Literal and Metaphoric Readings in Spatial Prepositions

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Abstract: The goal of this paper is to propose a novel compositional analysis of literal and metaphoric readings in spatial prepositions and prepositional phrases. It is shown that these types of readings emerge as the result of prepositions interacting with other parts of speech, such as verbs, DPs and temporal adverbs (e.g., *in one hour*). Two types of understudied data are discussed. The first set of data involves the interaction of literal and metaphoric readings with lexical aspect, including their distribution with temporal adverbs (e.g., *in one hour/for one hour*). The second set of data involves the co-existence of literal and metaphoric readings for prepositions in coordinated structures (e.g., *under the table* and *through the briefing*). The account suggests that both readings emerge as types of possible relations that spatial prepositions can denote, as part of a complex semantic domain that includes distinct semantic dimensions.

Keywords: metaphors, prepositions, lexical aspect, type-logical syntax, polysemy

1. Introduction

Formal and cognitive approaches to language differ in how they analyse *literal* and *metaphoric* readings for sentences.[1] Sentences are usually defined as having a literal

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[1] We use the label *reading* to discuss senses assigned to phrases and sentences, although our main focus will be on the metaphoric and literal readings of SPPs and corresponding coordinated phrases. When necessary, we explicitly mention which reading (sentential, phrasal) is at stake.

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reading when they denote a relation between entities and properties in a veridical manner (e.g., *Mario is blond*). Metaphoric readings, then, arise when sentences denote relations connecting entities and properties in a partially non-veridical, if not novel manner (e.g., *Mario is the sun*, for Mario being a guiding inspiration: Ortony 1979). Classic model-theoretic approaches treat metaphoric readings as a pragmatic, non-compositional phenomenon (Searle 1979; Black 1993). Classic cognitive linguistics approaches consider metaphoric readings as a reflection of non-linguistic relations between distinct conceptual domains (Lakoff and Johnson 1980; Lakoff 1987). Thus, neither perspective seems to address whether metaphoric readings can emerge in a compositional manner.

Recent analyses within model-theoretic (e.g., Stern 2011), cognitive (e.g., Evans 2006) and psycholinguistic (e.g., Glucksberg 2001) frameworks shed light on this matter. They suggest that both readings are a reflection of the *polysemy* of lexical categories. Polysemy, in turn, can be defined as a semantic property of lexical items, when they can have distinct but related senses (Riemer 2005; Kearns 2006). From a compositional perspective, polysemy can affect the range of readings of a phrase. When a polysemous lexical item (e.g., a head) distributes with[2] another lexical item (e.g., a complement), a specific reading can emerge for the phrase that the two constituents form.

In this paper I choose to concentrate on English *Spatial Prepositions* (SPs), which form a semi-functional category and are well-known for their polysemous nature (Lakoff 1987:416–464; Deignan 2003). Crucially, SPs can license literal and metaphoric readings, as exemplified in (1)–(2):

(1) Marco is in the kitchen.

(2) Marco is in love.

While *the kitchen* denotes a "position" where Marco is located, *love* denotes an emotional state that Marco is experiencing. Since both DPs distribute with the SP *in*, the type of relation this SP denotes depends on the interpretation of its complement DP (Steen 2007:ch. 6; Stern 2011). The SPP *in the kitchen* denotes a spatial relation between Marco and kitchen, with Marco being in its interior "part". The SPP *in love* denotes a non-spatial or metaphoric relation between Marco and "love", an emotional state that Marco is experiencing. Thus, literal/spatial and metaphoric/non-spatial readings first emerge at an SP *phrase* (SPP) level, and seem able to project at a sentential level. Once we go beyond the phrasal level, however, the compositional and recursive mechanisms

[2] I use the verb *distribute with* to discuss the data. I introduce the notion of *merge* in section 3.

governing the computation of these readings seem poorly understood. Here I concentrate on two understudied problems involving these readings in SPs, which are defined as follows.

First, the compositional interaction of verbs and their complements can determine the lexical aspect reading of a VP. Thus, SPPs and other phrases can determine whether a VP is telic/atelic, as the *in X time/for X time* diagnostics reveals (e.g., Zwarts 2005; Gehrke 2008; among others). This fact holds irrespective of the literal/metaphoric reading of an SPP, as shown in (3)–(4):

(3) Marco went to the shop in one hour/#for one hour.

(4) The troops were under huge pressure in one minute/for one minute.

In (3), the distribution of *went* with the literal SPP *to the shop* licenses a telic reading for the VP. The telic *Temporal Adverbial Phrase* (TAP) *in one hour* distributes with this VP to denote an event in which Marco reached the shop in one hour (cf. Zwarts 2005). The TAP *for one hour* cannot distribute with this sentence without rendering the sentence uninterpretable, at least when the "goal" reading is accessed.[3] Here and in the remainder of the paper, uninterpretability is marked via the symbol "#".

In (4), the distribution of *under* with the AP *huge pressure* suggests that the troops are in a certain state of mental stress: a metaphoric reading is accessed for this SPP. Since *under* is aspectually ambiguous, *under huge pressure* can describe either a telic state (the troops end up being under pressure) or an atelic one (the troops spend some time in this condition). Thus, the metaphoric/literal distinction seems bound to the SPP level, even though either reading can interact with lexical aspect readings.[4]

Second, metaphoric and literal readings are distinct but not mutually exclusive readings for phrases/sentences, and can interact in certain syntactic contexts. In this paper, I focus on *coordinated phrases* in which SPPs act as conjuncts, as a key syntactic context. My reasons for this choice can be explained as follows. Diagnostics on polysemy, and with them diagnostics for metaphoric and literal readings, can be

[3] If *Marco went to the shop* is interpreted as Marco reaching a location and possibly returning after completing some tasks, then *for one hour* becomes acceptable. The accessibility of this interpretation tends to be speaker- and context-sensitive, so I leave aside a broader discussion (cf. Zwarts 2005:704–705 for discussion). I thank an anonymous reviewer for this example.

[4] Note: (4) with *one minute* was judged to be less acceptable than with *for one minute* (respectively, we had F=3.0 and F=3.9: see section 2 for clarification). Speakers nevertheless considered possible to use either version of the sentence to describe a scenario in which the troops were put under pressure. SPPs with metaphoric readings can distribute with either type of TAP, although with varying degrees of acceptability.

divided into two groups: the "definitional test" and the "logical test(s)" (see Riemer 2010:ch. 8 and references therein for discussion). The definitional test involves the formulation of distinct senses with different truth conditions, to account the interpretation of a set of sentences. The logical test involves the co-existence of distinct senses in syntactic contexts involving repetition or deletion (e.g., VP deletion, anaphoric relations, coordination). The so-called "definitional test" is often used in the cognitive linguistics literature (e.g., Evans and Tyler 2001, 2004). However, its application can easily result in the over-generation of possible senses (cf. Kearns 2006:560; Riemer 2010:ch. 5). The logical tests lack this problem, even if they can require specific extra-linguistic felicity conditions to be met, for the sentences to be fully interpretable.

Among the different logical test types, the coordination test is often employed for confirming the existence of multiple senses and sense *types* in lexical items (Kearns 2006:562–563; Asher 2011:ch. 3). This test comes in two slightly different versions, each with distinct empirical ranges. The first version says that a lexical item *qua* a head can be considered polysemous if (and only if) it is assigned two distinct senses, when it takes a coordinated phrase as an argument (e.g., the verb *play* in *play football and Hamlet*). This version can be used to test the polysemy of single lexical items. Instead, the second version can be used to test the polysemy of sense types for single lexical items. This is the case, since it tests the existence of distinct sense types in two lexical items (e.g., VPs in *lunch was delicious but took forever*, Asher 2011:ch. 1 and references therein). As we are concerned in discussing how distinct sense types can be assigned to and interact in SP(P)s, the second version of the coordination test seems a germane choice for our goals.

The combinations of distinct sense types for lexical items in coordinated phrases are known as *zeugmas*, or *zeugmatic* readings (cf. Murphy 2003:ch. 4; Riemer 2010:ch. 5). Zeugmas can be considered evidence for the existence of distinct readings for SPPs, via their ability to license two distinct senses in the verb they distribute with. Consider (5).

(5) Marco got through the tunnel and over his fears, finally.

In (5), the phrase *through the tunnel and over his fears* involves two conjoined SPPs, *through the tunnel* and *over his fears*. They denote a location and a mental state that Marco has passed, respectively corresponding to literal and metaphoric readings conjoined via *and*. Consequently, the verb *got* is assigned two distinct senses, one per

SPP complement (and reading) it distributes with.[5] In other words, if a verb is involved in the licensing of a literal and metaphoric reading, it is because each SPP conjunct carries one of the two readings. This, in turn, is a reflection of SPs carrying both types of senses.

These two problems suggest that literal and metaphoric readings in SP(P)s still present understudied aspects. At the same time, these two problems also offer a challenge for model-theoretic and cognitive frameworks alike. Model-theoretic analyses of SPs investigate lexical aspect (e.g., Zwarts 2005) and literal readings (e.g., Zwarts and Winter 2000), but fall silent on metaphoric readings. Cognitive linguistics analyses lack the tools to investigate lexical aspect, and the data below the sentential level (e.g., Evans and Tyler 2001; Evans 2006). Since they forsake precise syntactic analyses, they cannot pinpoint what the scope of each reading is (e.g., the SPP for basic metaphoric readings). Thus, a unified account of (1)–(5), and of our two problems with it, is still outstanding.

The goal of this paper is to offer a formal account of the syntax and semantics of SPs that can capture how these readings emerge and interact in a compositional manner. My solution aims to show that these readings are computed at different syntactic "steps", which determine the scope of each reading (aspectual, literal/metaphoric). Thus, my solution also aims to show that formal accounts are better suited to handle data involving "metaphors" than cognitive accounts, at least with respect to SPs' data. I pursue this goal in two steps. First, I present a wider set of data regarding these patterns (section 2). Second, I offer a syntactic and semantic account of these readings, couched in a basic variant of type-logical syntax and a rich type theory (e.g., Moortgat 2010; Asher 2011:sec. 3–4). I show that this unified account can capture the data in (1)–(5), and the ones in section 2. I then offer the conclusions.

2. Data and Previous Analyses

The goal of this section is to discuss the data in more detail (§2.1), before I discuss previous proposals and *desiderata* for a theory of SPPs (§2.2). Note that all the data were collected via elicitation tasks in which native speakers (N=21) were asked to evaluate each sentence on a Lickert scale of "acceptability", with values ranging from 1 (poor) to 5 (excellent). For each sentence, a simple context was offered that would allow participants to easily access the distinct readings associated to each item (i.e., felicity

[5] As Murphy (2003:ch. 4) observes, among others, zeugmatic readings are context-sensitive, and a sentence may become infelicitous if the two senses cannot be teased apart. However, once felicity conditions are met, zeugmatic readings can be safely considered as proof for polysemy.

conditions were met). For instance, (5) was used to describe a scenario in which Mario tries to overcome claustrophobia. I consider "uninterpretable" all sentences that were scored <2.0, and "deviant" sentences between 2.0 and 3.0. Thus, "acceptable" sentences are those examples being scored >3.0: intuitively, "good", but not necessarily "perfect" (i.e., F=5.0). For reasons of space, the sample presented here is non-exhaustive: a wider set of SPs was tested. The data nevertheless accurately present the problems.

2.1. The Data: Types of Readings and Their Relations

The goal of this subsection is to present a taxonomy of SPs' sense *types*, before discussing their syntactic scope and their relation to the two problems mentioned in the introduction.

The polysemy of SPs has been amply documented, with several studies focusing on single SPs (e.g., *at*, Herskovits 1986; *over,* Evans and Tyler 2001; *around*, Zwarts 2004; *in*, Vandeloise 2010). A general claim is that spatial/literal type of an SP represents its "central" or prototypical sense, and other senses the "peripheral" ones (cf. Lakoff's 1993 notion of "Idealized Conceptual Model"). Furthermore, model-theoretic works on SPs distinguish between *locative* and *directional* (spatial) types, with locative types being further distinguished between *projective* and *non-projective* types (Cresswell 1978; Jackendoff 1990; Kracht 2002). However, recent works observe that SPs can often have either reading in a context (e.g., Zwarts 2005; Gehrke 2008), as shown in (6)–(9).

(6) Marco was at the beach.

(7) Marco arrived at the beach.

(8) Tarma was sitting behind the desk.

(9) Tarma went behind the desk.

Thus, Marco could be *at* or arrive *at* the beach (as in (6)–(7)), and Tarma could sit or go *behind* the desk (as in (8)–(9)). Distinct types of literal senses can co-exist and can also percolate at an SPP level, as readings for these phrases.

The existence of metaphoric readings for SPPs has apparently been first proposed as a distinction between "factive" readings describing actual motion, and "fictive" readings describing non-actual, "idealized" motion (Langacker 1987:170–173; Talmy 2000:ch. 1, 6). Fictive readings are thus one sub-type of metaphoric reading. Metaphoric readings also include a sub-type of "state" readings, holding when a given entity can experience a certain state over time (Evans 2010). Some examples are in (10)–(12).

(10) Fio rose above her problems, and completed the mission easily.

(11) Fio left her problems behind.

(12) Fio was on standby for further orders.

In (10), the SPP *above her problems* describes a non-physical relation between Fio and her problems. Via the contribution of the sense of *rise*, we understand that Fio overcomes her problems, rather than physically move at a higher altitude than the problems' putative location. A similar reasoning applies to *her problems behind* in (11) and *on standby* in (12). Fio's problems become part of the past, and she spends time "on" a standby state. Distinct metaphoric readings for SPPs are connected to the related sense types of SPs.

Metaphoric and literal readings for SPPs as distinct readings, then, emerge from the polysemy of SPs. Their status as distinct readings can be also tested via two diagnostics that appear not to have been discussed, in relation to these data. First, SPPs can distribute with *Measure Phrases* (MPs), but only if they have a literal, projective reading (e.g., *in front of*: Zwarts and Winter 2000; Morzycki 2005; Svenonius 2008). Second, SPPs in anaphoric relations with indexicals *here* and *there* can only have literal readings (Creary, Gowron and Nerbonne 1987; Kayne 2004). If an SPP has a metaphoric reading, then a sentence (text) becomes uninterpretable. These patterns are shown in (13)–(14).

(13) The plane rose ten meters above the hill/#above the problems.

(14) Marco was sitting here, behind the table/#behind his fears.

In (14), the SPP *above the hills* describes a certain direction that a given plane follows when rising, and the MP *ten meters* describes the length of the relevant stretch of space. Since the SPP *above the problems* does not provide a length scale, but a state that the plane can overcome, it cannot distribute with the MP *ten meters*, lest the sentence be uninterpretable. A similar reasoning applies to (14). If *here* is anaphorically related to the location that *behind the table* denotes, then the sentence is interpretable. If *here* is related to Marco's state of being *behind his fears*, then it is uninterpretable. Thus, MPs and indexicals' data suggest that the distinction between these readings is linguistically real.

However, other syntactic structures seem to license metaphoric readings when MPs and indexicals interact with SPPs.[6] Crucially, however, these patterns emerge when SPPs act as sentence-final modifiers, as (15)–(18) show.

(15) Fio was floating ten meters off the ground, after Marco proposed.

(16) Fio was floating ten meters off the ground, using her anti-gravity boots.

(17) Marco was sitting here, under the weather.

(18) Tarma was waiting there, on standby for further orders.

In (15), Fio is understood to be in a heightened emotional state, rather than literally floating at a certain height, as a consequence of Marco proposing. In (16), however, Fio is understood to literally float at ten meters, thanks to her boots. As in the case of TAPs, sentence-final adverbial SPPs can modify the interpretation of the sentence they distribute with. In (17)–(18) the SPPs *under the weather* and *on standby for further orders* carry metaphoric readings that percolate at the sentential level. In each of these examples the metaphoric readings seem to emerge via the sentence-final adverbial phrase contributing either a literal or metaphoric reading to the whole sentence, a manner parallel to TAPs' contribution.

Since we now have a clearer picture of the "basic" types of senses/readings for SPs and their relations, we can discuss the first understudied set of data involving lexical aspect. The examples in (19)–(24) offer a broader picture, foreshadowed via (3)–(4).

(19) Marco went above the hill in one minute/for one minute.

(20) Marco rose above his problems in one minute/for one minute.

(21) Marco slept in the room #in one hour/for one hour.

(22) Marco was in love with Peach #in one year/for one year.

(23) Marco went into the pub in one hour/#for one hour.

[6] I thank an anonymous reviewer for mentioning (15) and (17) as potential counterexamples to my analysis. I believe that my account can handle these examples, but I leave the readers to be the judges.

(24) Marco looked into the problem in one minute/#for one minute.

Consider (19)–(20) first. *Above* is considered aspectually ambiguous, since it can license either a telic or an atelic reading, at an SPP level (respectively called *non-cumulative/cumulative* readings in Zwarts 2005, for instance). Thus, *above the hill* can distribute with the verb *has gone*, also ambiguous, and the corresponding VP can distribute with either telic *in one minute* and atelic *for one minute*. The same reasoning applies to *above his problems* in (20), even if this SPP also has an inherently metaphoric (state) reading. Consider now (21)–(22): *in*, as a mostly locative SP, has an inherently atelic reading when it distributes with DPs. This reading emerges with either literal readings (e.g., *in the room*, as in (21)) and with metaphoric readings (e.g., *in love*, as in (22)). A similar reasoning applies to telic, directional *into* and its distribution with TAPs in (23)–(24). Hence, these sense dimensions seem to have distinct syntactic scope, in their interaction with other parts of speech. Metaphoric/literal readings are computed within the scope of SPPs, while lexical aspect readings extend to the scope of VPs, or minimal clause structures.

The second set of understudied data is connected to zeugmatic readings in coordinated phrases. Metaphoric and literal readings can interact in coordinated phrases, a fact that has only been observed in passing (Lakoff 1993:438–439; Gentner and Bowdle 2008:111). I dub this type of coordinated phrases *Boolean SPs*, since they involve the Boolean connective *and* (cf. Partee and Rooth 1983; Winter 2001). Consider (25)–(28).

(25) Marco slept through the briefing and under the table, this afternoon.

(26) Marco was in the room and on standby for the call from the captain.

(27) Marco walked under the bridge and into danger.

(28) Marco walked out of his problems and into the car.

In (25), the two SPPs *through the briefing* and *under the table* describe a "briefing" event, and also the location during which Mario has slept. In (26), the SPPs *in the room* and *on standby* describe Marco's location and current "state", with the SPP having a literal reading as the first conjunct. In (27) and (28) a "path" that Marco covers (i.e., *under the*

bridge, *into the car*), is conjoined with a "state" that comes into being for Marco (i.e., *walks…into danger*, *out of his problems*).[7]

A prediction that emerges is that, if these distinct readings can be conjoined, then distinct lexical aspect readings can be conjoined, too. A specific case occurs when TAPs distribute with SPPs as clause-mates and partake in Boolean SPs, as shown in (29)–(32).

(29) Fio went out of the woods and into the cave in one minute/#for one minute.

(30) Fio waited in the room and on standby #in one hour/for one hour.

(31) Fio went out of the hut in/#for one minute and towards danger #in/for one hour.

(32) Fio went through this ordeal in/for one day and inside the cave in/for one hour.

In (29)–(32), TAPs act as sentence-final adverbs (cf. Morzycki 2005); they scope over the VP clause they distribute with. The SPP determines the aspectual reading of the VP, since *gone* is ambiguous (cf. Zwarts 2005). Hence, the Boolean SPs including *out of the woods* and *into the cave* SPPs can only distribute with telic *in one minute*, since *into* and *out of* are telic. This analysis also applies to atelic *in* and *on* in (26), distributing with *for one hour*. However, TAPs can also act as clause-mates of SPPs, as in (31)–(32) (e.g., *out of the hut in one minute* in (27)). This is possible if their distribution licenses an interpretable sentence. Conversely, the clause *towards danger in one hour* renders (31) uninterpretable. In both cases, TAPs match the lexical aspect of their clause-mate, as the examples show.

Let us take stock. The emergence of these distinct reading types is a phrasal "reflection" of the rich polysemy of SPs. Metaphoric and literal readings are distinct readings for SPPs but can be conjoined in Boolean SPs, thus licensing zeugmatic readings for these phrases. This fact is indirectly tested via the coordination test, which is used to test the interaction of these distinct readings in SPPs. This fact also suggests that these readings form a single semantic domain. Their emergence and interaction, in turn, is tightly connected to the syntactic structure of SPPs, and the clauses/sentences they are part of. Therefore, a compositional account of these data must capture these facts in a systematic way, by offering an analysis of the syntax and semantics of SPs

[7] Speakers were asked to evaluate the inverse orderings of conjuncts as well. In the case of (23), the order *under the table and through the briefing* was considered slightly worse (F=3.9) than the order in (23) (F=4.3). When a causal connection between the two conjuncts can arise, the presented conjunct order is unproblematic (e.g., F=4.4, 4.3 for (23)–(24)), while the inverse counterparts are interpretable but deviant (e.g., F=2.9, 2.8 for ((23)–(24)). If Marco walks, under the bridge, it is likely that he walks into danger.

and related phrases (e.g., TAPs). Before I offer such an account, I review previous relevant analyses on metaphoric and literal readings, thereby fully motivating my novel account.

2.2. Previous Analyses: An Overview, and Some *Desiderata*

Before offering my account, I discuss previous accounts of metaphoric readings and their possible shortcomings. *Conceptual Metaphor Theory* (CMT) contends that metaphors are mappings between partially unrelated conceptual domains. One conceptual domain (the *target* domain) is understood via the conceptual structure of a second domain (the *source* domain), and the mapping established between two domains (Lakoff and Johnson 1980; Lakoff 1993; Gibbs 2008; Steen 2011). Consider (33).

(33) Love is a journey.

According to CMT, *love* and *journey* are nouns (our DPs) that describe concepts belonging to distinct conceptual domains: emotions for *love*, and activities for *journey*. A mapping between these two domains is established, and the domain of emotions determines how the "new" interpretation of *love* emerges. If love is a journey, then lovers will be conceived as paired participants in this journey (Lakoff 1993:401–404).

Aside CMT, at least four other models of metaphors as forms of conceptual mapping and domain integration have been proposed. The first model is *interactive property attribution model* (Glucksberg 2001). The key assumption in this model is that metaphoric readings involve forms of *class categorization*, such as love belonging to the domain of (types) of journeys. The second model is *conceptual blending theory* (Fauconnier and Turner 2000, 2008). According to this model, sentences denote the union or "blending" of distinct conceptual domains. The domain *E* of events, the domain *X* of entities in space, the domain *C* of abstract concepts are such domains. The third model is the *structure mapping theory* of metaphor (Gentner 1988; Gentner and Bowdle 2008). The model assumes that metaphors involve mappings ("alignments") between conceptual domains, created via "greedy merge", a *syntactic* operation that merges lexical units into sentences, and aligns conceptual domains as (set) unions of their conceptual spaces.

The fourth model is *Lexical Conceptual Cognitive Model* (LCCM) (Evans 2006, 2010), which proposes an account of semantic "networks" underpinning lexical items as directed acyclic graphs. Thus, if *love* and *journey* include an "event" sense in their network, this sense emerges in *love is a journey*. Crucially, only LCCM analyses the polysemy of SPs such as *in*. According to this model, SPs can have distinct spatial and "state" senses. However, LCCM excludes the possibility that distinct senses of SPs can

co-exist. The senses of an SP form an acyclic directed graph, a "taxonomy" of senses that are mutually exclusive, and can thus not co-exist in a single sentence. A different but related cognitive linguistics proposal is found in Sinha and Kuteva (1995). This work suggests that spatial senses ("configurations", in the work) are "distributed" among the senses of verbs, DPs and SPs. As for LCCM, however, an account of Boolean SPs is not within the reach of this framework, given its lack of a fine-grained syntactic analysis.

Classical model-theoretic analyses, instead, take a pragmatic perspective, since they treat metaphors as conversational implicatures that allow speakers and hearers to "share" a non-literal meaning. This occurs when an extra-linguistic context licences them (e.g., Grice 1979; Black 1993; Sperber and Wilson 2008). This perspective is shown via (34).

(34) Love is not a journey, but an intense emotional experience.

In (34), the second clause, *but an intense emotional experience*, shows that negation, also a logical operator, blocks a literal interpretation. Love is not conceived as a stretch of space between two locations, but rather as an emotion that humans can experience. Modern, context-sensitive theories of metaphors build on these insights to offer semantic, compositional analyses of metaphoric and literal readings. Three main approaches can be identified. A first approach builds on dynamic semantics frameworks and suggests that the partial interpretation of a sentence defines a *linguistic* context of interpretation, for example, the second clause in (34) (Stern 2008, 2011). A second approach offers an analysis of DPs based on generalized quantifiers as sets of properties of individuals (van Genabith 1999, 2001). In (34), the senses of *love* and *journey* denote sets of properties, with one property (i.e., their status as "types" of eventualities) being under discussion.

A third approach is found in the *Generative Lexicon* framework (GL, Pustejovsky 1995:ch. 4, 2013). In GL, lexical items are associated to layered sense structures, known as *qualia*. A common noun such as *hammer* can include the senses types *physical_object* (physical property), *wood* (constituency), and *building_tool* (telos). Metaphoric readings emerge when the qualia structures of two items are merged, and coerced into a single structure. By means of an example, consider the sentence *Tarma is a fox*. Simplifying matters, if the quale structure of *fox* includes the property $\lambda x.\neg$***human'***$(x)\wedge$***cunning'***(x), only the property of being cunning is ascribed to Tarma (i.e. we have ***cunning'***(t)).

Conceptual Semantics (CS) represents a formal approach that is also related to cognitive linguistics analyses (Jackendoff 1983, 1990). Unlike other formal approaches, it offers an account of SPs and their distinct readings. In CS, lexical items denote *lexical*

Conceptual Structures (LCSs), which involve the combination of universal semantic categories (e.g., PLACE, PATH, THING, OBJECT). The LCS of a sentence is based on the combination of the LCSs of its constituents. Importantly, CS includes the *thematic relation hypothesis* (Jackendoff 1990:188). Heads denote relational LCSs that assign the same roles to their LCS arguments, irrespective of their type. This is shown in (35)–(36).

(35) a. Marco goes to the plane.

b. [Event Go [Path [Thing Marco] to [Place at [Thing car]]]]

(36) a. Marco belongs to the peregrine falcons.

b. [State Beposs [Path [Thing Marco] to [Place at [Thing peregrine falcons]]]]

The LCSs in (35b) and (36b) show that *to* denotes a relational LCS that involves a path function that takes a place function as its argument. The minimal difference is that the place-function takes two different types of "thing" concepts as arguments (i.e., cars as locations vs. groups of individuals), but licenses the same types of thematic relations. One problem with CS, though, is that it does not cover the types of data that we have discussed so far. Thus, the theory could account our data only if extended beyond its original reach.

Overall, cognitive and formal analyses alike treat literal and metaphoric readings as distinct if not mutually exclusive readings, even though contemporary model-theoretic works suggest that metaphoric readings are inherently compositional. Furthermore, only LCCM and CS analyse SPs in some detail. However, since neither framework/model attempts to discuss the semantic relations between these readings and lexical aspect, they lack the tools to handle our data. The framework I propose in the next two sections, then, aims to offer such a unified account.

3. The Proposal: Syntactic Assumptions and the Analysis

The goal of this section is to introduce the structures and derivational system (§3.1) for the analysis of the data (§3.2). The crucial concern is to show "when" the scope of each reading is computed, by showing at which derivational step readings emerge.

3.1. Syntactic Assumptions

Traditional generative analyses of SPs build on the syntactic analysis found in CS, and suggest that SPs include two syntactic positions (Jackendoff 1990; Wunderlich 1991;

Kracht 2002). Common labels are "Path" and "Place", with PlaceP being the complement of Path head. Other proposals suggest that Place is a morphological segment of Path (e.g., van Riemsdijk 1998; Emonds 2000). An intermediate position suggests that the Place head, or an SP with similar properties, sits in the specifier position of another SP head (Hale and Keyser 2002). Current cartographic proposals suggest that SPs involve complex hierarchies of functional heads (Asbury 2008; Svenonius 2010; den Dikken 2010). These four types of structures are shown in (37)–(38).

(37) a. [PathP from [PlaceP under [DP the sofa]]]

b. [PathP [Path [Place in-] -to] [the room]]

c. [SP [SP ahead] of [DP the car]]

(38) [DeixP [here] (Deix) [DegP [ten m.] (Deg) [PathP to [Place in [Axpart front [Kase of [DP the car]]]]]

The structure in (37a) presents the classical analysis with *from under the sofa,* while the structure in (38b) presents the "morphological" analysis. Instead, (37c) presents Hale and Keyser's (2002) "P-within-P" hypothesis, in which a first P appears to be embedded within a second P acting as the "main" head (*ahead*, *of*, respectively). In (38), we have a cartographic analysis, which includes the two silent heads Deg(ree) and Deix(is), treated as projections of the "SP field". Each morpheme making up the SP *in front of* projects a specific head: Kase for *of*, Axpart for *front*, Place for *in*, and the two silent heads Deg and Deix that allow the introduction of an MP (*ten meters*) and an indexical (*here*).

For my purposes, the "P-within-P" hypothesis appears the more empirically viable analysis, for at least three reasons. First, it allows us to give a homogenous, even if coarse-grained analysis of SPPs' structure. Second, Boolean SPs can be treated as (non-spatial) Ps including SPs as their arguments, as the "P-within-P" label suggests. This is in line with similar but more general treatments of coordinating prepositions (Emonds 2000; Romeu 2014:ch. 5; see Camacho 2003 for a different analysis). Third, it indirectly licenses a simple analysis of TAPs, at a sentential and phrasal level. It allows us to assume that a silent T head, a "variant" of a P head, takes a VP as a specifier and a TAP its complement (cf. Morzycki 2005:ch. 1). Sentence-final SPPs can receive a structurally isomorphic analysis, although they involve a distinct silent head "F". Consider (39).

(39) a. [TAP [VP [DP Marco] went [SPP into the shop]] (T) [for one hour]]

b. [VP [DP Marco] got [ConjP [SPP through the tunnel] and [SPP over his fears]]]

c.[ConjP [TP [SPP through this ordeal] in [DP one d.]] and [TP [inside...] in [one h.]]]

d. [FP [VP [DP Marco] is sitting [DeixP here]] (F) [spp under the weather]]

The structure in (39a), based on (3), illustrates the structure of (sentential) TAPs. The structure in (39b), based on (5), illustrates the structure of a Boolean SP, while the structure in (39c), based on (32), illustrates the structure of Boolean SPs involving SPPs distributing with TAPs. The structure in (39d), based on (17), shows how a VP can be the specifier of a silent head F, another variant of P, which introduces sentence-final SPPs. As the structures show, the "P-within-P" structures arise since different lexical categories (silent T and F, verbs in (39a–b), Boolean connectives) project an abstract two-place head, called "P" in Hale and Keyser's (2002) framework.[8] Note that, for reasons of space, I ignore the internal structure of each conjunct, also leaving aside an analysis of DPs' structures (but see Szabolcsi 2010:ch. 1–2; Elbourne 2013:ch. 2).

My choice of the P-within-P hypothesis and of a minimalist architecture of grammar has one specific consequence. The derivation of the syntactic structures underpinning the examples becomes a necessary pre-requisite for the analysis of how scope and semantic relations are established in an incremental way. From a theoretical perspective, then, it becomes useful to introduce a simplified variant of TLS (Type Logical Syntax) (Moortgat 2010; Morrill 2011; see also Ursini 2014, 2015a, forthcoming) as a tool to represent how these structures are derived. First, the use of TLS allows us to explicitly represent the valence of the different heads and phrases in our analysis in an explicit manner, and with them *merge* as a syntactic operation. Second, TLS allows us to compute the scope of the relations that SPs and TAPs denote, thus establishing "when" each reading is computed.

The reduced TLS system is based on the connectives "/" and "•" to respectively represent the *right division* and *product* operations (Moortgat 2010:sec. 2; Morrill 2011:ch. 1). Division is an *idempotent*, *binary*, *associative* operation, while product is also a *non-commutative* operation: product types are taken as ordered pairs of types. I leave aside other connectives, as I do not deem them necessary for the analysis (e.g., left division "\" in Morrill 2011). I use a simplified version of syntactic types: each phrase is assigned type $\boldsymbol{p}$, and each head is assigned type $\boldsymbol{p}/\boldsymbol{p}/\boldsymbol{p}$. The minimal set of rules is defined in (40).

[8] I remain neutral on whether F and T are distinct heads or "positions", thereby licensing the merge of different types of sentential adverbs. See Morzycki (2005:ch. 1–2) and references therein for discussion.

(40) a. *Given a Lexicon* $\boldsymbol{L}$, $\boldsymbol{p} \in \boldsymbol{L}$ *is a syntactic type* (Lexical type)

b. *If* $\boldsymbol{x}$ *is a type and* $\boldsymbol{y}$ *is a type, then* $\boldsymbol{x}/\boldsymbol{y}$ *is a type* (Type formation: Division)

c. *If* $\boldsymbol{x}/\boldsymbol{y}$ *is a type and* $\boldsymbol{y}$ *is a type, then* $(\boldsymbol{x}/\boldsymbol{y})\bullet\boldsymbol{y} \vdash \boldsymbol{x}$, $\boldsymbol{y}\bullet(\boldsymbol{x}/\boldsymbol{y}) \vdash \boldsymbol{x}$ (Merge: forward ap.)

d. *Nothing else is a type* (Closure rule)

Rule 1 defines type $\boldsymbol{p}$ as the building block on which more complex types are built. Thus, $\boldsymbol{p}$ can be said to be the type of "phrases". Rule 2 defines how more complex types are formed. Rule 3, *forward application*, defines how lexical items interact to form more complex structures (e.g., phrases, sentences). This rule says that adjacent *and matching* types are cancelled out. If two types do not match (e.g., we merge $\boldsymbol{x}/\boldsymbol{z}$ and $\boldsymbol{y}$), a derivation is said to *diverge* or *crash*. The three-place connective "⊢" says that, if we take two matching types as inputs and combine them, then we can prove that their result is an output of a certain type. Thus, forward application acts as one type of *merge* operation, although other schemas can be defined (cf. Stabler 1997). Rule 4 says that types can only be derived via these rules. By eschewing the use of other connectives, our derivations take a top-down direction. Thus, our system is consistent with psychological models of sentence production (Levelt 1989; Phillips 2006) and metaphor comprehension (Gentner and Bowdle 2008). More importantly, it permits us to handle the data at hand seamlessly.

To capture the cyclical nature of our derivations, I define a *pre-order* as the pair of an interval set *I*, and an *addition* operation '+', that is, <*I*,+>. This pre-order represents an i*ndex set*, which allows to represent the steps in a derivation as ordered elements. I implement two labels, *Lexical selection* (LS) and *Merge Introduction* (MI), to represent the selection of a lexical item and the merge of two elements, respectively. As it will become clear in the next section, by "proving" that two lexical items form a syntactic unit, we can compute the scope of the corresponding reading. I now turn to the analysis.

3.2. The Analysis: Type and Scope Assignment

I begin by presenting the type assignment in (41). Heads are assigned type $\boldsymbol{p}/\boldsymbol{p}/\boldsymbol{p}$: silent SPs, verbs, Boolean *and*, silent heads (cf. Hale and Keyser 2002:ch. 1's "P" type). Phrases are assigned type $\boldsymbol{p}$ (for "phrase"): DPs, SPs in specifier position, TAPs, derived SPPs:

(41) a. $\boldsymbol{p}/\boldsymbol{p}/\boldsymbol{p} :=$ *{and, (P), (T), (F), of, is, went, slept, …}*

b. $\boldsymbol{p} :=$ *{in, the kitchen, love, in the kitchen, in love, through the briefing, …}*

I can now start my analysis by offering a derivation of (1), repeated here as (42a), to illustrate how a sentence including an SPP is derived in the system introduced above. In doing so, I also begin my discussion of readings and their scopes. The derivation is shown in (42).

(42) a. Marco is in the kitchen.

b. *t.* [Marco$_{p}$] (LS)

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

t+2. [Marco$_{p}$]•[is$_{p/p/p}$]⊢[$_{p/p}$[Marco$_{p}$] is$_{p/p/p}$] (MI)

t+3. [in$_{p}$] (LS)

t+4. [$_{p/p}$[Marco$_{p}$] is$_{p/p/p}$]•[in$_{p}$]⊢[$_{p}$[Marco$_{p}$] is$_{p/p/p}$ [in$_{p}$]] (MI)

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

t+6. [$_{p}$[Marco$_{p}$] is$_{p/p/p}$ [in$_{p}$]]•[(P)$_{p/p/p}$]⊢
[$_{p}$[Marco$_{p}$] is$_{p/p/p}$ [$_{p/p}$[in$_{p}$] (P)$_{p/p/p}$]] (MI: Associativity)

t+7. [the kitchen$_{p}$] (LS)

t+8. [$_{p}$[Marco$_{p}$] is$_{p/p/p}$ [$_{p/p}$[in$_{p}$] (P)$_{p/p/p}$]]•[the kitchen$_{p}$]⊢
[$_{p}$[Marco$_{p}$] is$_{p/p/p}$ [$_{p}$[in$_{p}$] (P)$_{p/p/p}$ [the kitchen$_{p}$]]] (MI)

The derivation shows that the SPP *in the kitchen* is derived when *in*, initially merged as the complement of the copula (step *t+4*) becomes the specifier of the silent P head (steps *t+4* to *t+6*). Via associativity of merge, the silent P is merged as the head that takes *in* as its "P within P", hence forming an SPP once *the kitchen* is merged (steps *t+7*, *t+8*). Although we do not explicitly mark this fact via type notation, the point of attachment for the silent P is established via a form of feature matching: a silent (S)P only attaches to another SP. Hence, the SPP *in the kitchen* is assigned type ***p***, becomes a complement of the verb, and determines the scope of the corresponding literal reading.
I can now show how an SPP carrying a metaphoric reading can be derived. We thus repeat (2) as (43a) and offer a partial derivation in (43b).

(43) a. Marco is in love.

b. *t+8.* [$_{p}$[Marco$_{p}$] is$_{p/p/p}$ [$_{p/p}$[in$_{p}$] (P)$_{p/p/p}$]]•[love$_{p}$]⊢
[$_{p}$[Marco$_{p}$] is$_{p/p/p}$ [$_{p}$[in$_{p}$] (P)$_{p/p/p}$ [love$_{p}$]]] (MI)

The crucial difference between (38b) and (39b) is that a DP denoting a mental state (*love*) is merged to form an SPP. Since this DP triggers the metaphoric reading, the scope of this reading corresponds to the SPP that is derived via merge, as in the case of (38a).

The next derivations I discuss analyse how TAPs are merged with VPs, as skeletal clausal sentences, and license specific aspectual readings at a sentential level. Consider (3), repeated here as (44a), and the partial derivations in (44b–c).

(44) a. Marco went to the shop in one hour/#for one hour.

b. *t+8*. [$_{p}$ Marco went to the shop] (MI)
t+9. [(T)$_{p/p/p}$] (LS)
t+10. [$_{p}$ Marco went to the shop]•[(T)$_{p/p/p}$]⊢
[$_{p/p}$[$_{p}$ Marco went to the shop](T)$_{p/p/p}$] (MI)
t+11. [$_{p}$ in one hour] (LS)
t+12. [$_{p/p}$[$_{p}$ Marco went to the shop](T)$_{p/p/p}$]•[$_{p}$ in one hour]⊢
[$_{p}$[$_{p}$ Marco went to the shop](T)$_{p/p/p}$[$_{p}$ in one hour]] (MI)

c. *t+12*. [$_{p/p}$[$_{p}$ Marco went to the shop](T)$_{p/p/p}$]•[$_{p}$ for one hour]⊢
[$_{p}$[$_{p}$ Marco went to the shop](T)$_{p/p/p}$[$_{p}$ for one hour]] (MI)

The derivation in (44b) shows that the silent head T takes two phrases, a VP and TAP, as its argument phrases. Since it establishes a relation between the senses of these two phrases, the eventual mismatch in lexical aspect value between these phrases can render a sentence uninterpretable, as in the case of (44c). Since the lexical aspect contribution of the SPP is "exhausted" within the scope of the VP, it does not interact with the TAP. Thus, so far we have a proof of the scope of literal and metaphoric readings as emerging (at least) at the SPP range, as seen in (42)–(43). We also have a precise proof on why lexical aspect readings have a sentential scope (i.e., the VP assigned type $\boldsymbol{p}$), as shown in (44).

With these results in mind, I move to the discussion of the Boolean SP examples. For this purpose, I repeat (25) as (45a), and offer its partial derivation in (45b).

(45) a. Marco slept through the briefing and under the table, this afternoon.

b. *k*. [$_{p}$ through the briefing] (MI)
k+1. [and$_{p/p/p}$] (LS)
k+2. [$_{p}$ through the briefing]•[and$_{p/p/p}$]⊢
[$_{p/p}$[$_{p}$ through the briefing] and$_{p/p/p}$] (MI)
k+3. [$_{p}$ under the table] (LS)
k+4. [$_{p/p}$[$_{p}$ through the briefing] and$_{p/p/p}$]•[$_{p}$ under the table]⊢
[$_{p}$[$_{p}$ through the briefing] and$_{p/p/p}$[$_{p}$ under the table]] (MI)

The derivation in (45b) shows that the scope of each literal/metaphoric reading, being bound to an SPP, can be conjoined with the reading(s) of the other conjunct. This indirectly predicts that, when a TAP is merged with an SPP, each complex conjunct determines the scope and interpretability of each lexical aspect reading. I repeat (29) as (46a) to illustrate this point, and offer partial derivations for these examples in (46b–c).

(46) a. Fio went through this ordeal in/for one day and inside the cave in/for one hour.

b. *k.* [$_{p}$ through this ordeal] (LS)
k+1. [(T)$_{p/p/p}$] (LS)
k+2. [$_{p}$ through this ordeal]•[(T)$_{p/p/p}$]⊢
[$_{p/p}$[$_{p}$ through this ordeal] (T)$_{p/p/p}$] (MI)
k+3. [$_{p}$ in one day] (LS)
k+4. [$_{p/p}$[$_{p}$ through this ordeal] (T)$_{p/p/p}$]•[$_{p}$ in one day]⊢
[$_{p}$[$_{p}$ through this ordeal] (T)$_{p/p/p}$[$_{p}$ in one day]] (MI)

c. *k.* [$_{p}$ through this ordeal (T) in one day] (MI)
k+1. [and$_{p/p/p}$]
k+2. [$_{p}$ through this ordeal…]•[and$_{p/p/p}$]⊢
[$_{p/p}$[$_{p}$ through this ordeal…] and$_{p/p/p}$] (MI)
k+3. [$_{p}$ inside the cave in one hour] (LS)
k+4. [$_{p/p}$[$_{p}$ through this ordeal in…] and$_{p/p/p}$]•[$_{p}$ inside the cave in one…]⊢
[$_{p}$[$_{p}$ through this ordeal…] and$_{p/p/p}$[$_{p}$ under the cave…]] (MI)

The derivation in (46b) shows how a TAP can be merged with an SPP. In my analysis, both phrases are of type ***p***, hence possible arguments of the silent head T. Consequently, the lexical aspect of an SPP can be matched with that of a TAP, within the scope of this phrase. This occurs whether an SPP has a literal or metaphoric reading, since these readings do not scope beyond the SPP range. Thus, we have a proof that these types of readings can co-exist, when they appear in the scope of Boolean SPs' conjuncts.

Overall, the discussion of syntactic data here has shown that the scope of the readings in our examples can be computed in a systematic way. Metaphoric and literal readings are thus computed within the scope of SPPs, a fact that explains why lexical aspect readings, which are computed at distinct scopes (VP, "extended" TPs as in (46b–c)), do not interact with these readings. This holds for Boolean SPs as well; their conjoined readings belong to an (extended) SPP scope.

Another important aspect is that the analysis outlined in (46) can be extended to examples (15)–(18). The *proviso* for this extension is that the silent functional head F

licenses the structure of these sentences as involving a "skeletal" VP and an SPP as arguments of this head. I repeat (16) as (47a) and (17) as (48a) to illustrate this point.

(47) a. Fio was floating ten meters off the ground, after Marco proposed.

b. *k*+4. $[_{p/p}[_{p}$ Fio…off the ground] $(F)_{p/p/p}]\bullet[_{p}$ after Marco proposed]$\vdash$
$[_{p}[_{p}$ Fio…off the ground] $(F)_{p/p/p}[_{p}$ after Marco proposed]] (MI)

(48) a. Marco is sitting here, under the weather.

b. *k*+4. $[_{p/p}[_{p}$ Marco is sitting here] $(F)_{p/p/p}]\bullet[_{p}$ under the weather]$\vdash$
$[_{p}[_{p}$ Marco is sitting here] $(F)_{p/p/p}[_{p}$ under the weather]] (MI)

The derivations in (47b) and (48b) show that the SPPs contributing a metaphoric reading, *after Marco proposed* and *under the weather*, have a sentential scope in virtue of their merging point. Hence, even if the clauses they merge with have a literal reading, the resulting sentence can be "re-interpreted" as having a metaphoric reading.

Overall, the type-logical analysis offered in (42)–(48) can offer formal proofs of the scope of each distinct reading discussed so far, whether they are literal/metaphoric or aspectual. Hence, it can already cover a broader empirical ground than previous proposals discussed in §2.2. For instance, CMT (e.g., Steen 2011) refrains from contemplating an analysis of syntactic structures, since the framework does not postulate a syntactic level of linguistic representations. Consequently, the possibility that the interaction of these readings can be precisely discussed becomes vanishingly small. A similar problem emerges in LCCM (Evans 2009) and GL (Asher and Pustejovsky 2013), and in other theories that lack thorough syntactic underpinnings.

On the other hand, my account avoids this problem, and also improves over previous integrated accounts of SPs (e.g., the CS account in Jackendoff 1983, 1990). This is the case, since it provides a more thorough assessment on the structure of SPPs. By looking at the fine-grained structure of SPPs and how *merge* derives these structures, we can assess how and when these distinct readings emerge in a compositional manner. I show why this is the case in the next section.

4. The Proposal: Semantic Assumptions and Analyses

The goal of this section is to present the semantic framework for the analysis (§4.1), before offering my account on how the distinct readings emerge (§4.2).

4.1. The Proposal: Type Theory and Analysis

The literature on the semantics of SPs offers several proposals on the ontological status of their denotations. Formal proposals include regions (Nam 1995; Kracht 2002), vectors (Zwarts and Winter 2000), paths for directional SPs (Jackendoff 1983, 1990; Zwarts 2005), eventualities (Landman 2000), and mappings between these domains (Krifka 1998; Gehrke 2008). Cognitive linguistics proposals suggest that metaphoric readings involve states (Evans 2006, 2010) or events (Lakoff 1993; Fauconnier and Turner 2008), associated to the individuals or concepts involved. Our discussion of the data suggests that literal and metaphoric readings are distinct *types* that can emerge and co-exist in Boolean SPs. Once we also consider aspectual readings, it is obvious that the analysis needs two components: a flexible theory of types, and an accurate but concise treatment of lexical aspect.

For these reasons, I assume that all parts of speech find their denotation in a universal type of *discourse referents*, borrowing a label from Discourse Representation Theory (DRT) (Kamp, van Genabith and Reyle 2011:ch. 0, 4). I then assume that the type of referents can have atomic types, such as individuals of type *d*, eventualities of type *e*, and locations of type *l*. Crucially, complex types can be formed as the union of these atomic types, and as part of the referents' domain. I treat events *e* as *sum* types of (at least) individuals *d* and locations *l*.[9] I conceive events not as primitives, but made of spatio-temporal locations and participants (cf. Krifka 1998; Asher 2011:ch. 4; Kamp, van Genabith and Reyle 2011:ch. 4); hence, they are defined as *structured referents*, referents that can include other types of referents, and corresponding relations, in their denotation.

One way to make the notion of structured referent precise is to spell out this use of events. In my account, an event is treated as a spatio-temporal unit or "index" in which some relation holds. Part of the elements making up this relation, then, are the individuals and locations involved in this spatio-temporal unit. To an extent, events as structured referents encapsulate and "record" the information that relations convey. *Qua* referents, they can be involved in various types of anaphoric relations (e.g., temporal and spatial relations, viz. examples with indexicals). Events, in this perspective, allow us to refer to relations, relations between relations, and their constituting elements as distinct referents or objects in discourse, with their corresponding types.

My perspective is similar to DRT and variants of event semantics that treat events as complex descriptions of facts (cf. Kamp, van Genabith and Reyle 2011 and Landman 2000, respectively). My analysis is also consistent with situation semantics, which

[9] Here I gloss over the temporal aspect of events and preposition senses. See Kracht (2002) for further discussion.

discusses situations as involving structural relations with their arguments (e.g., von Fintel 1994; Barwise and Perry 1999). Ontological proposals sketched in cognitive linguistics works take a similar stance, as they suggest that events/states are associated to metaphoric readings (e.g., Fauconnier and Turner 2008; Evans 2009). The intuition that I pursue in my account, then, is that the type of events is assigned to relations that involve referents belonging to distinct types, and are thus "blended" into a common semantic domain.

Let us make these intuitions formally precise, before addressing this aspect. We have a *Boolean Algebra* of types, ordered by the *part-of* relation: the triple $S=<T=\{L,D,\ldots\},\cup, \leq>$), with T our set of atomic referent types, "$\cup$" a sum operation and "$\leq$" a partial order on types. The rules of type-formation defined over this structure are as in (49).

(49) a. *Given a set S, $s \in S$ is a semantic type* (Lexical type)

b. *If a is a type and b is a type, then $a \rightarrow b$ is a type* (Type form.: functional type)

c. *If $a \rightarrow b$ is a type and b is a type, then $(a \rightarrow b) \times a \vDash b$* (Function application)

d. *Nothing else is a type* (Closure property)

These rules mirror in the semantic component the syntactic rules that we defined in (40), a point that I explain in more detail in the next few paragraphs. These rules include the (ternary) operator "$\vDash$", which is the semantic counterpart of "$\vdash$". If "$\vdash$" represents the relation between two syntactic inputs and their output, then "$\vDash$" represents the relation between the semantic interpretations of inputs and their output. The rules work as follows. Rule 1 defines the basic semantic type of referents, while rule 2 defines complex types via function abstraction. Rule 3 shows, instead, how these types interact via *function application*, the semantic counterpart of merge (Moortgat 2011:§2.2–2.3). Rule 4 says that no other rules of other type formation are employed, in our system.

By employing a Boolean approach, we can define the structure of these types and their relations. The sum of two types is defined as $a \cup b = \cup\{a,b\} = c$: the sum of two types a and b is a third, distinct type c. We can also define the part-of relation, represented as "$a \leq b$", which reads: "a is part of b". If a is part of b, then $(a \wedge b) = a$ and $(a \vee b) = b$. In words, if a type is part of (accessible to) another type, then their union will be the super-set type, and their intersection the sub-set type.

Since we employ the single semantic type s, which mirrors the single syntactic type $\boldsymbol{p}$, we have a type system that does not employ truth-values (cf. Chierchia and Turner 1988; Partee 2009). This is also consistent with cognitive and formal frameworks

that consider metaphoric readings as not involving veridical information (e.g., Gentner 1988; Steen 2011). Furthermore, "rich" type theories take a similar stance (e.g., situation semantics: von Fintel 1994; Barwise and Perry 1999; type theory with records: Cooper 2005). These formal theories assume that relations between lexical items and their senses can be captured as relations among their sense types, although they do not investigate the readings at stake in our discussion. Furthermore, the use of Boolean algebras for types brings my analysis close to GL (e.g., Pustejovsky 1995) and type composition logic (Asher 2011). These theories, however, start from a different universal type (entities *e*), and do not assume that the domain of types necessarily forms a Boolean algebra.

A more thorough discussion of such parallels would lead us too far afield, so I leave it aside. The most relevant aspect of this approach is the relation between syntactic and semantic types. In TLS, syntactic types are mapped onto semantic types and standard interpretations via type isomorphism (e.g., Moortgat 2011:96), as shown in (50).

(50) SYNTAX⇒SEMANTICS⇒INTERPRETATION

$\boldsymbol{p} \Rightarrow s \quad \Rightarrow s_l,\ s_d,\ s_c{:}(a_c \leq b_c),\ s_c{:}(x_a \leq y_b)$

$\boldsymbol{p}/\boldsymbol{p}/\boldsymbol{p} \Rightarrow s \rightarrow (s \rightarrow s) \quad \Rightarrow \lambda x.\lambda y.s_a{:}(x_a \leq y_a),\ \lambda x.\lambda y.s_c{:}(x_a \leq y_b)$

The semantic type *s* corresponds to the interpretation of the type $\boldsymbol{p}$, and can denote referents belonging to any sub-type (e.g., s_l). The semantic type $s \rightarrow (s \rightarrow s)$ corresponds to the interpretation of type $\boldsymbol{p}/\boldsymbol{p}/\boldsymbol{p}$, and denotes a relation between two referents, which in turn corresponds to a third referent (i.e., s_c in line 2). Since we are not using truth-values, saturated relations are mapped onto "structured" discourse referents *s* (cf. Cresswell 1985), such as spatial relations, rather than truth-values (i.e., we have $s_c{:}(a \leq b)$, rather than $(a \leq b)_t$).

This treatment of complex referents has one interesting consequence. As the definitions entail, every referent in a model is part of a type (domain): we have *a*≤*type* or *type(a)*. Hence, a relation between two referents also involves a relation between the referents' types. If the part-of relation *a*≤*b* holds, then the relation *type(a)*≤*type(b)* holds, too, with a special case if identity between referents holds (i.e., *type(a)*=*type(b)*). The types of arguments determine the type of a structured referent and its matching relation. For instance, if the interpretation of an SPP such as *in the kitchen* corresponds to a relation between locations (a kitchen *b* and its internal part *a*, i.e., $a_l \leq b_l$), then the type of its argument *a* must be included in, if not equal to the type of its argument *b*. Since *s* is the referent corresponding to this relation (i.e., we have $s{:}(a \leq b)$), the type of *s*

must correspond to the type of this relation, that is, *l*. The type of a structured referent and the arguments of its matching relation are logically related.

One important consequence of having these type relations is defined as follows. If $s{:}(a_a{\leq}b_a)$ is a (part-of) relation between referents, then the structured referent *s* will *inherit* the type *a* (i.e., we have s_a), the type associated to the relation between *a* type referents. TLS's *monotonicity* inference rule works in a similar manner but on syntactic types (i.e., heads and phrases: Moortgat 2011:111). Type *accommodation* (semantic) principles in type composition logic and GL work in a similar manner (Asher 2011 and Asher and Pustejovsky 2013, respectively). Thus, I label this type inheritance principle as "monotonicity", to use a more theory-neutral label.

From a formal perspective, monotonicity works as follows. If we have *a* of type *l* and *b* of type *l*, and $s{:}(a_l{,}{\leq}b_l)$, then *s* will be of type *l*. We have $type(s){=}(type(a{\leq}b))$, given the equations $type(s){=}((type(a){\cap}type(b){=}l{\cap}l)$ and $(type(a){\cup}type(b){=}l{\cup}l)))$. If we have *a* of type *l* and *b* of type *d*, and $s{:}(a_l{\leq}b_d)$, then *s* can only be defined if its arguments are "raised" to a complex type defined as their sum (i.e., $type(a){\cup}type(b){=}e$ and $type(a){\cap}type(b){=}\emptyset$). A relation between an individual and a location can be defined insofar as the type of the relation (and its arguments) is raised to their sum type. If we have a_l, then the type-raise operation $raise(type(s)){=}type(a){\cup}type(b)$ licenses this metaphoric reading, raising the type of arguments, relation and structured referent (to *e*, in this case). The resulting type assignment/type raising system is summarized in (51).

(51) $type(s){=}type(a_\sigma{\leq}b_\delta){=}$

1. δ, *iff* $\sigma{=}\delta$, $\sigma, \delta \in S$;
2. $raise(s){=}\sigma{\cup}\delta{=}\eta$, *iff* $\alpha{\neq}\delta$. $\eta \in S$.

Under this analysis, metaphoric readings involve the union or "update" of the type of a relation to include the types of its related arguments, via monotonicity. A similar proposal has been offered in cognitive linguistics studies, although not from a model-theoretic perspective (cf. Gentner's 1988 "greedy merge"; Fauconnier and Turner's 2000, 2008 notion of "blend"). More fine-grained analyses of type-shifting operations can be found in the literature, whether they involve literal or metaphoric readings (e.g., Partee and Rooth 1983; Winter 2001; Asher 2011; Pustejovsky 2013).[10] The crucial aspect of this proposal is that it allows us to account of the data, as I show in the next section.

[10] Note that *raise* also applies to arguments of a given relation. For instance, if we have $a_l{\leq}b_d$, via *raise* the arguments of this part-of relation are typed as events (i.e., we have $a_e{\leq}b_e$). In my derivations I only show how *raise* applies to structured referents *s*, in order to underline that metaphoric readings involve relations between lexical items with different sense types, but unified into a common semantic domain. See also Ursini and Giannella (forthcoming), for discussion.

4.2. The Proposal: The Analysis of the Data

I begin my analysis by first spelling out how we represent lexical aspect. In recent works on SPs (Krifka 1998; Zwarts 2005; Gehrke 2008), lexical aspect has been connected to their property to have cumulative denotation. For instance, in Krifka (1998) cumulativity is defined as a meta-property of *n*-ary predicates: $+CM(P_{\sigma})$ represents a predicate that has cumulative denotation (with σ a functional type). Since I assume that SPPs and VPs denote structured referents standing proxy for a relation, cumulativity can be represented as an operator binding these referents. We have ±*CM*.(s), or simply ±*CMs*: cumulativity acts as an aspectual operator on event referents (cf. *PROG(e)),* for progressive aspect in Kamp, van Genabith and Reyle 2011:ch. 4 and works therein).[11]

This notation can be used to represent a property of the relation that a referent stands for. The notation *+CM(s):R(a,b)* represents a relation as having cumulative denotation, and having non-cumulative denotation otherwise (i.e., *–CM(s):(R(a,b)*).). For reasons of simplicity, I use "–" to represent negation (i.e., "¬"), while "+" represents identity: we have "*+CM=CM'*". I can now offer a semantic type assignment in (52), and offer a fragment with sample senses for lexical items in (53).

(52) a. $s\rightarrow(s\rightarrow s)$*:={and, (P), (T), of, is, has gone, has slept,…}*

b. *s:={in, the kitchen, love, in the kitchen, in love, through the briefing,….}*

(53) a. [[in]]$\vDash in_l$, [[the kitchen]]$\vDash k_l$, [[in the kitchen]]$\vDash +CMs_l:(in_l \leq k_l))$

b. [[is]]$\vDash \lambda x.\lambda y.s:(x\leq y)_{s\rightarrow(s\rightarrow s)}$, [[and]]$\vDash \lambda x.\lambda y.s:(x\wedge y)_{s\rightarrow(s\rightarrow s)}$,
[[(T)]]$\vDash \lambda x.\lambda y.s_s:(x=y)$, [[(P)]]$\vDash \lambda x.\lambda y.+CMs:(x\leq y)_{s\rightarrow(s\rightarrow s)}$

In the assignment in (52), heads are interpreted as denoting relations, and phrases as denoting either simple or structured referents.[12] The fragment in (53), instead, offers some interpretations for lexical items based on their minimal or literal type. Hence, we assign type *l* to DPs denoting objects conceived as locations (here, *the kitchen*), in (53a). While *the kitchen* can be substituted by *here* (*Marco is in here*), *Marco* cannot, thus suggesting that these DPs have distinct semantic types (cf. Creary, Gowron and Nerbonne 1987; Kayne 2004). The type of a relation is computed via the type of its

[11] We would thus have the logical equivalence: $+CUM(s):R(x,y,s)\leftrightarrow \forall x.\forall y.\forall z.(X(x,z)\wedge X(y,z)\wedge X(x\vee y,z))$, with "±'"being the sum operation "∨". See Krifka (1998); Ursini (2015b) for further details.

[12] I leave aside the interpretation of temporal morphology on verbs, as it does not play a relevant role in the discussion of our examples. As a result, the copula and silent Ps appear to have the same interpretation.

arguments, as (51) indirectly shows. Thus, a silent P is inherently polysemous (i.e., its output type is the "general" s), as it must still compose with its arguments and their types. Also, I assume that silent T establishes an identity between an event and its relation (cf. Morzycki 2005), and silent P a relation between a landmark object and one part of the "space" defined with respect to it.

Let us now turn to the examples. I start with the interpretation of (42b), offered in (54).

(54) *t*. [[Marco]]$\vDash m_d$ (Int)

t+1. [[is]]$\vDash \lambda x.\lambda y.s\!:\!(x \leq y)_{s\rightarrow(s\rightarrow s)}$ (Int)

t+2. ([[Marco]])×[[is]]$\vDash \lambda x.\lambda y.s\!:\!(x \leq y)_{s\rightarrow(s\rightarrow s)}(m_d)=\lambda y.s\!:\!(m_d \leq y)_{(s\rightarrow s)}$ (FA)

t+3. [[in]]$\vDash in_l$ (Int)

t+4. [[Marco is]]×([[in]])$\vDash \lambda y.s\!:\!(m_d \leq y)_{(s\rightarrow s)}(in_l)=s_e\!:\!(m_d \leq in_l)$ (FA, Mon.)

t+5. [[(P)]]$\vDash \lambda x.\lambda y.{+}CMs'\!:\!(x \leq y)_{s\rightarrow(s\rightarrow s)}$ (Int)

t+6. [[Marco is in]])×[[(P)]]$\vDash (s_e\!:\!(m_d \leq in_l))\lambda x.\lambda y.{+}CMs'\!:\!(x \leq y)_{s\rightarrow(s\rightarrow s)}=$

$(s_e\!:\!(m_d \leq ((in_l)\lambda x.\lambda y.{+}CMs'\!:\!(x \leq y)_{s\rightarrow(s\rightarrow s)})=(s_e\!:\!(m_d \leq (\lambda y.{+}CMs'\!:\!(in_l \leq y)_{(s\rightarrow s)})$ (A; I)

t+7. [[the kitchen]]$\vDash k_l$ (Int)

t+8. [[Marco is in (P)]]×([[the kitchen]])$\vDash s_e\!:\!(m_d \leq ({+}CMs'\!:\!\lambda y.(in_l \leq y))_{(s\rightarrow s)}(k_l)=$

$s_e\!:\!(m_d \leq ({+}CMs_s'\!:\!(in_l \leq k_l))=$ (Associativity)

$s_e\!:\!(m_d \leq ({+}CMs_l'\!:\!(in_l \leq k_l))$ (FA, Monotonicity)

From steps *t* to *t+6*, we derive the partial VP *Marco is in (P)*, a VP that introduces a relation between the individual Marco and his current location, the internal part of a yet to be specified landmark object (i.e., the kitchen). A more thorough analysis of its geometrical sense could be formulated (cf. Zwarts and Winter 2000), but it is not crucial, for our purposes. This relation holds during an event s_e, although the label "state" may be more descriptively adequate in these cases. Note that, since I omit temporal morphology, this event referent appears free, but a suitable temporal operator can render it bounded, thereby avoiding ill-formed logical forms.[13]

From steps *t+6* to *t*+8, the ground DP *the kitchen* is interpreted as the spatial referent k_l and composed with the SPP, via associativity. The referent that *in the kitchen*

[13] Another aspect that plays a role at the steps *t+1* and t+4 is that copula and argument merge via *type accommodation*, and operation that "lowers" the type s to its sub-types d and l, in this case. While derivations require objects to be of matching type, principles such as accommodation and monotonicity handle the composition of sub-types within a domain. See Asher (2011:ch. 2–3) for discussion on this topic.

denotes is a spatial relation (type *l*), since it establishes a (cumulative) relation between locations, via monotonicity, a "literal reading" emerges, as the type of this relation. The "lexical aspect" reading, instead, corresponds to whether this relation has cumulative denotation or not, and is thus a distinct reading. Once this structured referent becomes the argument of the copula, the relation between two arguments of distinct types (an individual *d* and a location *l*) is mapped onto their sum type *e* of events. The full VP type, being distinct from that of its arguments, has a "metaphoric" reading. Marco is not literally the internal "part" of the kitchen. Rather, he is occupying this location during a certain event.

This apparently surprising result can be fully appreciated and motivated once we offer the interpretation of (43b) in (55), in abbreviated form:

(55) *t+8.* [[Marco is in (P)]]×([[love]]) $\vDash s{:}(m_d{\leq}(+CMs'{:}\lambda y.(in_l{\leq}y))_{(s\rightarrow s)}(l_d)=$

$s{:}(m_d{\leq}(+CMs'{:}\lambda y.(in_l{\leq}y))_{(s\rightarrow s)}(l_d))=s{:}(m_d{\leq}(+CMs_e'{:}(in_l{\leq}l_d))=$ (Associativity)

$s_e{:}(m_d{\leq}(+CMs_e'{:}(in_l{\leq}l_d))$ (FA, Monotonicity, type raise)

This derivation says that the SPP *in love* denotes the love emotion as the state that Mario is part of. While *in* denotes a location *l*, *love* denotes a type *d* referent, for instance a "kind" of emotion (cf. Chierchia and Turner 1988 on kinds). The type-shifting operation *raise* computes the type of the structured referent *s'* (i.e., we have *raise(type(s))=type(in)∪type(l)=d∪l=e*). In other words, This SPP has a "metaphorical" reading because its arguments are initially assigned distinct types, but their relation to their minimal sum type that includes both: events, as established via monotonicity.[14]

Now that we have solved this matter, we can address lexical aspect matters. For simplicity, I assume that TAPs denote structured referents, and have non-cumulative (*in X time*) or cumulative denotation (*for X time*). The simplified interpretations are *–CMs$_e$:(in-h)*, and *+CMs$_e$:(for-h)*, respectively. The composition of ambiguous *gone* with telic *to the shop* yields a non-cumulative VP; however, since we offer a compressed derivation, we leave a fully compositional treatment aside.[15] Consider (56a–b).

[14] Cf. again footnote 10 for discussion on how we represent *raise* and types.

[15] Since I assume that silent P is cumulative, *to* can be the specifier P that restricts this relation to one only including atomic (non-cumulative) locations/paths. Space reasons prevent me from discussing how a fully compositional treatment, based on Zwarts (2005) and related analyses, can be imported in my account.

(56) a. *t+8*. [[Marco went to the shop]]⊨*–CMs$_e$:**go′**(m,s$_l$′:(to≤sh))* (FA)

t+9. [[(T)]]⊨$\lambda x.\lambda y.s_s:(x=y)_{s\rightarrow(s\rightarrow s)}$ (Int)

t+10. [[Marco went to the shop]]×[[(T)]]⊨

*–CMs$_e$:**go′**(m,s$_l$′:(to≤sh))*$\lambda x.\lambda y.s:(x=y)_{s\rightarrow(s\rightarrow s)}$=$\lambda y.s:(CMs_e$:**go′**$(m,s_l'$:(to≤sh))=y)$_{s\rightarrow s}$

t+11. [[in one hour]]⊨*(–CMs:(in-h))*$_s$ (Int)

t+12. [[Marco has gone to the shop (T)]]×[[in one hour]]⊨

$\lambda y.s:(-CMs_e$:**go′**$(m,s_l'$:(to≤sh))=y))$_{s\rightarrow s}\times$((*–CMs:(in-h)*)$_s$)=

s_s:(*–CMs$_e$:**go′**(m,s$_l$′:(to≤sh))=(–CMs$_e$:(in-h)))* (FA, Monotonicity)

b. *t+12*. [[Marco went to the shop (T)]]×[[for one hour]]⊨

$\lambda y.s:(-CMs_e$:**go′**$(m,s_l'$:(to≤sh))=y))$_{s\rightarrow s}\times$((+CMs$_s$:(for-h)))=# (Der. Unint.)

In (56b), an event of going corresponds to a relation between Mario and a shop destination (i.e., the spatial relation exemplified by the referent *s$_l$′*). This relation lacks cumulative denotation: an event of going "to" the shop cannot include sub-events of going that also end at the shop. This event is identified with an event lasting one hour, and lacking any sub-events as well, by step *t+12*. If the lexical aspect values of VP and TAP do not match, as (56b) shows, then a sentence is uninterpretable. This fact, as the derivation shows, holds irrespective of the type of referent that an SPP, or a VP for that matter, denotes.

We can now address the Boolean SPs data, starting with the interpretation of (44) in (57). For the sake of clarity, I introduce consonant variables (e.g., *b*, *d*) to mark structured referents:

(57) *k*. [[through the briefing]]⊨*s$_e$:(tr≤bf)* (FA)

k+1. [[and]]⊨$\lambda x.\lambda y.b:(x\wedge y)_{s\rightarrow(s\rightarrow s)}$ (Int)

k+2. [[through the briefing]⊨[[and]]⊨*(s$_e$:(tr≤bf))*$\times\lambda x.\lambda y.b:(x\wedge y)_{s\rightarrow(s\rightarrow s)}$=

$\lambda y.b_s:(s_s$:(tr≤bf)$\wedge y)_{s\rightarrow(s\rightarrow s)}$ (FA)

k+3. [[under the table]]⊨*d$_l$:(un≤tb))* (FA)

k+4. [[through the briefing and]×[[under the table]]⊨

$\lambda y.b:(s_e$:(tr≤bf)$\wedge y)_{s\rightarrow s}\times(d_l$:(un≤tb)))=$b_l$:($s_e$:(tr≤bf)$\wedge d_l$:(un≤tb))) (FA, Monot.)

The derivation in (57) reads as follows. The first conjunct, *through the briefing*, denotes an event referent, in turn corresponding to a metaphoric reading, and the second (i.e., *under the table*) to a location/literal reading. Their meet type is *l*: this Boolean SP denotes a location where Mario sleeps, doing it so through the briefing event. Thus, the analysis can formally capture how zeugmatic readings emerge as a result of combining two distinct types of relations into a more complex relation.

I now discuss the last example, offering the interpretation of (45b) in (58).

(58) a. *k.* [[through this ordeal]]⊨$s\!:\!(tr\leq or))_{s}$ (FA)

k+1. [[(T)]]⊨$\lambda x.\lambda y.b\!:\!(x=y)_{s\rightarrow(s\rightarrow s)}$ (Int)

k+2. [[through this ordeal]]×[[(T)]]⊨$(s_{e}\!:\!(tr\leq or)))_{s}\times\lambda x.\lambda y.b\!:\!(x=y)_{s\rightarrow(s\rightarrow s)}=$
$\lambda y.b\!:\!(s_{e}\!:\!(tr\leq or)=y)_{(s\rightarrow s)}$ (FA)

k+3. [[in one day]]⊨$(\text{–}CMd_{e}\!:\!(in\text{-}d))$ (Int)

k+4. [[through this ordeal (T)]]×[[in one day]]⊨
$\lambda y.b\!:\!(s_{e}\!:\!(tr\leq or)=y)_{s\rightarrow s}\times(\text{–}CMd_{e}\!:\!(in\text{-}d))=b_{e}\!:\!(s_{e}\!:\!(tr\leq or)=\text{–}CMd_{e}\!:\!(in\text{-}d))$ (FA, M)

b. *k.* [[through this ordeal (T) in one day]]⊨$b_{s}\!:\!(s_{e}\!:\!(tr\leq or)=\text{–}CMd_{s}\!:\!(in\text{-}d))$ (FA)

k+1. [[and]]⊨$\lambda x.\lambda y.f_{s}\!:\!(x\wedge y)_{s\rightarrow(s\rightarrow s)}$ (Int)

k+2. [[through this ordeal…]]×[[and]]⊨
$(b_{e}\!:\!(s_{e}\!:\!(tr\leq or))=\text{–}CMd_{s}\!:\!(in\text{-}d))\times\lambda x.\lambda y.f\!:\!(x\wedge y)_{s\rightarrow(s\rightarrow s)}=$
$\lambda y.f\!:\!(b_{e}\!:\!(s_{e}\!:\!(tr\leq or)=\text{–}CMd_{e}\!:\!(in\text{-}d))\wedge y)_{s\rightarrow s}$ (FA)

k+3. [[inside the cave in one hour]]⊨$k_{e}\!:\!(s_{e}\!:\!(in\leq cv)=\text{–}CMl_{e}\!:\!(in\text{-}h))$

k+4. [[through this ordeal in one day and]×[inside the cave in one hour]⊨
$\lambda y.f\!:\!(b_{s}\!:\!(s_{e}\!:\!(tr\leq or)=\text{–}CMd_{e}\!:\!(in\text{-}d))\wedge y)_{s\rightarrow s}\times((k_{s}\!:\!(s_{e}\!:\!(in\leq cv)=\text{–}CMl_{e}\!:\!(in\text{-}h))=$
$f_{e}\!:\!(b_{s}\!:\!(s_{e}\!:\!(tr\leq or)=\text{–}CM_{e}\!:\!(in\text{-}d))\wedge k_{e}\!:\!(s_{e}\!:\!(in\leq cv))=\text{–}CMl_{e}\!:\!(in\text{-}h)))$ (FA, M.)

The derivation in (58a) shows that the first conjunct, *through this ordeal in one hour*, denotes an event that Marco experiences within the limited time of one hour. A similar derivation can be offered for the second conjunct, *inside the cave in one hour*, but I forego this step for space reasons. The full Boolean SP is derived in compressed form in (58b). Its sense describes a first event of Marco going through a certain ordeal, and a second event of him going inside the cave, both within a given amount of time. Note that the type of the conjuncts is "raised" to that of events, since the conjuncts describe relations of Marco going through an ordeal and inside the cave, respectively.

As this and the previous derivations show, the "readings" that we ascribe to Boolean SPs are flexible, and depend on their compositional interaction. Nevertheless, the denotation of each conjunct can be defined as being either non-cumulative or cumulative, thereby licensing the (possible) composition of an SPP with a TAP. We can capture the fact that these distinct sense directions co-exist in Boolean SPs, too. Therefore, the derivations in (54)–(56) allow us to solve the first problem (lexical aspect and metaphoric readings); the derivations in (57)–(58), the second problem (readings in Boolean SPs).

The interplay between MPs, indexicals and literal/metaphoric readings can also receive a compact but accurate account. Since the relevant examples would require a discussion of the semantics of MPs and indexicals, I focus on the sense types that these examples denote (but see Ursini and Akagi 2013 for further discussion). Our analysis in (47)–(48) shows that the sentential reading assigned to these examples hinges on the

contribution of sentence-final SPPs. Thus, *Fio is floating ten meters off the ground* can describe Fio's location or Fio's happiness state, depending on the SPP occurring in sentence-final position. In the case of *after Marco proposed* (viz. (15)), the non-spatial (temporal) sense of this SPP triggers a metaphoric reading. Similarly, *Marco sits here, under the weather* in (17) describes a scenario in which Mario is having a bad mood while occupying a given location. In both types of sentences, the readings of SPPs seem to play a crucial role in determining which sentential reading emerges, although in a compositional manner. Hence, the mediating semantic effect of F is that of establishing a relation between these readings.

I thus assume that F denotes an *elaboration* relation *EL* between two complex referents. In frameworks such as DRT and Segmented DRT, this and other rhetorical relations are defined as describing causal and/or temporal relations between referents (cf. Asher and Lascarides 2003:ch. 4; Asher 2011:ch. 5 and references therein). A full definition is not crucial here. It suffices to say that, if two referents *a* and *b* stand in an elaboration relation, then *b* elaborates on the information that *a* conveys. I thus assume that two relations and their corresponding structured referents stand in an elaboration relation. Consequently, the overarching type of this relation, and the structured referent that corresponds to the relation, is still computed via monotonicity. Hence, these sentences have metaphoric readings since VP and sentence-final SPP are assigned distinct readings. The resulting interpretations for (47a) and (48a) are presented in (59)–(60).

(59) *k*+4. [[Fio…off the ground (F) after Marco proposed]]⊨
$s_e{:}EL(a_l,b_e)$ (FA, Monotonicity, type raising)

(60) *k*+4. [[Marco is sitting here (F) under the weather]]⊨
$s_e{:}EL(c_l,d_e)$ (FA, Monotonicity, type raising)

These interpretations are vastly simplified, for a fully compositional treatment of these data would require more space and theoretical considerations. Nevertheless, the reading of these sentences is computed via the type relations between the structured referents that sentence-final SPPs and VPs denote (respectively *b*, *d* and *a*, *c*). Therefore, my account seems to hold for this type of sentential readings as well. Overall, my account can offer a solution to the first problem, how lexical aspect and metaphoric/literal readings interact, by offering an account of their scopal and compositional properties. It also offers a solution to the second problem, how metaphoric and literal readings are related and can be conjoined, by offering an account of Boolean SPs and sentence-final SPPs. By offering a unified account of

examples (1)–(32), we reach the main goal of this paper: a unified treatment of the syntax and semantics of SP(P)s with respect to their distinct readings.

Before I conclude, it is worth observing that cognitive linguistic accounts cannot offer an equivalent analysis. For instance, LCCM explicitly treats SPs' senses/readings as mutually exclusive. My account shows that a formal analysis of these data is empirically more adequate. Crucially, the account reconstructs "metaphoric" and "literal" readings as distinct reading types for SPPs, rather than as vaguely defined theoretical primitives. Since these readings correspond to the types assigned to the referents standing for relations (e.g., events), and lexical aspect to the structure of these referents/relations, their interplay is predicted, in this account. At the same time, the account makes precise the claims that "metaphors" map distinct semantic domains, while preserving their logical structures (e.g., Gentner and Bowdle 2008; Evans 2010).[16] After this theoretical *precis*, we can move to the conclusions.

5. Conclusions

In this paper I have presented a unified theory of metaphoric and literal readings in Spatial Prepositions (SPs) and SPPs, and connected this topic to an overarching theory of SPs. I have suggested that readings for SPPs are a reflection of the polysemy of SPs, which can find their senses in both related types. I have shown that metaphoric/ eventive and literal/spatial readings alike are context-sensitive, based on the emergent interaction of SPs with other categories. I also have shown how lexical aspect and the metaphoric/literal dimension of meaning form highly structured domains (Boolean algebras), *qua* dimensions of the meaning of SPs. I have then explained how under standard assumptions of current formal and cognitive linguistics approaches, these data are quite recalcitrant. Via my approach informed by minimalist analyses of SPs (e.g., Hale and Keyser 2002) and rich type theories (e.g., Asher 2011), an account is possible. Other data and problems can be certainly tackled, but I leave such goals aside, for now.

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[16] Note that I partly reconstruct the analysis of Boolean phrases found in Partee and Rooth (1983) and Winter (2001). I leave a precise discussion aside, for space reasons.

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