

A MOBILE APP TO MANAGE CHILDREN DENTAL ANXIETY: CONTEXT AND APPROACH

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ABSTRACT

Anxiety and fear related to dentistry interventions have been identified as problems affecting children. This reduces their quality of life and may have a negative impact on aspects such as sleep, self-esteem, mood, social relationships, and other psychological issues. The ARCADE project aims to design and develop a technological solution to manage children dental anxiety. This solution consists on a mobile system co-designed with children. An ecological momentary intervention is proposed using this solution before, during and after dentistry treatments. This paper presents a methodological approach to develop the project.

KEYWORDS

e-Health, Mobile Devices, Children Dental Anxiety, Usability

1. INTRODUCTION

Anxiety related to dental interventions is a common problem in children (Colares *et al.* 2013). There is evidence reporting the dentist role as a scary person (Majstorovic and Veerkamp *et al.* 2004). Colares *et al.* (2013) found a prevalence of dental anxiety of 14.4% in a study involving 970 children aged 5-12 years. Nicolas *et al.* (2010) assessed 1303 children aged 5 to 12 years and observed a slightly lower prevalence of 7.6%. Raja *et al.* 2015 conducted a study in Islamabad aimed to estimate the prevalence of dental anxiety in children aged 5 to 10 years. Their results showed that 38% of the 252 participants had moderate or severe anxiety. Bezabih *et al.* 2013 reported a prevalence of 74.1% of dental anxiety between moderate and severe in a study involving 240 children.

Children and teenage anxiety and fear have a meaningful impact on their dental health, as well as on their cooperative attitude when visiting dentist (Klingberg and Broberg 2007, Porritt *et al.* 2012). Those problems may even be the reason to avoid or discard some dentistry treatments, especially in the case of children. Therefore, they suppose a great challenge in children treatments, becoming a barrier for dental health professionals (Cohen *et al.* 2000). Managing those patients is stressful for those professionals, demanding longer treatments and more resources. The resulting experience is also less pleasant for both, patient and dentist (Moore and Brødsgaard 2001, Brahm *et al.* 2012).

Anxiety and fear produce emotional, physical, cognitive and behaviour interferences in individuals (Cohen *et al.* 2000). Scientific literature evidence suggests that children suffering anxiety and fear are likely to avoid dental health. That results in a higher incidence of untreated deteriorations and cavities compared to children with less anxiety and more cooperative attitude (Freeman 2007, Nicolas *et al.* 2010, Rantavuori *et al.* 2004, Townend *et al.* 2000, Versloot *et al.* 2004). Dental health and quality of life are connected, and therefore, dental anxiety may have a negative impact on children and teenagers mood and social relationships. Besides, it may cause sleep disorders, low self-esteem, as well as psychological problems (Armfield *et al.* 2006, Carvalho *et al.* 2012). On the other hand, it has been proved the existence of a narrow correlation between anxiety, pain stimuli and pain perception. In this sense, anxious patients feel higher and longer painful, increasing pain memory (Weisenberg *et al.* 1984, Al Absi and Rokke 1991).

2. DENTAL ANXIETY INTERVENTIONS

Dentistry interventions cause common anxiety and fear problems in some children resulting in a decrease of their quality of life. Therefore it is crucial to form evidence-based therapies to reduce or avoid those problems. Some therapies have been currently suggested which can be classified in three main different categories: psychotherapeutic, pharmacological, or a combination of both. Pharmacological therapies have showed a lower patients acceptance, being only effective in short-time treatments (*Forbes et al. 2012*). Appukuttan (2016) conducted a literature review on management strategies for dental anxiety and phobia patients. He identified psychological strategies such as: iatrosedative technique, behaviour management techniques, relaxation techniques, guided imagery, biofeedback, hypnotherapy, acupuncture, distraction, increased control, systematic desensitization or exposure therapy, positive reinforcement, cognitive therapy and cognitive behavioural therapy.

The current project aims to study the feasibility of designing and developing a technological solution to reduce dental anxiety problems among children 6-12 years of age. Some of the aforementioned techniques will be further implemented.

3. OBJETIVES AND APPROACH

3.1 Objectives

The main goal of ARCADE (App for Reducing Children's Anxiety in Dentistry Environment) project is to design and develop a technological solution to reduce anxiety that children suffer around dentistry interventions. This paper describes a methodology for:

- 1) Gathering and analysing children data about:
 - Dental anxiety.
 - Possible factors affecting anxiety.
 - Possible adoption barriers of technological solution to prevent or manage dental anxiety.
 - Preferences about games and possible distractor elements.
- 2) Gathering and analysing opinion from health professional and relatives about:
 - Barriers and facilitators to adopt technological solutions to prevent or manage dental anxiety.
 - Possible functionalities to include in technological solutions that can be useful to the patients.
 - Identifying possible challenges in the UCD (User-Centered Design) development process for the target collective.
 - Studying qualitatively and determining key functionalities for the app.
 - Establishing a typology of potential end users based on qualitative or quantitative variables to customize the solution.
 - Analysing different strategies of participatory design with the target collective.
 - Studying emotional modelling techniques as support to the intervention.
 - Assessing usability of the proposed solution, as well as satisfaction grade of all its users.
- 3) Doing co-design with children.

3.2 Approach

The protocol proposed in ARCADE project has three stages:

- 1) The first one consists in a user research study aimed to understand needs, preferences and capacities using a mobile digital assistive system of children suffering from dental anxiety. In this sense, three target groups are involved in the study: patient children (between 8 and 15 children), their relatives and health professionals (at least 2) who treat them. First, standardized questionnaires are used to assess children's dental anxiety. Then, children participate in an interview adapted to their ages. On the other hand, semi-structured interviews to relatives are carried out to complete data and identify possible

factors affecting to children dental anxiety. Finally, stakeholder interviews to health professionals are accomplished to identify relevant aspects for design and development of the mobile solution.

- 2) During the second stage, co-creation experiences are done by involving children (not necessarily patients) in design and develop tasks for the proposed technological solution.
- 3) During the third stage, an expert review is done with the abstract prototype, participating Information Technology professionals. Finally, prototype usability tests are accomplished with a group of children who are different to those participated in the previous stage.

3.2.1 Recruitment

Children are recruited from two dental clinics which have collaboration agreements with the University of Seville. Potential participants are identified initially by health professionals during interventions. Then, relatives are informed about ARCADE project and they are invited to participate in it. During the design and development phases (where the experiences of co-creation are performed), 10 children with ages between 6 and 12 years will participate. These children will not be patients. In all cases, it will be mandatory to obtain the informed consent of participants or their legal guardians.

3.2.2 Qualitative User Research

Semi-structured interviews are conducted in working sessions with children. Visual and/or graphic resources (pictograms and photographs) are used when convenient. Pictograms with faces representing the extracted scale of the SFP-R (Smiling Faces Program - Revised) (Buchanan, 2010) are used in not opened or Yes/No questions.

Similar techniques are followed in sessions with family members or health professionals. These sessions are conducted by an interviewer and participants communicate to him/her their assessments without interfering with his/her cultural beliefs, particularities, prejudices or opinions. The script of interviews are defined presenting first general purposed questions and then more specific ones.

The information collected during these interviews serve as a requirement for the design and functionality of the solution to be developed in ARCADE project.

3.2.3 Co-design

There are many articles in the scientific literature about co-creation (participatory design or co-design) with children and/or teenagers. In these processes children make the user interface design along with the collaboration and guidance of expert designers and using techniques adapted to their ages. In this project and during this experience no children data collection is made.

These participatory methods allow designers to identify design problems from the children's point of view. In addition, problems related to the children's lack of maturity when expressing themselves or even problems of shyness may be overcome (Baek, 2008). As a result, better and more usable designs are obtained.

Examples of co-creation techniques can be found in (Chung, 2010), (Clark, 2011), (Walsh, 2010) or more recently in (Doderio, 2014). Here gamification methods are proposed for making more attractive and productive the co-creation process.

4. CONCLUSIONS AND FURTHER WORK

Children dental anxiety is a health problem impacting on their quality of life. A literature review has been conducted to identify the context. Moreover, a methodological approach to design a technological solution for children with dental anxiety has been presented.

ARCADE project results will serve to expand knowledge about the use of technological solutions to reduce dental anxiety in children between 6 and 12 years. They will allow a better understanding of the possible facilitating factors and potential barriers of this type of solutions. The knowledge acquired in this study will allow the development of technological solutions adapted to this target group. The effectiveness of these solutions will be investigated in future projects.

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