an International Journal
of Theoretical Linguistics

Ángel L. Jiménez-Fernández
Editor-in-Chief
Universidad de Sevilla

Pilar Barbosa
Universidade do Minho

Victoria Camacho-Taboada
Universidad de Sevilla

Michelle Sheehan
University of Cambridge

Iberia

Editorial Team

Editors

Ángel L. Jiménez-Fernández, Editor-in-Chief, Universidad de Sevilla, Spain
Pilar Barbosa, Universidade do Minho, Portugal
Victoria Camacho-Taboada, Universidad de Sevilla, Spain
Michelle Sheehan, University of Cambridge, UK

Layout editor

Pedro J. Carrillo-Gomez, Chief Layout Editor, Universidad de Sevilla, Spain
Victoria Camacho-Taboada, Universidad de Sevilla, Spain
Alicia González Seco, Universidad de Sevilla, Spain
Estefanía Guerrero Robles, Universidad de Sevilla, Spain

Copy editors

Megan Devlin, University of Ulster, UK
Rebecca Woods, University of York, UK

Proofreaders

Victoria Camacho-Taboada, Universidad de Sevilla, Spain
Pedro J. Carrillo-Gomez, Universidad de Sevilla, Spain

Principal Contact

Ángel L. Jiménez-Fernández, Phd
Phone: (+34) 954 551 546
Fax: (+34) 954 551 516
Email: ajimfer@us.es

Support Contact

Pedro J. Carrillo-Gomez
Phone (+34) 620 581 485
pedrocarrillo@gmail.com

Mailing Address

Facultad de Filología
Universidad de Sevilla
C/ Palos de la Fra. s/n
41004 Sevilla (Spain)

Iberia

Scientific Committee

Iberia

Another Look at Modification
in Spatial Prepositions

Francesco-Alessio Ursini
Stockholms Universitet
francesco.ursini@english.su.se

Nobuaki Akagi
Macquarie University
jag.heter@hotmail.co-jp

Iberia

Another Look at Modification in Spatial Prepositions

Francesco-Alessio Ursini   Nobuaki Akagi
Stockholms Universitet   *Macquarie University*
francesco.ursini@english.su.se   jag.heter@hotmail.co-jp

Abstract

The goal of this paper is to propose a unification of two strands of research within the semantics of spatial prepositions. The first strand focuses on the so-called *modification problem*, which can be stated as follows. Some, but not all spatial prepositions can occur in sentences including measure phrases, such as ten meters (*Mario went ten meters in front of the car*). The second strand focuses on so-called *prepositional aspect*: the fact that some but not all spatial prepositions can occur with temporal adverbial phrases such as in one hour. A unified account is proposed, based on a minimal version of Type-Logical syntax combined with situation semantics. This unified account is shown to explain and predict why, for instance, telic prepositions cannot occur with measure phrases (viz. *ten meters to the park). A compositional analysis of the contribution to lexical aspect of measure phrases, and their compositional interplay with spatial prepositions and temporal adverbials, is offered in detail. The main conclusion is that measure phrases do contribute to the lexical aspect reading of a sentence, but do so in fairly subtle (and compositionally-based) ways.

Keywords: spatial prepositions, degree semantics, lexical aspect, measure phrases; morpho-semantics.

1   Introduction[*]

Spatial Prepositions (henceforth: SPs) have been the focus of much recent syntactic and semantic research. Current syntactic analyses of SPs have uncovered their fine-grained syntactic structure in thorough and accurate detail (Asbury 2008, Pantcheva 2011, the works in Asbury *et al.* 2008, Cinque & Rizzi 2010, a.o.). Recent semantic works have also thoroughly investigated SPs and their many dimensions of meaning (Zwarts & Winter 2000, Kracht 2002, Zwarts 2005, Gehrke

---

2008, a.o.). Given their novel insights on this category, these works seem to offer a theoretical platform from which certain well-known problems can be solved. In this paper, we focus on one such problem: the interplay between SPs, Measure Phrases (henceforth: MPs) *such as ten meters*, and Temporal Adverbial Phrases (henceforth: TAPs) such as *in/for X time* (Dowty 1979, 1989). We start from MPs, in our discussion. In recent work, Morzycki (2006: 279) observes that only certain SPs can occur with MPs, as shown in (1)-(2):

(1) The osprey is flying *ten meters* above the lake
(2) #The osprey is flying *ten meters* near the lake

Examples (1)-(2) show that while *above* can freely occur in a sentence containing the MP ten meters, the SP *near* cannot do so. The related sentence results is awkward or uninterpretable, a fact we represent via the symbol "#". As Morzycki (2006) suggests, SPs that have this distribution include a *monotonicity* property defined over the model-theoretic objects belonging to their denotation. In this case, Morzycki (2006) follows Zwarts & Winter (2000) in assuming that both SPs and MPs denote (sets of) vectors. Simplifying matters somewhat, SPs differ on whether they denote sets of vectors that can vary in possible "length", or sets that only include vectors within a certain interval of length. Only the first group of SPs denotes sets of vectors which share one key property, monotonicity. The sets of vectors in their denotation can be ordered along an increasing/decreasing scale of length. Those SPs that do not have this monotonicity property cannot occur with MPs (e.g. *near*).[1]

This work does not explore in further detail a more fine-grained analysis of which types of SPs have monotonic denotations. However, this analysis can lend itself to an interesting starting point for a more thorough account of these modification patterns. One aspect discussed within this analysis provides an interesting problem in need of a solution, which can be defined as follows. If MPs combine with verb phrases (VPs), then they can do so only when they denote a set of eventualities that are aspectually *atelic*, or *cumulative*.[2] Otherwise, they cannot combine with VPs, lest a sentence be uninterpretable. We show this pattern in examples (3)-(4):

(3) The osprey flew *one kilometer* in one hour

---

[1]We employ the more intuitive notions of "occurrence" and "distribution" for the introduction and section 2, in which we discuss our data. We will use more precise and formally defined notions in section 3 and 4, when we will have a clear picture status on the order and structure of the three phrases under discussion (SPs, MPs, TAPs).

[2] Here and in the remainder of the paper, we use the labels *telicity* and *telic* as interchangeable with *non- cumulativity* and *non-cumulative*, depending on which label makes the prose more fluid.

(4) #The osprey few *one kilometer* for one hour

As Morzycki (2006: 284) observes, the verb *fly* can receive an either atelic or telic interpretation, as events of flying seem to lack such a necessary "end-point". When an MP, *one kilometer*, appears as the argument of this verb, then only one type of TAP can combine with this phrase: the telic *in one hour*. The atelic four one hour renders the sentence uninterpretable.[3] This pattern is tightly related to the pattern displayed in (1)-(2), and to the fact that MPs can occur with SPs insofar as the modification condition is met. A natural conclusion from these facts is that, if MPs can only combine with phrases that denote atelic predicates, then SPs occur within these "atelic" phrases if they also denote atelic predicates. Interestingly, works such as Zwarts (2005) show in detail how a distinction between telic and atelic SPs can be made precise. This distinction is particularly clear with so-called *directional* SPs, and is based on their distributional patterns with TAPs:

(5) The car went to the park in one hour/*for one hour
(6) The car went towards the park *in one hour/for one hour

According to Zwarts (2005), certain directional SPs can only occur when telic TAPs, such as *in one hour* (e.g. *to, from, into*, and so on) also occur in a sentence. More accurately, an MP can act as a modifier of a complex verb and preposition phrase, only if it occurs with a certain sub-set of directional SPs. Other directional SPs, instead, can only occur in sentences including atelic TAPs, such as *for one hour* (e.g. *along, towards*). Hence, if we look at TAP and their distribution with SPs, then some SPs seem to form a class of atelic predicates (*above, towards*), while others form a telic class (*near, to*). An obvious question, briefly mentioned in Morzycki (2006), Zwarts (2008), is how the distributions of SPs with respect to MPs, and that of SPs with respect to TAPs are logically connected. A simple, pre-theoretical intuition is that both phenomena are licensed when certain semantic conditions are met. However, the exact nature of these conditions, and how they compositionally interact, is still poorly understood. An interesting but understudied pattern can be defined as follows. If an SP can denote an atelic predicate, then it can occur in a sentence containing an MP. If an atelic SP and an MP are part of a sentence, then a TAP can only occur when it denotes a telic predicate. This subtle distributional pattern is shown in (7)-(9):

(7) #The car went ten meters to the park

---

[3]Our discussion of TAPs as inherently telic or atelic is slightly imprecise, as both TAPs and MPs can be seen as phrases that highlight the lexical aspect of an SP. However, this imprecision will allow us to better highlight how these parts of speech interact, with respect to aspect. We will solve this imprecision by sections 3 and 4, as well.

(8) The car went ten meters towards the park

(9) The car went ten meters towards the park in one hour/#for one hour

Examples (7)-(8) show that atelic *towards*, but not telic *to*, can occur when the MP *ten meters* occurs in a sentence. Example (9) shows that, once *towards* and *ten meters* occur in a sentence, then the intended interpretation is telic, instead. In fact, the TAP that can combine with the modified verb and SP unit is the telic *in one hour*, not the atelic *for one hour*. Previous works contemplate the emergence of this pattern; however, they leave for future research its exact description and account.

The goal of this paper is to address this empirical void, and offer a formal account of the novel data that also makes correct, systematic predictions about their distribution. We aim to reach this goal by studying the connections among these three syntactic categories (MPs, SPs and TAPs), and the relevance of this analysis for a compositional theory. Our contention is that, if we offer a correct analysis of these categories, then we can actually *predict* the observed patterns in (1)-(9), as the compositional result of the interpretation of these categories. Specifically, we aim to define a unified analysis of the lexical aspect properties shared by *ten meters, towards, in one hour* and other members of the three categories under discussion. From this unified analysis, we aim to show that standard assumptions about compositionality can predict which sentences including one more of these elements are interpretable, and which are not. Therefore, we will ultimately suggest that we can account these patterns by considering them a reflection of how these three categories can (or cannot) contribute to lexical aspect.

By aiming to reach this goal, we also wish to reach two related, specific subgoals. First, we wish to expand previous findings on SPs, and offer a more thorough analysis of their distributional patterns with respect to MPs and TAPs. Since these data seem to be still understudied, we think that our analysis can shed light on these patterns. Second, we wish to offer a formal treatment of these connections, and suggest that we can explain *why* these patterns occur via this formal treatment. Therefore, we also aim to shed light on how MPs, and in general measure expressions can contribute to lexical aspect, as suggested in the literature (e.g. Morzycki 2006, Zwarts 2008).The paper is organized as follows. Section 2 presents in more thorough detail the data at hand, and outlines the empirical *explananda* that we aim to account. Section 3 proposes a formal framework for our analysis, which is based on a fragment of type-logical syntax, with a situation semantics interpretation. Section 4 offers an analysis of the data, and section 5 offers the conclusions to the paper.

2   General background: Notions and Data

The goal of this section is to outline key notions about the semantics of SPs. We first discuss general notions and well-documented data about SPs (section 2.1). We then move onto a discussion of the novel data about this category, and its distribution with MPs and TAPs (section 2.2).

It is generally acknowledged that SPs denote a relation between a located entity, or *figure*, and a landmark object that defines a spatial "reference system", a *ground* (Talmy 1978, 2000). Furthermore, SPs are generally assumed to be partitioned in two basic categories: *locative* and *directional* SPs. Locative SPs denote a "static" relation between figure and ground, as the figure remains in one certain position over a given interval of time. Directional SPs denote a "dynamic" relation, instead, as in the case of *to* or *towards*. The figure is understood to reach, leave or occupy a certain set of changing positions, over an interval of time (Cresswell 1978, Jackendoff 1983, 1990, Wunderlich 1991, 1993, a.o.). Furthermore, locative SPs are usually divided into *non-projective* and *projective* SPs, with examples being respectively *at* and *behind* (Cresswell 1978, Zwarts 1997, a.o.). Examples that present these notions are (10)-(12):

(10) The man sits at the desk   (locative, non-projective SP)

(11) The man sits behind the desk   (locative, projective SP)

(12) The man has gone to the desk   (directional SP)

In (10)-(12), the definite phrase (DP) *the man* denotes the figure, while the DP *the desk* denotes the ground. The SPs *at, behind, to* denote the spatial relations that hold between figure and ground. Each SP denotes a distinct, specific spatial relation that holds between the figure and ground. For instance, *at* denotes a relation in which a given man is sitting close to the desk, although the specific position is not mentioned (Herskovits 1986: ch.4). Instead, *behind* denotes a relation in which this man sits in one position that is located on the depth axis of the desk, in its "negative" verse (Zwarts 1997). So, *to* denotes a relation in which the figure has reached the ground, after having moved in direction of this ground (Jackendoff, 1983, a.o.). Overall, SPs can be divided in a tri-partite, slightly asymmetric taxonomy, with respect to their semantic content.[4]

This tri-partite distinction plays a role in the discussion of MP modification. This topic has been investigated in detail in one line of research known as *Vector Space Semantics* (henceforth: VSS, Zwarts 1997, 2010, Zwarts & Winter 2000, Winter 2001, 2005, 2006, Morzycki 2006, Svenonius 2008, Bohnemeyer 2012). VSS has

---

[4]This distinction plays a role for SPs, when they receive their spatial (i.e. literal) meaning. Other uses, especially when aspect is taken in consideration, may involve different partitions of the semantic space (Fong 1997, 2001, Roy & Svenonius, 2009, Gehrke 2008, a.o.).

cross-categorial applications but, for SPs, it mostly focuses on the locative type, hence it does not cover the distribution of MPs with directional SPs. To underline the importance of this proposal, we briefly discuss its core assumptions. The proposal is based on the assumption that SPs denote three-place relations that include one implicit argument. The nature of this *implicit* argument can be illustrated via Zwarts & Winter (2000)'s analysis of the modification problem, via the examples in (13)-(16):

(13) The car is *right ten meters* in front of the house

(14) The car is *diagonally one hundred meters* behind the house

(15) The lamp is *approximately two* meters above the table

(16) The ball is *exactly one meter* below the table

Examples (13)-(16) show that projective SPs can occur when two distinct types of modifiers also occur, in a sentence. One type is that of MPs, e.g. *ten meters*, the other is that of direction- or distance-denoting adverbs, e.g. *right, diagonally, approximately*. As Zwarts & Winter (2000: 178-179) argue, these data suggest that SPs denote an implicit argument, much like verbs denote an implicit event argument (Parsons 1990, Landman 2000, a.o.). However, VSS differs from standard event semantics accounts on its main ontological claim. Since these types of modifiers denote properties based on length (*ten meters*) and direction (*diagonally*), they appear to identify a specific type of implicit argument: a *vector*. So, SPs are treated as denoting sets of vectors[5] that extend from the ground's boundaries to the figure, along a given axis (e.g. the positive, vertical for *above*). [6] Since we are mostly concerned with MPs, however, we leave aside a more thorough discussion of direction-denoting adverbs.

Within this framework, monotonicity is proposed to be the key property over the denotation of a constituent that licenses modification by MP. For instance, SPs such as *below* are modeled as denoting a set of vectors with a given orientation and variable lengths. If the values that fall in the range of this denotation form a monotonic and non-trivial scale, then modification can occur. Since *below* can denote any set of vectors that ranges from a minimal, non-null length, and up to infinity (i.e. This set is "unbounded"), it can occur with *one meter*. Hence, modification by MP is only possible when an SP is monotonic, and does not include trivial values (cf. also Winter 2006, Morzycki 2006).

---

[5]VSS actually treat these as *characteristic functions* for vectors, i.e. as relations with an unsaturated vector argument. This difference is not important, here.

[6]The use of vectors as model-theoretic objects captures an intuition that is implicit in the label "projective": SPs denote objects that can be oriented along an axis or projection. These details about labels are immaterial, since we employ a different semantics framework for our analysis.

Monotonicity, as much as it is an important property in our discussion, is not the only property that seems to be connected to our data. Two other mirror properties play a role in this distribution, and are connected to the *prepositional aspect* of an SP (Zwarts 2005: 699, see also Fong 1997, 2001, Zwarts 2008, Ramchand 2008, a.o.). For the sake of clarity, we centre our discussion on Zwarts (2005). This and other works mostly focus on directional SPs and do not investigate, at least not directly, the prepositional aspect of locative SPs. Nevertheless, the basic assumption behind this analysis is that directional SPs denote *paths*, oriented stretches of space that are taken as primitive model-theoretic entities. Verbs are taken to denote events, so an opportune 'trace function" maps paths and their structural properties onto the domain of events (Link 1998, Krifka 1998, a.o.). This analysis divides directional SPs in three sub-types, based on their distribution with TAPs: *telic*, *atelic*, and *ambiguous* SPs. We illustrate these three sub-types in examples (17)-(21):

(17) The man went to the park in one hour/#for one hour   (*to*, telic SP)
(18) The man went towards the park in one hour/for one hour   (*towards*, atelic SP)
(19) The train traveled along the the river in one hour/for one hour   (*along*, at.SP)
(20) The car went through the tunnel in one hour/for one hour   (*through*, amb. SP)
(21) The car went across the tunnel in one hour/for one hour   (*around*, amb. SP)

According to this analysis, these patterns can be accounted by assuming that atelic SPs have a specific property: they have a *cumulative* denotation (Krifka 1998, Landman 2000, Kratzer 2003, Ramchand 2008, a.o.). Cumulativity is standardly defined as a property of denotations that include not only basic (or "atomic") entities, but also their mereological sums: in this case, sums of paths. So, an SP such as to lacks a cumulative denotation: a path that is "to" the cave does not have sub-paths that also are "to" the cave. On the other hand, a "towards" path is a path that includes sub-paths that also qualify as "towards" paths. So, *towards* and *along* have a cumulative denotation. In the case of ambiguous SPs such as *through*, *around* and others, their ambiguity arises from the possibility that these SPs denote a "single" path with a certain direction or "shape". For instance, a "through" path that begins and ends outside the tunnel will not include sub-paths that also begin and end outside the tunnel. A "through" path that is also located entirely within the tunnel will include such purely internal sub-paths. So, a structural property of SPs' denotation seems to also play a relevant role in these patterns, although in a slightly different way than in MPs' case.

We now take some stock about the topics we have discussed so far. Our discussion highlights the following key aspects of the semantics of SPs. The distribution of SPs with both MPs and TAPs seems to require a semantic analysis that slices across the more standard taxonomies proposed for this category. Although

a distinction between directional and locative SPs is intuitively appealing, both distributional patterns also seem to revolve around more abstract or formal properties of these types. The distribution of SPs such as *above* with MPs such as *two meters*, and that of SPs with TAPs such as in *one hour* supports this claim. Both monotonicity and cumulativity, if defined over the lexical aspect contribution of these constituents, seem to be such properties. Hence, an adequate analysis of these patterns should be centered on the semantic properties of monotonicity and cumulativity, the two properties that are related to the semantics of MPs and TAPs. In the next section, we discuss a range of novel data that allows us to make this analysis more precise.

2.1 The Novel Data

The goal of this section coincides with our first main goal. We aim to present in detail the data about SPs and their distribution with MPs and TAPs, data that still need a more thorough discussion. We reach this goal in a two-steps sequence. First, we give a thorough presentation of the "missing" distributional data about MP and TAPs with SPs. Second, we discuss the interaction of these two forms of interaction, and suggest the existence of a red line running through these data. This discussion will pave the way for our formal analysis, offered in sections 3 and 4.

We move onto our first topic. The possibility that MPs can occur with both locative and directional SPs has been only briefly discussed in the literature (Piñon 1993, Morzycki 2006, Zwarts 2008). For this reason, we focus on presenting the relevant, understudied data in more detail. Two factors are crucial, in this discussion. First, as our initial data suggest (viz. (1)-(9)), MPs can occur as a type of direct argument of verbs, with SP phrases seemingly occurring as optional element within this phrase. Second, MPs can occur only with certain types of directional SPs, and with projective locative SPs. Importantly, this distribution slices across lexical aspect types: atelic and ambiguous SPs can occur with MPs, telic ones do not. We expand the data we presented in (7)-(9) (cf. Zwarts 2005:745 for a list of directional SPs):

(22) #The car went one kilometer to the park

(23) #The man walked one hundred meters into the park

(24) #The car moved one kilometer out of the park

(25) #The car moved one kilometer from the park

(26) The car went ten meters towards the park

(27) The car traveled one kilometer along the river

(28) The car moved one kilometer through the tunnel

(29) The car moved one kilometer around the city

Examples (22)-(25) show that telic SPs such as to, into, out of and from cannot occur with MPs such as ten meters, one hundred meters or one kilometer.[7] Although the contextually defined distance can be indeed ten meters/one kilometer in length, the MP cannot occur in this linguistic context. Examples (26)-(29) show instead that the two atelic SPs towards and along, as well the ambiguous through, around, can combine with MPs. In this case, the distributional contraposition that emerges is between of telic vs. non-telic SPs, as MPs only seem to occur with the second type. Instead, the distribution of MPs with locative SPs cuts this category into non-projective and projective SPs. To see this fact, consider the examples in (30)-(39):[8]

(30) #The man is sitting ten meters beside the desk

(31) #The man is sitting ten meters in the room

(32) #The man is sitting ten meters at the desk

(33) #The man is sitting ten meters on the desk

(34) #The man is sitting ten meters out of the pub

(35) The osprey is hovering ten meters above the cloud

(36) The man is sitting ten meters to the left of the desk

(37) The osprey is hovering ten meters under the cloud

(38) The man is sitting ten meters inside the cave

(39) The man is sitting ten meters outside the cave

Examples (30)-(34) show that the non-projective SPs *at*, *in*, *on* and *out of*, among others, do not combine with MPs. Instead, examples (35)-(39) show that projective SPs *above*, *to the left of*, *inside* among others can combine with MPs freely. One possible explanation to this distributional pattern can be found within VSS. According to the VSS analysis, projective SPs include a monotonicity property in their denotation that non-projective SPs lack (Winter 2001, 2005, Morzycki 2006). In certain cases, this property seems connected to the presence of a certain morphological pattern. While *in* and *out of* cannot occur with MPs, their projective counterparts *inside* and *outside* can do so. A similar pattern seems to occur

---

[7]We note that the precise status of *out of* and *from* as telic SPs is at times disputed (Fong 2008). However, our argument does not hinge on the precise list of SPs within either class, only on their semantic properties. So, we take a less fine-grained analysis of these SPs.

[8]In these and other locative examples, we use the progressive form of "posture" verbs to illustrate our patterns. Standard copular constructions (e.g. *is in front of the desk*) make the testing of the relevant facts impossible (cf. #is in front of the desk for one hour).

with *to* and *towards*, for directional SPs.[9] Furthermore, several but not all projective SPs include the "nominal" copula *of*, in their structure. So, certain SPs seem to "become" projective, modified elements when a certain type of head is explicitly realized.

One question that arises from the patterns in (22)-(39) is whether monotonicity and cumulativity/atelicity interact in a systematic way. This question also raises a second question: whether TAPs are sensible to these patterns. Although Morzycki (2006) suggests that this is the case, a full analysis of this connection must still be fleshed out. Proposals in this direction seem to exist, although they offer rather preliminary answers. For instance, some works have suggested that locative SPs include a semantic dimension of lexical aspect (Tortora 2005, 2008, Folli 2002, 2008). However, these works focus on Italian data, and do not offer a formally precise semantic analysis. Furthermore, it is also generally acknowledged that locative SPs are inherently atelic. However, the relevant patterns are seldom discussed in detail (Zwarts 2005: fn. 1, Zwarts 2008). The examples in (40)-(44) aim to address this latter problem, by explicitly show why this is the case:

(40) The man is sitting in the park #in one hour/for one hour

(41) The cat is napping under the table #in one hour/for one hour

(42) The man is sitting outside the office #in one hour/for one hour

(43) The man is sitting behind the desk #in one hour/for one hour

(44) The man is sitting in front of the desk #in one hour/for one hour

If we take our lexical aspect stance to (40)-(44), then it is obvious that locative SPs have an inherently cumulative denotation. Intuitively, since locative SPs do not involve any change of position over time, the duration of the underlying eventuality is not inherently "bounded", or limited. Overall, the combined data in (22)-(44) suggest that the distribution of SPs with MPs seems governed by certain cross-categorial properties. Specifically, monotonicity seems to play a crucial role for locative SPs and their distribution with MPs, while cumulativity seems to govern their distribution with TAPs. Furthermore, the two properties seem to interact, at least with respect to the distribution of directional SPs with both MPs and TAPs.

We will discuss the precise details in section 3, as certain aspects require a more careful analysis. For the moment being, we turn our attention to our second topic: the combined distribution of our three categories. Although most works suggest that there are convergences between the distribution of MPs and TAPs with respect to SPs, few if any of these works have specifically studied these con-

---

[9]We note that this pattern includes exceptions: *beside* and *out of* seem non-projective SPs, although their morphological structure is can be considered that of projective ones. We consider these idiosyncratic data, and leave them aside for the time being (cf. Culicover 1999: ch. 4).

vergences. For this purpose, we expand the set of relevant data that we introduced in (9), via the examples in (45)-(50):

(45) The car went one kilometer towards the park in one minute/#for one minute
(46) The car traveled 80 kilometers along the river in one hour/#for one hour
(47) The car traveled one kilometer through the tunnel in one hour/#for one hour
(48) The car went ten kilometers around the city in one hour/#for one hour
(49) The car traveled one kilometer via the channel in one hour/#for one hour
(50) The car went ten kilometers across the city in one hour/#for one hour

Examples (45)-(50) suggest that there is an asymmetric, syntactic *and* semantic relation between sentences that do not involve TAPs, and those that do so. The intuition behind this claim can be defined as follows. Let us compare these examples with their MP-less counterparts in (18)-(21). We can notice that, if these ambiguous SPs occur with MPs, then they lose their ambiguity. More precisely, the combination of an MP with an SP turns cumulative/ambiguous SPs into non-cumulative SPs. One example is the phrase *one kilometer towards the park*, but other examples follow this pattern as well. This seems to be the case, because only the telic *one hour* can combine with this complex phrase. Hence, this pattern indirectly suggests that the sentences in (26)-(29) *become* inherently telic via the occurrence of an MP. If a TAP is added to a sentence, then the telic/atelic reading can compositionally emerge. In other words, the patterns we observe in (45)-(50) seem to suggest that one type of distributional pattern, that of MPs such as *ten meters* with SPs, determines another type of distributional pattern, that of TAPs such as *in one hour*. Interestingly, when projective SPs are involved one more semantic pattern emerges. Take the examples in (51)-(55):

(51) The man is sitting one meter in front of the desk #in one hour/for one hour
(52) The man is sitting one meter to the left of the desk #in one hour/for one hour
(53) The man is sitting one meter to the right the desk #in one hour/for one hour
(54) The man is sitting one meter behind the desk #in one hour/for one hour
(55) The osprey is hovering ten meters above the cloud #in one hour/for one hour

These examples suggest that, although MPs can occur in sentences including locative SPs, their contribution is aspectually transparent. That is, whether *in front* of occurs with *ten meters* or not, it can only occur with *for one hour*. This fact suggests that the precise type of SPs also plays a part in the licensing of a TAP. Since structural/aspectual properties seem to determine the distributional patterns of MPs and TAPs, it is safe to conclude that such properties determine the distribution of SPs, too. Overall, the examples in (45)-(55) suggest that the distribution

of TAPs is sensible, for the most part, to the subtle semantic properties of the complex constituent that SP and MP form, which in turn acts as an argument of a verb. Both "geometrical" distinctions (i.e. locative vs. directional), and lexical aspect distinctions (telic vs. non-telic) play a role. So, our semantic properties seem to follow certain hierarchical, inherently compositional patterns of distribution.

Another set of data that highlights the distribution of MPs, TAPs and SPs, and their hierarchical distribution involves the distribution of locative SPs with a certain sub-type of verbs of motion. It is known that a class of verbs of *motion*, such as *swim* or *float*, can denote either "directed" or "located" motion (Talmy 1983, Fong 1997, Folli 2002, 2008, Gehrke 2008, a.o.). A less discussed aspect of this distribution is that projective SPs can occur with MPs and verbs denoting these two slightly different types of motion.[10] When this happens, TAPs can occur as well, but the interpretation that emerges as a result depends on the TAP that occurs in a sentence. We show some examples involving *swim* and *float* in examples (56)-(61):

(56) The canoe floated 50 meters inside the cave
(57) The canoe floated 50 meters inside the cave in one hour/for one hour
(58) The girl swam 50 meters below the bridge
(59) The girl swam 50 meters below the bridge in one hour/for one hour
(60) The canoe floated inside the cave in one hour/for one hour
(61) The girl swam below the bridge in one hour/for one hour

The sentence in (56) includes the verb *floated* and SP phrase *inside the cave*, and can furthermore include either the TAP *in one hour* or the TAP *for one hour*, as (57) shows. The same holds for the sentence in (58), which includes the verb *swam* and the SP phrase *below the bridge*: both TAPs can occur as well, as (59) shows. However, in both (56) and (58) the sentential-level interpretation is ambiguous with respect to lexical aspect. When a TAP occurs, only one possible interpretation becomes accessible. For instance, when *in one hour* occurs with f*loated 50 meters inside the cave*, the sentence has a telic reading: the canoe moved 50 meters by floating. When *for one hour* occurs with this verb and SP phrase, the sentence has an atelic reading: the canoe floated at a 50 meters' distance from e.g. the walls of the cave. Note that the same pattern emerges when MPs do not occur in a sentence but SPs and TAPs do, as discussed in previous literature (viz. also (60)-(61)). So, verbs add a further layer of complexity in the "computation" of lexical aspect, with respect to the distribution of MPs, SPs and TAPs.

Before we attempt to offer an analysis for this complex set of data, we summarize our discussion in this section, and outline how we reached our first goal.

---

[10]We thank an anonymous reviewer for bringing this topic to our attention, as we did not discuss it in a previous version of the paper.

Our discussion of the novel data in (22)-(61) suggests that the interplay of our three syntactic categories (four, if we include verbs) is quite subtle. MPs such as *one kilometer* can occur with projective (locative) and cumulative (directional) SPs (*in front of, through*; among others). MPs cannot occur with non-projective or non-cumulative SPs (at, to; respectively). The combination of a projective SP and an MP is inherently cumulative, regardless of the MP's contribution. So, only a cumulative TAP can occur with this complex constituent. For instance, *one meter in front of the desk* can only occur with the TAP *for one hour*, but not with the TAP in one hour. Furthermore, the combination of a cumulative directional SP and an MP becomes non-cumulative. Only an MP such as *one kilometer* can occur with an SP phrase such as *towards the park*, but not with a TAP such as *for one hour*. Directional and locative SPs, when they can occur with MPs, display different interactional properties with respect to TAPs. Furthermore, different types of verbs can occur with these three categories. Verbs that are ambiguous between a directed and a located motion interpretation may be disambiguated by TAPs as modifiers. When this happens, SPs and MPs may (or may not) contribute to the overall lexical aspect reading.

This synopsis of the distributional patterns suggests that we have reached our first goal, that of presenting a broader and more accurate picture of the connections among these three categories. As we can easily observe, these distributional patterns also suggest that the compositional, piece-meal interaction of our three target constituents (SPs, MPs, TAPs) follows a certain syntactic and semantic "order" of realization. Therefore, we can assume that, if we propose an appropriate formal analysis of these constituents and their properties, then we can *predict* how these distributional patterns can emerge, in a compositional way. This formalization represents our second goal, which we pursue in sections 3 and 4.

3   The Formal apparatus

In this section we offer our syntactic and semantic assumptions about our constituents that will pave the way for our account in section 4. Section 3.1 offers the syntactic account, in which we first suggest which the most appropriate structure is for our four categories, and then implement a derivational, categorial analysis. Section 3.2 offers a semantic account, in which we offer a theory-neutral interpretation of our categories and their interpretations.

3.1   The Formal Apparatus: Morpho-Syntax

The goal of this section is to offer a morpho-syntactic account of SPs, TAPs, MPs and verbs that paves the way for our semantic analysis. Given our semantic goals, we will mostly focus on two aspects. The first is to capture the syntactic structures of our examples, and how our target phrases are hierarchically combined. The second is to give a syntactic account that allows a transparent mapping

onto a compositional semantics.

3.1.1   Morpho-Syntax: The Structural Analysis

The goal of this section is to motivate our morpho-syntactic analysis. We start by providing a brief survey of current proposals on the structure of SPs. Classical works on the structure of this category contend that SPs can be decomposed into two distinct, hierarchically arranged heads, known as "Path" and "Place", or "Dir(ection)" and "Loc(ative)". Most works follow this structural analysis (van Riemsdjik 1978, 1990, Jackendoff 1983, 1990, Wunderlich 1991, 1993, Tortora 2005, 2008, Folli 2008, a.o), at times implementing different labels (Kracht 2002, 2004, 2008 a.o.). While this approach has been quite influential, recent research in the cartographic approach suggests that a more fine-grained analysis of SPs and their structure is possible. Such an analysis stems from one core assumption of cartography. The core assumption states that each identifiable morpheme in an SP can project its own (functional) head;[11] hence, that SPs can involve several heads or "positions". Several proposals exist, to this effect (Koopman 2000, Svenonius 2006, 2010, Asbury 2008, den Dikken 2010, Fábregas 2007, Pantcheva 2008, 2010, 2011, a.o.). However, to maintain the discussion clear, we discuss a relatively conservative version of the cartographic approach: den Dikken (2010) (cf. also Svenonius 2010). We present the classical analysis in (62), and this version of the cartographic approach in (63):

(62) $[_{DirP}[_{MP}$ ten meters $]$ to $[_{LocP}$ in front of $[_{DP}$ the table $]]]$

(63) $[_{DegP}$ [ten meters] $[_{DirP}$ to $[_{LocP}$ in $[_{Axpart}$ front $[_{KaseP}$ of $[_{DP}$ the car $]]]]]]$

The key differences between (62) and (63) can be defined as follows. In (63) we have three more heads or "positions". Two of these heads are "Axpart" and "Kase", which represent the specific projections of the morphemes *front* and *of*, part of the SP *in front of*. In the classical analysis, these morphemes are considered as forming a single lexical unit, hence projecting one head: "Loc", in (62). The "Deg" head that introduces the MP *ten meters*, in the cartographic approach, is considered part of the extended projection of an SP. Hence, it represents the third new head in (63). So, the cartographic approach offers a more fine-grained analysis on the morpho-syntax of SPs than the classical approach, although it builds over this approach to a good extent.

While classical and cartographic approaches share a certain theoretical continuity, other proposals on the structure of SPs take a different stance. One such

---

[11]We do not wish to investigate the complex question on whether SPs are a functional or a lexical category, since this fairly complex topic is orthogonal to our debate, and would lead us too far afield.

example is based on the "Lexical Syntax" framework, and its "P-within-P" hypothesis (Hale & Keyser 2002: ch.4, Mateu 2002, 2008). In Lexical Syntax, each morpheme can be associated to one of four types of heads, depending on how many argument phrases it can combine with (0, 1 or 2 arguments). Furthermore, Hale & Keyser (2002) only focus on the structural or abstract properties of lexical items; they do not employ a fine-grained analysis of morpho-syntactic categories. So, no specific labels such as "Dir(ectional)" or "Loc(ative)" are employed, only labels such as the abstract "P" for a head with two arguments. The "P-within-P" hypothesis builds on these assumptions, and is based on one further central assumption. One morpheme of an SP acts as the "main" head; the other SPs are attached as (morphological) segments or "internal" elements of this head. Interestingly, variants of the classical approach exist, that offer a similar analysis (Emonds 1985, 2000, Kayne 1994, 2004, van Riemsdijk & Huysbregts 2007, a.o.). We show the corresponding structures in (64)-(67):

(64) $[_{PP}[_P$ in-] -to $[_{XP}$ the car]] (Lexical Syntax)

(65) $[_{PP}[_P$ in-] -side $[_{XP}$ the car]] (Lexical Syntax)

(66) $[_{PP}[_P$ in front]] of $[_{XP}$ the car]] (Lexical Syntax)

(67) $[_{DirP}[_{Dir}[_{Loc}$ in-]] -to] $[_{DP}$ the car]]

The structures in (64)-(66) read as follows. The SPs *into, inside and in front of* are analysed as the combination of a relational head (e.g. *of, -side, -to*), and a possibly complex phrase/argument SP in specifier position (e.g. *in, in front*). The structure in (67) is based on van Riemsdijk & Huysbregts (2007), which analyses the "Loc" head as a segment of the "Dir" head. Overall, as the structures in (64)-(67) show, the subtle differences between these approaches and cartographic/classic ones correspond to the "position" in the clausal spine of each head, as well as their specific "quantity". The intuition that SPs involve a complex structure, however, runs across each approach, although in different formulations.

Before we choose which structure of SPs to adopt, we look at the structure of our MPs ad TAPs. Standard approaches on MPs consider this category as a *part* of the so-called "Degree Phrases" (Kennedy 1999, 2007, Morzycki 2005, 2006), such as *ten meters long*. MPs such as *ten meters* are treated as a variant of (quantified) DPs that sit in the specifier position of a silent Degree head. Instead, APs such as long are placed in the complement position of this head. The structure of TAPs has been less studied, although an uncontroversial claim is that it involves a prepositional head, and a DP argument (Morzycki 2004, 2005, a.o.). We show these structures in (68)-(69):

(68) $[_{MeaP}[_{DP}$ ten meters] (Mea) $[_{AP}$ long]]

(69) [$_{PP}$ for [$_{DP}$ one hour]]

The structures for the MP *ten meters long* and the TAP *for one hour* should be straightforward to read, keeping in mind that we represent our silent Degree phrase as "(Mea)". One crucial assumption that this analysis allows us to propose is that, if SPs are part of a sentence, then a Measure head takes an SP phrase as its complement phrase. We make this assumption for one simple reason. Certain locative phrases can appear as particle-like phrases (e.g. *in front, ahead*), in these and other cases of "argument demotion" (Svenonius 2010), and occur with MPs, viz. (70a)-(71a). In such a case, the resulting MP acts as a complement of a verb. Given these data, a simple account of their structure can be the one in (70b)-(71b):

(70)   a. Mario is sitting ten meters in front (of the car)

   b. [$_{MeaP}$[$_{DP}$ ten meters] (Mea) [$_{SP}$ in front]]

(71)   a. Mario is sitting ten meters behind (the car)

   b. [$_{MeaP}$[$_{DP}$ ten meters] (Mea) [$_{SP}$ behind]]

The simple analysis of *ten meters in front* and *ten meters behind* which we can offer via this assumption is shown in (70b) and (71b). Importantly, if we take this analysis of MPs, we must take Lexical Syntax as our framework of reference. The reason is as follows. In our discussion of the data, one element seems to play a key role in the overt expression of licensing patterns. As we have seen in examples (30)-(39), certain SPs such as *in* can combine with relational morphemes such as −*side*, the resulting SP (inside) being able to occur with an MP. The morphological features and semantic content of a head matter: *into* cannot combine with MPs, unlike −*side*. So, a single morphological unit seems to determine this licensing pattern, depending on whether this unit can in turn denote certain structural values or not. In other words, both *inside* and *into* seem to involve the combination of two morpheme into a larger unit, with one morpheme (-*to* or -*side*) determining if the SP can occur with an MP. Although this fact would not be easily captured (if at all) in a cartographic approach, it finds a natural explanation in a Lexical Syntax analysis. The interpretation of the "main" head of an SP determines this licensing pattern, as the data suggest.

Another important aspect is that the data in (70)-(71) seem to suggest that the "internal" SP forms a single unit: demotion cannot target segments of a word. So, we cannot have the string #in (*front of the car*): demotion, as instance of ellipsis, seems to target "word" units (Merchant 2001, 2004, Fábregas 2011, a.o.). Although this fact could find an explanation within cartographic approaches as well, it finds a more natural explanation in an analysis that assumes that SPs consist of only two lexical units. Simplifying matters somewhat, this approach predicts that, if a head

SP and its complement are demoted (here, *of the car*), then the "internal" SP acts as a complement of the verb. This analysis is not directly accessible in a cartographic approach, as we have just discussed: ruling out *in*, but not *in front*, would require *ad hoc* assumptions.

From these considerations, we can conclude that an optimal account for our data is one that divides SPs "only" in two lexical units, and takes the internal unit to be a phrase in its own right. Lexical Syntax is such an approach, as it allows us to offer the structural analysis for SPs, as shown in (72). We then assume that SPs combine with Measure heads s as phrases sitting in the head's complement, thus forming a phrase with the DPs such as *ten meters*. The resulting MP becomes the complement phrase of a verb, forming a minimal sentential structure, e.g. a VP such as *Mario is sitting ten meters in front of the desk* (cf. (51)). A TAP, then, modifies this whole sentence, something that we represent by having a VP sitting in specifier position of a silent "(M)" head, as standardly assumed (cf. Morzycki 2005: ch.1). This is shown in (73):

(72) $[_{SP}[_{LocP}$ in front] of $[_{DP}$ the desk]]

(73) $[_{M'}[_{VP}$ sitting[MeaP$[_{DP}$ ten meters](Mea)$[_{SP}$ in front of the...]](M')$[_{PP}$for$[_{DP}$one hour]]]

The simplified structure in (73) says that a phrase such as *ten meters in front of the desk*, from (51), has the following structure. A silent measure head, labelled "(Mea)", takes an SP phrase (*in front of the desk*) and a "measure" DP (*ten meters*) as arguments. A verb, in this case is *sitting*, takes this MeaP and a subject DP as arguments, to form a sentence, which we represent as a VP in (73).[12] A second silent head, "(M')" mediates the combination of this VP and the TAP *for one hour* into a larger M'P phrase. Note that the SP phrase *in front of the car* is in turn the combination of an SP *head of*, with a locative phrase *in front* and a ground DP *the car*, as shown in (72). As the structure indirectly suggests, the order of composition, when both MPs are present, is that of an MP being merged before a TAP. Intuitively, our syntactic analysis can now mirror the licensing semantic patterns that we discussed in previous section. Our choice appears germane for our semantic account, since it captures the fact that the distribution of TAPs is sensible to the distribution of MPs, SPs and verbs, to varying degrees.

After this discussion, a *caveat* is in order. Although we make a certain theoretical choice in our proposal, other solutions could be possible. To our understanding, an equally acceptable semantic analysis can be offered, which is based on the classical/cartographic approaches we discussed so far. However, a cartographic approach would make the exact implementation of our analysis quite more complex, and perhaps more cumbersome than the necessary, when this analysis

---

[12]As it should be obvious, we abstract away from offering an analysis on any sentence-based functional structure. Hence, our sentences correspond to full VPs.

is possible at all. We will discuss more technical problems of the cartographic approach in section 3.1.2 once we have our theoretical apparatus at our disposal. Overall, we feel that opting for a simpler approach the syntax-semantics interface is an important goal, for us. Among other things, it allows us to focus on the main head SP (e.g. *to*, *of*, *-side*) as the locus at which semantic properties are ascribed. However, we leave open the question on whether our simpler approach is also the best approach, for a general theory of SPs. Our main concern, from this point onwards, is that of accounting how the structures in (70)-(73) can be *derived*, hence paving the way for our semantic analysis.

3.1.2   Morpho-Syntax: Type-Logical Syntax and Derivations

The goal of this section is to show how our structures can be derived by combining ("merging") the relevant lexical items together. Specifically, we aim to show how our constituents are merged together in an ordered way, so that we can capture how our "asymmetric" distributional patterns can emerge, as a result. For this purpose, we adopt some kernel assumptions of a syntactic framework known as *type-logical calculi* (Jäger 2005, Moortgat 2010, 2011, Morryll 1994, 2011, a.o.). More thorough presentations of this framework and its theoretical connections to other frameworks within the minimalist programme (e.g. Distributed Morphology: Harbour 2007, Harley 2012; a.o.), can be found in Ursini (2011, 2013a,b,c), Ursini & Akagi (2013b). In this paper, we simply offer a more "compact" presentation of the framework that allows us to focus on our distributional data. Our assumptions are defined as follows.

In type-logical calculi, syntactic categories or types are represented as either "complete" or "incomplete". Complete *types* represent syntactic objects that can act as distinct, independent units. For instance, the type *np* is the type of noun phrases such as *the boy*, a syntactic unit that can be independently an argument of a verb. Incomplete categories must combine with other categories, to form a complete category. Under this assumption, an attributive adjective such as *tall* is assigned the type *np/np*. This means, for instance, that an adjective must combine with a noun phrase (e.g. *man*) in order to form a (more complex) noun phrase (*tall man*).

The slash symbol "/" represents the *Merge* operation (cf. Chomsky 1999: 2-4, Morryll 2011: ch. 1, a.o.). This connective represents Merge as a *binary*, *associative* and *idempotent* operation. These properties are defined as follows. First, this operator takes two units and their types and merges them into one unit/type (binary property). Second, the order of application is not crucial, as long as the sequence of combined types is preserved (associativity). Third, if two constituents of the same type are combined, then the result will yield the same type (idempotence).[13]

---

[13]Formally, a connective "∧" is binary iff: a^b=(a, b); associative iff: $(a^{\wedge}b)^{\wedge}c = a^{\wedge}(b^{\wedge}c)$; idem-

We will discuss the relevance of these properties when they will play a crucial role in our derivations.

As we are mostly concerned with basic syntactic derivations, we only implement the right-associative version of Merge, which we call *Merge right*. We leave aside the possibility that other categorial connectives and "directions" of Merge can (or must) be implemented, in our treatment. We also have a second reason for this choice. Recall that the MeaP that results from merging an SP and a "quantity" DP (e.g. *ten meters in front of the desk*) acts as an argument of a verb. The resulting phrase determines which type of TAP is merged, successively. In linear order terms, we can assume that for SPs, derivations seem to proceed "left-to-right". Furthermore, this assumption is in line with models of production that aim for psychological reality (Levelt 1989, Jarema & Libben 2007, see also Phillips 1997, 2003, 2006, for a non-type-logical, minimalist proposal). We take this as an appealing, though not crucial property for our approach; however, we will discuss which data seem support this approach, when relevant.

We then implement a view of types that is based on, but not identical with Hale & Keyser's (2002) theory of Lexical Syntax. Our main difference from their theory is as follows. We only assume one atomic type, from which the other three types are derived as incomplete types. We call this atomic type p, mnemonic for "phrase". Via the definition of Merge right and our basic type, we can define the closure set of recursive types in our analysis via the following set of rules:[14]

(74) 1. p *is a syntactic type*   (lexical type)
      2. *If x is a type and y is a type, then x/y is a type*   (type formation)
      3. *If x/y is a type and y is a type, then $(y/x)/x:=y$, $y/(y/x):=x$*   (type reduction)
      4. *Nothing else is a type*   (closure property)

The rules in (74) read as follows. Given the atomic ("lexical") type of arguments p (rule 1), then one can recursively construct more complex types as the "association" of two (more) basic types (rule 2). Conversely, if one merges a complex type with a simple type, the result will be a "lower" type (rule 3). No other combinatoric options are available (rule 4). These rules allow us to spell out a minimal set of types that we can assign to our lexical items, which is the set **TYPE={p, p/p, $p/p/p$}**. This rather basic type set allows us to define one fragment of typed constituents that we will employ in our derivations, which we present in (75):

---

potent iff: $a^\wedge a = a$. These specific properties are not crucial, here.

[14]For the sake of simplicity, we use the (definitional) identity symbol ":=" in our derivations, which reads as "is defined as" or also "results in", rather than the standard turn-style symbol "⊢". Nothing crucial hinges on this notational change.

(75) a. $p/p/p$::=*{of, to,-side, (Mea), (M), is sitting, swam}*

   b. p::=*{Mario, the canoe, ten meters ,one kilometre, the car, in front, in, in one hour, for one hour, 50 meters}*

As the type assignment in (75) shows, heads are assigned type $p/p/p$, since they can sequentially merge with two arguments of type p, and form a (complex) phrase of type p. Note that our phrases are all assigned the type p, because they always act as arguments of some other functional unit that acts as a head. No lexical items are assigned the type p/p, as this type plays a role in different types of data (e.g. adjunction) that are not relevant, here. Note, though, that we can obtain this type when we merge two items, so we include it in our type set. Our assignment is incomplete, in the sense that we do not assign a type to each constituent we discuss in our examples. For instance, we assign the type p to the DP *Mario*, hence taking a very simplified approach to DP structure. We also treat progressive and past verbal forms as a single (verbal) head (is *sitting*, *swam*). Furthermore, we do not analyse TAPs such as *in one hour*, directly assigning them the type of phrases. For our purposes, this simplification allows us to discuss the distribution of verbs with our three categories, without any loss of precision. Although a more accurate analysis is possible (cf. Ursini 2013b,c), this simple approach to verbs and TAPs will suffice, for our analysis of the data.

For our derivations, we define a simple *pre-order* as the pair of an interval set *I*, and an *addition* operation "+", i.e. $<I,+>$. This pre-order represents an *index set*, which in turn allows to represents the steps in a derivation as ordered elements. We introduce the operations *Lexical selection* (henceforth: LS) and *Merge introduction* (henceforth: MI), as operations that respectively select an item from the enumeration, and merge items together. We show how this derivational system works by offering a derivation for the MP *ten meters in front of the car*, in (76):

(76) t. [ten meters$_p$]   (LS)

   t+1. [(Mea)$_{p/p/p}$]   (LS)

   t+2. [ten meters$_p$]/[(Mea)$_{p/p/p}$]:=[$_{p/p}$[ten meters$p$] (Mea)$_{p/p/p}$]   (MI)

   t+3. [in front$_p$]   (LS)

   t+4. [$_{p/p}$[ten meters$_p$] (Mea)$_{p/p/p}$]]/[in front$_p$]:=
      [$_p$[ten meters$_p$] (Mea)$_{p/p/p}$ [in front$_p$]]   (MI)

   t+5. [of $_{p/p/p}$]   (LS)

   t+6. [$_p$[ten meters$_p$] (Mea)$_{p/p/p}$ [in front$_p$]]/[of$_{p/p/p}$]:=
      [$_p$[ten meters$_p$] (Mea)$_{p/p/p}$ [$_{p/p}$[in front$_p$]] of$_{p/p/p}$]   (MI)

   t+7. [the car$_p$]   (LS)

The derivation in (76) reads as follows. From step *t* to step *t*+3, the complex constituent *ten meters in front* is derived, as phrase (of type p). This phrase, together the with ground (DP) phrase *the car*, is merged with *of*, from derivational steps *t*+4 to *t*+8. The result of this derivation is the phrase *ten meters in front of*

the car, which can then act as the complement phrase of a verb, such as is *sitting*[15]. Once we have shown how this type of phrases is derived, we can offer a "compressed" derivation for (51), repeated in (77a) in its interpretable form (i.e. including the TAP *for one hour*):

(77)   a. The man is sitting one meter in front of the desk for one hour

      b. t. $[$ the man$_p]$ (LS)

           t+1. $[$ is sitting$_{p/p/p}]$ (LS)

           t+2. $[$ the man$_p]/[$ is sitting$_{p/p/p}] := [_{p/p}[$ the man$_p$ $]$ is sitting$_{p/p/p}]$ (MI)

           t+3. $[$ in front of the desk$_p]$ (LS)

           t+4. $[_{p/p}[$ the man$_p]$ is sitting$_{p/p/p}]/[$ in front of the desk$_p]:=$
               $[_p[$ the man$_p]$ is sitting$_{p/p/p}[$ in front of the desk$_p]$ (MI)

           t+5. $[$ (Mod)$_{p/p/p}]$ (LS)

           t+6. $[$ the man…desk$_p]/[$ $(Mod)_{p/p/p}]:=[_{p/p}[$ the man…desk$_p]$(Mod)$_{p/p/p}]$ (MI)

           t+7. $[$ for one hour$_p]$ (LS)

           t+8. $[_{p/p}[$the man…desk$_p]$ (Mod)$_{p/p/p}]/[$for one hour$_p]:=$
               $[_p[$ the man…desk$_p]$(Mod)$_{p/p/p}[$for one hour$_p]]$ (MI)

This derivation reads as follows. From the steps *t* to *t*+4, the "partial" sentence *the man is sitting one meter in front of the desk* is derived, although in a rather compressed format. Steps *t*+5 to *t*+8 show how this sentence can be then modified by the TAP *in one hour*: a silent head, "(Mod)", takes the whole sentence (here, a VP) as its specifier phrase, and the TAP as its complement phrase. Note that we use elliptical forms (… *desk*) to simply maintain a certain compactness for our derivational steps. As a result, we are now able to capture standard structural analyses of this type of modification (Dowty 1979, 1989, Morzycki 2005; a.o.) via our more "dynamic" derivational system. Importantly, these derivations also show that a cartographic analysis would run into trouble. If we would treat each morpheme as a head of type $p/p/p$, even the merge of *in front* with *of* would case a type mismatch, which would need quite complex assumptions, for the derivation to proceed successfully. Our approach avoids this problem in a rather straightforward manner, and paves the way for our semantic approach. However, before we move to semantic matters, we offer some considerations on our derivations and the results they bring about.[16]

---

[15]This derivation also shows that our operation MI seems to "remove" structure, rather than introduce it: the type of the merged constituents is simpler than its input types. In this regard, our operation seems closer in purpose to "elimination" operations in TL calculi (cf. Morryll 2011: ch.1). However, we prefer the label "Merge Introduction", as it highlights that that a structure-building operation is introduced in a derivation and "introduces" a new constituent in the derivational space.

[16]Note: *of* and *the car* merge with *in front*, rather than with *the ten meters in front*, as we assume *of* takes a spatial phrase as its specifier. In this case, the *co-application* principle allows Merge to access the "smaller" phrase as a type input for the new head. The head of, of type $p_n/p/p$, can access the phrase *in front*, of type $p:=(p/p)/p_n$. Their Merge amounts to:

The goals of introducing this formal apparatus for syntactic derivations are two-fold. First, via our categorial approach, we can easily represent that both *ten meters* and *in front* are constituents that can act as independent phrases, as well as merge into a complex phrase (i.e. a MeaP). To an extent, our formalism allows to represent these lexical properties in a more transparent way than "standard" approaches. Second, via this format we can offer a more precise, hierarchically accurate treatment of our distributional data. In doing so, we can capture the observed semantic patterns as well. The intuition is that, by assuming that the precise semantic interpretation of a constituent is derived from its syntactic status, we can offer a systematic account of our distributional data. In particular, we will show that the distributional relation that holds between e.g. *ten meters*, *in front* and *for one hour* is result of the logical relations between heads. The same holds for verbs, in cases such as *swim* and *float*. To achieve this result, we move to our presentation of the semantic apparatus.

3.2   The Formal Apparatus: Situation Semantics

The goal of this section is to present the formal semantic assumptions that we employ in our analysis, and connect these assumptions to our syntactic model. From this integrated approach, we will offer our analysis and formalisation of the data in section 4, thus explaining how our derivational approach can predict our data.

We start from our ontological assumptions. Within the literature on SPs, there are several distinct assumptions on the ontological status of the implicit set of referents in the denotation of SPs. Several works differ from VSS, since they contend that locative SPs denote regions of Euclidean space (Wunderlich 1991, 1993, Asher & Sablayrolles 1995, Nam 1995, Krifka 1998, Kracht 2002, 2004, 2008, Maillat 2001, a.o.). Although it is possible to derive the notion of non-oriented region with that of oriented vector, such proposals are nevertheless technically distinct from VSS, on ontological matters. However, most if not all geometry-oriented works contend that directional SPs denote paths, seen as sequences of temporally connected regions or indexed vectors. So, the differences in assumptions among geometrical frameworks are quite subtle.

A different approach emerges in works that focus on the aspectual contribution of SPs. Some recent and not so recent proposals contend that SPs denote eventualities of some sort (Parsons 1990, Fong 1997, 2008, Kratzer 2003, a.o.). Hence, they liken SPs to verbs, and offer treatments parallel to those for verbs in event semantics (Parsons 1990, Landman 2000, 2004, Rothstein 2004, a.o.). Furthermore,

---

$(p/p)/p_n/p_n/(p/p)=(p/p)/(p/p)=p/p$, via one application of the so-called "cut rule" (Jäger 2005: ch.1, a.o.). In words, *of* merges with *in front*, forms the SP element *in front of*, and becomes part of a larger phrase (i.e. *the man is sitting ten meters in front*). See Moortgat (2010: ch. 2, 2011: § 2) for further discussion.

certain works suggest that directional SPs could denote paths, taken as a basic model-theoretic type of object (Link 1998, Krifka 1998, Zwarts 2005, 2008). Such paths, in turn, can be mapped onto the domain of events, belonging in turn to the verbal domain, via an opportune homomorphism (a "trace-function"). Hence, a tight connection between different semantic domains is part and parcel of these approaches.

Whether these ontological differences are conspicuous or not, a certain thin red line can be established among those works. One important aspect of our discussion so far can be defined as follows. Since we are concerned with distance-denoting MeaPs, tense/aspect denoting TAPs and their semantic interaction with SPs, we should ideally opt for a simple, homogeneous approach to ontological matters. This approach would furthermore mirror our syntactic commitments to a single atomic type, from which more complex types are recursively defined. Hence, the implementation of a simple semantic ontology allows us to define a transparent mapping between the two derivational levels.

For these reasons, we assume that all of our constituents denote *situations*, which can act as implicit or explicit referents, and which all belong to a general *set of situations*. We assume that the set of Situations is a partially ordered set that includes an empty situation as well (i.e. it forms a *Boolean algebra*: Keenan & Faltz 1985, Landman 1991, Szabolczi 1997, a.o.). Event semantics theories which also treat events as partially ordered domains are ontologically equivalent to our proposal, so we will not discuss them here (cf. Landman 2000). Hence, we assume that situations can include different *sub-types*, non-overlapping but partially ordered sub-sets of e.g. spatio-temporal or "human" referents (Barwise & Perry 1999, Kratzer 1989, 2007, Asher 2011 for a related proposal). Therefore, we maintain a simple semantic analysis, while at the same time remaining neutral on the precise ontological status of spatio-temporal situations, i.e. whether they are regions, vectors, and so on.

We turn to formal definitions. We represent this domain as the set S, of which we study the sub-type S' of spatial referents. The set S' includes a denumerably infinite set of elements (i.e. we have $S'=\{s,r,t,\ v\ldots,z\}$). We use "Quine's innovation", and assume that singleton sets represent *atomic* situations (i.e. s stands for $\{s\}$, see e.g. Schwarzschild 1996: ch.1), while complex sets represent *sum* situations (e.g. $\{\{s\},\{g\}\}$). So, all referents are represented as sets, which may or may not include distinct parts or sub-sets. Again, we also include the empty set $\{\varnothing\}$, so our structure is a full *Boolean algebra*, rather than a *Mereology*, a bottom-less (no empty set) structure. These definitions allow us to define both the possible *semantic type* set for our structure, and the types of semantic relations defined over this structure. We start by recursively defining the smallest semantic type set for this structure in (78):

(78) 1. *a is a semantic type*   (lexical type)
      2. *If a is a type and b is a type, then <a,b> is a type*   (functional type)
      3. *If <a,b> is a type and <b> is a type, then <a,b>/<a>=<b>*   (f. application)
      4. *Nothing else is a type*   (closure property)

The set of types generated by this definition is the set *TYPE = {<s>, <s,s >, <s,<s,s >}*. No (semantic) objects more complex than relations can exist (type *<s,<s,s> >*: Landman 1991: ch. 2-3), since we have one basic lexical type and one rule to build up complex types. The other two types are those of referents (type *<s>*), and functions, or one-place predicates (type *<s,s>*), which are obtained during our derivations, but not directly assigned to any items. Our third definition gives us *function application* as a rule to "simplify" types. It says what is the type of the constituent that corresponds to the Merge of two constituents (e.g. *<s>* from *<s,s>* and *<s>*).

The function application and the closure definition capture the intuition that all operations and relations on situations define an *automorphism.* They are defined over referents belonging to the same set of situations, and nothing else. We note that our types do not "end in *t*", as we represent relations as *structured* situations. Structured situations are situations with proper parts, and situations that include relations between these parts (e.g. Barwise & Etchemendy 1990, Barwise & Seligman 1997). So, they have the same type of "simple" situations, rather than that of truth-values. Hence, we leave aside the *t* type, as it is not necessary for our exposition.

We then implement a simple form of *λ-calculus* to define our basic meanings, and their ability to combine with other meanings, as per standard assumptions (Gamut, 1991). Since we are working with a Boolean Algebra as our structure of choice, we can define one basic relation over elements of the domain: the *part-of* relation. This relation is usually represented as "$a \leq b$", which reads: "a is part of b". The following properties hold: if a is part of b, then $a \cap b = a$ and $a \cup b = b$. In words, if a situation is part of another situation, then their union will be the "bigger" situation, and their intersection the "smaller" situation. Note that, as we implement Quine's innovation for our situations, the differences between mereological sum (product) and set union (intersection) are trascurable. So, we can conflate them in our discussion. For practical reasons, we will use a prefixed notation for this relation, i.e. P(a,b).

This basic assumption allows us to represent complex situations as relations: "$\lambda x.\lambda y.s:P(x,y)$". This reads: a complex situation is defined as a part-of relation P between two basic relations, e.g. a situation representing a ground, and one representing a distance. The intuition we pursue here is an extension of basic assumptions about the semantics of degrees (Kennedy 1999, 2007, Morzycki 2005, 2006, a.o.). Degree heads, *qua* heads with a relational structure and semantics,

denote relations whose precise content is specified by the specific lexical content of each head. However, a core partial ordering/part-of relation meaning can be assigned to each head, on which more specific properties such as cumulativity or monotonicity can be ascribed to. We will make this aspect precise in section 3, however.

We now define the relation between our syntactic and semantic types. We assume that the following *isomorphism* is defined, as a general instance of the *interpretation function*. When two units are merged, function application and λ-conversion applies, The result is a unit of "lower" type. So, the result of merging a unit with two p units is a Phrase, of a "recursive" p type, that denotes a *structured situation* $<s>$. We illustrate this mapping between morpho-syntax and semantics in (79):

(79) MORPHO-SYNTAX$\Rightarrow$SEMANTICS$\Rightarrow$INTERPRETATION

$$p/p/p \Rightarrow <s<s,s>> \Rightarrow \lambda x.\lambda y.s{:}P(x,y)$$
$$p \Rightarrow <s> \Rightarrow s,\ s{:}P(x,y)$$
$$p/p \Rightarrow <s,s> \Rightarrow \lambda y.s{:}P(c,y)$$

The mapping in (79) says that each of our morpho-syntactic types has a matching semantic type. While heads of type $p/p/p$ denote relations as complex situations, phrases of type p denote situations, which can be atomic or structured. Hence, the type p is mapped onto the type *<s>* in both cases. Since we define all our morpho-syntactic types as built out of a basic type (i.e. p) in one recursive fashion, the semantic types follow this principle too[17], as they are built on the basic type *<s>*. Partially reduced items, of type p/p, are mapped onto 1-places functions, of type *<s,s>*. As in (75), we limit ourselves to heads and arguments, as they are the only basic types that we employ in our derivations.

This principled mapping between morpho-syntax and semantics is a natural and appealing property of our categorial approach. The type of interpretations we assign to each unit, instead, bear a strong resemblance to classical situation semantics approaches (Barwise & Etchemendy 1990, Ginzburg 2005, Kratzer 2007, a.o.). Intuitively, via this approach we can capture the intuition that different constituents can be arguments of verbs (e.g. *ten meters*, *in front*, *in front of the car*). As we are going to see in the next section, via this approach we can also see how the "composition" of the meanings of the relevant elements determines which strings are interpretable, and which are not. However, this mapping must be enriched with a specific treatment of the semantics of our key constituents: MPs, SPs and TAPs. This is the goal of section 4.

---

[17]Other proposals take a similar stance to structured model-theoretic objects. Examples are structured meanings (Winter 1995), properties (Chierchia & Turner 1988), among others.

4 The Analysis

The goal of this section coincides with our second goal: that of bringing together the analysis of the data in (1)-(61) with our formal apparatus. In pursuing this goal, we aim to turn our distributional observations into predictions of our interpreted type-logical calculus. Our strategy is simple. We show that, if we adapt the lexical semantic properties of our key constituents to our framework and exploit our fully compositional calculus, we can *derive* the distributional patterns discussed so far. We divide our discussion in two sections of asymmetric length. We first present our specific assumptions about the interpretation of our lexical items (section 4.1). We then discuss how our analysis can compositionally derive the data observed in (1)-(61) (section 4.2), by offering some derivations of selected examples. We discuss our results, and how they are connected to the previous literature, before we conclude (section 4.3).

4.1 The Analysis: Basic Assumptions

We start by analysing the key semantic notions that we will employ in our analysis. Before we do so, we must offer a *proviso*. Although we follow standard approaches in the literature for our definitions (e.g. Krifka 1989, 1998, Winter 2005, Zwarts 2005), we take a somewhat simplified stance to these definitions. For instance, Krifka (1998) analyses in detail several types of semantic structures and how these structures can be telic or cumulative. In our approach, we take only some central definitions for our key properties, because our main concern is to show that the compositional combination of these key properties derives the observed interpretations. In this way, we can better concentrate on showing why, for instance, only the telic TAP *in one hour* can occur with the Measure phrase *ten meters in front of the car*, and so on.

We formally introduce two key properties for our analysis: cumulativity and monotonicity. Importantly, we assume that cumulativity can take two similar but distinct incarnations, depending on whether it is defined over locative or directional SPs. Our reason is as follows. An obvious difference between directional and locative SPs is that directional SPs denote model-theoretic objects that are ordered along one dimension, we call this property (relation) "precedence", a notion we will make precise in a few paragraphs. Intuitively, a figure that moves "to" a ground will cover a certain ordered set of positions over time: roughly, one situation will precede some other situation. Such an ordering is absent in a case in which a figure is instead located "in front" of a ground. So, we must represent this subtle semantic distinction in our formalization. Note that we leave open the possibility that an SP (or a verb, as we will see) can be ambiguous between a locative and a directional reading. Again, in this we follow much literature on the topic (Gehrke 2008, Zwarts 2008, a.o.). However, we will treat these two readings as

corresponding to two distinct and mutually exclusive versions of cumulativity.

Aside this distinction, we must also capture the fact that both projective and "atelic" SPs can have cumulative denotations. A way to capture these distinctions is the following. We can assume that cumulativity for directional SPs includes a "precedence" or "concatenation" property. This is a standard assumption, in approaches that look at the semantic structures of paths (Krifka 1998, Zwarts 2005, 2008, Ramchand & Tungseth 2006, Tungseth 2006, a.o.). So, to capture this aspect in our situation-based approach, and show how it is related to our distributional patterns, we make a distinction among two types of cumulativity: one for locative SPs, one for directional SPs. While we maintain the label "cumulativity" for the first notion, we introduce the theory-neutral label of *asymmetric cumulativity* (henceforth: A-cumulativity) for the second type.

A fourth, mirror notion is that of non-cumulativity/telicity, which plays a complementary role to that of cumulativity but, importantly, not to A-cumulativity. Telicity can be represented by explicitly stating that the situations in the denotation of a predicate do not stand in the part-of relation (Krifka 1998, see also Harbour 2007). These properties, *qua* properties of predicates, can be represented in a compact manner as *logical operators* defined over predicates, in turn defined over our structured situations. Operators can be seen the interpretation of abstract morphological features of the heads they are associated to. This is also a standard assumption in other minimalist frameworks (e.g. Distributed Morphology: Harbour 2007, Harley 2012, a.o.).[18] We offer the definitions of these four properties, as operators on situations, in (80)-(83):

(80) $CUMs{:}X(s) \Leftrightarrow \exists s'\exists s[X(s')\wedge X(s)\wedge s'{\neq}s\wedge\forall s'\forall s(X(s')\wedge X(s) \rightarrow X(s'{\oplus}s)]$

(81) $A\text{-}Cs{:}X(s) \Leftrightarrow \exists s'\exists s[X(s')\wedge X(s)\wedge s'{\neq}s\wedge\forall s'\forall s(X(s')\wedge X(s) \rightarrow X(s'{\oplus}s)\wedge(s'{<_{pc}}s\vee s{<_{pc}}s')]$

(82) $MONs{:}X(s) \Leftrightarrow s'{\leq}s \rightarrow X(s') \leq X(s)$

(83) $TELs{:}X(s) \Leftrightarrow \forall s'\forall s(X(s')\wedge X(s)) \rightarrow \neg s'{\leq}s$

The definitions in (80)-(83) read in prose as follows. If a predicate *X* is cumulative and non-empty, then for all the distinct situations in its denotation, their mereological sum will also be in the denotation of this predicate (cf. (80)). In our Boolean algebra approach, the mereological sum $s'{\oplus}s$ of two situations *s'* and *s* corresponds to a sum situation, call it *s"*. If a predicate is cumulative and asymmetric, in the sense that it denotes a set of directed situations, then one situation precedes the

---

[18]There are two ways to assign types to morphological features, in our system. One is by introducing a second operator, "•" (Product), that "bundles" features as single types (we have p•p: Jäger 2005, Morryll 2011). Another is to consider features as modifier-like elements, of type p/p, that are applied to heads in a sequential form (i.e. we have $((p/(p/p))/(p/p)=p)$ We are implicitly following the second approach, as it avoids introducing a second operator for our morpho-syntactic types. See, however, Ursini & Akagi (2013a) for a more thorough discussion

other (cf. (81)). A-cumulativity imposes a strict ordering on the situations of a predicate, whether these are simple or structured/sum situations. Similarly, a predicate X is monotonic if, given a part-of relation defined over a set of situations, the predicate preserves this monotonic relation (cf. (82)). For commodity, we restrict ourselves to upward monotonicity, in our definition. Instead, a predicate X is telic when it lacks proper parts that also belong to the denotation of the predicate under discussion (cf. (83)). According to this definition, then, telicity is akin to atomicity, in the sense that telic predicates denote atomic situations (cf. Krifka 1998, Zwarts 2005, Harbour 2007; a.o.).

The linguistic import of these properties can be defined as follows. Cumulativity says that for all the distinct paths (as situations) that are "towards" a house, then their sum will be "towards" this house. Asymmetric cumulativity is represented via the disjointed conditions *s'<s* and *s<s'*, which in turn represent the fact that, for instance, the concatenation of two "towards" paths must come in a certain order. The relation "$<_{pc}$" stands for the "precedence" relation which, simplifying matters somewhat, says that one element precedes another element, in a given (ordered) domain (Krifka 1998: 204). Monotonicity, instead, works as follows. Take two situations that are partially ordered, and are both in the denotation of an "in front" predicate. If this is the case, then one "in front" situation will be part of another "in front" situation. Instead, if a predicate is telic, then the situations in its denotation will not possibly stand in the part-of relation. A path/situation that is "to" the house" cannot be part of another path that is also "to" the house. Conversely, two paths that are "towards" the house can be combined into a longer "towards" path, and related via a precedence relation, which represents their internal linear order.

An important consequence of these definitions is that they allow how to show why these properties stand in certain semantic relations. From (80) and (81), we can deduce that an A-cumulative predicate is also monotonic, but also that the monotonicity of a cumulative predicate can be derived. This is the case, because the existence of sum situations in the denotation of a predicate *(X(s'⊕s))* entails that a part-of relation between these situations can be defined. Simplifying matters somewhat, if a predicate has cumulative denotation, then for all the situations *s, s', s"* we can assume that the relation $X(s) \leq X(s' \oplus s")$ holds, as $s \leq s' \oplus s"$ holds, too. Furthermore, from (80), (81) and (82) we can deduce[19] that cumulativity can be defined as the inverse relation of telicity, since telicity lacks a partial order that (indirectly) defines cumulativity. A-cumulativity and telicity share a different relation, but we defer a discussion of the precise details to our discussion of a case in which these properties interact.

---

[19] A formal discussion (and proof) of these relations can be found in Krifka (1998), among others. We do not discuss this aspect here, as we think that it would make the prose too cumbersome.

We will discuss the actual linguistic realizations of these properties via the derivations of some examples. Now, we can offer an interpretation of our lexical items based on our type assignments, and from which we can show how we can derive the interpretation of our examples. Some sample interpretations are shown in (84). Elements in the a.-list are of type *<s,<s,s> >*, items in the (b)-list are type *<s>*:

(84)   a. $[[of]]:=\lambda x.\lambda y.MONs:\boldsymbol{P'}(x,y)$, $[[(P)]]=\lambda x.\lambda y.MONs:\boldsymbol{P'}(x,y)$,
            $[[at]]:= \lambda x.\lambda y.\boldsymbol{MONs:P'}(x,y)$, $[[to]]=\lambda x.\lambda y.TELs:\boldsymbol{to'}(x,y)$,
            $[[\boldsymbol{-side}]]:=\lambda x.\lambda y.CUMs:side'(x,y)$, $[[(D)]]=\lambda x.\lambda y.A\text{-}CUMs:\boldsymbol{P'}(x,y)$,
            $[[(Mea)]]:=\lambda x.\lambda y.MONs:\boldsymbol{Mea'}(x,y)$, $[[(M)]]:=\lambda x.\lambda y.s:(x\wedge y)$
            $[[float]]=\lambda x.\lambda y.\pm A\text{-}CUMs:\boldsymbol{float'}(x,y)$, $[[is sitting]]=\lambda x.\lambda y.CUMs:sit'(x,y)$

        b. $[[in front]]:=in\text{-}fr$, $[[in]]:=in$, $[[above]]:=ab$, $[[along]]:=al$,
            $[[the car]]:=c$, $[[the park]]:=p$, $[[the river]]:=r$, $[[the cloud]]:=cl$,
            $[[the canoe]]=cn$, $[[ten meters]]:=10\text{-}mt$, $[[one hundred meters]]:=100\text{-}m$,
            $[[50 meters]]:=50\text{-}m$, $[[one kilometer]]:=1\text{-}km$,
            $[[in one hour]]:=TELs:\boldsymbol{one\text{-}H'}(s)$, $[[for one hour]]:=CUMs:\boldsymbol{one\text{-}H'}(s)$

In prose, each head denotes a part-of (monotonic) relation that can combine with two arguments, and form a structured situation as a result. This structured situation is then specified with respect to a structural property, whether this property is monotonicity, telicity or cumulativity. So, the specific interpretation of each head depends on whether it has the asymmetric cumulative property or not, such as silent *D* heads (for "Directional"), or Projective heads *P*. Furthermore, each head can carry its own specific lexical content. For instance, the denotations of the verbs *float* and *is sitting* represent this lexical content as a property that identifies the type of situation under discussion. A similar consideration applies to our SPs and TAPs, as the translations show. Note that, in our translations, we abstract away from both temporal and (grammatical) aspect morphology of verbs, as we do not offer an interpretation for past and progressive morphemes. To the best of our understanding, this aspect is not crucial, for the correct analysis of our data.

One important aspect of our translations for verbs is that we represent the semantic ambiguity of verbs such as *float* and *swam* (i.e. directed vs. located motion) as a rather simplified form of *lexical underspecification* (Poesio 2001: ch.4, Harbour 2007, Egg 2011, Ursini 2013c, a.o.). For instance, *float* is represented as either denoting an A-cumulative or not A-cumulative sequence of situations: that is, a directed or non-directed (located) structured situation. The symbol "±" represents that the interpretation of this verb is the set-theoretical union of these two possible (and disjointed) readings: *CUM* and *A-CUM*, or more accurately a cumulative and an a-cumulative reading. Note that, although A-cumulativity is not the exact complementary property of cumulativity, this notation will make our analysis easier to read. We defer to the next section an explanation of how this form

of underspecification is solved.

Other important aspects of our translations pertain to the translations we offer for SPs and other heads. For instance, while we assume that *of* denotes the part-of relation, we take that other heads such as *to* or *−side* (as in *inside*) differ in the specific type of relation they denote. Note that our head *M*, the head that allows the combination of a complex phrase with the TAPs *in/for X time*, has a conjunctive semantics.[20] We take this to be a fairly uncontroversial assumption, as it parallels standard treatments of adverbs, from a semantic perspective (cf. Morzycki 2005: ch.1). Our minimal change consists in having a relational element, rather than an adjunct-like element, to capture this interpretation. Again, we show how this assumption derives the relevant interpretation in the next section.

One distinction that we think being relevant for our analysis, based on the VSS approach, is that between non-projective and projective SPs. The main semantic difference between these two categories is that non-projective SPs lack a specific orientation for set of vectors they denote. Informally, the vectors in the denotation of *at* do not form a scale with respect to a given length and dimension (Zwarts & Winter 2000: 181, Bohnemeyer 2012). In our approach, this is captured as a property that we label as "$\neg MON$", and that represents the lack of an ordering over the situations within the denotation of *at*. This is in part inaccurate, as *at* seems to denote a structured, although not "ordered" set of situations (Nam 1995, Zwarts 2010, Ursini & Akagi 2013a for experimental evidence). For our purposes, an analysis of this lack of internal "order" seems to correctly capture the semantic difference between this non-projective SP and other projective SPs (e.g. *in front of*, *above*). More importantly, it suffices to offer an analysis of the distributional patterns that we are going to discuss next.

4.2 The Analysis: The Derivational Data

We now show how and why our analysis can actually predict the data we have discussed so far. We do by directly offering *interpreted* versions of the basic syntactic derivations discussed in (76)-(77). Intuitively, while each sentence can receive the same type of syntactic derivation, the semantic interpretation of each specific sentence will determine the specific result of this interpretive process. For this reason, we do not explicitly represent Merge, but rather use brackets to mark arguments as opposed to relations. We then state the semantic types of lexical items and the operation involved, which is either *interpretation* (henceforth: Int) or *function application* (henceforth: FA), respectively the semantic counterparts of Lexical selection and Merge. We start by offering a derivation of our example (23), repeated here as (85):

---

[20]In our mereological approach, conjunction "$\wedge$" and set intersection "$\cap$" are semantically equivalent. We maintain this distinction to better highlight the semantic contribution of TAPs.

(85)   a. #The man walked one hundred meters into the park

   b. *t.*   [[one hundred meters]]:=*100-m*,   (type *<s>*, Int)
   t+1. [[(Mea)]]:=$\lambda x.\lambda y.MONs$:***Mea'****(x,y)*   (type *<s,<s,s»*, Int)
   t+2. ([[one hundred meters]])[[(Mea)]]:=
         *(100-m)$\lambda x.\lambda y.MONs$:**Mea'***(x,y) = $\lambda y.MONs$:**Mea'***(100-m,y)*   (type *<s,s>* FA)
   t+3. [[in]]:=*in*   (type *<s>*, Int)
   t+4. [[one hundred meters (Mea)]]([[in]]):=
         $\lambda y.MONs$:***Mea'****(100-m,y)(in)=MONs:**Mea'***(100m,in)*   (type *<s>*, FA)
   t+5. [[to]]:=$\lambda x.\lambda y.TELs$:***to'****(x,y)*   (type *<s,<s,s»*, Int)
   t+6. ([[one hundred meters (Mea) in]])[[to]]:=
         (MONs:Mea' (100-t,in)) $\lambda x.\lambda y.TELs$' :to' (x,y) =
         $\lambda y.MONs$:Mea'(100-m, TELs':to'(in,y))= # (result unint., derivation crashes)

The reason for the derivation crashing is simple. Telicity is defined as the lack of a part-of relation between situations (i.e. ($\neg s'\leq s$)), so a telic predicate cannot become part of a predicate that, in turn, is ordered via a part-of relation (i.e. $s'\leq s$). If we employ explicit structural relations rather than their implicit operator counterparts, we have $s\leq\neg(s''\leq s')$ as our situation structure for (85). This structure reads: there is a situation that should lack proper parts (the negated part), but these missing proper parts have parts on their own.[21] This paradoxical relation is, of course, not a possible object if our model of discourse, *unless* we take the involved situations to correspond to the empty set {ø}. So, we correctly rule out that MPs such as *one hundred meters*, *ten meters* can combine with telic SPs such as to, into and so on. Therefore, our account can now *predict* the data in (22)-(25), by (correctly) deriving uninterpretable sentences as sentences that denote the null value in the model.

   One important observation is the following. Similar patterns are often modelled via presuppositions on predicates, in the literature (Krifka 1998: 216-217 on TAPs, Morzycki 2005: ch.1 on adjectival modification). In our presupposition-less approach, we can derive and hence *predict* which phrases are uninterpretable by simply having their composition to denote an "impossible" situation. When *to* merges with *ten meters in*, function application yields an uninterpretable result: a situation with the wrong structure becomes part of another structured situation. This result, however, is not a possible result for the composition of an MP and an SP. We show how an interpretable phrase can emerge, by offering a derivation for (26), repeated here as (86):

---

[21] Step *t+6* implicitly captures the semantic reflex of co-application, since the relation denoted by *to* is "embedded" within the larger relation denoted by *ten meters into the park*. Formally, we have: *(MONs:**Mea'***(100-t,in))$\lambda x.\lambda y.TELs$:***to'****(x,y) = ($\lambda y.$(MONs:**Mea'***(100-t,y)))((in)$\lambda x.\lambda y.TELs$':***to'****(x,y)) = ($\lambda y.$(MONs:**Mea'***(100-t,y)))($\lambda y.TELs$':***to'****(in,y)) = ($\lambda y.$MONs:**Mea'***(100-t,TELs':**to'***(in,y).* In words, one argument (*in*) is "passed" onto the new relation, which is then *composed* with the previous function via function composition. See Moortgat (2010: ch. 2, 2011: §2) for discussion, once more. Uninterpretability emerges as a structural inconsistency that *emerges* from this derivation, then.

(86) a. The car traveled one kilometer along the river

    b. *t.* $[[$ one kilometer $]]:=$ *1-km*,   (type *<s>*, Int)

        t+1. $[[$ (Mea) $]]:=\lambda x.\lambda y.MONs:\boldsymbol{Mea}'(x,y)$ (type *<s,<s,s»*, Int)

        t+2. $([[$ one kilometer $]])[[$ (Mea) $]]:=$ (type *<s,s»*, FA)

                  $(1-km)\lambda x.\lambda y.MONs:\boldsymbol{Mea}'(x,y)=\lambda y.MONs:\boldsymbol{Mea}'(1-km,y)$

        t+3. $[[$ along $]]:=al$ (type *<s>*, Int)

        t+4. $[[$ one kilometer (Mea) $]]([[$ along $]]):=$ (type *<s>*, FA)

                  $\lambda y.MONs:\boldsymbol{Mea}'(1-km,y)(al)= MONs:\boldsymbol{Mea}'(1-km,al)$

        t+5. $[[$ (D) $]]:=\lambda x.\lambda y.A\text{-}CUMs':\boldsymbol{P}'(x,y)$ (type *<s,<s,s»*, Int)

        t+6. $([[$ one kilometer (Mea) along $]])[[$ (D) $]]:=$ (type *<s,s»*, FA)

                  $(MONs:\boldsymbol{Mea}'(1-km,in))\lambda x.\lambda y.A\text{-}CUMs':\boldsymbol{P}'(x,y)= \lambda y.MONs:\boldsymbol{Mea}'$

                  $(1-km, A\text{-}CUMs':\boldsymbol{P}(al,y)) = \lambda y.A\text{-}CUMs:\boldsymbol{Mea}'(1-km,s:\boldsymbol{P}(al,y))$

        t+7. $[[$ the river $]]:=r$

        t+8. $[[$ one kilometer (Mea) along (D) $]]([[$ the river $]]):=$ (type *<s>*, FA)

                  $\lambda y.A\text{-}CUMs:\boldsymbol{Mea}'(1-km, s':\boldsymbol{P}(al,y))(r)=$

                  $A\text{-}CUMs:\boldsymbol{Mea}'(1-km, s':\boldsymbol{P}(al,r))$

The derivation reads as follows. From steps *t* to *t*+4, the interpretation of *ten meters along* is derived, as a relation between a given length (one kilometer) and a specific spatial dimension to which this length is ascribed. When this phrase is merged with a silent head and the other argument *the river*, from steps *t*+5 to *t*+8, the ground object is specified, with respect to which this "along" relation is defined. During step t+6, an important process of the derivation takes place. Recall that we defined asymmetric cumulativity as cumulativity with a precedence relation defined over the domain of its objects. When an asymmetric cumulative structured situation becomes part of a monotonic structured situation, the monotonicity property selects one of the two ordering relations: either $s'<_{pc}s$ or $s<_{pc}s'$. So, the "global" situation becomes asymmetrically cumulative, via what could be considered a phenomenon of percolation/projection of one local semantic property to a more global domain (Harbour 2007: ch. 2-4, Adger 2010, for discussion).[22] We represent this result by representing the projecting property, A-cumulativity, as the main operator for the resulting situation.

    This selection has another semantic consequence. Since one situation part will be defined as being having a certain lexical property, in this case being *one kilometer along a river*, there will not be any "whole" parts that will have this property as well. In other words, one kilometer along the river turns out to denote a telic predicate, as a logical consequence of the interaction between two non-telic meanings. We can now predict (26)-(29), since we can account why telic directional SPs

---

[22]If we consider semantic properties extensionally, then a part-of relation among properties can be established among properties. In this sense, the semantic effect of composing monotonic situation with a cumulative situation, to obtain a cumulative denotation, can be represented as follows: *CUM∪MON=CUM*, by definition. The same holds for the other combinations of properties. See Zwarts (2008) for a more thorough discussion on the ordering relations among these properties.

cannot merge and compose with MPs, but also why (symmetric) cumulative SPs can do so. One further prediction is that non-projective locative SPs cannot merge with MPs, while projective SPs can do so. This is shown via (32) and (35), repeated here as (87)-(88):

(87) a. #The man is sitting ten meters at the desk

b. *t.* [[ten meters]]:= *10-m,*   (type *<s>*, Int)
t+1. [[(Mea)]]:=$\lambda x.\lambda y.MONs$:***Mea****'(x,y)*   (type *<s,<s,s> >*, Int)
t+2. ([[ten meters]])[[(Mea)]]:=
       *(10-m)$\lambda x.\lambda y.MONs$:**Mea**'(x,y) = $\lambda y.MONs$:**Mea**'(100-m,y)* (type *<s,s* , FA)
t+3. [[(s)]]:=*s*   (type *<s>*, Int)
t+4. [[ten meters (Mea)]]([[(s)]]):=   (type *<s>*, FA)
       *$\lambda y.MONs$:**Mea**'(10-m,y)(s)= MONs:**Mea**'(10-m,s)*
t+5. [[at]]:=$\lambda x.\lambda y.\neg MONs$':***at****'(x,y)*   (type *<s,<s,s> >*, Int)
t+6. ([[ten meters (Mea) (s)]])[[at]]:=
       *(MONs:**Mea**'(10-m,(s)))$\lambda x.\lambda y.\neg MONs$:**at**'(x,y)=#*   (derivation crashes)

(88) a. The osprey is hovering ten meters above the cloud

b. *t.* [[ten meters]]:= *10-m,*   (type *<s>*, Int)
t+1. [[(Mea)]]:=$\lambda x.\lambda y.MONs$:***Mea****'(x,y)*   (type *<s,<s,s> >*, Int.)
t+2. ([[ten meters]])[[(Mea)]]:=
       *(10-m)$\lambda x.\lambda y.MONs$:**Mea**'(x,y) = $\lambda y.MONs$:**Mea**'(10-m,y)* (type *<s,s>*, FA)
t+3. [[above]]:=*ab*   (type *<s>*, Int)
t+4. [[ten meters (Mea)]]([[ab]]):=
       *$\lambda y.MONs$:**Mea**'(10-m,y)(ab)=MONs:**Mea**'(10-mt,ab)*   (type *<s>*, FA)
t+5. [[(P)]]:=$\lambda x.\lambda y.MONs$':***P****'(x,y)*
t+6. ([[ten meters (Mea) above]])[[(P)]]:=
       *(MONs:**Mea**'(10-m,ab))$\lambda x.\lambda y.MONs$':**P**'(x,y)=*
       *$\lambda y.MONs$:**Mea**'(10-m,s':**P**'(ab,y))*   (type *<s,s>*, Int)
t+7. [[the cloud]]:=*cl*
t+8. [[ten meters (Mea) above (P)]]([[the cloud]]):=
       *$\lambda y.MONs$:**Mea**'(10-m,s':**P**'(ab,y))(r)=*
       *MON:**Mea**'(10-m,s':**P**'(ab,r))*   (type *<s>*, FA)

These derivations closely mirror the derivations in (85)-(86). In the case of (87), the mismatch between properties is the following. A situation *s'* is defined as being non-monotonic, as well as part of a monotonic situation *s*. A paradoxical model-theoretic object, an "impossible" situation, is derived; hence the corresponding phrase is uninterpretable. In the case of (88), the interpretation is a Monotonic, structured situation: a situation in which a distance of ten meters between cloud and the osprey's position is defined as part of a larger situation. Again, we represent the percolation/projection of properties by removing redundant operators (here, *MON*). Overall, our account can now predict the data in (30)-(39), since it can account how MPs can merge with projective locative SPs (here, *above*), but not with non-projective SPs (here, *at*).

We can now focus on our most complex data, starting from the examples in (40)-(55). We show how MeaPs such as one *kilometer towards the park* can (indirectly) merge with certain TAPs but not others: in this case, *in one minute*. We start our derivations from the interpretations of the MeaPs, to maintain the discussion relatively simple. For space reasons, we employ the constants a and b for situations, aside the standard s. We also omit the part of the derivation that generates the full VP of which *one kilometer towards the park* is the complement. This is not problematic, as verbs do not play a crucial role, at least not in these examples (but see again (77) for a full derivation). We then repeat example (45) as (89), and split the two possible forms of the sentences into two parallel derivations, illustrated in (89b)-(89c):

(89) a. The car went one kilometer towards the park in one minute/#for one minute

b. *t+k.* [[one kilometer towards the park]]:=
$A\text{-}CUMa\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p))$ (type <s>, FA)

k+1. [[(M)]]:=$\lambda x.\lambda y.s\text{:}(x\wedge y)$

k+2. ([[one kilometer towards the park]])[[M]]:=
$(A\text{-}CUMa\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)))\lambda x.\lambda y.s\text{:}(x\wedge y)=$
$\lambda y.s\text{:}(A\text{-}CUMa\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)))\wedge y)$ (type <s,s>, FA)

k+3. [[in one minute]]:=$TELb\text{:}\textbf{one-min'}(b)$ (type <s>, Int)

k+4. [[one kilometer towards the park (M)]]([[in one minute]]):=
$\lambda y.s\text{:}(A\text{-}CUMa\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)))\wedge y)\ (TELb\text{:}\textbf{one-min'}(b))=$
$s\text{:}(A\text{-}CUMa\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)))\wedge TELb\text{:}\textbf{one-min'}(b))=$
$s\text{:}(A\text{-}CUMs\textbf{P'}(s\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)))\wedge TELs\text{:}\textbf{one-min'}(s))=$
$TELs\text{:}(a\text{:}\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)))\wedge b\text{:}\textbf{one-min'}(b))$ (type <s>, FA)

c. *t+k.* [[one kilometer towards the park]]:=
$A\text{-}CUMa\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)$ (type <s>, FA)

k+1. [[(M)]]:=$\lambda x.\lambda y.s\text{:}(x\wedge y)$ (type <s,<s,s> >, Int)

k+2. ([[one kilometer towards the park]])[[M]]:=
$(A\text{-}CUMa\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)))\lambda x.\lambda y.s\text{:}(x\wedge y)=$
$\lambda y.s\text{:}(A\text{-}CUMa\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)))\wedge y)$ (type <s,s>, FA)

k+3. [[for one minute]]:=$CUMb\text{:}\textbf{one-min'}(b)$ (type <s>, Int)

k+4. [[one kilometer towards the park (M)]]([[for one minute]]):=
$\lambda y.s\text{:}(A\text{-}CUMa\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)))\wedge y)\ (CUMb\text{:}\textbf{one-min'}(b))=$
$s\text{:}(A\text{-}CUMa\textbf{P'}(a\text{:}\textbf{Mea'}(1\text{-}km,s'\text{:}(tw,p)))\wedge CUMb\text{:}\textbf{one-min'}(b))=\#$ (d. crashes)

Recall that this is a partial misrepresentation of the syntactic structure of these sentences, although it is inconsequential and explanatorily more immediate, since *M* actually merges with a full VP. The derivations in (89b) and (89c) read as follows. In (89b), the two phrases *one kilometer towards* the park and *in one minute* denote an A-cumulative and a telic predicate, respectively. When they are conjoined via a silent head *M*, they both introduce conjoined structured situations that are bound by two distinct operators, *A-CUM* and *TEL*. The intersection of these conjoined structure is the set of situations that are ordered according to a

precedence relation, and lack proper parts: telic (and ordered) situations. So, we can simply apply a basic logical identity, and have the telic operator to bind the main situation *s*, as shown in (89b). In (89c), this is not possible: the conjunction of two situations *a* and *b* is defined as having two complementary properties at the same time. A structured situation *s*, is defined as being symmetrically and asymmetrically cumulative. This yields an uninterpretable situation, hence the derivation crashes. A symmetrical result yields for MeaPs involving projective SPs, such as *ten meters above the cloud*. We show this specific pattern via a "compressed" derivation of (55), repeated here as (90):

(90)   a. The osprey is hovering ten meters above the cloud #in one hour/for one hour

   b. *t+m.* [[ten meters above the cloud (M)]]([[in one hour]]):=
   $\lambda y.s:(MONa\textbf{P'}(a:\textbf{Mea'}(10\text{-}m,s':(ab,cl)))\land y)$ $(TELb:\textbf{one-h'}(b))=$
   $s:(MONa\textbf{P'}(a:\textbf{Mea'}(10\text{-}m,s':(ab,cl)))\land TELb:\textbf{one-h'}(b))=\#$ (der. crashes)

   c. t+m. [[ten meters above the cloud (M)]]([[for one hour]]):=
   $\lambda y.s:(MONa\textbf{P'}(a:\textbf{Mea'}(10\text{-}m,s':(ab,cl)))\land y)$ $(CUMb:\textbf{one-h'}(b))=$
   $s:(MONa\textbf{P'}(a:\textbf{Mea'}(10\text{-}m,s':(ab,cl)))\land CUMb:\textbf{one-h'}(b))=$
   $MONs:\textbf{P'}(a:\textbf{Mea'}(10\text{-}m,s':(ab,cl)))\land b:\textbf{one-min'}(b))$ (type *<s>*, FA)

The derivations in (90) should be straightforward to read. The MeaP *ten meters above the cloud* denotes a cumulative structured situation, as we have seen in (88). When a cumulative MeaP combines with a TAP, only the cumulative *for one hour* will yield an interpretable result, as shown in (90c).When the merged TAP is the telic or non-cumulative *in one hour*, instead, the result will be an uninterpretable situation, as shown in (90b). Note that, since cumulativity entails monotonicity, the intersection of two situations having these two properties will correspond to a "larger" monotonic situation. This entailment is indirectly represented in (90c), in which the *MON* operator binds the "larger" situation variable *s*.

The derivation in (90b) shows that, aside being disjointed properties, cumulativity and A-cumulativity have a different semantic relation with telicity. Therefore, the distribution of phrases denoting cumulative predicates (e.g. *ten meters above the cloud*) is *predicted* to differ from predicates denoting a-cumulative predicates (e.g. *ten meters towards the park*). The interplay of TAPs with these phrases confirms these predictions, as we have seen so far. With these results in hand, we can conclude that our analysis can now account the data in (40)-(55). To account our final set of data, that discussed in (56)-(61), we need to present one final derivation that shows how an ambiguous verb such as *float* can merge with MeaPs. For this purpose, we repeat (57) as (91a), and employ a "full" syntactic structure. We show its partial derivation in (91b):

(91)   a. The canoe floated 50 meters inside the cave in one hour/for one hour

   b. *t+k.* [[the canoe floated]]:=$\lambda y.\pm A\text{-}CUMf:\textbf{float'}(c,y)$ (type *<s,s>*, Int)

$k+1.$[[50 meters inside the cave]]:=$MONs$:***Mea'**(50-m,s'**side'**:(in,cv))$ (*<s>*, I.)
$k+2.$([[the canoe… floated 50 meters]]) [[inside the cave]]:=
    $\lambda y.\pm A$-$CUMf$:***float'**(c,y)(MONs$:***Mea'**(50-m,s'$:***side'**:(in,cv)))=$
    A-$CUMf$:***float'**(c,s:***Mea'**(50-m,s'***side'**:(in,cv)),$
    $CUMf$:***float'**(c,s:***Mea'**(50-m,s'***side'**:(in,cv)$

The derivation in (91b) reads as follows. By the step $t+k+2$, two possible interpretations are derived for (91a), as in the case of (58). So, by this derivational step (91a) is ambiguous, or more accurately underspecified. These interpretations are represented in set-theoretic format, for the sake of clarity. The first interpretation says that a situation in which a canoe floats 50 meters inside the cave is a telic situation: the canoe covers a certain distance while floating. The second interpretation says that a situation in which a canoe floats 50 meters inside a cave is a situation in which this occurs at a certain distance from some implicit border. This situation is cumulative, in the sense that it includes proper situations located at the same distance, but not involving directed movement. Again, the cumulativity as a percolating property seems to determine the "global" properties of a structured situation. Recall also that our use of the symbol "±" is a short-hand for a situation being either A-cumulative or cumulative, rather than not cumulative. This notation allows us to represent these two properties as being mutually exclusive. We call these two situations *d* and *z*, respectively, and show in (92)-(93) what happens when they combine with *in one hour* and *for one hour*:

(92) $t+n.$ ([[the canoe…the cave (M)]])[[in one hour]]:=
       (*{A-CUMd,CUMz*∧TELb:**one-h'**(b))=TEL(d∧b:**one-h'**(b),Ø}

(93) $t+n.$ ([[the canoe…the cave (M)]])[[for one hour]]:=
       (*{A-CUMd,CUMz*∧CUMb:**one-h'**(b))=Ø,CUM(z∧b:**one-h'**(b)}

In words, (92) says that only one of the two interpretations for this sentence is compatible with *in one hour*. Since *in one hour* denotes a telic, oriented and bounded situation, only the corresponding interpretation for *the canoe floated 50 meters inside the cave* offers a non-empty interpretation. The inverse holds when *for one hour* s merged, for obvious reasons. So, we can capture our last set of data, those presented in (56)-(61). Overall, our analysis can now cover all the data presented in section 2 and as a consequence, our initial set of data that motivated our initial inquiry, those in (1)-(9). We think that this is a welcome result, as it suggests that we have reached our second goal, that of predicting our data via our compositional approach. We discuss some consequences of this result in the next section.

4.3 The Analysis: Discussion and Connections

In this section we discuss the results that we obtained via our analysis. As it should be obvious from our discussion, we are now able to predict the patterns

we have discussed so far, since we can systematically *derive* which phrases are interpretable, and which phrases are not. This result has become possible for one simple reason. We have defined a simple logic of structural properties, and explained how our three categories (MeaPs, SPs, TAPs) can include these properties in their denotations. We have then shown that this logic can be extended to the interplay of these three categories with verbs, although we have offered a perhaps less thorough analysis of this interplay. These properties (cumulativity, telicity, a-cumulativity, monotonicity), *qua* logical properties, can systematically constrain the range of possible combinations of constituents that can occur. We have then shown that, via basic principles of compositional semantics and the ability to compute the actual values of the properties composed together, certain interpretations can or cannot emerge. Therefore, we have shown that with an opportunely structured approach to compositional matters, it is possible to account our data in a straightforward way.

One practical example is as follows. When *ten meters* and *above* compose together, the interpretation of the relevant Measure phrase corresponds to a certain structured situation. Given the structure of this situation, it is possible to predict which other situations can be composed further, and which cannot. Simplifying matters somewhat, if we compose the structured situation denoted by *for one hour* with *ten meters above*, we obtain a structured situation that can be defined in our model. If we compose the situation denoted by *ten meters above* with that denoted by *in one hour*, instead, the result will be an uninterpretable (i.e. empty) situation.

Importantly, these simple assumptions are consistent with much literature on MeaPs (Morzycki 2005, 2006, a.o.). This is the case, as we show that monotonicity is a central property that governs the distribution of this category with other categories, in this case SPs and TAPs. These assumptions are also consistent with our knowledge of SPs, in particular with those works that study prepositional aspect in detail (Zwarts 2005, 2008, Ramchand & Tungseth 2006, a.o.). This is also the case, as we show that not only TAPs but also MeaPs can influence, somehow, prepositional aspect. If we consider that we implement a treatment of lexical aspect that imports broader assumptions about this category (e.g. Krifka 1998), the advantages of our theory should be clear. We have offered a unified, thorough and compositional approach of seemingly distinct phenomena. This is a welcome result.

One important aspect of our proposal is that we also offer a simplified treatment of semantic matters in which certain principles are derived from the compositional process. For instance, works on prepositional aspect suggest the (un)-interpretability of phrases such as *walk to the store in one hour/#for one hour* are a consequence of a "structural" mismatch. The path structure of the SP *to the store* and event structure the verb *walk* do not match, with respect to structural

properties such as cumulativity and telicity. The homomorphism that maps these domains (a "trace function"θ) fails to map the relevant set of paths to that of events (Zwarts 2005: 720-725, Ramchand & Tungseth 2006: 166). So, no event/path interface is defined.

In our approach, on the other hand, we capture these facts in a simple way, as we use one single semantic type, that of structured situations. We then show that, if the wrong sub-types of situations combine together, then the result will be uninterpretable. Furthermore, we have shown that we can apply this result to a still poorly understood set of data, those involving MeaPs, SPs and TAPs. We have shown that MPs such as *ten meters*, SPs such as *above*, and TAPs such as *for one hour* do interact with respect to lexical aspect. A general aspect of our solution is that we can now predict what interpretation emerge, when different properties compose together. For instance, the merge of *ten meters* with *above the cloud* is predicted to denote a cumulative, non-telic predicate, whereas the merge of *ten meters* with *towards the park* is predicted to be A-cumulative. Given this emergent interpretation, we can then predict whether telic or atelic TAPs (*in one hour*, *for one hour*) can merge with each MeaP, accordingly. The observed patterns can be now formulated as results of our derivational system.

Furthermore, we can also extend this analysis to the contribution of verbs, which play a key role in this distribution. The fact that we can capture the interplay between ambiguous verbs such as *float*, their argument MeaPs and their interaction with TAPs further supports our analysis. In other words, our analysis can correctly predict that a combination of verb and MeaP, such as *floated 50 meters inside the cave*, may be aspectually ambiguous and may be disambiguated via the merge of either *in one hour* or *one hour.* Hence, we think that our choice has turned out to be quite appropriate, since it can capture these facts via one simple, but very principled derivational analysis.

We observe that our syntactic choices could be considered somewhat controversial or, at least with respect to modification aspects, quite "heterodox". However, one important fact suggests that our analysis is on the right track. Although our choices seem to diverge from more standard approaches to SPs, we actually follow fairly standard treatments of our modifiers. In particular, our suggestion that MPs may include spatial-like degree elements, such as *along* or *in front*, allows us to bring the analysis of modified SPs very close to that of other modified categories. So, aside the cross-categorial parallels on semantic matters, we also capture cross-categorial parallels on syntactic matters. The same reasoning holds for TAPs, too: this is a welcome result.

One important aspect in favor of our unorthodox choice is that our "left-to-right" approach to derivational matters, perhaps the most controversial choice in our analysis, finds further support in our results. If this were not the case, then we

could entertain a case in which a derivation proceeds right to left, instead. In that case, an ambiguous SP phrase such as *across* the *city* can occur in a sentence that merges with either the TAP *in one hour* or *for one hour* (cf. (50)). Semantics-wise, the results would respectively be a non-cumulative and a cumulative predicate (*went across the city in one hour*, *went across the city for one hour*). In such a case, we would then erroneously predict that both phrases could combine with an MP such as *one kilometer*. So, *went across the city for one hour* would combine with *one kilometer*, and the interpretation would conflate to that of the interpretable *went across the city in one hour*. This prediction runs contrary to the facts we discussed so far, so must reject it.

Instead, in our "left-to-right" approach this prediction does not emerge, as we have seen. So, although our main concern has been that of offering a semantic account of our data, we think that our analysis correctly captures syntactic aspects of SPs and their structure, too. At the same time, it suggests that syntactic derivations and their production are perhaps closer to models of grammar that conflate production to comprehension/parsing (Morryll 2011, Phillips 2006). Overall, we think that our approach shows a strong consistency with previous research on SPs, degree phrases such as MeaPs and TAPs. This approach also offers a way to connect apparently unrelated semantic phenomena, such as the aspectual contribution of MeaPs, and its effect on "geometric" and "aspectual" dimensions of the meanings of SPs. With these considerations in hand, we turn to our conclusions.

5   Conclusions

Our goal in this paper has been to offer a unified approach to two oustanding problems that exist in the literature on SPs. One problem is their ability to combine with MeaPs, the other is their ability to combine with TAPs. We have discussed how both problems can be reduced to a general problem that pertains the prepositional aspect properties of SPs. In other words, we have shown how the interaction of MeaPs, SPs and TAPs is reflected on their aspectual contribution. In pursuing this goal, we have investigated a still understudied problem of SPs: how their distribution with MeaPs is in turn sensible to the properties of TAPs. In other words, we have discussed the interpretation of phrases such as *ten meters above the cloud*, *one kilometer towards the park* and several other phrases. We have then shown that this interpretation can determine whether a non-telic TAP such as *for one minute* or a telic *in one minute* can occur with MeaPs including SPs. Furthermore, we have shown that our analysis can account the interaction of these three categories with verbs, although we did so in a perhaps sketchier and more approximate way.

Our analysis has shown that, if we define a common semantic interpretation for each category, then these patterns can be predicted as a consequence of the compositional interaction of these constituents. Via our situation semantics

approach, as a direct interpretation of a simple type-logical syntactic analysis, we have shown that these data are not just accounted for, but actually *predicted*. We can offer a simple, principled reason on why *ten meters* cannot merge with *into*. The SP would compose with a MeaP that denotes the "wrong" type of situation, for a sentence to be interpretable. Again, we have shown that aside the situations semantic-framed analysis, our analysis correctly captures one basic intuition about the data in (1)-(61), and be consistent with previous literature (Morzycki, 2006). At a certain level of understanding, both *ten meters above the cloud* and *for one hour* denote structural properties of situations, or what we have called lexical aspect.

Overall, we have offered a better picture of the understudied aspects of SPs, MeaPs as degree heads, and TAPs as aspectually-oriented elements. In doing so, we have also suggested that a unified perspective to the syntax and semantics of these categories can be offered. With such a perspective, and a simple but rigorous compositional approach to the compositional process, we can easily derive the correct interpretation for our examples. It goes without saying that, although our analysis appears correct for our set of data, other data are still in need of a solution. For instance, we have purposefully ignored whether "direction" adverbs such as *right* can also contribute to aspect. We also have entirely focused on English, and know little on whether our analysis carries cross-linguistic impact (e.g. to Italian: Folli 2008). Several other problems still in need of a solution could be discussed; we leave, however, a further and more thorough discussion for future research.

6   References

Adger, David. 2010. A minimalist theory of feature structure. In Anna Kibort & Greville Corbett (eds.), *Features: Perspectives on a Key Notion in Linguistics*, 185-218. Oxford: Oxford University Press.

Asbury, Anna. 2008. *The morphosyntax of case and adpositions*. Doctoral Dissertation, Utrecht University.

Asbury, Anna, Jakub Dotlacil, Berit Gehrke, & Rick Nouwen (eds.). 2008. *Syntax and Semantics of Spatial P*. John Benjamins, Amsterdam.

Asher, Nicholas. 2011. *Lexical Meaning in Context: A Web of Words*. Cambridge University Press.

Asher, Nicholas & Paul Sablayrolles. 1995. A Typology and Discourse Semantics for Motion Verbs and Spatial PPs in French. *Journal of Semantics* 12 (2), 163-209.

Barwise, John, & John Etchemendy. 1990. Information, infons and inference. In Robin Cooper. (ed), *Situation semantics and its applications, vol. 1*. Stanford, CA: CSLI publications, 30-64.

Barwise, John, & Joe Perry. 1999. *Situations and attitudes, 2nd edition*. Cambridge, MA: The MIT Press.

Barwise, John, & Jerry Seligman. 1997. *Information flow: the logic of distributed systems.* Cambridge: Cambridge University Press.

Bohnemeyer, Jurgen. 2012. A Vector Space Semantics for Reference Frames in Yucatec. In Elizabeth Bogal-Allbritten (Ed.), *Proceedings of the sixth meeting on the Semantics of Under-Represented Languages in the Americas (SULA 6) and SULA-Bar.* Amherst: GLSA Publications, 15-34.

Chomsky, Noam. 1999. *Derivation by phase.* Cambridge, MA: The MIT Press.

Cinque, Guglielmo, and Luigi Rizzi (eds.). 2010. Mapping Spatial PPs. *The cartography of syntactic structures, vol.6.* Oxford, Oxford University Press.

Chierchia, Gennaro, & Turner, Robert. 1988. *Semantics and property theory. Linguistics and Philosophy* 11 (3), 191-216.

Cresswell, Maxwell J. 1978. Prepositions and points of view. *Linguistics* and *Philosophy* 2 (1), 1-41.

Culicover, Peter W. 1999. *Syntactic Nuts.* Oxford University Press.

Dikken, Marcel den. 2010. On the functional structure of locative and directional PPs. In Guglielmo Cinque & Luigi Rizzi. (eds.), *The Cartography of Syntactic Structures: vol. 6.* Oxford: Oxford University Press.

Dowty, David. 1979. *Word meaning and Montague Grammar.* Dordrecht: Reidel.

Dowty, David. 1989. Semantic content of thematic roles. In Barbara Partee, Gennaro Chierchia & Ken Turner (eds.), *Properties, types and meanings.* Dordrecht, Kluwer, 69-130.

Egg, Marcus. 2011. Underspecification. In Claudia Maienborn, Klaus von Heusinger, & Paul Portner (eds): *Semantics: an international handbook of natural language meaning*, vol.1. Berlin: de Gruyter, 533-572.

Emonds, John. 1985. *A Unified Theory of Syntactic Categories.* Dordrecht: Foris Publications.

Emonds, John. 2000. *Lexicon and Grammar: the English Syntacticon.* Mouton de Gruyter, Berlin.

Fábregas. Antonio. 2007. In Monika Basíc, Marina Pantcheva, Minjeong Son, and Peter Svenonius (eds.), *Tromsø Working Papers on Language & Linguistics: Nordlyd 34.2, special issue on Space, Motion, and Result*, 1–32.

Fábregas. Antonio. 2011. On why Word Phases cannot account for Lexical Integrity Effects. *Lingue & Linguaggio* X (1), 3-28.

Folli, Raffaella. 2002. *Constructing Telicity in English and Italian.* Doctoral Dissertation, University of Oxford.

Folli, Raffaella. 2008. Complex PPs in Italian. In Asbury, Anna, Jakub Dotlacil, Berit Gehrke, and Rick Nouwen (eds.). *Syntax and Semantics of Spatial P.* John Benjamins, Amsterdam, 190-220.

Fong, Vivienne. 1997. *The Order of Things: What Directional Locatives Denote.* Doctoral Dissertation, Stanford.

Fong, Vivienne. 2001. *Into doing something: where is the path in event predicates?*. Paper presented at the Paths and Telicity in Event Structure (ESSLLI Workshop), Manchester.

Fong, Vivienne. 2008. *From the source.* Paper presented a the conference on the Syntax and Semantics of spatial P, Utrecht.

Gamut, L.T.F. 1991. *Language, Logic and Meaning, Part 2.* Chicago, MN: Chicago University Press.

Gehrke, Berit 2008. *Ps in Motion: On the Semantics and Syntax of P Elements and Motion Events.* Doctoral Dissertation, Utrecht University.

Ginzburg, Jonathan. 2005. Situation Semantics: the ontological balance sheet. *Research on Language and Computation* 3 (4), 363-389.

Hale, Ken, and Samuel J. Keyser. 2002. *Prolegomenona to a Theory of Argument Structure.* Cambridge, MA: MIT Press.

Harbour, Daniel. 2007. *Morphosemantic Number: From Kiowa Noun Classes to UG Number Features.* Dordrecht: Springer.

Harley, Heidi. 2012. Semantics in Distributed Morphology. In Maierborn, C. K. von Heusinger, & P. Portner (eds.), *Semantics: An International Handbook of Natural Language Meaning.* Amsterdam: De Gruyter, 688-709.

Herskovits, Annette. 1986. *Language and Spatial Cognition: An Interdisciplinary Study of the Prepositions in English.* Cambridge: Cambridge University Press.

Jackendoff, Ray. 1983. *Semantics and Cognition.* Cambridge, MA: The MIT Press.

Jackendoff, Ray. 1990. *Semantic structures.* Cambridge, MA: The MIT Press.

Jäger, Gerard. 2005. *Anaphora And Type Logical Grammar.* Springer: Dordrecht.

Jarema, Gonia & Gary Libben (Eds.). 2007. *The mental lexicon: core perspectives.* Amsterdam, Elsevier.

Kayne, Richard. 1994. *The Antisymmetry of Syntax.* Cambridge, MA: The MIT Press.

Kayne, Richard 2004. Here and there. In Caroline Leclére, Edmond Laporte, Marcel Piot, & Marie Silberztein (eds.), *Lexique Syntaxe, et Lexique-Grammaire /Syntax, Lexis, & Lexicon-Grammar: Papers in Honor of Maurice Gross.* Amsterdam: John Benjamins, 253–275.

Kennedy, Chris. 1999. *Projecting the Adjective: The Syntax and Semantics of Gradability and Comparison.* Outstanding Dissertations in Linguistics Series. New York: Garland Press.

Kennedy, Chris. 2007. Vagueness and Grammar: The Semantics of Relative and Absolute Gradable Adjectives. *Linguistics and Philosophy* 30 (1), 1-45.

Keenan, Edward L., & Leonard M. Faltz. 1985. *Boolean Semantics for Natural Language.* Dordrecht: Reidel.

Koopman, Hilda. 2000. Prepositions, postpositions, circumpositions and particles: The structure of Dutch PPs. In Hilda Koopman (ed.), *The syntax of specifiers*

and heads. London: Routledge, 204-260.

Kracht, Marcus. 2002. On the semantics of locatives. *Linguistics and Philosophy*. 25 (1), 57-132.

Kracht, Marcus. 2004. Against the Feature Bundle Theory of Case. In Ellen Brandner, and Heike Zinsmeister (eds.), *New perspectives on case theory*. Stanford, CA: CSLI publications, 165-190.

Kracht, Marcus. 2008. The fine structure of spatial expressions. In Asbury, Anna, Jakub Dotlacil, Berit Gehrke, & Rick Nouwen (eds.). *Syntax and Semantics of Spatial P*. Amsterdam: John Benjamins, 35-62.

Kratzer, Angelika. 1989. An Investigation of the lumps of thought. *Linguistics and Philosophy* 12 (5), 607-653.

Kratzer, Angelika. 2003. The event argument and the semantics of verbs. To appear, Cambridge, MA: the MIT Press.

Kratzer, Angelika. 2007. *Situations in Natural Language Semantics. In Edward N. Zalta (Ed.), The Stanford Encyclopedia of Philosophy (Winter 2010 Edition)*. Available at: <http://plato.stanford.edu/entries/situations-semantics/> [04/20/2013]

Krifka, Manfred 1989. Nominal reference, temporal constitution and quantification in event semantics. In Renate Bartsch, Johan van Benthem and Peter van Emde Boas (eds.), *Semantics and Contextual Expressions*, Dordrecht: Foris, 75-115.

Krifka, Manfred. 1998. The origins of telicity. In Susan Rothstein (ed.), *Events and Grammar*, 197-235. Dordrecht: Kluwer.

Landman, Fred. 1991. *Semantic Structures*. Dordrecht: Kluwer.

Landman, Fred. 2000. *Events and Plurality*. Dordrecht: Kluwer Academic Publishers.

Landman, Fred. 2004. *Indefinites and the Type of Sets*. New York: Blackwell.

Levelt William J. M. 1989. *Speaking: From intention to articulation*. Cambridge, MA: MIT Press.

Link, Godehard. 1998. *Algebraic semantics in Language and Philosophy*. Stanford, CA: CSLI publications.

Maillat, Didier. 2001. Directional PPs and Reference Frames in DRT, in *Proceedings of the International Association for Computational Linguistics 2001 Conference. Toulouse: Université de Toulouse* - Le Mirail.

Mateu, Jaume. 2002. *Argument structure*. Relational construal at the syntax-semantics interface. Bellaterra: Universitat Autònoma de Barcelona dissertation. Available at <http://webs2002.uab.es/clt/publicacions/tesis/index.html> [03/03/2013]

Mateu, Jaume. 2008. On the l-syntax of directionality/resultativity. In Anna Asbury, Jacub Dotlačil, Berit Gehrke, Øystein Nilsen, & Rick Nouwen (eds.), *The*

Syntax and Semantics of Spatial P. Amsterdam: John Benjamins, 221-250.

Merchant Jason. 2001. *The syntax of silence: Sluicing, islands, and the theory of ellipsis.* Oxford: Oxford University Press.

Merchant, J. (2004). Fragments and ellipsis. *Linguistics and Philosophy* 27 (6), 661-738.

Moortgat, Michael J. 2010. Typelogical grammar. In Edward N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Winter 2010 Edition). Stanford.

Moortgat, Michael.J. 2011. Categorial Type Logics. In Johan van Benthem & Alice ter Meulen (Eds.), *Handbook of Logic and Language. Second Edition* Elsevier.

Morryll, Glynn. 1994. *Type-logical Grammar: categorial Logic of signs.* Dordrecht: Kluwer Academic Publishers.

Morrill, Glynn. 2011. *Categorial Grammar: Logical Syntax, Semantics, and Processing.* Oxford University Press.

Morzycki, Marcin. 2004. Expressive Modification and the licensing of Measure Phrases. *Journal of Semantics* 28 (3), 401-411.

Morzycki, Marcyn. 2005. *Mediated modification: functional structure and the interpretation of Modifier Position.* Ph.D. dissertation. Amherst, MA: University of Massachussetts.

Morzycki, Marcin. 2006. Atelicity and Measure Phrases: Licensing Measure Phrase Modification Across AP, PP, and VP. In Donald Baumer, David Montero, & Michael Scanlon (eds.), *Proceedings of the 25th West Coast Conference on Formal Linguistics.* Somerville, MA: Cascadilla Proceedings Project, 279-287.

Nam, Senghou. 1995. *The Semantics of locative prepositional phrases in English.* Doctoral Dissertation, UCLA.

Pantcheva, Marina. 2008. The Place of place in Persian. In Anna Asbury, Jacub Dotlačil, Berit Gehrke, Øystein Nilsen, & Rick Nouwen (eds.), *The Syntax and Semantics of Spatial P.* Amsterdam: John Benjamins, 305-330.

Pantcheva, Marina. 2010. The syntactic structure of Locations, Goals, and Sources. *Linguistics* 48 (5), 1043-1083.

Pantcheva, Marina. 2011. *Decomposing Path: The Nanosyntax of Directional Expressions.* University of Tromsø dissertation.

Parsons, Terence. 1990. *Events in the semantics of English.* Cambridge, MA: the MIT Press.

Phillips, Colin. 1997. *Order and structure.* Doctoral Dissertation, MIT.

Phillips. Colin. 2003. Linear order and constituency. *Linguistic Inquiry* 34 (1), 1-46.

Phillips, Colin. 2006. The real-time status of island phenomena. *Language* 82 (5), 795-823.

Piñon, Christopher J. 1993. Paths and their names, in Katherine Beals et al. (eds.), *Chicago Linguistics Society* 29, Vol. 2. Chicago Linguistics Society, Chicago, 287–303.

Poesio, Massimo. 2001. *Incrementality and Underspecification in Semantic Processing*, CSLI Publications.

Rothstein, Susan. 2004. *Structuring Events: A Study in the Semantics of Lexical Aspect.* Oxford: Blackwell.

Ramchand, Gillian. 2008. *Verb Meaning and the Lexicon: A First Phase Syntax.* Cambridge University Press.

Ramchand, Gillian & Mai Tungseth. 2006. In Peter Svenonius (ed.), *Nordlyd: Tromsø Working Papers in Linguistics, special issue on Adpositions*, 33.2, 149 –175.

Riemsdijk, Henk van. 1978. *A Case Study in Syntactic Markedness.* Dordrecht: Foris Publications.

Riemsdijk, Henk van. 1990. Functional Prepositions. In Harm Pinkster & Inge Genée (eds.)*Unity in Diversity. Festschrift for Simon Dik* . Dordrecht, 229-241.

Riemsdijk, Henk van & Riny Huybregts. 2007. Location and locality. In Marc van Oostendorp & Elena Anagnostopoulou, (eds.), *Progress in Grammar: Articles at the 20th Anniversary of the Comparison of Grammatical Models Group in Tilburg.* Meertens Instituut, Amsterdam, 123-140.

Roy, Isabelle & Peter Svenonius. 2009. Complex prepositions. In Jean François, Émanuel Gilbert, Cecile Guimier, & Michael Krause (eds,), *Autour de la Préposition.* Presses universitaires de Caen, 105–116.. Schwarzschild, Roger. 1996. *Pluralities.* Dordrecht: Springer.

Svenonius, Peter. 2006. The emergence of axial parts. Nordlyd, Troms University Working Papers in Language and Linguistics 33 (1), 49-77.

Svenonius, Peter. 2008. Projections of P. In Anna Asbury, Jacub Dotlačil, Berit Gehrke, ystein Nilsen, & Rick Nouwen (eds.), *The Syntax and Semantics of Spatial P.* John Benjamins, Amsterdam, 63-84.

Svenonius, Peter. 2010. Spatial P in English. In Guglielmo Cinque & Luigi Rizzi, *The Cartography of syntactic Structures: vol.* 6. Oxford: Oxford University Press, 127-160.

Szabolczi, Anna. 1997. Background notions in Lattice Theory and Generalized Quantifiers. In Anna Szabolczi (ed.), *Ways of Scope-Taking.* Dordrecht, Kluwer, 1-27.

Talmy, Leonard. 1978. Figure and ground in complex sentences. In Joseph E. Greenberg (ed.), *Universals of Human Language, vol. 4: Syntax.* Stanford: Stanford University Press, 625-649.

Talmy, Leonard. 1983. How language structures space. In Herman L. Pick, Jr. & Linda P. Acredolo (eds.), *Spatial orientation: Theory, research, and application.* New York: Plenum Press, 225-282.

Talmy, Leonard. 2000. *Towards a cognitive Linguistics.* Cambridge, MA: the MIT press.

Tortora, Christina. 2005. The preposition's preposition in Italian: Evidence for

boundedness of space. In Robert Gess & Edward Rubin (eds), *Theoretical and Experimental Approaches to Romance Linguistics.* Amsterdam: John Benjamins, 307–327.

Tortora, Christina. 2008. Aspect inside PLACE PPs, in Anna Asbury, Jacub Dotlačil, Berit Gehrke, Øystein Nilsen, & Rick Nouwen (eds.), *The Syntax and Semantics of Spatial P*, 273-301. Amsterdam: John Benjamins.

Tungseth, Mai. 2006. *Verbal Prepositions in Norwegian: Paths, Places and Possession.* PhD thesis, University of Tromsø.

Ursini, Francesco-Alessio. 2011. On The Syntax and Semantics of "Ser" and "Estar". *Lingue & Linguaggio* 9 (1), 57-87.

Ursini, Francesco-Alessio. 2013a. *Esse* and *Sta*: Auxiliary selection in the Aquilan dialect. Dialectologia 10 (1), 107-134.

Ursini, Francesco-Alessio. 2013b. On The Syntax and Semantics of "Tener" and "Haber". *Lingue & Linguaggio* 11 (1), 89-120.

Ursini, Francesco-Alessio. 2013c. On the Syntax and Semantics of Spatial Ps in Spanish. *Borealis: An international journal about Hispanic Linguistics* 2 (1), 117- 166.

Ursini, Francesco-Alessio & Nobuaki Akagi. 2013a. The interpretation of spatial At: An Experimental Study. *Journal of Cognitive Science* 14 (1), 47-76.

Ursini, Francesco-Alessio & Akagi, Nobuaki. 2013b. On the distributed morphology and semantics of spatial Ps. In Il-Jae Lee and Uujinbai Dolgormaa (eds.), *Proceedings of the 15th Seoul International Conference on Generative Grammar (SICOGG 15).* Hankuk University Press, Seoul, 447-468.

Winter, Yoad. 2001. Measure phrase modification in vector space semantics'. In Megerdoomian, Karine and Leora A. Bar-el, eds., *WCCFL XX. Cascadilla Publications*, Somerville, Mass, 15-30.

Winter, Yoad. 2005. 'Cross-categorial restrictions on measure phrase modification'. *Linguistics & Philosophy* 28 (2), 233-388.

Winter, Yoad 2006. Closure and telicity across categories. In Christpher Tancredi, Maki Kanazawa, Inu Imani, & Ken Kusumoto, (eds.), *Proceedings of Semantics and Linguistic Theory (SALT16).* Ithaca, NY: Cornell University Press, 210-218.

Wunderlich, Dieter. 1991. How do prepositional phrases fit into compositional syntax and semantics?, *Linguistics* 29 (5), 591-621.

Wunderlich, Dieter. 1993. On German "um": Semantic and Conceptual Aspects. *Linguistics* 31 (1), 111-133.

Zwarts, Joost. 1997. Vectors as relative positions. *Journal of Semantics* 14 (1), 57-87.

Zwarts, Joost. 2005. Prepositional Aspect and the Algebra of paths. *Linguistic and Philosophy* 28 (6), 699-740.

Zwarts, Joost. 2008. Aspects of a typology of direction. In Susan Rothstein (ed.), *Theoretical and Crosslinguistic Approaches to the Semantics of Aspects*, 79-106.

Amsterdam: John Benjamins.

Zwarts, Joost. 2010. A hierarchy of locations: evidence from the encoding of direction in adpositions and cases. *Linguistics* 48 (5), 983-1009.

Zwarts, Joost, and Yoad Winter. 2000. Vector space semantics: a Model-Theoretic analysis of Locative Prepositions. *Journal of Logic, Language and Information* 9 (2) 169-211.

Francesco-Alessio Ursini
Stockholms Universitet
francesco.ursini@english.su.se

Nobuaki Akagi
Macquarie University
jag.heter@hotmail.co-jp