity center of the wheelchair, better agility, conducive to forehand and backhand attack. Since the backhand side of the wheelchair is movable, enabling with wider area for attack and easy to control the striking points in space as well as larger strength in striking the ball. It also provides fast position shifting for dive-saving larger angle serve, and it is easy to handle the center attack (close to body) which is conducive to a variety of serve tactics.

3.2.5 Discussions for the preparation of wheelchair seating

As for this subject, the seating is the position on seat based on the tactics characteristics for the bodily and mentally disabled athlete. The proper seating can allow the familiarized tactics a chance to work to compensate the technique disadvantage in addition to more comprehensive coverage.

From the statistics findings in Table 5, this signifies that most the male and female athletes seating on wheelchair in preparation style adopts the parallel style (Male 73:27; Female 57:43). This could be resulted from the athletes tend to be using backhand as well as attack-prone tactics. Therefore, the parallel preparation would be easier to initiate with explosive attack when adopting backhand approach. Nonetheless, relatively speaking, it would impede the forehand technique development. In reality, this is less than desired for the overall tactics. For beginners, the backhand in long pimpled paddle can adopt this seating preparation method, nevertheless, for those wheelchair athletes with attack in high speed mode, this is not recommended.

4.Conclusions

Handshake grip has been the mainstream for Taiwan table tennis sport. Still, the pen-hold has the tactical characteristics in technique. The pad rubber can be pimpled which has the characteristics of enabling the spin with varieties; it allows the player with either the attack or defense, slow or fast maneuvers. And this approach is adopted by most wheelchair players. For those middle and high levels wheelchair athletes, they tend to adopt unlock or semi-locked control of wheelchair, which can enhance the agility of wheelchair control.

The lack of balanced development in disability levels and classifications has been well noted in Taiwan wheelchair table tennis athletes, entailed with deficiency of low level and severely disabled population. The sporting life span for the wheelchair athlete is normally longer than those who can stand up straight, in addition to the training effectiveness rendering them with high effectiveness in a very short time span. In the future, with the competition goal tending to be less difficult in attending the international tournament, these would be the focused items in promoting table tennis sport for bodily and mentally disabled wheelchair players in Taiwan.

References

[1] Cao Ben, "Analysis of Bounce on Long Pimpled Rubber of Table Tennis, " *Journal of Jilin Institute of Physical Education,* Vol. 20, No. 3, pp. 132-133, 2004.

[2] International Paralympic Committee, "*1996 Atlanta paralympic Game; General and functional classification guide*; "1996.

[3] Lee Chia and Dan Tau, "The point of veiw about the PE performance evaluation attack with backhand reverse side of the penholder racket ," *Liaoning Sport Sceience and Technology*, Vol. 28, No. 6, pp. 62, 2006.

[4] Lin,Kuang-Hua,"TableTennis classification, "*Chinese Taipei paralympic Committee magazine*, No. 2, pp. 18-20,1994

The Behavior of Leisure Participation of College Table Tennis Athletes

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Abstract

The purpose of this study was to analyze the mediator effect of degree of sport participation between exercise self-efficacy and behavior of leisure participation, and to explore the current situation of exercise self-efficacy, degree of sport participation, and behavior of leisure participation of college table tennis athletes at 2008 National Intercollegiate Athletic Game. A total response of questionnaires was 400, and the valid sample was 329. The data was analyzed by the descriptive statistics and hierarchical regression. The results of this study were as followed:

1. The current situation of exercise self-efficacy, degree of sport participation, and behavior of leisure participation of college table tennis athletes.

(a) The mean of the total exercise self-efficacy of the subject was 2.88. (b) The percentage of the different degree of sport participation was almost the same. (c) The mean of behavior of leisure participation was 2.71, and the static leisure behavior had the highest mean score (M=3.84).

2 There was partial mediator effect of degree of sport participation between exercise self-efficacy and behavior of leisure participation.

Key Words : Exercise Self-efficacy, Degree of Sport Participation, Behavior of Leisure Participation, Mediator, College Table Tennis Athletes

1. INTRODUCTION

1.1 Research Background and Motive

Making collegiate table tennis team as example, players are divided into two types: “Open Group Physical Education Course” and “General Group General Courses”. For open group players, in addition to regular training, they have to sustain professional training loading and the pressure of results breakthrough. To do training or to rest seems to be their daily routine. Comparatively, players of general group have more freedom in time management.

The ways players arrange and utilize their leisure time after training affect training effects and competition results. However, San-Chai Tu (2003) found that domestic players mostly engage in taking alcoholic drinks, strolling around, playing cards, playing computer games, and other activities which affect athletic training effects and competition results. Therefore, it is necessary to understand collegiate table tennis players’ leisure participation and the factors affecting leisure participation as to provide the coach as reference for physical fitness restoration in addition to professional training.

A research on recent university alumni physical activities in the United States of America(Sparling & Snow, 2002) indicates that physical activity patterns during college years are important influences on habitual physical activity during overall adult life. There are 84.7% of college students had been regular exercisers persevere in their physical activity in the years following graduation. Conversely, 81.3% of those who had been nonexercisers during college time do not voluntarily participate in any exercises and even do lesser exercise after graduation. Domestic researches also pointed out that (Szy-Chao Lee, 2000; Rui-Chee Chen, 2001 ; Chien-Li Huang, 2002, Miao-Chun Lai, 2003; Li-Fong Lin, 2004)also pointed out there is positive correlation between college students’ exercise self-efficacy and regular exercise behavior. With this, it is derived that the general public exercising

habits is formed during college life. Through physical education or leisure activity courses, college students are exposed to positive sports and leisure experience. At the same time, sports and leisure behavior become a part of daily life which is not easily be affected by weather or any other external factors (such as money, time, transportation, etc.) which then further influence individual exercise capacity determination; this is known as exercise self-efficacy. Dzewaltowski (1989) and Garcia and King （1991）pointed out that exercise self-efficacy refers to individual confidence degree of initial or sustaining exercises under the specific exercise circumstance of short of support or with limitation. Domestic researches show that（Tai-Chang Hsu, 2000; Rui-Chee Chen, 2001） in general public, there is positive correlation between exercise self-efficacy and degree of exercise participation. Besides, exercise self-efficacy is the important predictive factor of degree of exercise participation (Guan-Ru Chen, 2004). But, among all the researches related to exercise self-efficacy and degree of exercise participation, there is very rare discussion on the influence of athletes' exercise self-efficacy on the degree of exercise participation. For this reason, this research uses collegiate table tennis players as the research objects in analyzing the moderating effects of degree of exercise participation between exercise self-efficacy and leisure participation behavior.

1.2 Research Objectives

(1) To understand the current conditions of exercise self-efficacy, degree of exercise participation, leisure participation behavior of collegiate table tennis players.

(2) To examine the moderating effects of collegiate table tennis players' degree of exercise participation between exercise self-efficacy and leisure participation behavior.

2. RESEARCH METHODOLOGY

2.1 Research Object

Making table tennis team participated in 2008 National Intercollegiate Athletic Game as the main research object, this research examines the relations among players' exercise self-efficacy, degree of exercise participation, and leisure participation behavior. Convenient sampling is adopted. There are 400 questionnaires issued to 22 colleges. Total of 362 questionnaires retrieved with 90.5% of valid response rate. After deleting 33 invalid samples, the effective questionnaire return ratio is 82.25%.

2.2 Research Tools

(1) Exercise Self-Efficacy Scale

The exercise self-efficacy of this research adopted Li-Fong Lin（2004） "Exercise Self-Efficacy Table" for evaluation purpose. Total of 15 questions with 0.87Crobbach's α. Scoring is based on Likert scale, from "5 points" to "1 point", the levels are divided according to the sequence of "absolute confidence", "80 percent confidence", "50 percent confidence", "20 percent confidence", and "absolute no confidence". The higher the score is, the higher the object's exercise self-efficacy is. Lower score means lower exercise self-efficacy of the object.

(2) Degree of exercise participation

This research adopts the formula of Blair (1984), Chi-Chiang Chong（2000）. Calculation is base on the product sum of exercise frequency, exercise hours, and exercise intensity. The higher the score is, the more exercises are participated. The formula is as follow:

Degree of Exercise Participation = 8 × weekly vigorous exercises frequency × exercise duration + 4 × weekly exercise frequency × exercise duration + 1.5 × weekly mild exercise frequency ×exercise duration

The degree of exercise participation of all the research objects is divided into three groups. Percentile rank is used to divide the participation degrees into: high degree of exercise participation, medium degree of exercise participation, and low degree of exercise participation.

(3) Leisure participation behavior scale

The leisure participation of this research refers to the types and frequency of collegiate table tennis players' leisure activities. This scale is made by referring to the leisure participation scale of Shun-Cong Cheng（2001）. The types of activities are divided into three dimensions: physical fitness, consumptive, and static leisure. Likert scale is used for participation frequency measurement. "Never participated", "Seldom participate", "Occasionally participate", "Often participate", and "Regular participate" are given with "1 point" to "5 point" in sequence. The higher the score is, the better the leisure participation is. The lower the score is, the worse the leisure participation is.

2.3 Data Analysis

This research adopts SPSS 12 .0 Chinese edition as statistical analysis software. Statistical analysis methodologies are as follow:

(1) To understand the current conditions of research objects' exercise self-efficacy, degree of exercise participation, and leisure participation behavior by descriptive statistics.

(2) To analyze the moderating effects of collegiate table tennis players' degree of exercise participation between exercise self-efficacy and leisure participation behavior with the use of hierarchical multiple regression.
(3) The significance level of all statistical tests of this research is set as $\alpha < .05$.

3. CONCLUSION AND DISCUSSION

3.1 Current Conditions Analysis

(1) The current exercise self-efficacy of collegiate table tennis players.

As shown in Table 1, under the circumstances of short of support or with limitation, collegiate table tennis players only reaches the average value of confidence degree in maintaining regular exercises. From this finding, it was necessary to reinforce the willingness of collegiate table tennis players in putting more effort and maintaining exercises under all kinds of limitations and difficulties.

Table 1 Exercise Self-Efficacy of Collegiate Tennis Players Fact Sheet

Exercise Self-Efficacy	Average	Standard Deviation
1. When I am out of time, I still manage to get some time to do regular exercises.	3.08	0.94
2. When I feel tired, I still can do regular exercises.	2.89	0.91
3. When the weather is no good, I still can do regular exercises.	3.11	1.01
4. When I am not feeling well, I still can do regular exercises.	2.43	0.94
5. When I am not in good mood, I still can do regular exercises.	3.27	1.04
6. When I feel lazy, I still can do some regular exercises.	2.85	0.96
7. When I have no companion for exercise, I still can do regular exercises.	2.87	1.07
8. When I have a lot of homework to be done (such as test, assignment), I still can do regular exercises.	2.64	1.00
9. When I need to do part-time job, I still can do regular exercises.	2.84	1.00
10. When I need to spend more money on exercise, I still can do regular exercises.	3.00	0.96
11. When my whole body feels ache and discomfort, I still can do regular exercises.	3.00	1.03
12. When there is no appropriate venue for exercise, I still can do regular exercises.	2.71	0.96
13. When my close friends ask me out to have fun, I can still reject them and do the regular exercises as planned.	2.70	1.06
14. When there is something more interesting available (such as watching television), I still can do regular exercises.	2.90	1.07
15. When there are a lot of house chores need to be helped out, I still can do regular exercises.	3.01	0.97
Grand Average	2.88	0.62

(2) The current condition of collegiate tennis players' degree of exercise participation

According to the findings from Table 2, there is no significant difference among collegiate tennis players distribution variance among high exercise participation degree, medium exercise participation degree, and low exercise participation degree. Presumably, this is related to the objects. The players are divided into open group and general group. Training time for open group is longer and the frequency and intensity of training content are higher too. Particularly, when there is competition, the open group players are under stress. Comparatively, general group players have more relaxing training and the content is mostly focuses in basic movements. That is why open group players' training frequency and intensity are low. They have no pressure on competition results. And, their training time is spontaneous.

Table 2 Collegiate Table Tennis Players' Degree of Exercise Participation Fact Sheet

Degree of Exercise Participation	Number	Percentage (%)	Average
High exercise participation degree	112	34.0%	5373.86
Medium exercise participation degree	105	31.9%	2273.74
Low exercise participation degree	112	34.0%	794.09
TOTAL	329	100%	2825.39

(3) The current condition of collegiate tennis players' leisure participation behavior.

According to Table 3 findings, current collegiate table tennis players mostly participate in indoor and static leisure activities such as watching television, watching video tapes, listening to radio, listening to music, and sleeping. These findings match with the research findings of Ching-Chong Yu (2003) on the current conditions of athlete leisure activities. The research shows that the players always participate in those static leisure activities which are not physical vigor consuming and help in settling the body and mind. This phenomenon can be explained with The Compensatory Theory by Friedrich Engels and Marx (translated by Shu-Fang Tu, 1996). Compensatory Theory stated that when someone has the chance to avoid from his regular routine job, he will do something which is completely contrary. Meaning, people use leisure time to balance their jobs or the depressing feelings of bored from work. This illustrated that some leisure activities (translated by Shu-Fang Tu 1996) of athletes or porters were more on static leisure activities when they were off from duties (translated by Yi-Guan Ye and others, 2005)

Table 3 Collegiate Table Tennis Players' Leisure Participation Behavior Fact Sheet

Activity Classification	Activity	Average	Standard Deviation
Physical Fitness	1. Jogging, hiking	3.05	0.98
	2. Swimming	2.43	0.96
	3. Mountain-Climbing	2.37	0.94
	4. Aerobics	1.86	0.96
	5. Canoe, boating	1.42	0.83
	6. Cycling	2.55	1.15
	7. Skateboarding	1.40	0.83
	8. Rock Climbing	1.35	0.80
	9. Weight Training	2.47	1.18
	Average Score	2.10	0.96
Consumptive Leisure	10. Shopping	3.33	1.01
	11. Movie Watching	3.21	1.04
	12. Singing in KTV	2.90	0.96
	13. Going to internet cafe	2.04	1.07
	14. Enjoying concerts	1.99	1.01
	15. Soak in Hot Spring	2.17	0.96
	16. SPA	1.96	1.04
	17. Billiards	2.04	1.04
	18. Golfing	1.59	0.95
	19. Shopping in night market	3.60	0.99
	Average Score	2.48	0.63
Static Leisure	20. Watching television, video tapes	4.01	0.93
	21.Listening to radio, music	4.06	0.97
	22. Playing computer games	3.33	1.26
	23.Internet Surfing or Online Game	3.82	1.13
	24. Sleeping	4.22	0.98
	25. Reading	3.50	1.08
	26. Chatting	3.94	1.00
	Average Score	3.84	0.55
	Grand Average	2.71	

3.2 The moderating effect analysis of degree of exercise participation between exercise self-efficacy and leisure participation behavior.

(1) The moderating effect of the degree of exercise participation between exercise self-efficacy and physical fitness leisure participation behavior.

From the data of Model 1 in Table 4, there were 2% explained total variance. There was 0.2% explained of total variance in Model 2, 2.2% in Model 3, and 2.8% in Model 4. There was significant positive influence of exercise self-efficacy on the degree of exercise participation. And, there was also significant positive influence of exercise self-efficacy on physical fitness leisure participation behavior. However, there was no significant influence of the degree of exercise participation on physical fitness leisure participation behavior. Further tested with chows test, F value of 3.08 (< F*=3.84) doest not reach significant level. Therefore, the degree of exercise participation did not play moderating role between exercise self-efficacy and physical fitness leisure participation behavior.

Table 4 Physical Fitness was Dependent Variable of Hierarchical Multiple Regression Analysis

Dependent Variable / Independent Variable	Exercise Participation	Leisure Participation Behavior (Physical Fitness)	Leisure Participation Behavior (Physical Fitness)	Leisure Participation Behavior (Physical Fitness)
	Model 1	Model 2	Model 3	Model 4
Exercise Self-efficacy	.152*	---	.157*	.172*
Degree of Exercise Participation (moderating)	---	-.070	---	-.097
R Square	.023	.005	.025	.034
Max-rescaled R-Square	.020	.002	.022	.028
Chow Test of Model 3 and Model 4	F=3.08 < F*=3.84			

* p < 0.05

(2) The moderating effect of the degree of exercise participation between exercise self-efficacy and consumptive leisure participation behavior.

From the data of Model 1 in Table 5, there were 2% explained total variance. There was 1.1% explained of total variance in Model 2, 0.9% in Model 3, and 2.5% in Model 4. There was significant positive influence of exercise self-efficacy on the degree of exercise participation. And, there was also significant positive influence of exercise self-efficacy on consumptive leisure participation behavior. However, there was positive significant influence of the degree of exercise participation on consumptive leisure participation behavior. Further tested with chows test, F value of 6.34 (< F*=3.84) has reached significant level. Therefore, the degree of exercise participation played moderating role between exercise self-efficacy and consumptive leisure participation behavior.

Table 5 Consumptive Leisure was Dependent Variable of Hierarchical Multiple Regression Analysis

Dependent Variable / Independent Variable	Exercise Participation	Leisure Participation Behavior (Consumptive Leisure)	Leisure Participation Behavior (Consumptive Leisure)	Leisure Participation Behavior (Consumptive Leisure)
	Model 1	Model 2	Model 3	Model 4
Exercise Self-efficacy	.152*	---	.110*	.131*
Degree of	---	-.119*	---	-.139*

Exercise Participation (moderating)				
R Square	.023	.014	.012	.031
Max-rescaled R-Square	.020	.011	.009	.025
Chow Test of Model 3 and Model 4	F=6.34 > F*=3.84			

* p < 0.05

(3) The moderating effect of the degree of exercise participation between exercise self-efficacy and static leisure participation behavior.

From the data of Model 1 in Table 6, there were 2% explained total variance. There was 0.1% explained of total variance in Model 2, 0.5% in Model 3, and 0.8% in Model 4. There was significant positive influence of exercise self-efficacy on the degree of exercise participation. And, there was also significant positive influence of exercise self-efficacy on physical fitness leisure participation behavior. However, there is no significant influence of the degree of exercise participation on static leisure participation behavior. Further tested with chows test, F value of 1.92 (< F*=3.84) did not reach significant level. Therefore, the degree of exercise participation does not play moderating role between exercise self-efficacy and static leisure participation behavior.

Table 6 Static Leisure was Dependent Variable of Hierarchical Multiple Regression Analysis

Dependent Variable / Independent Variable	Exercise Participation	Leisure Participation Behavior (Static Leisure)	Leisure Participation Behavior (Static Leisure)	Leisure Participation Behavior (Static Leisure)
	Model 1	Model 2	Model 3	Model 4
Exercise Self-efficacy	.152*	---	-.089	-.100
Degree of Exercise Participation (moderating)	---	.062	---	.077
R Square	.023	.004	.008	.014
Max-rescaled R-Square	.020	.001	.005	.008
Chow Test	F=1.92 < F*=3.84			

of Model 3 and Model 4	

* $p < 0.05$

4. CONCLUSION

The findings of the research showed that there is average of 2.88 of collegiate table tennis players' exercise self-efficacy. This reveals that the confidence level of objects in maintaining regular exercise gets close to average under special circumstances. In another word, collegiate table tennis players' exercise self-efficacy is low. There are 112 players of high exercise participation which account for 34.0%, 105 (31.9%) players of medium exercise participation, and 112 players of which account for 34.0% of low exercise participation. These show that there was not much difference of distribution in terms of collegiate table tennis players on the degree of exercise participation. There was total average of 2.71 leisure participation behavior of collegiate table tennis players during their leisure time. Among all, static activities occupy the most (M=3.84), with comparatively higher proportions in watching television, watching video tapes, listening to radio, listening to music, and sleeping. Tested and verified by hierarchical multiple regression and chow test, the degree of exercise participation only has moderating effect between exercise self-efficacy and consumptive leisure participation behavior. Meanwhile, between exercise self-efficacy and static leisure participation behavior, the degree of exercise participation plays no moderating role.

5. PROPOSAL

The findings of this research revealed that collegiate table tennis players' self-efficacy in overall exercises only reach the average of 2.88 average. Coaches have to focus on the ways to increase table tennis players' exercise self-efficacy in future professional trainings. Relevant units shall reinforce the leisure education concepts of basic level coaches so that training is focuses more on players' overall development rather than limited to special-type training. Train up the players for voluntarily exercise participation or competition desire as to increase their exercise self-efficacy.

It is found in the findings that there was low leisure participation frequency of most of the collegiate table tennis players. According to literature reviews （Chuan-Tsou Chen, 1993）, if the players are able to arrange positive leisure activities during non-exercising and sleeping hours, their bodies and minds for sure obtain adequate rest which is helpful in future trainings and upgrades of competition results. This is to propose colleges shall carry out proper planning on campus leisure facilities with more diversified leisure activities information, reinforce leisure education courses, upgrading collegiate students' cognition and skills of leisure. Meanwhile, coaches shall train up table tennis players with different leisure skills in making choices of balance leisure participation. Expose the players with new activity varieties and effective time management. Choosing the suitable leisure activities contribute to physical fitness restoration as well as the advancement of training effects and competition results.

Research findings also showed that degree of exercise participation only possesses moderating effect between exercise self-efficacy and consumptive leisure participation. But, there was only 3.1% of R Square value. Meaning, there are 96.9% of unexplained. Therefore, this was to propose to future researches that other variables can be obtained from literature review or practical experience as for further examination and analysis.

BIBLIOGRAPHY

Ching-Chong Yu (2003). *Study on Leisure Cognition and Participation of the Athletics Players of Taoyuan County Middle School Athletes*. Unpublished master's degree thesis, Department of Physical Education, National Taiwan Normal University, Taipei City.

Szy-Chao Lee (2000). *The Determinants of Regular Exercise Behavior of Nursing Students in National Taipei College of Nursing*. Unpublished master's degree thesis, Department of Health Promotion and Health Education, National Taiwan Normal University, Taipei City.

San-Chai Tu (2003). *The Study of Weightlifters Leisure Behavior in Taiwan.*. Unpublished Master's degree thesis, Graduate Institute of Physical Education, National College of Physical Education and Sports, Taoyuan County.

Yen-Chou Lin (1984). The Research of Recreational Area Selection for Recreationist. *Urban Planning*, 10, 33-49.

Li-Fong Lin (2004). *Explaining College Students Exercise Behavior Change：A Longitudinal Application of the Transtheoretical Model*. Unpublished Master's degree thesis, Department of Health Promotion and Health Education, NatVional Taiwan Normal University, Taipei City.

Chien-Li Huang (2002). *The Relationship between Social supports, Exercises Resources and Exercise Behaviors among Nursing Students.* Unpublished Master's degree thesis, Department of Health Promotion and Health Education, National Taiwan Normal University, Taipei City.

Chuan-Tsou Chen (1993). The Physiological Characteristics Training of Velocity, Muscle Strength, Stamina. *International Sports Science Conference theses,* Taichung City: National Taiwan College of Physical Education.

Yi-Shiang Chen (2001). *Examine the Relations of Self-Efficacy, Target Setting Related Variables and In-Line Skating Performance by Path Analysis*. Journal of National Taipei Teachers College, 14, 761-769.

Rui-Chee Chen (2001). *The Research of Determinants of Exercise Behavior of Students in a Vocational High School in Hsinchu City*. Unpublished Master's degree thesis, Department of Health Promotion and Health Education, National Taiwan Normal University, Taipei City.

Guan-Ru Chen (2004). *Factors Influencing Physical Activity among University Students with Different BMI Levels*. Unpublished Master's degree thesis, Department of Nursing, College of Nursing, National Cheng Kung University, Tainan City.

Tai-Chang Hsu (2000). *Research on Elementary School Teachers' Exercise Behavior and the Related Factors.* Unpublished Master's degree thesis, Graduate Institute of Physical Education, National College of Physical Education and Sports, Taoyuan County.

Shun-Cong Cheng (2001). *The Related Research of University Student's Living Pattern, Leisure Motive, and Leisure Participation*. Unpublished Master's degree thesis, Graduate Institute of Physical Education, National College of Physical Education and Sports, Taoyuan County.

Miao-Chun Lai (2003). *The Research of Examining University Students' Exercise Behavior by Applying Health Promotion Model*. Unpublished Master's degree thesis, Department of Health Promotion and Health Education, National Taiwan Normal University, Taipei City.

Chi-Chiang Chong (2000). Influence of Exercise Self-Efficacy on University Students' Exercise Behaviors. *Journal of Science and Technology,* 9 (1), 59-80.

Ministry of Education (2008). 2008 National Intercollegiate Athletic Game http://2008niag.ncue.edu.tw/ Date of Internet Access: June 30th, 2008

Ministry of Education (2008). Information Network of Physical Education and Health Education, Ministry of Education. http://140.122.72.62/ Date of Internet Access: July 2nd, 2008

Blair, S. N. (1984a). How to assess exercise habits and physical fitness. In Behavioral health: A handbook of health enhancement and disease prevention (pp. 424-477). New York: John Wiley and Sons.

Dzewaltowski, D. A.(1989). Toward a model of exercise motivation. *Journal of Sportand Exercise Psychology,* 11(3), 251-269.

Garcia, A.W.& King, A.C. (1991) Predicting long-term adherence to aerobic exercise : A comparison of two models. *Journal of Sport and Exercise Psychology,* 13(4), 394-410.

Bammel, G.& Burrus-Bammel, L. L. (1996)。Leisure and Human behavior（Translated by Shu-Fang Tu）. Taipei City: Laureate（The original published 1982）

Leisure in Your Life：An Exploration (2005)。Leisure in Your Life: An Exploration（Translated by Yi-Guan Ye, Chong-Chi Wu, Wei-Chin Wang, Jia-Ru Yen, Yu-Liang Lin）. Taipei City: Creative & More Inc.

Sparling B. P.& Snow K. T. (2002). Physical activity pattem in recent college alumni. *Research Quarterly for Exercise and Sport,* 73, 200-205.

A Study on the Technical Analysis and Attack-Deffense Performance of Men's Top Four Single Players in 2008 Olympic Games

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Abstract

The purpose of this study was to examine the three-stage skill, attack-defense performance, zones of scoring points of elite male table tennis players. The study was observed the semi-finalists (Ma Lin, Wang Hau, Wang Li-gin, and Persson, G.) of table tennis men's single in 2008 Beijing Olympic Games. We analyzed all games of the four subjects played using three-stage skill and attack-defense skill analysis table. The results as follows:

1. All subjects were "Pass" in most of three-stage skill evaluative index. The using percentage of rally part was below evaluative index in all players.
2. The main scoring techniques for the top four players were serve-then-attack part (serve point and forehand attack), receive-then-attack part (forehand attack and backhand attack), and rally part (counter-driver and forehand attack) in three-stage skill. Top four players' scoring percentage of three-stage skill was significantly higher than those of their opponents, but no difference in using percentage.
3. There were significant differences in attack-defense performance and zones of scoring points but no difference was found in zones of losing points of four players.
4. The stepwise regression analysis data showed that the scoring percentage of attack-defense in three-stage skill could be effectively to predict the performance.

Key words: table tennis, skill analysis, scoring techniques, zones of scoring points.

1. Introduction

1.1 Research background

Professional sports of competitive nature must involve the passion and aggressiveness to win, the breakthrough of one's limitations and the pursuit of enhancement in skills [1], and the development of modern table tennis is an item in sports that places even more emphasis, in the context of skill enhancement, on speed, strength, power, endurance, flexibility, agility and good reflexes [2]. Once equipped with the aforementioned capabilities, these capabilities are mainly reflected in the ample demonstration of techniques and tactics for the purpose of obtaining the best performance in contests. With the incorporation of table tennis as an item of Olympic Games in 1988, countries of the world have been even placing more focus on the implementation of more scientific analysis to further give aid to methods that enhance the tactical performance of table tennis techniques.

However, amongst all the analytical methods on table tennis techniques, the three-stage skill analysis proposed by Chinese scholars Wu and Li [3] received the widest affirmation with excellent efficacy in its implementation. The content of the analysis is to divide the 24 techniques in a given table tennis match into 3 stages, namely, serve-then-attack part (S.T.A.P), receive-then-attack part (R.T.A.P) and rally part (R.P), the function of which is to record the scoring and using percentages of players in the stages of the match for the evaluation and comparison thereof with established experiential models, in order to provide diagnosis on players' technical and tactical conditions. Due to the fact

that this analytical method has assisted Chinese players in having extraordinary performance in the Olympics and world championships, this method has a pivotal standing in the arena of analysis on table tennis techniques in China. It is with the aforementioned that provides the foundation and motive for the researcher to regard the three-stage skill analysis methodology as the focus in this study.

The three-stage skill analysis methodology, since its debut and development to this day, still remains widely in use, but the analytical model on techniques and tactics are bound to be revised after some major changes to regulations, such as the use of large balls in year 2000, the 11-scores-per-game scheme adopted in 2001, as well as non-blocked service in 2002. For instance, the advantage of S.T.A.P was decreased, the position of R.T.A.P increased, the using percentage of R.P was decreased [4], and rally endurance was the crucial and key factor determining the outcome, victory of the match [5-7]. In particular, the use of falling-zone tactics becomes a vital component winning a match, and the control over the falling zone is more of an important factor when assessing the quality of techniques [8]. Those who are capable of breaking away from the norms and changing the conventional falling zones and routes will ultimately be able to effectively inhibit the changes in opponents' falling zones, hence creating more opportunities to score for themselves [9]. Because of the aforementioned, it is the attempt of this study take the top four players of the singles' table tennis match in 2008 Beijing Olympics as the research subjects, using the three-stage skill analysis as the major research focus to explore the performance of the players' techniques in the three stages, and further exploring the their respective attack-defense performance and main scoring techniques, in collaboration with the analysis of falling-zone tactics and scoring performance. It is the belief of the study that under such a research framework, not only is it able to analyze the technical, tactical performance amongst elite players and current trends of development; it is also to provide a point of reference for young players in their future training.

1.2 The purpose of the research

1.2.1 Comparing the differences in the performance of the three-stage skill between the top four players and the opponents they encounter.

1.2.2 Comparing the differences in attack-defense performance amongst the top four players in the match.

1.2.3 Comparing the differences in zones of scoring, losing points amongst the top four players in the match.

1.2.4 Analyzing the impact of attack-defense scoring percentage of three-stage skill in elite male table tennis players.

1.3 Definition

1.3.1 Serve-then-attack part (S.T.A.P): referring to the serving side serving the ball and serving side hitting the ball again.

1.3.2 Receive-then-attack part (R.T.A.P): referring to the receiving side hitting the ball the first and second times.

1.3.3 Rally part (R.P): referring to the serving side hitting the ball after the third time, and receiving side hitting the ball after the third time.

1.3.4 Scoring percentage = scores won in a part / (scores won in a part + scores lost in a part) × 100%.

1.3.5 Using percentage = (scores won in a part + scores lost in a part) / sum of scores won and lost in a game × 100%.

1.3.6 Scoring technique: referring to the winning technique in a match for a player, regardless of serving, receiving, rallying, regardless of attacking or defending.

1.3.7 Attack-defense performance: referring to the scoring victory of the player, divided into attacking and defensive scoring techniques. Attacking techniques are divided into direct serve point, forehand attacks (including drive, smash, flip and fast push), backhand attacks (including drive, smash, flip and fast push) and

counter-drivers (including forehand and backhand counter-driver). In regards to defensive techniques, there are drop shot, long push and block (including lob)

1.3.8 Zones of scoring points: referring to the falling zone of the scoring victory of the player in the match, divided into forehand position, center position and backhand position.

1.3.9 Zones of losing points: referring to the falling zone for the final missing point of the player in the match, divided into forehand position, center position and backhand position.

1.3.10 Performance: the basis is the winning percentage of the player in every game. The winning percentage for each game = scoring points of a game ÷ (scoring points of a game＋losing points of a game) × 100%.

2. Methods

2.1 Research subjects

The research subjects were set to the top four table tennis players in 2008 Beijing Olympics (Ma Lin, Wang Hao, Wang Liqin and Persson,G.) and the 12 players they encounter in the individual singles' games (including Wu Shang-eun, Yo Kan, Ko Lai-chark, Cheung Yuk, Tan Rui-wu, Blaszczyk, L., Schlager, W., Karakasevic, A., Samsonov, V., Primorac, Z., Tokic, B., and Kreanga, K.) with a total of 16 players.

2.2 Research tools

2.2.1 Personal computer

2.2.2 Recording tables of table tennis matches: The three-stage skill analysis table developed by Wu and Li [1] is adopted. The attack-defense skill analysis table developed by Hsu [9] was adopted to record the scoring techniques and zones of scoring points in the respective stage.

2.3 Steps of implementation

2.3.1 The acquisition of data

The acquisition of data in this study was conducted by the researcher directly entering the Hichannel for the direct web cast of 2008 Beijing Olympics provided by Hinet, and performing the task of recording on the matches to be analyzed. The web address is as follows: http://hichannel.hinet.net/2008olympic/film.jsp?dt=6.

2.3.2 Method of record keeping

First of all, the video was played by Windows Media Player, and the research will immediately hit "Pause" whenever players of both sides hit the ball, to analyze and recorded the technical term and falling zone in the attack-defense skill analysis table, and every stroke was recorded in detail according to the aforementioned manner. Next, the total hits of every point were used to ascertain to which winning player the point belonged in terms of the technical attribute of the stage, and the result was recorded in the three-stage skill analysis table. If the difficulty of determining the route of the ball was encountered during the analyzing and recording process, then the video was rewound for repeated viewing till appropriate analysis could be conducted. Because the manner of analysis was such that each stroke was analyzed and recorded, the time spent on each point was fairly extensive; thus, each analysis was conducted for one game only in order to avoid possible errors when recording due to tiredness and fatigue.

2.4 Data analysis

After the confirmation that the acquired data was without any error, the statistics software SPSS for Windows 12.0 was subsequently employed for the task of statistical analysis. The acquired data was analyzed using the following methods: descriptive analysis, independent *t* test, χ^2 test and stepwise regression

.

3. Results and discussion

3.1 The analysis of difference on the three-stage skills performance between the top four players and their opponents

3.1.1 The analysis of Top four player three-stage skill evaluative index

It was obtained from Table 1 that all subjects were "Pass" in most of three-stage skill evaluative index. The using percentage of R.P was below evaluative index in all players. In particular, the scoring percentage for S.T.A.P (59.11%/Excellent) and the using percentage (33.06%/Pass) for S.T.A.P demonstrated the most extraordinary performance.

On an individual level, player Ma Lin had 4 indexes out of 6 reaching "pass" and above, amongst which the scoring percentage for S.T.A.P (77.15%/Excellent) and R.T.A.P (62.60%/Excellent) were the highest of all 4 players; regarding the scoring percentage (42.73%/No pass) or using percentage (39.61%/No pass) in R.P were somewhat unsatisfactory. Wang Hao showed better performance in the scoring percentage (60.41%/Excellent), using percentage (33.70%/Pass) in R.T.A.P, as well as the scoring percentage in R.P (42.27%/ No pass), but the other 3 indexes did not reach "Pass" and above. In the case of Wang Li-qin, only the using percentage in S.T.A.P (22.83%) and R.P (42.45%) were at "No pass" level, and the other 4 items demonstrated fair performance, especially the scoring percentage for the skills of 3 stages all reach "Excellent" level. Persson's performance was the same as Ma Lin, in that only the scoring percentage (40.50%/Fail) and using percentage (42.33%) for R.P demonstrated unsatisfactory performance, and the other 4 indexes all reached "Pass" level. Such results were identical with those conducted by Li, Zhao, and Zhang [10], and Zhang [4]. According to the findings of Li et al. [10] and Zhang [4] with the implementation of new regulations, extraordinary world-class players compete more fiercely during the first three strokes, in particular, there existed a clear trend of "regression towards mean-value" when it came to using percentage of the three-stages. In comparison with the times before the implementation of the new regulations, the using percentage for R.T.A.P showed a tremendous increase, whereas the using percentage for R.P showed an apparent decrease. According to the findings of Zhang [4], since the change of regulations, the main performance of technical and tactical characteristics for elite players was the decreased advantage of S.T.A.P, the position of R.T.A.P was increased, and the using percentage of R.P showed decrease. Such findings apparently differentiate themselves from the perspective shared by many most scholars after the change to the use of large balls, i.e., the number of rounds will increase. The causes for the aforementioned may be due to the renovation on equipment the creation of new techniques that, once again, make rotation and speed return to their original state, or relating to faster rotation [11].

Table 1 Top four player three-stage skill evaluative index

Three-stage skills	Players	Scoring percentage/ index	Using percentage/ index
S.T.A.P	Ma Lin	77.15% / Excellent	26.28% / Pass
	Wang Hao	57.26% / No pass	23.55% / No pass
	Wang Li-gin	72.58% / Excellent	22.83% / No pass
	Persson, G.	63.15% / Good	26.95% / Pass

	Total	67.49% / Good	25.17% / Pass
R.T.A.P	Ma Lin	62.60% / Excellent	34.11% / Pass
	Wang Hao	60.41% / Excellent	33.70% / Pass
	Wang Li-gin	57.93% / Excellent	34.72% / Pass
	Persson, G.	56.48% / Excellent	30.73% / Pass
	Total	59.11% / Excellent	33.06% / Pass
R.P	Ma Lin	42.73% / No pass	39.61% / No pass
	Wang Hao	47.27% / Good	42.75% / No pass
	Wang Li-gin	55.90% / Excellent	42.45% / No pass
	Persson, G.	40.50% / No pass	42.33% / No pass
	Total	45.88% / Pass	41.77% / No pass

3.1.2 The analysis of difference on the three-stage skills performance between the top four players and their opponents.

It could be obtained from Table 2 that the S.T.A.P scoring percentage ($t=5.50$, $p<.05$), R.T.A.P scoring percentage ($t=4.06$, $p<.05$) and R.P scoring percentage ($t=4.06$, $p<.05$) in the three-stage skill scoring percentage for the top four players, as well as their opponents' scoring percentage. It reached significant difference. There was no difference in regards to the 3 variables in using percentage. It could be discovered from the analysis on the average scores amongst the variables that the average scores of the 3 variables in scoring percentage for the top four players were significant higher than those of their opponents, demonstrated that the scoring performance in S.T.A.P, R.T.A.P and R.P were better than their opponents, and their techniques were more comprehensive.

According to the three-stage skill theory proposed by Wu and Li [1] , scoring percentage and using percentage were proportionate to performance; that was, the scoring percentage and using percentage in the stages was higher, then performance was higher accordingly. The possible caused for no difference in using percentage was that most players demonstrated a similar pattern in their use of tactics. In addition, according to the studies of Chu [7] and Zhang [4] shown, players with different competitive capabilities demonstrated their differences primarily in the area of scoring percentage. It could be known from the aforementioned that the technical and tactical foundation for the sport of table tennis lies in outstanding specialties and no visible technical weakness. Under identical technical and tactical usage conditions, the competition amongst players are directly reflected in scoring percentage, in that the probability of victory is greater when the scoring percentage is higher. Therefore, if a coach implements the analysis on the scoring percentage based on three-stage skills when conducting routine trainings, such analysis can be used as an important reference when evaluating the player's improvement on technical and tactical capability.

Table 2 The difference on the three-stage skills performance between the top four players and their opponents

Three-stage skills	Players	N	M	SD	t	Sig.

S.T.A.P Scoring percentage	Top four	98	67.49	24.19	3.70 *	.000
	Opponents	58	52.36	25.49		
R.T.A.P Scoring percentage	Top four	98	59.11	20.93	5.50 *	.000
	Opponents	58	39.50	22.40		
R.P Scoring percentage	Top four	98	45.88	19.77	4.06 *	.000
	Opponents	58	33.30	16.72		
S.T.A.P Using percentage	Top four	98	25.16	8.63	-.38	.705
	Opponents	58	25.76	10.46		
R.T.A.P Using percentage	Top four	98	33.06	9.20	.40	.684
	Opponents	58	32.46	8.23		
R.P Using percentage	Top four	98	41.77	12.37	-.00	.996
	Opponents	58	41.78	13.03		

* P < .05

3.2 The analysis on the difference in attack-defense performance amongst the top four players in the match.

3.2.1 The analysis on the top four players' performance on scores won of attack-defense techniques

The performance on scores won and scores lost of the four players in their techniques in each stage were shown in Table 3. Also, it could be known from Table 4 that the four players' performance on scores won of attack-defense reach significant difference (χ^2= 89.90, p<.05). From the total, the attack-defense scoring performance of the top four players were mainly on attack scoring, in which forehand attack (29.7%) and counter-driver (26.1%) had the highest scoring percentage. If technical characteristics were evaluated based on personal performance, players with the best performance were: Ma Lin (forehand attack, 31.6%); Wang Hao (backhand attack, 29.4%); Want Li-qin (forehand attack, 29.6%); and Persson (forehand attack, 30.3%). If the players' performance was analyzed based on individual techniques, it was as follows: serve point (Wang Li-qin, 10.6%), forehand attack (Ma Lin, 31.6%), backhand attack (Wang Hao, 29.4%), counter-driver (Persson, 29.0%), drop shot (Ma Lin, 17.0%), long push (Wang Liqin, 4.0%) and block (Persson, 13.7%), showing that the top four players all had their exclusive techniques in terms of skill demonstration. It could be known from a further comparison (Table 3) that the technical characteristic for Ma Lin was forehand attack and drop shot, and forehand attack is mainly demonstrated in higher scoring points in S.T.A.P, whereas drop shot technique was demonstrated in R.T.A.P. It was discovered from above and the findings on Ma Lin by Cui and Qu [12], that characteristics for Ma Lin such as the high serve then attacking percentage, great execution, stronger transitioning skill of forehand topspin loop and the ability of counter-drive far away from the table were similar. With regards to Wang Hao, his technical characteristics were reflected on the backhand attacks in R.T.A.P, demonstrated that he was fairly aggressive when receiving and attacking that fully brings out the technical characteristics of "pen-held grip backside hit". Wang Li-qin's technical characteristics were forehand attack scoring in R.T.A.P, and counter-driver in R.P. The study conducted by Li [13] on Wang Li-qin also showed the same results, in which the using percentage of serving then forehand counter-driver

was lower, whereas the ability of forehand counter-driver after receiving then attack was stronger; the forehand counter-driver in R.P was the most extraordinary part of Wang Liqin's tactical system. The main technical characteristics of Persson were forehand attack and counter-driver scoring, the former being reflected in R.T.A.P, and counter-driver in R.P. This showed that Persson's performance in attack techniques was quite outstanding.

From the above discussion, the main scoring techniques for the top four players were S.T.A.P (serve point and forehand attack), R.T.A.P (forehand attack and backhand attack), and R.P (counter-drive and forehand attack) in the three-stage skill. Amongst all the table tennis techniques, pen-hold-grip or shake-hands grip players still opt for forehand attack as the main scoring tactic, and this result was consistent with the findings of Otchevac and Drianovski [14], Zhang [4] and Hao et al. [15]. The primary reason for such results is because forehand attack is more powerful and smoother coordination of footsteps.

Table 3 The performance on scores won and scores lost of top four players in three-stage skills

Three-stage skills	Players			
	Ma Lin	Wang Hao	Wang Li-gin	Persson, G.
S-T-A-P scores won (%)	Forehand attack (11.3%)	Serve point (7.7%)	Serve point (10.6%)	Forehand attack (11.7%)
S-T-A-P scores lost (%)	Counter-driver (4.5%)	Block (6.5%)	Forehand attack (6.5%)	Counter-driver (8.3%)
R-T-A-P scores won (%)	Drop shot (12.6%)	Backhand attack (14.9%)	Forehand attack (8.8%)	Forehand attack (13.0%)
R-T-A-P scores lost (%)	Block (16.3%)	Block (12.45)	Block (14.4%)	Block (9.6%)
R-P scores won (%)	Counter-driver (15.8%)	Forehand attack (13.4%)	Counter-driver (16.4%)	counter-driver (16.0%)
R-P scores lost (%)	Block (29.2%)	Counter-driver (19.5%)	Counter-driver (22.2%)	Block (29.2%)

Table 4 The analysis on the top four players' performance on scores won of attack-defense techniques

Attack and defense techniques		**Players**				**Total (%)**	χ^2	**Sig.**
		Ma Lin	Wang Hao	Wang Li-gin	Persson, G.			
Attack	Serve point (%)	9.3%	7.7%	10.6%	9.8%	9.4%	89.90*	.000
	Forehand attack (%)	31.6%	26.3%	29.6%	30.3%	29.7%		
	Backhand attack (%)	9.3%	29.4%	13.7%	10.4%	14.7%		
	Counter-drivers (%)	25.9%	22.7%	25.2%	29.0%	26.1%		
Defense	Drop shot (%)	17.0%	4.1%	6.6%	5.2%	8.3%		
	Long push (%)	2.0%	3.6%	4.0%	1.6%	2.7%		
	Block (%)	4.9%	6.2%	10.2%	13.7%	9.1%		
Total (%)		100.0%	100.0%	100.0%	100.0%	100.0%		

*p < .05

3.2.2 The analysis of the top four players' performance on scores lost of attack-defense techniques.

It could be known from Table 5 that the performance of scores lost of attack-defense for the top four players reached significant difference (χ^2 = 51.41, p<.05). Overall, the top four players had the highest percentage of scores lost of attack-defense in block (42.7%) and counter-drive (29.7%). If the analysis on the techniques with the highest percentage of scores lost was conducted according to individual performance, it could be known that the main scores lost technique for all four players was block technique; secondly was counter-driver technique. If a comparison was conducted with Table 3, it could be known that the four players' block and counter-drive were mainly reflected in the percentage of scores lost in R.P, especially Ma Lin's block in R.P, and Persson's counter-drive in R.P, were relatively weaker in comparison with other two players. This demonstrated that those who had a better handle in R.P had a better chance of winning.

In addition, it was known from the analysis on other players' major techniques regarding scores lost that Wang Liqin's forehand attack scoring was his main scoring technique, but he also had the highest percentage of scores lost amongst the four players, showing that he quite frequently uses forehand attack. Wang Hao also demonstrated the same result, in that his backhand attack was his main scoring technique, but he also had the highest percentage of scores lost amongst the four players, showing his confidence and dependence on backhand attack technique. As such, the current development of table tennis skills all require being more proactive, aggressive, speedy, more in speed, as well require better quality in hitting balls, and in terms of tactics, the requirement is comprehensive tactics in both defense and attack [6, 16] . That is, players must seek every opportunity to launch powerful attack in a match, such that their opponents are unable to mount up counterattack resulting in missing, or they use counter-driver to attack back whenever there is an opportunity in order to seek more chance for scores won. Such a proactive tactic inevitably will place psychological pressure on opponents, but the training requirement on players' muscle strength and endurance will be higher than before.

Table 5 The analysis of the top four players' performance on scores lost of attack-defense techniques

Attack and defense techniques		Players				Total (%)	χ^2	Sig.
		Ma Lin	Wang Hao	Wang Li-gin	Persson, G.			
Attack	Forehand attack (%)	10.2%	11.2%	18.3%	13.7%	13.3%	51.41*	.000
	Backhand attack (%)	4.0%	20.1%	9.2%	4.3%	8.5%		
	Counter-driver (%)	30.7%	27.2%	28.8%	31.0%	29.7%		
Defense	Drop shot (%)	4.0%	4.7%	4.6%	4.0%	4.3%		
	Long push (%)	1.1%	1.8%	2.6%	1.0%	1.5%		
	Block (%)	50.0%	34.9%	36.6%	46.0%	42.7%		
Total (%)		100.0%	100.0%	100.0%	100.0%	100.0%		

*p < .05

3.3 The analysis on the difference zones of scoring and losing points amongst the top four players

3.3.1 The analysis on the difference zones of scoring points for the top four players

It was known from Table 6 that the zones of scoring points for the four players reached significant difference ($\chi^2 =$ 23.79, p<.05). Overall, the performance of scoring points for the four players was the best when attacking their opponents' backhand positions. It was known from an analysis on the distribution of zones from individual characteristics that Ma Lin preferred attacking opponent's center position for scoring; Wang Hao was good at attacking opponents' left and right large angles; Wang Li-gin mainly attacked opponents' backhand position; Persson was accustomed to attacking opponents' the center position of backhand position.

Major factors to victory in a table tennis match are speed, rotation, power, zones, and curve, but the players in previous matches placed more emphasis on speed, rotation and power till the 3 major changes to rules resulting in the control of zones as the important factor of evaluating the quality of skills [8]. Also, based on the results of analysis, only Wang Hao's zones of scoring points were more evenly distributed in left and right positions, fully expanding the range of movement of opponents, increasing the difficulty for opponents' ability to confirm the effective zones and thus making good use of the tactic of zones, the other three players all were good at attacking opponents' backhand position of left half of the table for scoring points. This apparently ran contrary to the viewpoints of Zhang [4] who believed that the change to new regulations should enable players to break the status quo and switch the focus from the left half of the table to the right half in order to confuse opponents' habits and focus. It showed that players, when in a match, are still accustomed to primarily using backhand against backhand, and will not hastily change routes under uncertain situations.

Table 6 The analysis on the difference zones of scoring points for the top four players

Zones of scoring points	Players				Total (%)	χ^2	sig.
	Ma Lin	Wang Hao	Wang Li-gin	Persson, G.			
Forehand position (%)	22.3%	34.0%	29.2%	23.5%	26.6%	23.79*	.000
Center position (%)	43.3%	23.7%	29.6%	36.5%	34.1%		
Backhand position (%)	34.4%	42.3%	41.2%	40.1%	39.3%		
Total (%)	100.0%	100.0%	100.0%	100.0%	100.0%		

*p < .05

3.3.2 The analysis on the difference zones of losing points for the top four players

Based on Table 7, it was known that the four players' performance on zones of losing points did not reach significant difference ($\chi^2 =$ 8.35, p>.05). It could be seen from the Table 7 that the result was due to the fact that the top four players' main zones of losing points all were at backhand position, showed that their opponents were also accustomed to using backhand against backhand during contest, and were not willing to attempt changing hitting position without absolute certainty. This also means that the four players were weaker in the handling of backhand position than forehand

position and center position balls. It could also be inferred from the result, regarding the zone tactics used by top players of the world. That it is still as what experts believed; that the game tactics of world top players were to reduce the opponent's return quality, to keep press on the weakness and to suppress opponent's strong techniques.

Table 7 The analysis on the difference zones of losing points for the top four players

Zones of losing points	Players				Total (%)	χ^2	sig.
	Ma Lin	Wang Hao	Wang Li-gin	Persson, G.			
Forehand position (%)	37.5%	26.0%	26.8%	33.3%	31.5%	8.35	.214
Center position (%)	24.4%	30.8%	30.7%	30.0%	29.1%		
Backhand position (%)	38.1%	43.2%	42.5%	36.7%	39.5%		
Total (%)	100.0%	100.0%	100.0%	100.0%	100.0%		

*p < .05

3.4 The analysis on attack-defense scoring percentage of three-stage skills to the elite male players' performance

Through a stepwise regression conducted in this study, it was known (Table 8) the F value of the overall model was 160.86, reaching a significant standard ($p<.05$), and the $R^2_{(adj)} = 0.908$, showed that the variables could be interpreted holistically to be the 90.8% of the total variance of performance. In addition, it was known from the analysis results that the 6 independent variables in this study could be effectively to predict players' performance, and they showed positively significant influence; according to the degree of influence: R.P attack scoring percentage (β=0.607), R.T.A.P attack scoring percentage (β=0.519), R.T.A.P defense scoring percentage (β=0.464), S.T.A.P attack scoring percentage (β=0.455), R.P defense scoring percentage (β=0.244), and S.T.A.P defense scoring percentage (β=0.176).

It could be known from the aforementioned that the scoring percentage of attack-defense in three-stage skill could be effectively to predict the performance, and when the attack-defense scoring percentage was higher, the player's performance was better. It is revealed from the study that R.P attack scoring percentage had the most significant influence on performance; secondly was the R.T.A.P attack scoring percentage; thirdly was the R.T.A.P defense scoring percentage. Hence, it was known that the change to the 3 regulations indeed causes significant change to the tactical characteristics of excellent players, in that the advantage of S.T.A.P previously now is decreased, and the scoring position of R.T.A.P and R.P is increased. Therefore, players should be made more conscious to strength receive-then-attack skills, and especially as they enter rally situation, the key factor to victory is to effective use tactical change to create scoring opportunities for themselves.

Table 8 The analysis on attack-defense scoring percentage of three-stage skills to the elite male players' performance

Variables	R^2	F	B	Beta	t	VIF
(Constant)			5.707		3.277*	
R.P attack scoring percentage	.312	44.90*	.361	.607	17.484*	1.273

S.T.A.P attack scoring percentage	.554	61.26*	.234	.455	14.231*	1.082
R.T.A.P defense scoring percentage	.628	55.48*	.328	.464	12.544*	1.443
R.T.A.P attack scoring percentage	.834	122.86*	.296	.519	14.522*	1.350
R.P defense scoring percentage	.879	142.58*	.339	.244	7.058*	1.263
S.T.A.P defense scoring percentage	.908	160.86*	.175	.176	5.454*	1.099

*p < .05

4. Conclusions and suggestions

4.1 Conclusions

4.1.1 From without significant difference in the 3 indicators of three-stage skills such as using percentage, it was known that the overall used of techniques and tactics amongst the elite male table tennis players of the world were generally identical, and the competition amongst players are directly reflected in scoring percentage, namely, players who were equipped with all the scoring capabilities of the three-stage skills would have better chance of victory.

4.1.2 The main scoring techniques for the top four players were S.T.A.P (serve point and forehand attack), R.T.A.P (forehand attack and backhand attack), and R.P (counter-driver and forehand attack) in three-stage skill.

4.1.3 Since the four players' performance on attack-defense scores won and lost all reached significant difference, each player had his own unique techniques to victory regarding the demonstration of their skills, and in the same manner, they also had corresponding technical shortcomings. Especially, whoever could reduce the errors in R.P in future matches could have a higher chance of victory.

4.1.4 Currently, top players of the world are still accustomed to using backhand position against backhand position, and will not opt for changing zones when they are not certain. This showed that the game tactics of world top players were to reduce the opponent's return quality, to keep press on the weakness and to suppress opponent's strong techniques.

4.1.5 The stepwise regression analysis data showed that the scoring percentage of attack-defense in three-stage skill could be effectively to predict the performance, and when players' scoring percentage was higher, their performance was better. In addition, "R.P attack scoring percentage" had the greatest influence on performance, demonstrating that the implementation of the new system for matches present a significant change in elite players' technical and tactical characteristics, in that the advantage of S.T.A.P was decreased, and the position of R.T.A.P and R.P was increased.

4.2 Suggestions

4.2.1 In addition to solid basic techniques as the foundation, when trainers train young players, they need to strengthen players to be more aggressive, more proactive, faster attack-defense switching, as well as to improve on technical and tactical combination when strengthening players' tactical training. When the mutual contention amongst them is stronger, then these players are required to be equipped with three-stage scoring capability such that they can contend with world-class players.

4.2.2 It is beyond doubt that each player should hold his unique technique style; such is not to be ignored. Therefore, it is desirable to establish own styles in the skill-learning stage, and promote at least one or two scoring techniques according to one's own style, or strengthen weak techniques.

4.2.3 Players should be strengthened with the concept of falling zone tactics during routine training; meanwhile strengthening backhand position attack-defense

capability; especially the proportion dedicated to training time should significantly be increased.

4.2.4 During routine training, in addition to strengthening the ability of R.T.A.P, a key factor to victory is the effective use of tactical changes when entering R.P should also be emphasized in order to creative scoring opportunities.

References

[1] R. D. Steadward, "Integration and sport in the Paralympics movement," *Sport Science Review*, Vol. 5, No. 1, pp. 26-41, 1996.

[2] M. Kondric, M. Supej, B. Nemec, R. Hudetz, and J. Koscak, "Possibilities to reduce speed and spin by changing the thickness of sponge, upper layer or total thickness of sandwich rubber," *Proceedings book* (pp. 393-400, 2007.). Zagreb, University of Zagreb, Faculty of Kinesiology: 10th anniversary ITTF sports science congress.

[3] H. Q. Wu, and Z. B. LI, "A research on the method of the technical diagnosis of table tennis athletes," World table tennis, No.2, pp. 8-40, 1990.

[4] Y. Q. Zhang, "Analysis on tactical character of elite junior table tennis players in China," *China sport science and technology*, Vol. 42, No. 1, pp. 99-101, 2006.

[5] J. X. Liu, and L. B. Chen, "Influences of new rules on sport of the ping-pong ball," *Journal of Jingmen Technical College*, Vol.18, No. 3, pp.64-66, 2003.

[6] K. H. Chang, "The study of the attack-defend skills and performances of the elite in the table tennis contests," *Journal of physical education in higher education*, Vol.6, No. 1, pp.169-180, 2004.

[7] C. Y. Chu, "An investigation to the relationships among three-part skill analysis in table tennis, psychological variables, and table tennis performance," *Journal of Taipei Physical Education College*, No. 13, pp. 54-73, 2005.

[8] Q. F. Zhang, "Analysis on attacking point of men's team final in 47th world table tennis championship," *China sport science and technology*, Vol. 40, No. 6, pp 64-66, 2004.

[9] M.H. Hsu, "The analysis of attacking route and falling point by woman wheelchair table tennis player in class three: A case study of Chen Yu-ming player," *Journal of Chung Hsin Physical Education*, No. 8, pp. 23-32, 2007.

[10] J. L. Li, X. Zhao, and C. H. Zhang, "Influence of New Rules on the Development of Table Tennis Techniques," *Journal of Beijing Sport University*, Vol. 28, No. 10, pp. 1414-1416, 2005.

[11] W. M. Pei, B. J. Cheng, and & Y. Q. Lv, "On the law of table tennis regulation evolution in recent 20 years," *Journal of PLA Institute of Physical Education*, Vol. 25, No. 2, pp. 89-92, 2006.

[12] F. H. Cui, and X. X. Qu, "Skill analysis on Ma Lin in the 45th world table tennis championship-Discuss the development trend of the pen - hold fast attack method," Journal of Sports and Science, Vol. 24, No. 1 pp. 61-63, 2003.

[13] L. Li, "Technological and tactical analysis of pull loop of forehand of Wang Li- qin in the matches of the 48th world table tennis Championship," *Journal of Chengdu Sport University*, Vol.31, No. 6, pp. 112-114, 2005.

[14] G. Otchevac, and Y. Drianovski, "Comparative analysis of the games of the finalists from the biggest International and Bulgarian Table Tennis Competitions in 2000," *Table Tennis Scienc*e, No. 4 & 5, pp.155-166, 2002.

[15] Z. Hao, X. L. Cai, Y. J. Hao, J. J. Zhang, and M. L. Hao, "Analysis on Ryu Seung-min's technique and tactics in man's single table tennis final and semifinal of the 28th Olympic Games in Athens," *Journal of Beijing Sport University*, Vol. 30, No.2,

pp. 258-260, 2007.

[16] X. D. Xu, "Analysis the new characteristic of the table tennis training from the 48th world table tennis championship**,**" *Journal of Harbin Physical Education Institute,* Vol.23, No. 6, pp 109-113, 2005.

Social Aspects to Promote International Friendship and Cooperation:

A case for Mbale Tigers Table Tennis Club in Uganda Table Tennis Association

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ABSTRACT
Mbale Tigers Table Tennis Club (MTTTC) was founded in 1992 but formerly established in 2003 as a social club aimed at building a generation of young, disciplined and competitive Table Tennis Players who would become all round personalities in the Table Tennis industry. The ultimate goal is to build a Table Tennis Academy that will support the building of a Table Tennis Industry in Uganda. The club then started working with Twiga and formed a Project code named Laupa Luning Table Tennis Project.The project was a result of a research carried out in Mbale Tigers Table Tennis club and its community on the impact of sports on the leadership qualities of children. However many social benefits have accrued to the functioning of the club The social benefits realized include; social services like education, health, housing and positive social values and attitudes and relationships at local, national and international levels with good cooperation and friendship as defined in a Memorandum of understanding and cooperation signed between Laupa Lunning Table Tennis Project Promoters (Stefan Laupa and Joel Lunning), the founder and promoter of Mbale Tigers Table Tennis Club and the local government of Mbale District in Uganda in East Africa.Mbale Tigers Table Tennis Club method combines professional training, practice and competition with good results and contribute efforts towards achieving the millennium development goals among others; groom young sportsmen and ladies in leadership skills, fight poverty and extreme hunger, promote Universal Primary Education, protect the environment, promote Human Rights and Fight against HIV/AIDSThe Swedish International Development Agency (SIDA) through TWIGA a Swedish NGO has made significant financial contribution to Mbale Tigers since 2005 to facilitate the strategy to identify, train and expose players to local, National, Regional and International Table Tennis competitions and also pursue the millennium development goals. (ref:www.mbaletigers.com/www.twiga.se/www.ittf.com)Children 6-18 years now dominate the national team of Cadet Boys and Girls, Girls and Boys under 17 years and also feature dominantly in the Women's Team. They have started getting to the Men's team category with ease. Kids have benefited from Education seminars and have greatly changed their social behavior, values and attitudes. Reports from schools, families and community members indicate a significant change in the life styles of most of them who happen to be residing in a slum area near the location of the project office-Maluku.Other income generating activities like Bicycle taxi, internet café and workshop for locally making table tennis tables aimed at making Mbale Tigers a self-reliant club in a near future have been implemented and have impacted positively on the outlook of the kids, workers of the club and community. SIDA and TWIGA have twice supported cultural exchange programs in which Mbale Tigers Kids and one leader have traveled to Sweden for at least three weeks to share experiences through tour and travel, competition, Conferences and training in elite Clubs like Angby and Mariedal Sports Clubs.UN Habitat which awarded a certificate of merit to Mbale Tigers in recognition of its involvement of Youth in the Project, recommended that Mbale Tigers replicate this project in the East African countries.The leadership of the Government of Uganda, ATTF, ITTF through its Goodwill Fund, Computer Aid and the population of Ugandan Table Tennis administrators, players and sponsors recognize Mbale Tigers Table Tennis Club Model as the most successful sports organization worth supporting and encouraging if sports in general and Table Tennis in particular has to grow into an Industry for career development, job creation, income generation and proactive innovations to bridge gaps in the social development process in Africa south of the Sahara in general and Uganda in particular.

Key Words：International friendship cooperation Social values attitudes Uganda Table Tennis

Introduction

Mbale Tigers Table Tennis Club started as a comm unity based project drawing on the talents of children liv ing around the main center, Maluku Youth Center in Mb ale Town. As a children's project the aim was to introdu ce basic playing techniques and allow growth and devel opment of the players to become competitive table tenni s players. Maluku area is one of the sub-urbs of Mbale, a major town in Eastern Uganda in East Africa where th e Maluku Youth Center is located. The center was gra nted to Mbale Tigers Table Tennis Club because its foun der, Matsyetsye Emmanuel was a youth leader with exceptional social values, attitudes, management skills and basic knowledge about sports development. Emmanuel has worked in Mbale District and has several initiatives in other Districts of Bududa and Kampala involving youth in sports, Student leadership and Youth Ending Hunger development activities.The Youth leadership of Mbale District and top leaders of that District also have a great desire to support any initiative aimed at tapping and improving the talents of youth. So the free accessibility of the center to activities of Mbale Tigers Table Tennis Club greatly boosted success of LLTTP project without

hindrance. It is through friendship at local and district level that such a facility was granted to Mbale Tigers Table Tennis Club to start the LLTTP project to have a systematic approach in identifying, training and exposing children to local, national and International competitions. Subsequently, international friendship through the Swedish NGO Twiga and the person of Stefan Laupa the project Manager in Sweden made it possible for SIDA to support Mbale Tigers to implement the LLTTP project from which this paper is now being presented.

Background

Mbale Tigers Table Tennis Club philosophy of Sports and Table Tennis in particular is that Table Tennis is a factor for Youth Development. That is why our target group 6-18 years now has amazing results. Youth will be able to get playing and life skills, earn income, create employment and fight HIV/AIDS, Poverty, Drug abuse and alcoholism using the Table Tennis ball. We feel we are also directly and indirectly contributing to the achievement of the millennium development goals set by world leaders. The Vision is to create a generation of all round Table Tennis personalities able to work in a Table Tennis Industry we are humbly building. That such a vision can be realized even faster when we have a Table Tennis Academy and also establish local and International manufacturing Table Tennis companies. Sports in a family, at school or through peer influence serve as a physio-therapy. Whether exercised as a cultural practice as in china where Table Tennis is a national sport or introduced as a new sport any where has a lot to do with the social development factors. Talented and not talented individuals acquire positive social values and attitudes through just playing, training, practice and competition. Positive social values, attitudes and proven good practices as defined in the Olympic charter, ITTF Constitution, UTTA Constitution and Mbale Tigers Memorandum and Articles of Association have been explored by Mbale Tigers Table Tennis Club and we now have nine children whom we feel are a living example of our achievement since we started LLTTP Project in Mbale Tigers Table Tennis Club.

Management of Mbale Tigers believes that Table Tennis has the social dimension that promotes friendship and cooperation at local, national and International level. Such friendship at local and national level is the basis for international friendship and cooperation. Therefore building the international sporting fraternity begins with genuine local, national and continental friendship and cooperation for which this paper now seeks to present a case for Mbale Tigers. Mbale Tigers Table Tennis Club as a registered Club in Uganda Table Tennis Association serves as a model club in Uganda and East Africa as recommended by UN Habitat 2006 MILGAP Masharik Award; where other Clubs in Universities and schools emulate their working methods. Through individuals, teams and clubs, international friendship and cooperation can be realized. But most importantly that such friendship and cooperation are determined by different circumstances therefore are realized more quickly or slowly because of the variances in economic, political, cultural and other factors like technology, governance issues, Environmental issues, drug abuse, Human Rights violations, HIV/AIDS to mention but a few. Such factors when addressed may promote cooperation and international cooperation among individuals working in the Table Tennis institutions and related agencies for development of the entire sporting society

Strategic programs in Mbale Tigers

Identifying Talented Kids through meetings and exposure

Through regularized meetings and competitions organized within Mbale Tigers and the Uganda Table Tennis Association as per the annual calendar activities, we have made deliberate contacts with Primary and secondary schools, Universities, social clubs, families, Banks and former and current Table Tennis players and administrators. We are therefore are able to identify children 6-18 years to play the game of Table Tennis. Our desire is to create a generation of young, disciplined, competitive Table Tennis players and also contribute towards the achievement of the eight Millennium development goals set by world leaders in 2000.

Training and Training Camps

Our success in Table Tennis development in Mbale Tigers has largely depended on equipping the identified talents with basic training, practice and competition skills.Training sessions have been conducted among the identified talented children who benefit as beginners. Mbale Tigers has a systematic program based on its budget to conduct such training camps within the club and the pilot schools and centers. The club management ensures all those players maintain their presence train to reach competitive standards in the Cadet class, the boys under 17 and also prepare to play in the Youth competitions. Only such players can make it in the senior competitions and can qualify to play in the elite class for Continental, Commonwealth, World Championships and the Olympic games. Our guiding principle has been the 4P plan approved by ITTF to plan, participate, popularity and profit in Table Tennis.

Exposing them to local, National and International Competitions

Mbale Tigers Kids now form the best cadet and Junior boys and Girls players who are the future of Table Tennis teams in Uganda, East Africa and perhaps Africa at large.Through local Competitions such as Mbale Open, Mbale Schools and Holiday clinics and daily training, Kids have developed a competitive spirit. The kids have represented Uganda at the East Africa Table Tennis Championships, All Africa Games in Algeria 2007, Commonwealth Games March 2006 and Commonwealth Youth Games in July 2008. They will

represent Uganda at the Uganda Open International 2nd – 5th April 2009, Commonwealth Table Tennis Championships 19th – 25th May in Glasgow and World Championships in April 28th – 5th May 2009 in Yokohama Japan If they get sponsorship.

Education Seminars, Income generation activities.

Through regularized Education Seminars on HIV/AIDS, Environment, Human Rights, Gender, Leadership, Kno wledge about sports Associations and Sports injuries.

We have embarked on a canteen to provide water and snacks for players and visitors, Internet Café for training children in Computer literacy and also avail communication channel via internet for all members and neighbors, Workshop for local manufacture of Table Tennis Tables, repair and maintenance. Such a venture requires more input of finances, marketing and promotion through various activities at the club. I wish to invite investors to come to Uganda because all machinery for manufacture of all Table Tennis equipment and tools will be tax exempted. The President of Uganda has promised me this. Industrial machinery of all sorts shall be freely allowed in Uganda.

Change in Social values and Attitude of children.

Many children have changed their behaviour, attitudes and life skills in general and lived as role models. Through such good behavior with knowledge, they have won scholarships to study in their schools without paying school dues. Amina Kibone in Nabumali High School, Rita Nekesa in Mbale SS, Zura Khaukha, Eddy Omongole and Amina Namaganda in Mbale Progressive have all enjoyed scholarship because of their competence in playing Table Tennis and also exhibit good sports character and personality.

Networking

Mbale Tigers has networked with Sporting, Youth and development agencies with similar objectives. They have explored the Public – Private partnership with the Local government administration of Mbale District local government that offered space for office and playing. The club has also used the facility for a canteen and workshop for furniture for making Table Tennis Tables. Have networked with Uganda Youth Network that promotes advocacy and sensitization of youth in development activities. We have worked with TWIGA, SIDA, Computer Aid and volunteer youth from Sweden to consolidate our achievements on personal development of the youth giving them more knowledge about life and sporting skills.

Uniqueness of Mbale Tigers Table Tennis Club

Mbale Tigers Table Tennis club has the biggest number of Children in Uganda playing Table Tennis using the approved basic playing skills because the club has a paid, committed coach and able leadership and management. Most children playing well now studying in secondary and Primary schools study on scholarship. Most tournaments organized in Uganda whether local or regional feature Mbale Tigers Kids as best. Usually they walk away with 90% of the prizes including trophies and medals. Without Mbale Tigers Teams of Cadets, the Girls and Boys, tournaments are not interesting.

All Tournaments attract big crowds to witness kids beating adults!! The Kids represent the female and Girls and Boys and Girls and Cadet Boys and Cadet Girl's players for Uganda.People from Kampala and Kenya take holidays in Mbale to play with the Kids so as to improve their playing skills and also learn about our method. We have attended an International conference in Sweden in November 2007 and shared our experiences about our methods with other NGO from other Asian, African, European an American countries. We have generated a lot of Friendship at local, national, regional and now International level for the children, our partners and managers/leaders in the Table Tennis fraternity in the 20 paid clubs in Uganda Table Tennis Association and in the pilot centers of the club in Mbale

Way forward and appeal

Mbale Tigers continuously attract young players in Primary schools to play the game of Table Tennis and this increases every year. We therefore need more coaches, equipment and training for the administrators who ought to keep pace with increasing demand for the Table Tennis services. A more enduring policy of development with strategic actions are required if a table tennis industry has to be built on a sustainable basis. The first major policy move is to make concrete table tennis tables in all major regions of Uganda.

Secondly is to attract major sponsorship of our activities on a regularized basis atleast on a yearly basis. Establish a Table Tennis outlet with a range of Table Tennis products and services including Table Tennis basic equipment and tools, literature materials and Table Tennis electronics like Robots, TT CDs. Establish a Table Tennis Academy with a fully fledged campus of a routine school curriculum but focuses on Table Tennis development from Nursery school level to post primary education up to the age of 18 years. We have excelled in international cooperation from the level of funding to cultural exchange visits and now proposals to expand our international cooperation through friendship. We have received equipment, computers and other gifts for children ranging from scholastic materials books, pens to clothes, shoes and school fees.

References

1) ITTF Coaching Manual, Level 1 2005 edition
2) NCS Statute 1964 of Uganda government
3) Uganda Olympic Committee Charter
4) Uganda Local Government Act, 1997
5) Mbale Tigers Statute 2003
6) Memorandum of Understanding and Cooperation 2003 between Mbale Tigers Table Tennis Club , LLTTP and Mbale District local government

Table 1: A summary of internationally exposed players and officials of Mbale Tigers Table Tennis 2003-2008

With support from TWIGA, SIDA, Computer AID, Mbale District local Government, International Table Tennis Federation (ITTF Goodwill Fund) and recognized by UN Habitat, and Central Government of the Republic of Uganda

No	Name	Sex	Age	Level of Play	International Exposure
1	Kibone Amina (Role Model in the Club) and on scholarship in S$ in Nabumali High school	F	17	Participant	Kenya Burundi Commonwealth Games Melbourne Australia 2006 Cultural Exchange program in Sweden 2008
2	Nambozo Asha (On scholarship in Manafa HS	F	16	Participant	Kenya Burundi Commonwealth Games Melbourne Australia 2006
3	Nabulondera Evalyn (On scholarship in Nabumali High School) S4	F	16	Participant	Kenya All Africa Games in Algeria 2007
4	Nekesa Rita (Voted Table Tennis player of the year 2006 in Uganda) and on scholarship in Mbale Secondary school S5	F	17	Participant	Kenya Burundi Cultural Exchange program in Sweden 2008
5	Nakibule Regina in S5 on scholarship in Mbale SS in S5	F	17	Participant	Kenya Cultural Exchange program in Sweden 2008
6	Khaukha Zura National schools champion on scholarship in Mbale Progressive	F	16	Participant	Kenya Commonwealth Games in Pune India
7	Namaganda Amina in Mbale Progressive on scholarship	F	16	Participant	Kenya Burundi Commonwealth Games in Pune India
8	Wamusi Ivan (10th Best player in National league) has been on scholarship in Manafa HS now in S5	M	17	Participant	Kenya Cultural Exchange program in Sweden 2008
9	Omongole Eddy (Now ranked after CWTTC in Pune India July 2008) on scholarship in Mbale Progressive	M	16	Entered main draw for Men	Kenya Commonwealth Youth Games in Pune India
10	Mutete Jude (Now national coach after German Course)	M	29	Coach/Player	Kampala International University, Mbale Tigers, Uganda Table Tennis Association, Africa University games, World University Games German Coaching Course
11	Matsyetsye Emmanuel (Now to host Uganda Open International on ITTF Calendar, have bidded to host Africa Junior Champs 2010 in Uganda), Spearheading the National Organisation of Sports Associations and Federations in Uganda a professional sports body that will supplement activities of existing sports bodies.	M	49	Executive Director Mbale Tigers Table Tennis Club & President Uganda Table Tennis Association Leader of Delegation/Team Manager	Kenya Tanzania Rwanda World Championships Manchester 1997 World Championships Netherlands 1999 World Championships China 2008 Commonwealth Youth Games Pune India 2008