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ON THE POLYSEMY OF SPANISH SPATIAL PS

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ABSTRACT. The goal of this paper is to investigate the polysemy of Spanish spatial prepositions (*a*, *en*, *hacia*, among others), and offer a syntactic and semantic treatment of this phenomenon. The core idea behind this account is that these prepositions can denote sets of possible locations that are involved in spatial relations. Consequently, the compositional interaction of polysemous prepositions with other parts of speech can determine which specific sense emerges in a sentence. The analysis is couched in a Type-Logical Grammar approach. It addresses data that have not previously been analysed in the literature, involving so-called Boolean constructions (e.g. *en la estación y la calle*). Also, the paper shows that a single treatment can capture all the relevant data. Therefore, the analysis shows that polysemy is a grammar phenomenon that is better accounted for in architectures with a distinct syntactic/derivational component (e.g. Distributed Morphology), than in architectures lacking this component (e.g. Cognitive Linguistics approaches). Consequences for a theory of grammar are discussed.

Keywords. Polysemy; Zeugma Test; spatial prepositions; Distributed Morphology; Type-Logical Syntax

RESUMEN. El objetivo de este artículo es investigar la polisemia de las preposiciones espaciales españolas (*a*, *en*, *hacia*, entre otras), y proporcionar un tratamiento sintáctico y semántico de este fenómeno. La idea fundamental de nuestra propuesta es que estas preposiciones pueden denotar conjuntos de locaciones posibles que están involucradas en las relaciones espaciales. En consecuencia, la interacción composicional de las preposiciones polisémicas con otras categorías determinan qué significado específico surge en una oración. El análisis se incardina en una aproximación de Type-Logical Grammar. Discute datos que no han sido analizados previamente en la bibliografía, incluyendo las construcciones booleanas (e.g. *en la estación y la calle*). Este trabajo también muestra que un tratamiento unificado puede dar cuenta de todos los datos relevantes. Así, el análisis muestra que la polisemia es un fenómeno gramatical que se debe discutir en arquitecturas gramaticales con un componente sintáctico / derivacional independiente (por ejemplo, Morfología Distribuida) y no en arquitecturas que carecen de este componente (por ejemplo, las aproximaciones de lingüística cognitiva). Se discuten las consecuencias de esto para una teoría de la gramática.

Palabras clave. polisemia; prueba del zeugma; preposiciones espaciales; Morfología Distribuida; Type-Logical Syntax

1. Introduction

Polysemy is standardly defined as the ability of a lexical item to have several related senses (e.g. Riemer 2005: ch. 3). At least three approaches have been proposed to account this phenomenon. Traditional formal views analyze polysemy as a type of conversational implicature, since they assume that lexical items are inherently monosemous (Montague 1973, Searle 1979, Ruhl 1989; Heim & Kratzer 1998). Cognitive linguistics approaches consider most lexical items as inherently polysemous, finding their meanings in *Idealized Conceptual Models* (ICMs) (Lakoff 1987, Lakoff & Turner 1989, Evans & Tyler 2001, 2004a, b; Evans 2009, 2010a, b). Modern formal views also accept the possibility that lexical items can be polysemous

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(e.g. Pustejovsky 1991, 1995, 2013's *Generative Lexicon* or GL; Asher's 2011 *Type Logical Calculus* or TLC). Hence, they offer formal treatments of polysemous terms centered on algebraic structures: *qualia* in GL, type hierarchies in TLC.

Polysemy is usually associated to lexical categories: nouns, verbs, adjectives. However, cognitive linguistics approaches have also investigated *spatial prepositions* (henceforth SPs), whose status as either a lexical or functional category is less clear-cut (cf. Zwarts 2010a). A classic case in English is the SP *over*, which has been amply discussed in the cognitive linguistic literature (e.g. Lakoff 1987, 1993; Brugmann 1988). According to these works, *over* can have several meanings, depending on both the *external* and *internal* context of use: [1]

(1) The plane is flying over the cloud
(2) The boy has gone over the hill

Thus, (1) can describe a scenario in which a plane covers a trajectory that spans a stretch of space higher than the cloud. Instead, (2) can describe a scenario in which a boy reaches the topmost position of a hill. Since *over* describes two distinct spatial trajectories, it is inherently polysemous. According to e.g. Lakoff (1993), this polysemy reflects our non-linguistic conceptualization of these spatial trajectories, rather than an exclusively linguistic pattern.

A symmetrical analysis is offered in classical formal approaches. According to Searle (1979), if polysemy arises via conversational implicatures, then it is a pragmatic, post-linguistic phenomenon. Modern formal analyses such as GL and TLC, instead, treat polysemy as a purely linguistic phenomenon, by attributing multiple related senses to a single lexical item. However, only few works in the GL mould have investigated the polysemy of SPs in any detail (Chung 2011; Lee 2013). Furthermore, these analyses have modelled the senses of single SPs, but have not attempted a full analysis of the *relations* amongst the multiple senses of distinct SPs. Thus, these relations are their properties are still understudied.

The picture becomes more complex once we consider the fact that *syntactic* matters play a key role in the emergence of polysemy in SPs. Recently, Romeu (2013, 2014) has successfully shown that *Spanish SPs* (henceforth SSPs) can be polysemous, and that their syntactic context of distribution can disambiguate their interpretation. When *en* is part of the SSP *enfrente de*, it seems to denote an external location, defined along a frontal axis, and can distribute with a *Measure Phrase* (henceforth MP).[2] When it occurs as a distinct SSP, *en* can denote inclusion like its English cognate *in*, and cannot distribute with MPs, as (3)-(4) show:

(3) *Mario está diez metros enfrente de-l coche*
Mario is.E ten meters EN-front of-the car
'Mario is ten meters in front of the car'
(4) *Mario está ∅/#diez metros en el coche*
Mario is.E ∅/#ten meters EN the car
'Mario is in(-side) the car'

[1]The *syntactic* or *internal* context is the syntactic or discourse structure against which a lexical item is evaluated, as opposed to the *external* or *extra-linguistic* context (e.g. von Fintel 1994: ch. 2; Pustejovsky 1995: ch.3).
[2] We use the phraseological verb "distribute with" in a pre-theoretical manner, to present the distributional data in this section. In section 3, we introduce the notion of *merge*, to account our data.

Before we discuss (3)-(4), we make a *precís*. As we focus on SSPs, we do not investigate the internal (syntactic) structure of DPs, but only their semantic contribution. We then label as *figure* DP and *ground* DP the phrases that denote the located entity and landmark object, respectively (Talmy 2000).[3] In these and the other examples, we gloss polysemous SSPs via capital letters, presenting specific senses in the possible translations. In (3), *en* occurs as a prefix to *frente*, forming the complex SSP *enfrente*. In (4), *en* occurs as a stand-alone SSP and seems to have its (central) sense of a containment relation: a figure is entirely contained in a ground (or partially, hence the optional *–side* in our translation). While *enfrente* can distribute with the MP *diez metros*, *en* cannot do so. Thus, *en* seems to have distinct possible senses ("inclusion", "projection"), based on the other lexical items it distributes with.

Although very thorough, these two works cover only part of the data and diagnostics that identify polysemous items. Most works on polysemy offer two key types of polysemy tests: the *definitional* test, and the *logical* or *zeugma* test (e.g. Geeraerts 1993: 223-243; Allwood 2003; Nerlich 2003: ch.2; Riemer 2005: ch.3-6, 2010: ch.5). The definitional test, usually employed in cognitive linguistic works (e.g. Evans & Tyler 2001, 2004 a,b) states that a word is polysemous if (and only if) it requires one definition per sense. The zeugma test can be said to be "theory-neutral", and comes in two variants, defined as follows. First, if the conjuncts of a coordinated phrase distribute with the same item(s) and no contradictory interpretation arises, then the lexical item has at least two distinct senses. Second, if an item can occur twice, distributing with each conjunct, but its second occurrence undergoes *ellipsis* and two distinct senses emerge, then this lexical item is polysemous. Consider (5)-(6):

(5) Mario is courting Peach and a disaster
(6) The quartet is playing Schönberg and so are Real Madrid

In (5), the sense of *courting* varies with respect to the conjuncts in the coordinated phrase *Peach and a disaster*. The sense of *courting* when applied to that of *Peach* involves a certain type of sentimental practice. The sense of this verb involves a desire to seek disasters, when applied to the sense of *a disaster*, barring rather context-sensitive and metaphoric readings. In (6), the elided verb *playing* cannot involve the same sense attested in the first conjunct. A given quartet is performing music; Real Madrid as a football team are playing a match.

A traditional point of controversy is the empirical import of these tests. As discussed in Riemer (2005: ch.3-4; 2010: ch.5), the definitional test suffers from the risk of overgeneration. Since the use in a syntactic context can be exploited to identify a sense, one can possibly list as many senses as the uses of a given lexical item (cf. also Allwood 2003: ch.1). Therefore, the definitional test cannot distinguish senses from their contingent uses. The zeugma test, in particular its first variant in (5), can be used to avoid this problem. If two senses are distinct, their use in a sentence should be acceptable; if not, then an uninterpretable sentence should emerge (cf. also Chung 2011: ch.1-2). Via this test, a clear contrast between senses can be established. Alas, previous studies on the polysemy of SPs do not apply this test to SSPs. Even if Romeu (2013, 2014) clearly show how syntactic structure plays a crucial role for the polysemy of SSPs, they do not cover examples related to the two variants of the zeugma test. Thus, a key type of evidence for the polysemy of (S)SPs is outstanding.

[3] We follow standard Leipzig glossing rules (Croft 2003). Thus, we gloss *estar* as the linear combination of an abstract Copula and a feature *S* that denotes a certain type of relation (i.e. "Cop.S"), and cases of fused preposition and definite article such as *de-l* 'of-the' via hyphenation (i.e. "of-the").

In order to shed some initial light, we introduce two variants of the first zeugma test, our key choice for the testing of polysemy in SSPs. In the first variant, a coordinated phrase includes two conjuncts headed by the same lexical item (i.e. *en* in (7)). In the second variant, a given head takes a conjunct phrase as an argument. Polysemy arises when the head's sense is "distributed" to each conjunct (i.e. *la estación y la calle* in (8)). Consider then (7)-(8):

(7) a. *Mario está sentado en la mesa y Luigi en la cama*
Mario is.E sat EN the table and Luigi EN the bed
b. 'Mario is sitting at the desk and Luigi on/in the bed'
c. '#Mario is sitting in the desk and Luigi on/in the bed'
(8) a. *Los coches están parqueados en la estación y la calle*
The cars is.E-PL parked EN the station and the street
b. 'The cars are parked at the station and on the street'
c. '#The cars are parked in the station and in the street'

In (7), the coordinated SSPs *en la mesa* 'at the desk' and *en la cama* 'on the bed' respectively denote the locations of the two figure DPs and their referents: Mario and Luigi.[4] The two coordinated SSPs seem to have different interpretations, viz. (7b): Mario is "at" the desk, Luigi "on" or "in" the bed. If *en* would only have an inclusion sense then (7a) would become uninterpretable, as (7c) shows. In (8), instead, the SSP *en* takes a coordinated DP *la estación y la calle* 'the station and the street', as its ground. Thus, (8) is understood as describing a situation in which various cars are parked 'on' the street and 'at' the station, rather than the cars being 'in' both locations, viz. (8b)-(8c). Overall, in both syntactic contexts different but related senses of *en* seem to emerge. However, previous accounts of SSPs and polysemy have not addressed this type of data. Therefore, a compositional treatment of this phenomenon and its relation to SSPs, their syntax and semantics, seems still outstanding.

The goal of this paper is to offer an account of the polysemy of SSPs, which also aims to extend previous results on this phenomenon (e.g. Chung 2011; Romeu 2013, 2014). The core aspect of our analysis is based on the idea that polysemous SSPs find their related senses in a structured domain of "locations". When combined with other parts of speech, a specific location can be selected, and a given interpretation for a sentence can emerge. Thus, the possible senses of polysemous SSPs can be individuated and organized in "network senses", which are then constrained via the emergence of syntactic structure. Our paper is organized as follows. We first present and discuss a broader set of data, which shows that the polysemy of SSPs is usually computed at a phrasal level, which can also include coordinated phrases (section 2). We then offer a syntactic and semantic analysis of how these relevant structures are derived and interpreted, based on Type Logical Syntax (Moortgat 2011), within a Distributed Morphology architecture (Halle & Marantz: sections 3-4). Section 5 concludes the paper.

2. Data and Previous Analyses

The goal of this section is to present a broader set of data, and explain the role of the zeugma test in our analysis (section 2.1). We then present previous accounts of SSPs and polysemy, thereby motivating the need for our analysis of the data (section 2.2).

[4]Our analysis of these constructions can be extended to constructions involving *disjunction* (e.g. *o* 'or'), as the other Boolean operator. The precise details are not crucial here, so we leave them aside.

2.1. The Data: SSPs

In this section we cover a key set of polysemous SSPs: *en*, *a*, *de*, *desde*, *hacia*, *hasta, por*, *para entre*, *sobre*, *por*, *bajo*. The list is based on standard discussions of SSPs and their senses found in descriptive grammars of Spanish (e.g. Bosque & demonte 1999: ch. 20; Butt & Benjamin 2004: ch. 28; RAE 2010: ch.29). Their spatial senses are also attested in the *Diccionario de la lengua Española* (DRAE, 2014), along with their non-spatial senses. Another reason for discussing these SSPs is that Romeu (2014) offers a thorough analysis of their polysemy, even if in a narrower set of syntactic contexts. In discussing these SSPs, we will also broaden our discussion to the polysemy other SSP types, such as *enfrente de.* Before discussing our data, we introduce the descriptive labels that we employ in our discussion.

We define *mono-morphemic* or *simple* SSPs those SSPs that have one distinct morpheme, e.g. *en*, *bajo* and the other SSPs in our list. We define *poly-morphemic* or *complex* SSPs those SSPs that include at least two distinct morphemes, e.g. *en*, *frente* and *de*. Complex SSPs are usually the combination of a simple SSP and a lexical item usually labelled as “Axpart”, e.g. *frente* (Svenonius 2006, 2008, 2010; Fábregas 2007; Romeu 2014: ch.3). In cases such as *enfrente de*, then, two simple SSPs can be said to distribute with an Axpart P, forming a complex SSP. Although we need to clarify some further aspects of Axpart Ps as we proceed along our discussion, these syntactic labels will suffice for our discussion of the data.

We then define some semantic labels. Most SSPs can have either a *directional* or a *locative* sense. They can either denote the path that a moving figure covers or a given location that a figure occupies (e.g. Talmy 1985, 2000; Romeu 2014: ch.2). Locative senses can be split into *topological* and *projective* types (e.g. Cresswell 1978: 1-4; Zwarts & Winter 2000: 171-172). Topological senses denote geometrical relations lacking an “axial” component, unlike projective senses. We sometimes use the label “projective” also for a sub-set of directional SSPs, in particular those that can distribute with MPs.

We then use the umbrella term “Boolean SSPs” for a set of distinct constructions based on the conjoining of SSP phrases, or related categories (MPs, DPs). Boolean SSPs are in turn a sub-type of *generalized conjunction* constructions, involving conjoined phrases of various syntactic types (Partee & Rooth, 1983; Keenan & Faltz 1985; Winter 2001). The relation between this construction and the zeugma test, as foreshadowed via (7)-(8), plays a key role in our analysis. We choose this variant of the zeugma test for two reasons. First, it provides a way to easily test whether speakers can accept our test sentences and their SSPs as polysemous. As it will become clear in the discussion of our examples, sentences including Boolean SSPs can describe one or more figure located in slightly different locations; hence, participants could easily imagine contexts in which the sentences were appropriate. Second, it explicitly offers support for the Boolean algebra type of approach that we wish to offer in section 4, as it will become clear through our discussion of the data.

We then outline three patterns of polysemy that we investigate in SSPs: the first pattern is well-known, the second and third are novel. The first pattern involves the *directional/locative alternation*. However, we discuss this alternation in its connection to the other polysemy patterns. The second pattern involves the sets of related senses that each SSP can have in context. We label this set as *the sense network* of an SSP, borrowing the label (and only the label) from cognitive linguistics (cf. Evans & Tyler 2001). The third pattern involves Boolean SSPs, and how distinct senses can be combined accordingly, and will be our main topic of discussion. Overall, we analyze which senses of SSPs can be attributed to each SSP (first, second pattern), and whether these senses can be considered distinct but related (third pattern).

Before we begin, we offer a *précis* on data collection. All the sentences have been tested via an elicitation test. For each sentence, participants (N=25) were asked to evaluate whether a sentence could be used to describe a given scenario. Participants were then asked whether the English translations we offered would capture these senses. All native speakers were selected on a criterion of near-native proficiency in English. For examples involving Boolean SSPs, this choice ensured that participants would explicitly evaluate whether a monosemous interpretation or a polysemous one would be more appropriate in context. The test offered instructions in Spanish, and participants were invited to offer further comments in Spanish, below each example. A Likert scale ranging from 1 (unacceptable) to 5 (perfect) was used to evaluate examples and their translations. An average score of 2.0 or lower was considered "uninterpretable", while scores between 2.0 and 3.0, a level of acceptance definable as "marginal", are discussed on a case by case basis.

2.1.1. *En*

We begin our discussion with *en*. As we have seen in (3)-(4) and (7)-(8), *en* can denote various topological relations, including the "core" sense of inclusion (called "conjoint" in Romeu 2013). Five properties seem to play a role in defining *en*'s network sense.

First, *en* cannot distribute with MPs, as shown in (3)-(4); *en* lacks a projective sense (Winter 2005; Morzycki 2005, 2006). Second, *en* can also have a directional sense, akin to English *into*, but when it distributes with verbs denoting ingressive motion (e.g. Romeu 2013). A "located motion" is also available, especially when *en* distributes with verbs denoting a manner of motion, but lacking a directional component (cf. Fong 1997; Kracht 2002, 2004; Zwarts 2005, 2008). This second property is displayed in (9)-(10):

(9) a. *Mario entra en el coche*
Mario goes EN the car
b. 'Mario goes into the car'
c. '#Mario goes inside the car'
(10) a. *Mario nada en el lago*
Mario swims EN the lake
b. 'Mario awims inside the lake'
c. '#Mario swims into the lake'

While (9a) can only have a directional interpretation, (10a) can only have a locative one, as shown via the translations in (9b)-(9c) and (10b)-(10c). Mario swims while being in the lake.

A third property pertains to *en*'s sense network. *En* also includes senses that correspond to support, attachment and external location, akin to English *on* and *at* (Bowerman 1996; Bowerman & Choi 2001; Zwarts 2010b). Ground and figure must be in contact, and the geometrical features of the ground may determine the specific relation at stake (Fábregas 2007; Romeu 2013; 2014: ch.4). These patterns are shown in (11)-(13):

(11) a. *La tirita está en la pierna*
The Band-Aid is.E EN the leg
b. ‘The Band-Aid is on the leg’
c. ‘#The Band-Aid is in the leg’
(12) a. *La pintura está en la pared*
The picture is.E EN the wall
b. ‘The painting is on the wall’
c. ’#The painting is in the wall’
(13) a. *Mario está en la playa*
Mario is.E EN the beach
b. ‘Mario is at the beach’
c. ‘#Mario is in the beach’

If *en* denotes an inclusion relation, then the sentences would become uninterpretable, as shown in (11c), (12c), and (13c). Felicity conditions play a role, when these senses are accessed. Thus, (11a) describes a scenario in which a Band-Aid is attached to a leg; it is not an “internal” part of the leg. Instead, (12c) only is appropriate when describing a scenario in which a painting is inserted inside a wall; (13c), only if Mario is “buried” in the beach.

Fourth, since *en* can have a sense capturing an externally located position, it can alternate with *a* in distribution (Fábregas 2007, 2010; Romeu 2013, 2014: ch.3-4). Although we discuss the fuller range of relevant data involving *a* in the next section, we show here that *en* and *a* can alternate in locative constructions when “cardinal” positions are involved. Only *en* can be used to capture the location of one (sub-) ground within the space defined with respect to another ground. When the two located entities are not in an inclusion relation, then *a* is used to capture this relation. This is shown in (14)-(15):

(14) *Bilbao está en el/#al norte de España*
Bilbao is.E EN the/A-the North of Spain
‘Bilbao is in the North of Spain’
(15) *Paris está #en el/al norte de España*
Paris is.E EN the/A-the North of Spain
‘Paris is to the North of Spain’

In words, since Bilbao is a city within the Spanish territory, it is “included” in Spain, hence only *en* is allowed, in (14). The converse holds in (15): Paris is not part of Spain, and can be said to lie outside of this country.[5] Thus, *en* and *a* seem to differ with respect to their ability to denote an external, possibly “cardinal” location of a figure with respect to a ground.

A fifth property is that these distinct senses can co-exist in Boolean SSPs, whether they involve coordinated DPs or SSPs, as we discussed in the introduction. The zeugma test successfully applies to these senses of *en,* as (16)-(17) show:

[5] Note that we consider these examples uninterpretable, rather than ungrammatical (*contra* Romeu 2014: ch.3). The syntactic structure of these examples is sound, but the examples lack an interpretation in the model of discourse. We return to this point in section 4.2.2.

(16) a. *Las manzanas están en la rama y la bolsa*
The apples are.E EN the branch and the bag
b. 'The apples are on the branch and in the bag'
c. '#The apples are in the branch and in the bag'
(17) a. *Las manzanas están en la rama y las naranjas en la bolsa*
The apples are.E EN the branch and the oranges EN the bag
b. 'The apples are on the branch and the oranges in the bag'
c. '#The apples are in the branch and the oranges in the bag'
(18) *Mario está en la playa y enfrente del mar*
Mario is.E EN the beach and in-front of-the sea
'Mario is at beach and in front of the sea'

Thus, (16)-(17) suggest that Boolean SSPs including SSPs and DPs as conjuncts, and with *en* as the core SSP, necessarily involve distinct senses of this SSP. Instead, (18) suggests that *en* can occur as a simple SSP and as part of the complex SSP *enfrente*, possibly with slightly different senses (i.e. "general" external location vs. frontal position). Overall, these five properties and the data in (11)-(18) suggest that the directional/locative alternation (first pattern) is attested for *en*, which includes an ample sense network (second pattern). These senses can co-exist in Boolean SSPs, although distinct (third pattern).

2.1.2. *A*

The simple SSP *a* displays various forms of polysemy, especially once we analyse its non-spatial senses (cf. Pavón 1999; Real Puigdollers 2010; Demonte 2011). Here we focus on six properties that play a role with respect to its spatial sense network.

First, the sense networks of *a* and *en* partially overlap, as shown via (14)-(15). The crucial difference is that *a* cannot denote an internal, locative relation. Second, *a* mostly displays a directional sense, but it can have a locative sense when it distributes with Axpart Ps to form a complex SSP. When a figure moves, *a* denotes that the figure (usually) reaches the ground, but does not reach its internal parts (cf. the "disjunctive" location analysis of Romeu 2013: 464). The lexical content of the Axpart term determines whether the resulting complex SSP has either a topological or a projective sense, and can distribute with MPs. As a simple SSP, *a* cannot distribute with MPs, lest a sentence be uninterpretable. Consider thus (19)-(22):

(19) *Mario #está/va a la playa*
Mario #is.E/ goes A the beach
'Mario #is at/goes to the beach'
(20) *Mario está sentado un metro a la derecha/a la izquierda de Luigi*
Mario is.E sit-PF one metre A the right/ A the left of Luigi
'Mario is sitting one meter to the right/left of Luigi'
(21) *Mario está sentado ∅/#un metro al medio/final de la carretera*
Mario is.E sit-PF ∅/#one metre A-the middle/end of the road
'Mario is sitting #one meter in the middle/at the end of the road'
(22) *Mario está ∅/#diez metros a-l piano/teléfono*
Mario is.E ∅/#ten meters at/to-the piano/the phone
'Mario is at the piano//phone'

While (19) displays the directional sense of *a*, (20) shows that *a* can have a locative sense when it is part of projective, complex SSPs *a la izquierda*, and *a la derecha.*

However, if a complex SSP denotes a "region" or part of a location (e.g. the final or middle part of a road, viz. (21)), then MPs cannot distribute with these SSPs (cf. also Nam 1995: ch.2; Zwarts & Winter 2000: 170-172). Furthermore, *a* can also distribute with certain ground DPs such as *piano*, and have a topological reading, viz. (22) (cf. Fábregas 2007: 179-180; Romeu 2013: 465-466). In these cases, a locative sense can arise, if the figure is be involved in some action performed "at" the ground, such as playing music (cf. Coventry & Garrod 2004: ch.6).

Third, part of the senses in the network of *a* overlap with those of *hasta*, *hacia*, and other SSPs (Romeu 2014: ch. 4). The directional senses of *a* can overlap with those of *hasta* 'to' and *hacia* 'towards', the locative ones with those of *junto a* 'next to' and *acerca de* 'near'. In these cases, the distribution of *a* with MPs is blocked. This is not the case for *hacia*, which can distribute with MPs, as we show in (23)-(24):

(23) *Mario va ∅/#diez metros a la playa*
Mario goes ∅/#ten metres A the beach
'Mario goes #ten meters to the beach'
(24) *Mario va diez metros hacia la playa*
Mario goes ten metres HACIA the beach
'Mario goes ten meters towards the beach'

In words, (23) can describe a situation in which Mario goes in the direction of the beach but does not actually reach it (i.e. it goes "towards" the beach). However, an MP can distribute with *a*, to specify the exact distance, unlike *hacia* in (24). Hence, the sense difference between *a* and *hacia* seems to involve a distinction between *a* denoting Mario's reaching the beach, and *hacia* denoting Mario's direction of movement, which can cover a certain length.

Fourth, *a* can act as a head in certain complex SSPs, such as *junto a*, 'next to', *adjunto a* 'attached to', *frente a* 'opposite' the rare *fuera a* 'outside of' and similar others. Although the spatial sense is most clear for *junto a*, this small set of SSPs can have both directional and topological senses, but not projective ones, as (25) shows:

(25) *Mario está/va ∅/#diez metros junto a Luigi*
Mario is.E/goes ∅/#ten metres next to Luigi
'Mario is/goes #ten meters next to Luigi'

In these cases, aside *a* displaying the ability of acting as a head, the inherently topological sense of *a* is preserved, in locative readings: no MPs can distribute with *a*.

Fifth, *a-* can be a prefix to a set of Axpart elements, forming complex SSPs that cannot distribute with *de* (Fábregas 2007, 2010; Romeu 2014: ch.3). When this h, ground DP's ellipsis or *argument demotion* (Merchant 2001: ch.3) is obligatory, viz. (26)-(27):

(26) *Mario está detrás de la casa. Luigi está a-lante (*de la casa)*
Mario is.E behind of-the house. Luigi is.E a-head (of the house)
'Mario is behind the house. Mario is in front (of the house)'
(27) *Mario está un metro dentro de la casa. Luigi está #diez metros afuera*
Mario is.E one meter inside of the house. Mario is.E ten meters outside
'Mario is one meter inside the house. Mario is ten meters outside'

(28) *a-lante*, *a-trás, a-bajo, a-rriba*, *a-fuera*, *a-dentro*;

The list of SSPs that display these properties is in (28). Note that the *a*- series SSPs seem to only have topological senses, as (27) shows. This has interesting consequences regarding the semantic relation between this series and the *de*- series of SSPs. However, we discuss this matter in more detail in section 2.1.3, once we discuss the *de*- series.

Sixth, *a* in Boolean SSPs can receive distinct interpretations. This holds whether *a* occurs as a simple SSP or as part of a complex SSP, as shown in (29)-(30):

(29) a. *Los hombres están sentados a-l piano y a los lados del comedor*
The men are.E. sit-PF. A-the piano and A the sides of-the dining table
b. 'The men are sitting at the piano and at the sides of the dining table'
c. '#The men are sitting at the piano and to the sides of the dining table'
(30) *Los coches llegan a la playa y diez metros enfrente del mar*
The cars arrive A the beach and ten meters EN-front of-the sea
'The cars arrive at the beach and ten meters in front of the sea'

Thus, the men described in (29) are sitting at the piano and at the sides of the table, conceived as distinct location. A similar reasoning applies to the cars' positions and distance, in (30). Overall, these six properties and the data in (19)-(30) suggest that our three patterns can be attested for *a*, too. They also show that sense network of this SSP includes different senses than those making up the *en* sense network. Hence, the polysemy of these SSPs is well attested, since the zeugma test gives evidence for it. We now turn to *de* and its patterns.

2.1.3. *De*

The preposition *de* can occur as a head in most complex SSPs, including phrases that lack a spatial sense (cf. *a favor de* 'in favour of': Butt & Benjamin 2004: ch. 28). Here, we focus on its ability to distribute with other simple SSPs (e.g. *a*) and Axpart Ps (Fábregas 2007; Romeu 2014: ch.4). Hence, we focus on four properties of *de* that are defined for its spatial senses.

First, SSPs with *de* as a head can alternate between a locative and directional sense, as in the case of *en* and *a*. Second, complex SSPs with *de* as a head can distribute with MPs, insofar as they have a projective, rather than a topological/region sense. Consider (31)-(33):

(31) *Mario está/va en-cima de la colina*
Mario is.E/goes on-top DE the hill
'Mario is/goes on top of the hill'
(32) *Mario está/va diez metros detrás de-l coche*
Mario is.E/goes ten meters behind DE-the car
'Mario is/goes ten meters behind the car'
(33) *#Mario está/va diez metros a-l fin de la caverna*
Mario is.E/goes ten meters A-the end DE the cavern
'Mario is/goes ten meters in/to the end of the cavern'

In words, SSPs that include *de* as a head can have either a locative or directional sense. The complex SSP (e.g. *encima*, *detrás*, *al fin*) that distributes with this head determines whether the SSP has a projective sense, and can distribute with an MP.

A third property pertains to how SSPs including *de* as a head can distribute hin Boolean SSPs, in complement and specifier position. This "symmetric" pattern is shown in (34)-(35):

(34) *Los hombres están sentados/van dentro y detrás del coche*
The men are.E sit-PF/go inside and behind DE-the car
'The men are sitting/go inside and behind the car'
(35) *Los hombres están sentados dentro y al medio de la caverna*
The men are.E sit-PF inside and A-the middle DE the cave
'The men are sitting/go inside and behind the car'

Hence, (34) can describe either a scenario in which some men are sitting inside the car and some behind it, or one in which the men reach these locations. This fact also offers evidence supporting the zeugma test for *de*, although in an indirect way. The two conjoined complex SSPs denote distinct types of spatial relations. In (35), projective and region senses are combined: the men can be described as being inside and in the middle of the cave. Thus, the Boolean SSPs in specifier position can denote fairly complex types of "hybrid" spatial relations, by distributing with *de* in both argumental positions.

Fourth, there is also a series of Axpart Ps including *de-* as a prefix. This series alternates in distribution with the *a-* series. These SSPs must distribute with a ground DP, blocking argument demotion, and with the head *de* within an SSP. Two examples are *encima* and *detrás* in (31)-(32).The list of these SSPs is in (36):

(36) *de-bajo*, *de-trás*, *d-entro*, *de-lante*, *en-cima;*

This list includes *en-cima*, as its etymological history can be traced to the more complex SSP *dencima* (Fábregas 2007). These SSPs display the same type of weak polysemy of the *a-* series, given their ability to overlap in sense with other SSPs (e.g. *en* and *dentro de*, viz. section 2.1.1). This weak polysemy, in turn, is partly connected to the polysemy of *de-* as a prefix. Overall, (29)-(34) show that *de* displays all of our three patterns of polysemy, although via the contribution of complex SSPs in specifier position.

2.1.4. *Desde, Hacia, Hasta, Por, Para, Entre, Sobre & Bajo*

The other simple SSPs that we discuss display more restricted sense networks. For this reason, we discuss their polysemy and related data within the space of this section.

We start from *desde*, which has three key properties with respect to polysemy. First, *desde* can have a locative and directional reading, although its locative reading is extremely restricted: it mostly emerges when the "place origin" of the figure is described. Second, *desde* can only distribute with MPs if *a* introduces the MP, and can refer to a static location of the figure. Third, *desde* seems to have two slightly distinct senses, since it can denote movement 'from' or 'out of' a ground. These patterns are shown in (37)-(39):

(37) *Mario es/arriba desde Marte*
Mario is.S/arrives DESDE Marte
'Mario is/arrives from Marte'

(38) *Mario está/#arriba a un kilómetro desde de-l coche*
Mario is.E/#comes A one kilometre DESDE DE-the car
'Mario is/#arrives at one kilometre from the car'
(39) a. *Los hombres llegan desde la caverna y la playa*
The men arrive DESDE the cavern and the beach
b. 'The men come out the cavern and from the beach'
c. 'The men come from the cavern and from the beach'

As (37) shows, Mars can be the location where Mario originates from, or alternatively the location where he is arriving from. Instead, (38) shows that *a* and the MP *un kilómetro* can distribute with *desde* and denote a location defined with respect to the car, which Mario occupies. In (39), the Boolean SSP, *desde la caverna y la playa*, can capture the two slightly different senses for *desde*. Note that English *from* only allows us to approximate this distinction, since it can cover the sense of *out of* (Fong 2008). An interpretation like (39c), with the men coming from outside the cavern and from the beach is also possible, even if less preferred. Thus, each of the three patterns is attested for *desde*, although in a limited form.

The three polysemy patterns can also be found in the sense network of *hacia*. This SSP is usually associated with directional readings involving a figure getting closer to, but not reaching the ground, akin to English 'towards'. Locative senses can emerge when posture verbs describe the figure's location as being 'near' the ground, especially when animate grounds are involved (Moldovan 2010; Romeu 2013: ch. 4). Some of its senses can distribute with MPs, and can be part of Boolean SSPs. We illustrate these properties in (40)-(42):

(40) *Mario va diez metros hacia Peach*
Mario goes ten meters HACIA Peach
'Mario goes ten meters towards Peach'
(41) a. *Mario está sentado hacia Luigi*
Mario is.E sit-PF HACIA Luigi
b. 'Mario is sitting next to Luigi'
c. 'Mario is sitting near Luigi'
(42) *Luigi va hacia Mario y hacia Peach*
Luigi goes HACIA Mario and HACIA Peach
'Mario goes towards/next to Mario and towards/next to Peach'

In (40), the distribution of *hacia* with MPs parallels that of *towards* with this category (Zwarts 2008). In (41), a possible locative sense for *hacia* emerges, as the example describes Mario sitting in the direction of Luigi, and possibly very close or close to him, as the translations with 'next to' and 'near' suggest. These senses are certainly more marginal, although nevertheless accessible to speakers (F=2.2, F=2.3 respectively). The Boolean SSP in (42) shows that these senses can be treated as distinct. If two SSPs act as conjuncts, the distinct instances of *hacia* can have the two slightly different 'next to' and 'towards' senses to co-exist. Thus, Luigi is understood as possibly ending up next to either Peach or Mario, or possibly towards/next to both. Hence, *hacia* displays a more limited locative/directional alternation (first pattern), a less extensive sense network (second pattern), and a less clear distinction amongst senses (third pattern). Nevertheless, each pattern is attested, to an extent.

Unlike *hacia*, the polysemous nature of *hasta* is rather limited. This is the case, since *hasta* mostly has a directional sense, much like English *to*, and lacks a projective-like sense that allows distribution with MPs (cf. Moldovan 2010; Romeu 2013: ch.4). A subtle pattern that emerges in Boolean SSPs is that *hasta* can have two slightly different senses translatable as 'to' and 'into'. A figure can reach a location close to the ground, or can end up inside this ground. Consider (43)-(44):

(43) a. *Los hombres van ∅/#diez metros hasta la caverna*
b. 'The men go ∅/ten meters to the cavern
c. '#The men go to the cavern'
(44) a. *Los hombres vuelven hasta la caverna y la playa*
b. 'The men return into the cave and to the beach'
c. '#The men return into the cave and into the beach'

Although this pattern is clearly attested with "pure" Boolean SSPs, it can emerge when the "DP" sub-type is involved. In this case, speakers usually assign an interpretation such as (43-b) to (44-a), since (44-c) would render the sentence uninterpretable, barring peculiar scenarios rendering this reading felicitous.

The pair of SSPs *por* and *para* presents a more complex picture. Both SSPs have several spatial and non-spatial senses (Butt & Benjamin 2004: ch. 28). For our purposes, it suffices to say that *por* in its spatial declination seems to denote some types of directional senses, translatable as 'through', 'across', 'around', 'along' and possibly others, and a locative sense akin to 'near'. In this latter case, *por* seems to overlap in its sense with *acerca de*, literally 'near of'. These senses can distribute with MPs. At least in the directional cases, Boolean SSPs confirm the existence of these distinct senses. These patterns are shown in (45)-(47):

(45) *Mario camina un kilómetro por el bosque*
Mario walks one kilometre POR the woods
'Mario walks one kilometre through the woods'
(46) *Mario está un metro por el lago*
Mario is.E one metre POR the lake
'Mario is one metre near the lake'
(47) a. *Mario va por el túnel y el lago*
Mario goes POR the tunnel and the lake
b. 'Mario goes through the tunnel and across the lake'
c. 'Mario goes through the tunnel and through the lake'

In words, (45)-(46) show that the directional and locative senses of *por* can distribute with MPs. Instead, (46b) shows that at least two senses of this SSP, akin to English 'through' and 'across', can emerge when two conjoined DPs are part of a Boolean SSP. It is also possible to have a single sense for both conjuncts, as (47c) shows, although such a reading tends to be based on the interpretation of DPs. The average evaluation for (47c) was F=2.1, unlike the much preferred (47b) (F=4.9). Other senses are also accessible, as participants could also interpret (47a) as describing a scenario in which Mario walks around or along the lake.[6] Overall, *por* also displays all three polysemy patterns, although in a limited manner.

[6]Most participants offered comments regarding the nature and shape of the lake that they envisioned, to support these interpretations. Although we omit these results to avoid going too far afield from our main discussion, we will discuss how these senses can be captured in section 4.2.2.

A similarly restricted picture holds for *para*. This SSP mostly has a directional sense in its spatial declination, and seems to act as a hyperonym term to *hacia* and *hasta*. It can be ambiguous between overlapping with the sense(s) of either SSP. Interestingly, the distribution of *para* with an MP seems to select the 'towards' sense, mirroring the patterns discussed in (43). These patterns are presented in (48)-(49):

(48) *Mario camina un kilómetro para el centro de la ciudad*
Mario walks one kilometre PARA the centre of the city
'Mario walks one kilometer #to/towards the city's center'
(49) a. *Mario va para el lago y las montañas*
Mario goes PARA the lake and the mountains
b. 'Mario goes towards the lake and the mountains'
c. Mario goes to the lake and towards the mountains'

For (49), it is important to notice that both the interpretations in (49b) and (49c) are possible, although the one in (49c) is marginal (F=2.3). Nevertheless, these data offer evidence, even if to a limited extent, for the existence of the three patterns in *para*, too.

The SSP *entre* seems to capture a sense of inclusion that involves a projective dimension (Fábregas 2007; Ursini 2013; Romeu 2014: ch: 5). This SSP has two slightly different senses, akin to English 'between' and 'within'. It can denote a figure that is located between two grounds, and at a certain distance from both, but not necessarily in a convex space, viz. (50)-(51):

(50) a. *Mario va/está entre las murallas*
Mario goes/is.E ENTRE the walls
b. 'Mario is within the city walls'
c. '#Mario is between the city walls'
(51) a. *Mario está un metro entre Peach y Luigi*
Mario is.E one metre ENTRE Peach and Luigi
b. 'Mario is one meter between Peach and Luigi'
c. '#Mario is one metre within Peach and Luigi'

Thus, (50)-(51) show that the 'within' sense is only accessed when a ground DP like *the walls* is involved. The'between' sense is accessed via a Boolean SSP. And the two conjoined DPs denote the locations that act as grounds for the figure (here, Peach and Luigi for Mario). As for the other SSPs discussed in this section, each pattern is attested in a limited fashion.

We conclude our discussion with *sobre* and *bajo*. Two properties of these SSPs are important, for our discussion. First, both SSPS are polysemous along the directional/locative sense dimension. Second, both can only capture the position of a figure as being in contact or at a certain distance from to the ground, thus having topological and projective senses. Thus, *sobre* can be translated as either 'on top of' (cf. *encima de*) and as 'above/over', whereas *bajo* can be translated as 'under/below' and 'beneath' (cf. also Romeu 2014: ch.5). Only the projective senses distribute with MPs, but Boolean SSPs can easily include both senses. They may involve an MP that takes scope only over the second conjunct. Consider (52)-(54):

(52) a. *La lámpara está sobre/bajo la mesa*
The lamp is.E SOBRE/BAJO the table
b. 'The lamp is on top of/beneath the table'
c. 'The lamp is above/under the table'

(53) a. *Los pájaros vuelan sobre la nube y la montaña*
The birds fly SOBRE the cloud and the cloud
b. 'The birds fly over the cloud and on top of the mountain'
c. 'The birds fly over the cloud and over the mountain'

(54) a. *Los pájaros vuelan un kilómetro bajo la nube y el avión*
The birds fly one kilometer BAJO the cloud and the plane
b. 'The birds fly below the cloud and the plane'
c. '#The birds fly beneath the cloud and the plane'

As (52) shows, both senses for these two SSPs can be accessed, in the opportune context. This is also the case in Boolean SSPs, although a monosemous interpretation is preferred over a polysemous one (i.e. (53c) over (53b)). Only one interpretation becomes accessible if the Boolean SSPs distribute with an MP: MPs require a projective sense, as (54) shows. This example also confirms that the directional/locative alternation holds for this SSP and, symmetrically, for *sobre*. Thus, even for these two SSPs, each of the three patterns is attested.

Let us take some stock. As we have discussed, almost all the simple SSPs can display the first pattern of polysemy: the directional/locative alternation. The network sense (second) pattern is also attested, as each SSP can denote certain related senses. The third, "Boolean" pattern is confirmed for most, but not all of the SSPs (cf. *sobre*, *bajo*), although the distinct senses of each SSPs can be usually teased apart. Overall, the role of each pattern suggests that both semantic matters (i.e. the network sense data) and syntactic matters (Boolean SSPs as instances of the zeugma test) require novel account of polysemy in SSPs. Before we offer and motivate one, we discuss previous accounts, and their possible shortcomings.

2.2. Previous accounts of Polysemy and SSPs

There are several works that offer an analysis of the putative polysemy of SPs for English, several works on the study of a single SP's network sense exist. Examples include *in* (Vandeloise 1994, 2005, 2010); *over* (Lakoff 1993; Evans & Tyler 2001), *around* (Zwarts 2004), *to* (Jackendoff 1983: ch.4, Evans & Tyler 2004a); *on* (Feist 2004; Feist & Gentner 2012); and *at* (Herskovits 1986; Feist 2006; Coventry & Garrod 2004: ch.6). Similar analyses have been proposed for SPs in other languages (e.g. French: Vandeloise 1994, 2010; Vieu & Aurnaugue 2007). In most if not all analyses, the different senses are assumed to be organized in fairly rich, but highly organized networks, e.g. Zwarts' (2004) lattice structure for *around*. This wealth of senses is seen as evidence in favour of SPs being inherently polysemous.

A recent account on the polysemy of English SPs is known as the *general polysemy approach* (e.g. Evans & Tyler 2001, 2004a, b; Vandeloise 2005, 2010). It suggests that SPs have a central sense, which captures the spatial "proto-scene" that an SP describes. From this sense, more specific spatial and non-spatial senses form the ICM (Idealized Conceptual Model) of one SP, the network of senses connected to the proto-scene sense. These senses are defined with respect to their decreasing prototypicality. If *in* in its prototypical use has a sense of inclusion, then its senses not involving convex grounds (e.g. *in the air*) will be distinct from the central sense.

Since distinct SPs may include several senses, the possibility arises that some senses are shared among SSPs, and hence that ICMs partially overlap.

A similar approach can be found in the *Lexical Conceptual Cognitive Model* (henceforth LCCM) theory of Evans (2006, 2009, 2010b, 2015). This proposal accounts the polysemy of English SPs by appealing to two assumptions. First, SPs' multiple senses form ICMs/network senses. Second, their specific senses in context are selected via a compositional interaction with other parts of a sentence. Two lexical items are combined via the operations of *lexical concept selection* and *fusion* (two syntactic operations), and their senses are integrated and combined via *lexical concept integration* and *interpretation*, two semantic operations. When two lexical items are selected and "fused" to form a unit, their conceptual content is integrated and combined into a specific semantic representation.

Formal semantics analyses follow a similar tack, although from a mathematically precise perspective. Here we focus on the GL account, as other accounts offer a similar analysis (Pustejovsky 1991, 1995, 2013; Asher & Pustejovsky 2010; Asher & Lascarides 2003, Mao & Zhou 2008; TLC. Asher 2011). In GL, lexical items are associated to qualia structures, which include the range of possible sense *types* that a word can have. Examples include nouns including senses that describe physical properties, constituency and its 'telos' (purpose). A common noun such as *hammer* can include the types ***physical_object'*** (physical property), ***wood'*** (constituency), and ***building_tool'*** (telos). Qualia structures and equivalent structures (e.g. "product" types in TLC) are represented via complex types, known as "dot object" types. Thus, the type for *hammer* would roughly correspond to the dot type $po{\bullet}const{\bullet}tel$, with this dot object type being a sub-type of e, the type of entities. The "sub-type" relation $po{\bullet}const{\bullet}tel{\sqsubseteq}e$ would then represent this relation between these two types.[7]

Within GL and related accounts, only few works investigate the polysemy of SPs. One example of a GL analysis of English and Korean SPs is Chung (2011). According to this proposal, SPs denote qualia structures akin to those of verbs, but also include category-specific qualia, such as ***arrangement'*** and ***region'***. While the first type of *quale* captures the spatial "arrangement" of the figure with respect to the ground (i.e. its projective sense), the second *quale* specifies which is involved in a spatial relation. Via these qualia, the proposal shows that the fine-grained distinctions among the senses of *on*, *in* and other SPs in both languages can be formalized in some detail.

Although each of these frameworks offer a view of the several senses associated to an SP that can arise via polysemy, they all share certain problematic assumptions. First, these frameworks follow a definitional test approach, with all of the complications that this approach comports. For instance, the general polysemy and LCCM approaches assume that an SP such as *over* includes 21 different senses. Furthermore, the relations amongst senses and defining features are simply motivated on frequency and use (Evans & Tyler 2004b; Evans 2010). Under this approach, the distributional patterns of MPs with SSPs, and Boolean SSPs would remain unaccounted for. This is the case, as no tools are offered to model uninterpretable sentences, or the emergence of distinct, co-existing senses (cf. Evans 2015). By falling silent on the very notion of "acceptability", these frameworks cannot account the whole set of data we discussed so far, and can be thus left aside.

GL accounts also tend to be based on the definitional test (cf. Pustejovsky 1995: ch.1-2). Furthermore, they generally lack a precise analysis of how sense networks

[7] Here we use the symbols "•" and "⊑" to discuss the GL treatment of polysemy, although we will propose a different, type-logical use in section 3.

can emerge and, with them, how overlapping senses amongst SSPs can also emerge. Even if Chung (2011) discusses the polysemy of SPs within a GL framework, the absence of zeugma test data for SPs renders the analysis problematic. Furthermore, we need to consider the fact that the morphological and syntactic aspects of SPs are also left aside. Overall, this work only offers a semantic perspective. Therefore, it seems obvious that if we wish to account the polysemy patterns we have discussed, then we need an alternative framework.

Let us now concentrate on SSPs, and in particular on their morpho-syntactic accounts. It is fair to say that the syntactic and morphological properties of SSPs have been investigated in thorough detail. One classic analysis is the *preposición tras preposición* ('preposition after preposition', or PtP: Bosque 1997), which is centred on two core assumptions. First, only Spatial Ps involve two distinct, hierarchical positions, respectively called *origen* 'origin' and *situación* 'situation'. Second, this structure corresponds to the classic bi-partite structure for English SPs, with its matching semantics (Jackedoff 1983, 1990; Wunderlich 1991, 1993; Nam 1995; Kracht 2002, 2004).The relevant types of SSPs structures are illustrated in (55):

(55) a.[$_{\text{SITUATION}}$ PREP (en) [$_{\text{OBJECT}}$ NOUN (la sala)]]
b.[$_{\text{ORIGIN}}$ PREP (desde) [$_{\text{SITUATION}}$ PREP (sobre) [$_{\text{OBJECT}}$ NOUN (la mesa)]]]

According to Bosque (1997), the fact that SSPs such as **a en la mesa* are not attested, but those such as *desde sobre la mesa* are, is evidence that supports the dual analysis in (55). However, if we assume that the Origin head only projects when a directional is present, then a curious *empasse* arises. Since the locative/directional alternation is attested for most SSPs, the presence of an Origin head with a "flexible" semantics seems necessary. Once we consider the multiple senses and Boolean SSPs data, the need for a more precise but flexible structure seems obvious, since this analysis falls silent on these data. The PtP hypothesis requires a theoretical extension, to be able to account our data.

Recent proposals on SSPs have offered a more fine-grained approach to their structure. As we foreshadowed in the previous section, Fábregas (2007) and Romeu (2013, 2014) have offered thorough accounts on the morphology and syntax of SSPs, based on variants of "Nano-syntax" (Starke 2009). Both works assume that SSPs involve a sequence of heads projecting from each morpheme making up a lexical item. However, these proposals differ with respect to the precise structures that they propose, as well as the range of data they cover. While Fábregas (2007) concentrates on the morpho-syntax of axial terms (e.g. *frente* in *enfrente*), Romeu (2014) covers a broader set of data, and offers an analysis of polysemous patterns. We present their analyses of the structure of SSPs in (56)-(57):

(56) [$_{\text{Place}}$ en [$_{\text{Axpart}}$ frente [$_{\delta}$ H [$_{\gamma}$ H [$_{\text{Kase}}$ de [$_{\text{DP}}$ la mesa]]]]]] (Fábregas 2007: ex. (13))
(57) [$_{\text{RelP}}$ [$_{\text{Mod}}$ Conj] en- [$_{\text{AxpartP}}$ -frente [$_{\text{RegP}}$ Reg[$_{\text{DP}}$ de la mesa]]]] (Romeu 2014: ch.2)

In Fábregas' (2007) analysis, presented in (56), an SSP such as *en frente de* corresponds to the sequence of heads Place, Axpart and Kase, plus the silent heads "δ" and "γ". The head Kase introduces a morpheme (here, *de*) that allows the marking of the ground DP for case. The head γ captures the part-of relation that can be established between ground and part of the ground that the figure occupies. The head δ captures the underlying scalar structure of the distance between ground and relevant part that the figure occupies, instead. The Axpart head is the projection that *frente*, *adelante* and Axpart Ps contribute to this structure. A Direction head, not included here for reasons of space can also project a corresponding sense.

In Romeu's (2013, 2014) analysis, presented in (57), a different set of positions/heads is assumed to underlie SSPs' structure, as the labels RelP, RegP suggest. A Reg(ion) head takes a DP, licensing a spatial interpretation for the object it denotes. An Axpart head can specify the axis along a given spatial relation. The Rel head can establish a relation between this location and a figure DP, or a relation between this location and another set of locations. The second phrase denoting these possible locations is labelled "Mod", and governs the patterns of lexicalization observed in SSPs. The Mod(ifier) phrase lexicalises with the Rel head, determining which spatial relation an SSP denotes. For instance, the "Conj(unction)" phrase in (56) denotes a position for the figure that can be internal as well as external to the ground. In this case, the lexicalised Rel head is *en*. Other possible values for Mod include Deix and Deg, heads that can introduce deitical elements (e.g. *aquí* and *diez metros*, respectively), in the opportune licensing conditions. Thus, SSPs can be polysemous, since their interpretation depends on which head (or cluster of heads) they can lexicalize (e.g. Rel or Reg).

As our discussion suggests, these two proposals seem to offer us a fine-grained set of syntactic tools for the analysis of our data. However, the Boolean SSPs pattern remains partially outside the range of each proposal. Although juxtaposed SSPs are analysed in Romeu (2014: ch.5) as involving a silent Coor(dination) head (e.g. *de su casa al colegio*), Boolean SSPs cases are not addressed. As a consequence, the third pattern and the zeugma test are not accounted in any detail, from a syntactic perspective. However, an analysis of this key polysemy pattern is still outstanding. Furthermore, since the semantic relations among and within SSPs (i.e. their sense networks), are not fully explored, a more thorough semantics of their polysemy patterns is also outstanding. As matters stand, then, the theoretical proposals on SSPs that we have at our disposal, syntactic and semantic alike, require some further extensions to cover the data in (3)-(55). Such a compelling empirical reason moves us to offer such an account in the next two sections.

3. The Proposal: Morpho-Syntactic Assumptions and Analyses

The goal of this section is to present our formal apparatus (section 3.1); we then offer an account of the data (section 3.2), and a discussion of the results (section 3.3).

3.1. The Proposal: Morpho-Syntactic Assumptions

The goal of this section is to present our morpho-syntactic framework, based on *Type Logical Syntax* (henceforth: TLS) as a derivational system (Moortgat 2010, 2011; Morrill 2011). Since TLS is a powerful formal tool, but does not offer precise assumptions regarding the architecture of grammar, we take a conservative variant of *Distributed Morphology* as our model of reference (e.g. Halle & Marantz 1993; Marantz 1997; Harbour 2007). The system has been proposed in previous work that analyses SPs in other languages (Ursini 2013, 2014, 2015a, b, 2016, in press; Ursini & Akagi 2013a). However, in this paper we attempt an extension to polysemy. The overarching choice of DM is not crucial to our purposes, since other minimalist frameworks would also offer us the same perspective on grammar architecture (e.g. Nanosysntax: Romeu 2013, 2014; Fábregas 2014). Insofar as we take a minimalist perspective, we believe that our data can find a solid account.

Three key assumptions of DM seem to be germane to our goals. First, morphology and syntax form a single computational system. Second, morphemes are conceived as clusters/sets of features, which can include sets of feature types (e.g. Halle & Marantz 1993; Harbour 2007; Embick 2013). Morphemes can also act as heads, and can have flexible valence (cf. also Hale & Keyser 2002). Third, semantic interpretation and phonological (vocabulary) insertion occur after morphological derivations have generated structures (e.g. Embick & Noyer 2001, 2006; Harley 2010; Embick 2013). Recall now that our data suggest that morphological and syntactic structures are seamlessly connected. The data also suggest that some SSPs have flexible valence (e.g. *en*, *a*, *de*) and that spell-out patterns reflect syntactic structures. We can thus conclude that DM offers kernel assumptions that seem to justify our choice, given the type of data we need to account.

Since it will be important to capture the interaction of features and structures in a principled way, we need a formal apparatus that can model the corresponding derivations. We choose TLS, since it places a great emphasis on a transparent syntax-semantics interface, and a rigorous derivational system. Other options are possible (e.g. Stabler 1997's Minimalist Grammar), but we leave a more thorough exploration of this possibility for future research.[8]

We start by defining our basic building blocks. In TLS, morpho-syntactic categories are mapped or assigned onto *types,* which are represented as being either "complete" or "incomplete" information units. Complete types represent derivational elements that can stand as distinct, independent elements (e.g. *np* for noun phrases as *the girl*). Incomplete types are elements that must combine with other elements to form a complete type. For instance, an intransitive verb such as *runs* can be assigned type $np\backslash s$, since it can combine with an *np* item, *the girl*. The result is the sentence *the girl runs*, which is assigned the type *s* of "sentences". We use the convention of calling *np*, in the type $np\backslash s$ and the standalone type *np*, as the *input* type. We than call *s*, the resulting type after this process, the *output* type.

Consider now our SSPs data. Since simple SSPs seem to govern the derivation, interpretation and phonological realization of their phrases, we need a tool that represent "when" their contribution occurs, at a syntactic, derivational level. As our data suggest, a more fine-grained approach to types than the one found in TLS seems necessary. Within DM, this fact is captured by assuming that category-less roots with category-assigning elements, e.g. *v*, *p*, and *n* (Harley 2010; Acquaviva & Panagioditis 2009; Acquaviva 2014a, b). In a TLS analysis, we can capture this fact by using a universal type ***p***, mnemonic for "phrase" and "product of features", and from which other types are recursively defined. Thus, the domain of ***p*** is a structure of *features* or more accurately feature *types.* These types can then include feature sub-types. Lexical items can convey information about one or more of these features, clustered as single units (e.g. Carpenter 1992; Heylen 1999; cf. also Adger 2010).

Before we pursue this aspect of our analysis, we introduce the connectives that allow us to define complex types. We introduce two families of connectives. One family governs the composition of types; the second family governs their lexical structure. Our choice is based on two facts. First, all SSPs seem to share similar if not identical morpho-syntactic structures and distribution with respect to other categories, such as MPs, DPs and verbs. Thus, the rules that govern their merge with other

[8] A theoretical *precis* is necessary. While DM takes a constructionst perspective to grammar architecture, TLS is considered a "lexicalist" theory: lexical items encode a rich amount of information about their properties. The quote marks are necessary, since TLS presents a derivational approach on how lexical items are combined, as one can expect in constructionist grammars. Thus, TLS and other categorial approaches present a perspective that merges the "lexicalist" vs. "constructionist" debate (see Fábregas & Scalise 2011: ch.1 for discussion).

categories also govern how their constituting features are "structured". Second, if *en* and other SSPs are polysemous, then the feature that carries the lexical content of an SSP can denote a sense network, as part of this SSP's sense. The same reasoning applies to all the other SSPs discussed so far.

For the first family, we introduce the connectives "/" and "•" to represent the *right division* (or "slash") and the *product* operations (Moortgat 2010, §2; Morrill 2011: ch. 1). We define right division as a *binary*, *associative* operation, and product as a *non-commutative* operation: $\boldsymbol{a}\bullet\boldsymbol{b}$ is made of the ordered pair $\boldsymbol{a}$ and $\boldsymbol{b}$. For the second family, we introduce the *join* operator "$\sqcup$", a Boolean operator that is *binary*, *associative* and *commutative* (Carpenter 1992; Heylen 1997a, b, 1999). This operator allows us to define a (feature) type as the sum of (sub-)features in a feature domain, possibly corresponding to the sum of all features making up a feature type.[9] Our rules of type composition are defined in (58):

(58) 1. *Given a Lexicon* $\boldsymbol{L}$, $\boldsymbol{p}$ *is a morphological type* (Lexical type)
2. *If* $\boldsymbol{x}$ *is a type and* $\boldsymbol{y}$ *is a type, then* $\boldsymbol{x/y}$ *is a type* (Type formation: division)
3. *If* $\boldsymbol{x}$ *is a type and* $\boldsymbol{y}$ *is a type, then* $\boldsymbol{x}\bullet\boldsymbol{y}$ *is a type* (Type formation: product)
4. *If* x *is a type, then* $\sqcup x$ *is a type* (Type formation: join)
5. *If* $\boldsymbol{x/y}$ *is a type and* $\boldsymbol{y}$ *is a type, then* $\boldsymbol{(x/y)\bullet y\vdash x;\ y\bullet(x/y)\vdash x}$ (Merge: f.appl.)
6. *If* $\boldsymbol{a/b}$ *is a type and* $\boldsymbol{b/c}$ *is a type, then* $\boldsymbol{a/b\bullet b/c\vdash a/c}$ (Merge: cut rule)
7. *Nothing else is a type* (Closure rule)

Rule 1 introduces $\boldsymbol{p}$ as the basic type, while rules 2 and 3 define how more complex types are formed. While rule 2 allows the definition of the so-called "functional" (or division) types, rule 3 allows the definition of product types. Functional types are assigned to heads and affixes, whereas product types are instead assigned to morphemes *qua* clusters of features. Such an assumption entails that basic features are assigned the type $\boldsymbol{p}$ of phrases, which perhaps can also be conceived as mnemonic for *predicates* in this case. Rule 4 defines that a type $\boldsymbol{p}$ can correspond to the sum of its possible sub-types, corresponding to a form of morphological underspecification/ambiguity. Hence, underspecified terms are polysemous, and can license the emergence of underspecified interpretations, as discussed in section 2.2.

Rules 5 and 6 define how morphemes (phrases, sentences) are combined. Rule 5 is known as *forward application* (Moortgat 2011 §2.1; Morryll 2011: ch.1). Two *matching* types (e.g. $\boldsymbol{x}$ and x) are "cancelled out", but if they do not match (e.g. we merge $\boldsymbol{x}$ and $\boldsymbol{y}$), a derivation is said to *diverge* or *crash*.[10] This rule represents a TLS version of the *merge* operation in DM, as a ternary relation *Rxyz* between two inputs x and y (head and argument) and output z (the resulting phrase). In our TLS system, the merge operation operates in a "distributed" manner: the product ("•") of possibly

[9] The attentive reader will have noticed that we use the notions of feature "sub-type", rather than feature "value". The subtle difference is that values do not allow to establish relations between features. This fact would be reflected onto semantic interpretation, and prevent us from giving an account of the structure of sense networks, and patterns such as sense overlaps amongst SSPs. In other words, our syntactic theory must meet certain *interface conditions*, for its analysis to be empirically adequate. See Carpenter (1992: ch.3-4) for discussion.

[10] The forward application rule is normally defined only via the rule $\boldsymbol{(a/b)\bullet b\vdash a}$ (cf. Moortgat 2010 2.1§). The proof $\boldsymbol{a\bullet(b/a)\vdash b}$ is based on proving the relation between types involving the right division connective with those involving the left division connective (e.g. $\boldsymbol{a/b\vdash b\backslash a}$). Via these equivalences, we can use a system only involving the right division connective. We do not offer the proof, as it is elementary but long. See Morryll (2011: ch.2) for discussion.

complex (i.e. division: "/") types proves the existence of a larger constituent, a result that we represent via "⊢". Rule 6 is known as the *cut*/*transitivity* rule, and permits us to merge complex types with adjacent and matching types together. Like rule 5, it acts as a merge schema. Rule 7 says that no other rules are needed to account our data.[11]

Via this set of assumptions, we can generate the minimal type set ***TYPE={p, p/p, p/p/p, p•p, ⊔p,…}***. Larger but finite types set may be recursively defined, since our theory models heads which can only take up to two arguments (cf. Morryll 2011: ch.1). However, this set will suffice, for our purposes. As a first approximation, ***p*** is the type of phrases (e.g. *la cama*), ***p/p/p*** is the type of heads *qua* relational elements (e.g. *de*). The product type ***p•p*** is the type of phrases carrying specific features or sub-types thereof. The join type ***⊔p*** represents features with underspecified sub-features, and intuitively is the type of *en* and other polysemous SSPs. We discuss the precise details on how these types are "used" in derivations in the next section, when we discuss the data.

We now wrap up our syntactic assumptions. We capture the cyclic nature of our derivations by defining 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 us to represent the steps in a derivation as ordered elements. We implement two operations, *lexical selection* (LS) and *merge introduction* (MI) to explicitly note the introduction of a new element in a derivation and the merging of two elements, respectively. Consider (59):

(59) a. *Pazu loves Chitta*

b. *t.*	[$\text{Pazu}_{\boldsymbol{p}}$]	(LS)
t+1.	[$\text{loves}_{\boldsymbol{p/p/p}}$]	(MI)
t+2.	[$\text{Pazu}_{\boldsymbol{p}}$]•[$\text{loves}_{\boldsymbol{p/p/p}}$]⊢[$_{\boldsymbol{p/p}}$[$\text{Pazu}_{\boldsymbol{p}}$] $\text{loves}_{\boldsymbol{p/p/p}}$]	(MI)
t+3.	[$\text{Chitta}_{\boldsymbol{p}}$]	(LS)
t+4.	[$_{\boldsymbol{p/p}}$[$\text{Pazu}_{\boldsymbol{p}}$] $\text{loves}_{\boldsymbol{p/p/p}}$]•[$\text{Chitta}_{\boldsymbol{p}}$]⊢[$_{\boldsymbol{p}}$[$\text{Pazu}_{\boldsymbol{p}}$] $\text{loves}_{\boldsymbol{p/p/p}}$ [$\text{Chitta}_{\boldsymbol{p}}$]]	(MI)

In this derivation, the DP *Pazu* is merged with the transitive verb *loves*. Since the first element is assigned type ***p*** and the second type ***p/p/p,*** the merge of these elements, *Pazu loves,* is assigned type ***p/p***, as a *result* of this derivational process. The further merge of *Chitta* allows the full sentence *Pazu loves Chitta* to be formed, an object of type ***p***, as a "skeletal" VP. As it should be obvious, our derivations proceed in a top-down fashion. This is consistent with psychologically-oriented analyses of sentence production and processing (Levelt 1989; Phillips 2006; Jarema & Libben 2006). Crucially, this approach allows us to offer a simple derivational account of our data, as discussed in the next section.

3.2. The Proposal: Morpho-Syntactic Derivations

The goal of this section is to present our syntactic proposal (section 3.2.1), and how it accounts the morpho-syntactic data (sections 3.2.2, 3.2.3).

3.2.1. The Proposal: Basic Structures and Modes of Type Assignment

[11] The use of the join operator allows us to capture the properties of underspecified terms as symmetric "unions" of sub-features (cf. Johnson & Bayer 1995; Bernardi & Szabolcsi 2008). Other connectives, e.g. the left division/slash "\", and "⊓", the meet operator from the second family (Heylen 1997a, b), are not crucial, here. See the previous footnote on why we can leave left division aside.

We start by motivating our choice for the structure of SSPs that we adopt in our derivations. Although we have discussed data mostly involving simple SSPs, the internal structure of SSPs from the *a-* and *de-* series suggests that a fine-grained analysis structure of SSPs is necessary. Furthermore, the analysis proposed in Romeu (2014) suggests that SSPs involve categories with flexible valence. Reg and Axpart are treated as heads that only require a complement to form a phrase, while Mod phrases can act as phrases with 0-valence.[12] Thus, SSPs seem to invite a more flexible account of the valence of its constituting morphemes than those proposed in cartographic works (e.g. Svenonius 2010; den Dikken 2010).

For this reason, we offer an analysis of the structure of SSPs that is similar to Romeu (2014), although with some key differences. We assume that SSPs include a Rel head, with a flexible semantics, but also that Axpart is a phrasal element, denoting a specific location with respect to the ground (e.g. Pantcheva 2008, Terzi 2008). We then treat Reg heads as heads taking ground DP complements, forming a RegP and returning the location that partakes in the overall spatial relation. We also introduce a silent head "Deg" that takes an MP as its specifier, and an SSP phrase as its complement. We do not investigate the internal structure of MPs and DegPs, although fine-grained analyses exist (e.g. Kennedy 1999, 2007; Landman 2004, 2004; Svenonius 2010). For our purposes, a simplified analysis of DegPs as elements of an extended "SP field" can suffice for the semantic analysis of our examples, and the distribution of MPs. We display these structures in (60):

(60) a. [$_{DegP}$ [$_{MP}$ diez metros] (Deg) [$_{RelP}$[$_{RegP}$ en- [$_{AxpartP}$ -frente]] del [$_{DP}$ scallop]]]
b. [$_{VP}$[$_{DP}$ Mario] está [$_{DegP}$[$_{MP}$ diez metros] Deg [$_{RelP}$ enfrente del scallop]]]
c. [$_{ConjP}$[$_{DegP}$[diez metros enfrente de la cama] y [$_{RelP}$ a la izquierzda del scallop]]]

The structure in (60a) shows our analysis of SSPPs distributing with MPs. The structure in (60b) illustrates the skeletal clausal structure that we employ for our data. Both this structure, and the one in (60c), employ a simplified analysis of *enfrente* for simple reasons of space. We leave aside a more thorough analysis of the contribution of verbal/clausal elements to sentence structure, and their interplay with SSPs (but see Romeu 2014: ch.6 for discussion). Instead, the structure in (60c) offers a standard analysis we adopt for Boolean SSPs (e.g. Winter 2001: ch.2-3; Romeu 2014: ch.5; see Camacho 2003 for a different analysis). Some considerations on these structures are however due, before we continue.

The structure in (60a) is partially reminiscent of other non-cartographic analyses for SPs. One example is the "P-within-P" hypothesis (e.g. Hale & Keyser 2002, Mateu 2008), but other accounts offer similar analyses (e.g. van Riemsdjick 1990, 1998; van Riemsdijck & Huysbregts 2007). Note that we consider articles (D heads) fused with prepositions as a single unit, although we use the label "DP" for our ground phrases (ultimately, NPs), for mere expository reasons. Recall now, from our discussion of Boolean SSPs, that examples involving conjuncts of slightly different categories (e.g. SSPs and DegPs) create an *impasse* in a label-driven analysis. Ideally, Boolean SSPs should only include conjuncts of the same type (e.g. ***p*** for both conjuncts). Our solution to this *impasse* is defined as follows.

[12] The analysis that Romeu (2014) offers for certain SSPs (e.g. *desde*) suggests that Mod phrases can also be 1-place heads that take an argument (a specifier). We have not addressed this aspect in (37)-(39), as it is not crucial to our discussion, although it is consistent with the analysis we wish to offer.

Our first assumption is that DPs and MPs are assigned type ***p•p***, the type of arguments/phrases carrying specific (nominal) features.[13] Second, we assign the type ***⊔p•p*** to simple SSPs (e.g. *en*, *a*, *sobre*). We thus assume that these elements determine the polysemous nature of the phrase they are part of, at a semantic level. Their morpho-syntactic type carries information about this semantic property, corresponding to the sum type ***⊔p***, and information about their status as SPs (i.e. the feature ***p***). Axpart Ps (e.g. *frente*, *Norte*) are assigned type ***p•p*** of noun-like elements, and rely on simple SSPs to become part of a complex SSP. Thus, *frente* is assigned the type of NPs (cf. *el frente*), by merging with *en* it can become a complex SSP, *enfrente* (cf. again Pantcheva 2008, Terzi 2010). We fully spell out this account and its consequences in the next section.

Third, heads are assigned a set of related functional types, although their precise type depends on each head and its distribution. Rel heads (e.g. *de*) are assigned the more specific type ***p/p/⊔p***, since they merge with simple SSPs in specifier position. The other heads (Deg and the verbs *estar* and *ir*) are instead assigned type ***p•p/p/p•p*** of relations, with the *proviso* that their arguments can carry features. We make the same assumption for conjunction *y*, as it can take any pair of argument phrases and return a phrase ***p*** as a result, hence its syncagorematic status.

Fourth, recall that there is relation between *de*, *a* as heads and *de-*, *a-* as prefixes, and between *a* as a simple SSP and *a-* as a prefix. This suggests that SSPs display a form of very constrained *polymorphism*, since lexical items can be assigned different types in different syntactic contexts. We can capture this fact via the so-called *residual rule*. This rule governs the suppression and promotion of arguments, and their respective types (Moortgat 2010; 2011 §2.2). It determines, for istance, how a phrasal element (e.g. *en*) can become an affix to an Axpart SP (e.g. *frente*) to form a complex SSP (i.e. *enfrente*). The precise import of this rule will become clear once we discuss the data. Here, we first define this rule and two of the variants we employ in this paper in (61):

(61) *Residual rule:* ***a•b/c⊢a/b/c***, ***a•b⊢a/b;***

In words, the residual rule says that an affix-like element can become a head, and a phrasal element can become an affix, respectively. For instance, an SSP can become an affix by “shifting” its specific type ***p*** in input position: from ***⊔•p*** to ***⊔p/p*** (e.g. *en-* in *enfrente*). The rule ***a•b/c⊢a/b/c*** has a more specific interpretation: an affix-like element can become a head (e.g. *de-* becomes the head *de*). Hence, the changes in valence that we observe for our simple SSPs can be captured in a simple but principled way, via the residual rule.[14]

We can now offer our type assignment for our lexical items in (62):

(62) a. ***p•p***:=*{ Mario, coche, diez metros, frente, dentro, detrás, Norte, la estación, la via,…}*

b. ***⊔p•p***:=*{en, a, sobre, bajo, alante,…}*

[13] We do not use superscripts to differentiate the relevant features as (sub-)types (e.g. ***p•p'***), as this imprecision makes our derivation more compact and nevertheless clear.

[14] Standard definitions of the residual rule (e.g. Morryll 2011: ch.2) involve equivalence relations between types involving left and reight division. Here we use only two of these rules, as we are only concernced with changes in valance. A more thorough discussion of this rule would thus lead us too far afield.

c. ***p•p/p/p•p***≔*{estar, ir, sentar, y, Deg}*
d.. ***p/p/⊔p***≔*{P, de}*
e. ***⊔ p/p***≔*{en-, a-, de-}*

As our assignment suggests, different categories find a unified analysis and type assignment.[15] Our TLS analysis captures the fact that, for instance, both *en* and *diez metros* can be arguments (specifier) of a "P" head. Our assignment also indirectly suggests that the polymorphic nature of SSPs such as *en* entails that these items can be assigned different types, based on their syntactic context of occurrence. This context-sensitivity also entails that certain semantic differences in interpretation should be predicted, related to the status as head or affix of an SSP. We discuss these and other predictions once we turn to the analsysis.

3.2.2. The Proposal: *En, A, De*

We start from an analysis of the SSPs we discussed in sections 2.1.1-2.1.3. In order to maintain our derivation (relatively) compact, we mostly derive the SSPP occurring in each example, whether it be a "simple" or Boolean SSPP. For space reasons, our derivations involve simplified types for arguments, e.g. the type ***p•p/p/p•p*** is simplified as ***p/p/p***. We repeat (3) as (63a), and offer our first derivation in (63b):

(63) a. *Mario está diez metros enfrente del coche*
b. *t.* [diez metros$_{p}$] (LS)
t+1. [Deg $_{p/p/p}$] (LS)
t+2. [diez metros$_{p}$]•[Deg$_{p/p/p}$]⊢[$_{p/p}$[$_{p}$ diez metros] Deg$_{p/p/p}$] (MI)
t+3. [en$_{\sqcup p\bullet p}$] (LS)
t+4. [$_{p/p}$[$_{p}$ diez m.] Deg$_{p/p/p}$]•[en$_{\sqcup p\bullet p}$]⊢[$_{p}$[$_{p}$ diez m.]Deg$_{p/p/p}$[en$_{\sqcup p\bullet p}$] (MI)
t+5. [frente$_{p}$] (LS)
t+6. [$_{p/p}$[$_{p}$ diez metros] Deg$_{p/p/p}$[en$_{\sqcup p\bullet p}$]]•[frente$_{p}$]⊢
[$_{p}$[$_{p}$ diez metros] Deg$_{p/p/p}$[*en*$_{\sqcup p/p}$[frente$_{p}$]]]⊢ (Residual Rule, Ass.)
[$_{p}$[$_{p}$ Diez metros] Deg$_{p/p/p}$[$_{\sqcup p}$ enfrente]] (MI)
t+7. [de$_{p/p/\sqcup p}$] (LS)
t+8. [$_{p}$[$_{p}$ Diez metros] Deg$_{p/p/p}$[$_{\sqcup p}$ enfrente]]•[de-$_{/p/p/\sqcup p}$]⊢
[$_{p}$[$_{p}$ Diez metros] Deg$_{p/p/p}$[$_{p/p}$[$_{\sqcup p}$ enfrente] de-$_{p/p/\sqcup p}$]] (MI, Associativity)
t+9. [-$l_{p/p}$] (LS)
t+10. [$_{p}$[$_{p}$ Diez metros] Deg$_{p/p/p}$[$_{p/p}$[$_{\sqcup p}$ enfrente] de-$_{p/p/\sqcup p}$]]•[-$l_{p/p}$]⊢
[$_{p}$[$_{p}$ Diez metros] Deg$_{p/p/p}$[$_{p/p}$[$_{\sqcup p}$ enfrente] del$_{p/p/\sqcup p}$]] (MI: Cut rule)
t.+11. [coche$_{p}$] (LS)
t+12. [$_{p}$[$_{p}$ Diez m.] Deg$_{p/p/p}$[$_{p/p}$[$_{\sqcup p}$ enfrente] del$_{p/p/\sqcup p}$]]•[coche$_{p}$]⊢
[$_{p}$[$_{p}$ Diez m.] Deg$_{p/p/p}$[$_{p}$[$_{\sqcup p}$ enfrente] del$_{p/p/\sqcup p}$ [coche$_{p}$]]] (MI)

The first key steps are *t+4* to *t+6*: *en* is merged as an argument of the Deg head. It then becomes an affix-like item via the residual rule, when *frente* is selected and merged with it. When this happens, the polysemous SSP *enfrente* is formed.[16] This

[15]Note that the type of *a-* and *de-* should be ***⊔p•p/p,*** in order to fully account the type relations amongst the different realizations of these lexical items. We use the simpler type ***⊔p/p*** for readability.

[16]The type of *en* is ***⊔p•p***, a sub-type of the general type ***p*** (i.e. we have ***(⊔p•p)⊑p***). Hence, *type accommodation* is permitted (Bernardi & Szabolcsi 2008), which in turns allows the continuation of the derivation. We do not spell out this operation, as it only plays a role in few derivational steps (i.e. in (64), (65)).

comples SSP can then merge with silent "P" and the ground DP to form an SSP, *enfrente del coche*, in turn a complement of the Deg head (steps *t+7* to *t+10*). Note that, at step *t+6*, *enfrente* forms a "partial" SSP phrase, which then becomes the specifier phrase of the full SSP phrase *enfrente del coche*. Once *de* is merged, its input type $\boldsymbol{\sqcup p}$ determines its point of attachment. It merges with *enfrente*, which becomes its specifier argument via associativity, forming a phrase which is the complement of a Deg phrase. This indirectly *predicts* that *enfrente* has a polysemous interpretation, like its constituting SP *en*, since its assigned type is also $\boldsymbol{\sqcup p}$. We discuss this prediction in more detail in section 4, however.

The next key steps are *t+7* to *t+10*. We assume that *-l*, a realization of the definite article, is a 1-place head of type ***p/p*** (cf. Ritter 1991, 1993), rather than a head ***p/p/p*** (cf. Szabolcsi 2010). Consequently, *-l* can merge with *de*, and form a "conflated" type of simple SSP (cf. Asbury 2008: ch. 2-3). Via one instance of the cut rule, the only merge rule applicable in this context, we have *enfrente del*. We thus suggest that the phonological operation "fusion" occurs when two elements are merged via the intervention of the residual rule, here *en* and *frente* (e.g. Embick & Noyer 2001, 2006; Embick 2013). In both cases, we have operations that merge items by also manipulating their valence, and forming "new" lexical items (here, *del*). Thus, spell-out patterns seem to "record" these forms of structural manipulation via the fusion operation, whereby "fused" items are spelt out as a single lexical item or "word" (cf. also Embick 2013 for a similar argument).

We return to this point in section 3.2.4, as we now move to the discussion and derivation of our example (4), here repeated as (64a). Its derivation is in (64b):

(64) a. *Mario está en el coche*

b. *t.* [Mario$_{p}$] (LS)
t+1. [está$_{p/p/p}$] (LS)
t+2. [Mario$_{p}$]•[está$_{p/p/p}$]⊢[$_{p/p}$[Mario$_{p}$] está$_{p/p/p}$]] (MI)
t+3. [en$_{\sqcup p \bullet p}$] (LS)
t+4. [$_{p/p}$[Mario$_{p}$] está$_{p/p/p}$]]•[en$_{\sqcup p \bullet p}$]⊢[$_{p}$[Mario$_{p}$] está$_{p/p/p}$[en$_{\sqcup p \bullet p}$] (MI)
t+5. [(P) el$_{p/p/\sqcup p}$] (LS)
t+6. [$_{p}$[Mario$_{p}$] esta$_{p/p/p}$ [en$_{p \bullet \sqcup p}$]]•[(P) el$_{p/p/\sqcup p}$]⊢ (MI)
[$_{p}$[Mario$_{p}$] está$_{p/p/p}$ [$_{\sqcup p \bullet p}$[en$_{\sqcup p \bullet p}$]•[(P) el$_{p/p/\sqcup p}$]]⊢ (Residual rule)
[$_{p}$[Mario$_{p}$] está$_{p/p/p}$ [$_{p/p}$[en$_{\sqcup p \bullet p}$] P el$_{p/p/\sqcup p}$]] (MI: Associativity)
t+7. [coche$_{p}$] (LS)
t+8. [$_{p}$[Mario$_{p}$] está$_{p/p/p}$ [$_{p/p}$[en$_{\sqcup p \bullet p}$] P el$_{p/p/\sqcup p}$]]•[coche$_{p}$]⊢
[$_{p}$[Mario$_{p}$] está$_{p/p/p}$ [$_{p}$[en$_{\sqcup p \bullet p}$] P el$_{p/p/\sqcup p}$[coche$_{p}$]]] (MI)

In (64b), step *t+4*: *en* merges with *Mario está* to form the partial clause *Mario está en*, of type ***p***. The silent head (P) and *el* are then merged, so that the SPP *en (P) el* is formed, and merged with the NP *coche* (*t+5* to *t+8*). Note that we can indirectly see that the polysemous interpretation of *en el* can be resolved at a phrasal level, as discussed in section 2. Once the phrase *en el coche* is formed (step *t+8*), a spatial relation between a set of locations denoted by *en* and a ground (*el coche*) is defined, as a non-polysemous phrase of type ***p***.[17]

[17] We could have assigned type $\boldsymbol{\sqcup p \bullet p/p}$ to *en*, given the residual rule, with *Mario está en el* being of type ***p/p***, before merging with *coche*. This analysis would have licensed a non-relational semantics for SSPs, and unattested forms of conflation, e.g. **esta-en*. Our apparently more cumbersome derivation avoids this problem.

By this point, a tight connection between phrasal structure and the resolution of polysemy seems evident. This fact can be further corroborated via or analysis of Boolean SSPs. For this purpose, we repeat (7) as (65a), and assume that an ellipsis mechanism is at work, allowing the deletion of a Copula head that matches the same features of the first *estar* (Merchant 2001, 2012). Since now we have a full model for a derivation of our SSPPs, we can offer again a partial derivation in (65b). We abbreviate lexical items for simple reasons of space:

(65) a. *Mario está sentado en la mesa y Luigi h en la cama*

b. *t.* $[_{p}[\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p}\ [\text{ la mesa}_{p}]]$ (LS)

t+1. $[\text{ y}_{p/p/p}]$ (LS)

t+2. $[_{p}[\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p \bullet p}[\text{ la mesa}_{p}]]\bullet[\text{ y}_{p/p/p}]\vdash$
$[_{p/p}[_{p}[\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p}[\text{ la mesa}_{p}]]\ \text{y}_{p/p/p}]$ (MI)

t+3. $[_{p}[\text{ Peach}_{p}]\ (\text{e})_{p/p/p}\ [\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p}[\text{ la cama}_{p}]]$ (LS)

t+4. $[_{p/p}[_{p}[\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p}[\text{m}_{p}]]\ \text{y}_{p/p/p}]\bullet[_{p}[\text{ Lu}_{p}]\ (\text{e})_{p/p/p}\ [\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p}[\text{ c}_{p}]]\vdash$
$[_{p}[_{p}[\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p \bullet p}[\text{ m}_{p}]]\ \text{y}_{p/p/p}\ [_{p}[\text{Lu}_{p}]\ (\text{e})_{p/p/p}[\text{ en}_{\sqcup p \bullet p}]\text{P}_{p/p/\sqcup p \bullet p}\ [\text{ c}_{p}]]]$ (MI)

Our derivation in (65b) shows that the two instances of *en* represent the two phrasal levels at which the polysemy of *en* can play a role. Once each instance of *en* becomes part of its corresponding conjunct phrase, two relations respectively involving Mario and Peach can be defined. This suggests that Boolean SSPs can trigger underspecification: that is, two or more senses are accessible for a lexical item, at a sentential level (Pustejovsky 1998: 326-327). Thus, we can capture the fact that *en* has distinct readings in each of the conjuncts it is part of, although we cannot capture which readings emerge, a task we defer to section 4.2.

We continue our analysis of Boolean SPs by offering a derivation of a DP sub-type. For this purpose, we repeat (8) as (66a). Its derivation is in (66b):

(66) a. *Los coches están parqueados en la estación y la calle*

b. *t.* $[_{p/p}[\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p}]\bullet[\text{ la estación}_{p}]\vdash[_{p/p}[\text{ en}_{\sqcup p \bullet p}]\text{P}_{p/p/\sqcup p}[\text{ la estación}_{p}]]$ (LS)

t+1. $[\text{ y}_{p/p/p}]$ (LS)

t+2. $[_{p/p}[\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p}\ [\text{ la estación}_{p}]]\bullet[\text{ y}_{p/p/p}]\vdash$
$[_{p/p}[\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p}\ [_{p/p}[\text{ la estación}_{p}]\ \text{y}_{p/p/p}]]$ (MI: Associativity)

t+3. $[\text{ la via}_{p}]$ (LS)

t+4. $[_{p/p}[\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p}\ [_{p/p}[\text{ la estación}_{p}]\ \text{y}_{p/p/p}]]\bullet[\text{ la via}_{p}]\vdash$
$[_{p}[\text{ en}_{\sqcup p \bullet p}]\ \text{P}_{p/p/\sqcup p}\ [_{p}[\text{ la estación}_{p}]\ \text{y}_{p/p/p}\ [\text{ la via}_{p}]]]$ (MI)

The derivation in (66b) says that a Boolean SSP is formed by merging *y* with two conjunct DPs (*la estación*, *la via*), acting as the two grounds of the underlying spatial relation(s). The precise relations that emerge can only be accounted once we look at the semantic side of our derivation. For the time being, however, we can observe that this sub-type of Boolean SSP also seems to receive a polysemous interpretation at a phrasal level. This happens when the polysemous *en* becomes semantically related to the "Boolean ground" *la estación y la via*.

We can now concentrate on the structure of "region" SSPs, such as *al norte de España*. We repeat (14) as (67a), and derive both forms in (67b) and (67c), respectively:

(67) a. *Bilbao está en el/#al norte de España*

b. *t*. [en (P) el$_{\sqcup p\bullet p}$] (LS)
t+1. [norte$_{p}$] (LS)
t+2. [en (P) el$_{\sqcup p\bullet p}$]$\bullet$[norte$_{p}$]$\vdash$[en (P) el$_{\sqcup p/p}$]$\bullet$[norte$_{p}$]$\vdash$
[$_{\sqcup p}$[en (P) el$_{\sqcup p/p}$ [norte$_{p}$]] (MI: residual)
t+3. [de$_{p/p/\sqcup p}$] (LS)
t+4. [$_{\sqcup p}$[en (P) el$_{\sqcup p/p}$[norte$_{p}$]]$\bullet$[de$_{p/p/\sqcup p}$]$\vdash$
[$_{p/p}$[$_{\sqcup p\bullet p}$[en (P) el$_{\sqcup p/p}$[norte$_{p}$]] de$_{p/p/\sqcup p}$ (MI)
t+5. [España$_{p}$] (LS)
t+6. [$_{p/p}$[$_{\sqcup p}$[en (P) el$_{\sqcup p/p}$[norte$_{p}$]] de$_{p/p/\sqcup p}$]$\bullet$[España$_{p}$]$\vdash$
[$_{p}$[$_{\sqcup p}$[en (P) el$_{\sqcup p/p}$[norte$_{p}$]] de$_{p/p/\sqcup p}$[España$_{p}$]] (MI)

c. *t*. [al$_{\sqcup p'\bullet p}$] (LS)
t+1. [norte$_{p}$] (LS)
t+2. [al$_{\sqcup p'\bullet p}$]$\bullet$[norte$_{p}$]$\vdash$
[al$_{\sqcup p'/p}$]$\bullet$[norte$_{p}$]$\vdash$[$_{\sqcup p}$[al$_{\sqcup p/p}$ [norte$_{p}$]] (MI: residual)
t+3. [de$_{p/p/\sqcup p}$] (LS)
t+4. [$_{\sqcup p'\bullet p}$[al$_{\sqcup p/'p}$[norte$_{p}$]]$\bullet$[de$_{p/p/\sqcup p}$]$\vdash$[$_{p/p}$[$_{\sqcup p'\bullet p}$[al$_{\sqcup p/p}$[norte$_{p}$]] de$_{p/p/\sqcup p}$] (MI)
t+5. [España$_{p}$] (LS)
t+6. [$_{p/p}$[$_{\sqcup p'\bullet p}$[al$_{\sqcup p/p}$[norte$_{p}$]] de$_{p/p/\sqcup p}$]$\bullet$[España$_{p}$]$\vdash$
[$_{p}$[$_{\sqcup p'\bullet p}$[al$_{\sqcup p/p}$[norte$_{p}$]] de$_{p/p/\sqcup p}$[España$_{p}$]] (MI)

In (67b), *en el norte* is formed via the residual rule, and is then merged with *de* (step *t+2*). This allows us to assign type $\sqcup p\bullet p$ to *norte*, so that the derivation can proceed as per standard definitions. The key difference with (66c), in our analysis, is that the sum type of *en* includes a different set of sub-features than that of *a*, a fact which we mark via the super-script ***p'***. Whether *al/en el norte de España* can be merged *and* interpreted in a structure depends on the relation they capture, rather than their syntactic structure (*pace* Romeu 2013).

We conclude this section by offering a derivation for (34), repeated here as (68a), in order to show how Boolean SSPs in specifier position can be formed:

(68) a. *Los hombres están sentados/van dentro y detrás del coche*
b. *t*. [$_{p/p}$[dentro$_{p}$] y$_{p/p/p}$]$\bullet$[detrás$_{p}$]$\vdash$[$_{p}$[dentro$_{p}$] y$_{p/p/p}$[detrás$_{p}$]] (MI)
t+1. [del$_{p/p/\sqcup p}$] (LS)
t+2. [$_{\sqcup p}$[dentro$_{p}$] y$_{p/p/p}$[detrás$_{p}$]]$\bullet$[del$_{p/p/\sqcup p}$]$\vdash$ (PI)
[$_{p/p}$[$_{\sqcup p}$[dentro$_{p}$] y$_{p/p/p}$[detrás$_{p}$]] del$_{p/p/\sqcup p}$] (MI)
t+3. [coche$_{p}$] (LS)
t+4. [$_{p/p}$[$_{\sqcup p}$[dentro$_{p}$] y$_{p/p/p}$[detrás$_{p}$]] del$_{p/p/\sqcup p}$]$\bullet$[coche$_{p}$]$\vdash$
[$_{p}$[$_{\sqcup p}$[dentro$_{p}$] y$_{p/p/p}$[detrás$_{p}$]] del$_{p/p/\sqcup p}$] [coche$_{p}$]] (MI)

Our partial derivation in (68b) reads as follows. The merge of *dentro* with *y* and of this constituent with *detrás* forms a Boolean SSP. The resulting "compound" SSP phrase becomes the specifier of the whole SSP phrase *dentro y detrás del coche*. In step *t+2* of (67b), we see that the sum features are introduced via PI (Product Introduction: cf. Carpenter 1992; Bayer & Johnson 1995; Heylen 1997), so that *dentro y detrás* can merge with *de*. In our TLS analysis, PI acts as a simple percolation mechanism that can change the type of the whole phrase as a Boolean SSP. The polysemous status of these two simple SSPs is percolated at a phrasal level, so that the derivation can be safely completed: we have the SPP *dentro y detrás del* *coche*.[18] This syntactic operation makes one subtle prediction: *dentro y detrás* denote a sum of locations, hence it can have a polysemous interpretation. Thus, our syntactic derivations seem to make subtle predictions as to how our SSPPs can be interpreted in phrasal contexts. With these results in mind, we turn our attention to the other SSPs.

3.2.3. The Proposal: *Desde, Hacia, Hasta, Por, Para, Entre, Sobre & Bajo*

We can now derive the structure of all the SSPPs we have discussed, including both types of Boolean SSPs. Thus, we use this section to offer a further proof that our analysis can account all the data we discussion in section 2.1.4.

For this purpose, we start by offering a partial derivation of (44), repeated as (69a), to illustrate how *hasta* can merge with two conjoined ground DPs:

(69) a. *Los hombres vuelven hasta la caverna y la playa*
b. *t.* [$_{p/p}$[hasta$_{\sqcup p\bullet p}$]P$_{p/p/\sqcup p}$]•[a cueva$_{p}$]$\vdash$[$_{p/p}$[hasta$_{\sqcup p\bullet p}$]P$_{p/p/\sqcup p}$[la cueva$_{p}$]] (LS)
t+1. [y$_{p/p/p}$] (LS)
t+2. [$_{p/p}$[hasta$_{\sqcup p\bullet p}$] P$_{p/p/\sqcup p}$[la cueva$_{p}$]]•[y$_{p/p/p}$]$\vdash$
[$_{p/p}$[hasta$_{\sqcup p\bullet p}$] P$_{p/p/\sqcup p}$[$_{p/p}$[la cueva$_{p}$] y$_{p/p/p}$]] (MI: Associativity)
t+3. [la playa$_{p}$] (LS)
t+4. [$_{p/p}$[hasta$_{\sqcup p\bullet p}$] P$_{p/p/\sqcup p}$ [$_{p/p}$[la cueva$_{p}$] y$_{p/p/p}$]]•[la playa$_{p}$]$\vdash$
[$_{p}$[hasta$_{\sqcup p\bullet p}$] P$_{p/p/\sqcup p}$[$_{p}$[la cueva$_{p}$] y$_{p/p/p}$ [la playa$_{p}$]]] (MI)

This derivation shows that the merge of *hasta* with a Boolean SSP, here *la cueva y la playa*, proceeds in a manner entirely parallel to that of *en*. Although the simple SSPs that can be merged in a structure vary in their precise lexical content (sense and exponent), their role in syntactic derivations is homogenous. Thus, "when" a simple SSP is merged with a silent P head and an SSPP is derived, polysemy can be resolved, at a semantic level. We can illustrate this point via a derivation of (54), an example which includes *bajo*, repeated as (70a):

(70) a. *Los pájaros vuelan un kilómetro bajo la nube y el avión*
b. *t+6.* [$_{p}$[$_{p}$ un kilómetro] Deg$_{p/p/p}$[$_{\sqcup p}$ bajo la nube]] (MI)
t+7. [y$_{p/p/p}$] (LS)
t+8. [$_{p}$[$_{p}$ un kilómetro] Deg$_{p/p/p}$[$_{\sqcup p}$ bajo la nube]]•[y$_{p/p/p}$] $\vdash$
[$_{p}$[$_{p}$ un kilómetro] Deg$_{p/p/p}$[[$_{\sqcup p}$ bajo la nube] y$_{p/p/p}$] (MI: Associativity)
t+9. [el avión$_{p}$] (LS)
t+10. [$_{p/p/}$[$_{p}$ un kilómetro] Deg$_{p/p/p}$[[$_{\sqcup p}$ bajo la nube] y$_{p/p/p}$]•[el avión$_{p}$]$\vdash$
[$_{p}$[$_{p}$ un kilómetro] Deg$_{p/p/p}$[[$_{\sqcup p}$ bajo la nube] y$_{p/p/p}$[el avión$_{p}$]] (MI)

The derivation in (70b) shows that a sentence including *bajo*, amongst the many SSPs discussed in section 2.1.4, follows a similar derivational pattern to our other derivations. Thus, this analysis can be applied to all the other SSPs discussed in that section, too. The SSP *bajo* is polysemous, hence of type $\boldsymbol{\sqcup p\bullet p}$, but once *bajo* merges within an SSP (*bajo la nube*), this type is not active anymore. The merge of the second conjunct in the Boolean SSP simply adds a second ground that is involved in an unambiguous spatial relation. The distance that the bird flies at, from both grounds,

[18] Note that the slight asymmetry in types between these Boolean SSPs and those in complement position (e.g. (65b)) is only apparent, as we use type $\boldsymbol{p}$ instead of $\boldsymbol{p\bullet p}$ in these derivations for mere reasons of simplicity.

is specified via the MP *un kilómetro*. The differences that emerge amongst these SSPs, as these derivations suggest, seem purely semantic in nature.

By this point, we have a syntactic account of all the SPP data in (3)-(53), except for the discourse examples in (26)-(27). Before we start addressing these examples, though, a *precís* is necessary. The few TLS proposals that attempt to model discourse structure employ a special type for discourse units, represented as the type *D* (e.g. Jäger 2001, 2005). In our framework, however, it is possible to refrain from introducing a discourse-specific type. Our derivations show that sentences are assigned type ***p*** (viz. (67b)). Thus, it seems possible to merge two sentences into a larger unit (a "text": Asher 1993: ch. 2, 2011: ch. 2), by employing the merge schemas. A useful and important consequence of this fact is that sentences and texts can be derived in a parallel fashion, then.

We then have two different options at our disposal, to account how the merge of sentences into texts comes into being. According to the first option, one sentence is raised to a functional type, and takes a second sentence as its argument (Jäger 2001, 2005). For instance, a first sentence would be raised from type ***p*** to type ***p/p***. According to the second option, based on Asher (2011), two steps can license "sentential" merge. First, via product introduction at least one feature per sentence is re-introduced (e.g. from type ***p*** to type $\boldsymbol{p \bullet \sqcup p}$). Second, sentences as units including the re-introduced types can be merged via the cut rule, as far as the re-introduced types match. The first option involves the first sentence taking the second sentence as a possible "further" clause: the second sentence "completes" the first sentence. The second option involves merging sentences via their features, if some of these features match: the two sentences describe the same events and referents.

We opt for the second option, as it permits us to offer a semantic analysis of anaphoric relations that will prove to be better suited to handle our data. We repeat (26) as (71a). Recall that *a-* and *de-* are assigned the type $\boldsymbol{\sqcup p/p}$, as prefixes (cf. (6e)). We then offer a derivation for the structure of *alante* and *delante* in (71b-c), and a very compressed derivation in (71d):

(71) a. *Mario está detrás de la casa. Luigi está a-lante *(de la casa)*

b. *t* [a-$_{\sqcup p/p}$] (LS)
t+1. [-lante$_{p}$] (LS)
t+2. [a-$_{\sqcup p/p}$]•[-lante$_{p}$]⊢[$_{\sqcup p}$ alante] (MI)

c. *t.* [de-$_{\sqcup p/p}$] (LS)
t+1. [-lante$_{p}$] (LS)
t+2. [de$_{\sqcup p/p}$]•[-lante$_{p}$]⊢[$_{\sqcup p}$delante] (MI)

d. *t.* [$_{p}$ Mario está detras de la casa]⊢[$_{p\bullet\sqcup p}$ Mario está detrás de la casa] (PI)
t+1. [$_{p}$ Luigi está alante]⊢[$_{\sqcup p\bullet p}$ Luigi está alante] (PI)
t+2. [$_{p\bullet\sqcup p}$ Mario está detrás de la casa]•[$_{\sqcup p\bullet p}$ Luigi está alante]⊢
[$_{p\bullet p}$ [$_{p\bullet\sqcup p}$ Mario está detrás de la casa.][$_{\sqcup p\bullet p}$ Luigi esta alante]] (MI: C.R.)

The derivation in (71b) shows that *alante* is formed via the merge of *a-* as an affixal element, and *–lante* as a nominal-like element. When the two elements are merged together, the polysemous SSP *alante* is derived. The polysemous nature of *alante* seems to coincide with ability to denote several locations that would qualify as "in front". The derivation in (71c) shows that *delante* is derived in an entirely parallel fashion. We thus have a parallel with *enfrente*, and similar other SSPs, since polysemy seems to emerge because of one item, *a*, being polysemous and percolating this property at a word level. Note, furthermore, that in these cases the residual rule manipulates the valence of heads *a* and *de*, turning them into the prefiixes *a-* and *de-*. One lexical item is spelt out via fusion, as in the *enfrente* case.

We can now discuss (71d). This derivation captures a well-established fact about the "syntax" of discourses. Two sentences can merge when they are *cohesive*: at least one feature at either the nominal or temporal level must match (e.g. Kehler 2011; Ward & Birner 2012). That is, sentences must involve argument DPs or VPs-like elements with matching features, which allow the creation of anaphoric relations. In our case, the cohesion of our examples is also based on the anaphoric relations created among SSPPs. The two SSPPs *alante* and *delante* are polysemous, and denote a spatial relation based on the same ground DP, thus they are anaphorically related. In Jäger's (2001, 2005) analysis, only the first sentence would have carried the relevant features, creating a cohesion mismatch: first and second sentence do not carry information about the same ground. Our choice can easily avoid this problem, instead.

When cohesion is established, argument demotion as a form of (necessary) ellipsis is licensed (e.g. Merchant 2001, 2004; Ward & Birner 2012). If these items are not merged, then product introduction can re-introduce the relevant feature "to the right" of type $\boldsymbol{p}$. A sentence such as *Mario está detrás* s marked as a sentence carrying information about a location, via the re-introduction of this feature. Since product is not commutative, this is the only option by which this operation can occur (cf. the "right frontier constraint" of Zeevat 2011). Note now that, once we assume that *a* and *en*, but also *a* and *de* represent different feature sets, this distinction must percolate to their polysemy-based type assignment. In other words, *alante* is the only SSP that can be merged in (71d), and that blocks the merge of *de la casa*. The features it carries prevent this ill-formed structure from being derived. We can now tackle the semantic side of our data, but before we do, we briefly discuss these results.

3.3. The Proposal: A Morpho-Syntactic Discussion

Our main result, so far, is an analysis of our syntactic structures and contexts in which polysemous SSPs can be disambiguated. Four sub-results constitute our analysis.

First, if a polysemous simple SSP such as *en*, of type $\boldsymbol{\sqcup p}$, merges with a silent P and a DP (e.g. *coche*), the disambiguation of this SSP seems to occur "when" the SSPP is derived. A similar reasoning applies when *en* merges with *frent*e. The resulting *enfrente* is polysemous, although in a more restricted way. When this SSP merges with *de* and a DP (*el coche*) to form a phrase (e.g. *enfrente del coche*), the resulting type for *en* and *enfrente* (i.e. $\boldsymbol{p}$) indirectly tells us that its polysemous reading is resolved. This fact recursively holds for Boolean SSPs, although the precise structure of the sub-types of Boolean SSPs can determine "when" polysemy is resolved. Thus, SSPs can receive a specific interpretation whether they merge within different types of Boolean SSPs. The reverse may also hold true, since SSPPs can be underspecified, and involve distinct senses for an SSP (e.g. *tirita en la pierna*). Overall, our analysis extends previous results (e.g. Romeu 2013) to our novel data.

Second, we also have seen that there seems to be an interesting parallel between syntactic operations (residual rule, associativity) that manipulate structural properties such as valence, and phonological operations (insertion, fusion). Thus, *enfrente*, *alante* and several other SSPs all share the property of being exponents whose underlying structure is in a sense compressed, with fusion acting as a "record" of these processes. Although far from a full theory of spell-out, this analysis suggests that phonological operations can target multiple but related heads (e.g. *en*, *(P)*, *el*), or even phrases (e.g. *bajo* as a phrasal element). Thus, it also seems consistent with DM, and other theories of spell-out within minimalism (e.g. Embick & Noyer 2001, 2006; Harbour 2007: ch.5; Fábregas 2009, 2014).

Third, our account seems to avoid one rather minor, but unwelcome consequence of Romeu (2014)'s analysis, since fusion and insertion operations can only target "modified" units. In Romeu (2014)'s analysis, it would be possible to spell-out complex phrases via a single exponent. Thus, the possibility of a mono-morphemic SSP spelling out the equivalent of *un kilómetro bajo la nube* (from (69a)) could arise, unless more specific constraints would be postulated to block such forms. The derivation in (69b) shows that none of the derivational steps that generate this SSPP involve structural operations such as the cut or residual rules. Therefore, this possibility is ruled out. As our main concern is to address the polysemy of SSPs, we find this to be a welcome, although indirect result.

Fourth, another interesting consequence of this analysis is that we can offer a very preliminary, but nevertheless minimalist account of "discourse syntax" (in the sense of Hardt 2013). We can offer an account of how sentences are merged to form discourses (viz. (70d)), as a natural extension of our sentential syntax. Via this account, we can capture the role of the morphological alternation between the *a-* and *de-* series, thus seamlessly connecting the different possible types for these SSPs into one account. The approach also suggests that the use of a dedicated connective to syntactically represent polysemy seems empirically motivated. Since the *a-* and *de-*SSPs are related via the presence of the type $\boldsymbol{\sqcup p}$, they license a cohesion relation between sentences. This syntactic relation is then interpreted as a semantic relation that establishes the identity of the ground referent under discussion. Thus, the semantic coherence of a text can be derived once syntactic cohesion is established (c.f. Asher 1993, 2011; Kehler 2011; Ward & Birner 2012; Hardt 2013).

Overall, the approach can account these licensing patterns, and the patterns involving MPs, Boolean SPs and discourse examples via a single system. This falso suggests that our top-down approach seems an empirically sound choice: it can derive morphological, syntactic and sentential structures via one set of rules.

4. The Proposal: Semantics

The goal of this section is to present a situation semantics interpretation for our derivations, enriched with a "richer" account on the ontology underpinning SSPs (section 4.1). We analyze our data, and offer a general discussion (section 4.2, 4.3).

4.1. The Proposal: A Situation Semantics Analysis

There is a vast literature on the semantics of SPs, with a wealth of proposals on the ontological status of their denotations. Some works suggest that SPs denote geometrical entities, such as regions (Nam 1995; Kracht 2002, 2004), vectors (Zwarts and Winter 2000; Bohnemeyer 2012), and paths (Jackendoff 1983; 1990; Zwarts 2005). Other works suggest that SPs simply denote events (Landman 2000; Rothstein 2004) or situations (Kratzer 1989, 2007; Elbourne 2005, 2013). Some proposals combine both types of approaches (e.g. Krifka 1998; Evans & Tyler 2001, 2004, a, b; Evans 2006, 2009; Gehrke 2008), suggesting that these entities form ontologically inclusive domains.

Since our aim is to account the polysemous nature of SSPs and their interplay with other parts of speech, a simple but flexible ontology becomes highly desirable. Thus, we assume that our domain of discourse includes a universal type of *situations*. SSPs find their denotations in the sub-type of *locations* (Barwise and Etchemendy 1990; von Fintel 1994, ch.2; Barwise & Perry 1999; Kratzer 1989, 2007). We represent this domain as the set S, of which we (mostly) study the sub-type L of locations. The set L includes a denumerably infinite set of elements (i.e. we have $L=\{s, r, t, v,...,z\}$). For reasons or readability, we only use one sub-script for our terms (e.g. s_s), as it will be clear when we are talking about locations or other specific sub-types.

We use "Quine's innovation", and assume that singleton sets represent *atomic* situations (i.e. s stands for $\{s\}$: Schwarzschild 1996: ch.1), while complex sets represent *sum* situations (e.g. $\{s,g\}$). Thus, all referents are represented as sets, which may or may not be made of distinct sub-sets. The empty situation is thus represented via the empty set "$\varnothing$". We then assume that our set of situations forms a *Boolean algebra*, a partially ordered set that also includes an empty situation (Landman 1991: ch. 2-3; Szabolcsi 1997, 2010). The set of rules for these types is defined in (72):

(72) 1. *Given a set S, s is a semantic type* (Lexical type)
2. *If a is a type and b is a type, then* $a \rightarrow b$ *is a type* (Functional type)
3. *If a is a type and b is a type, then* $a \times b$ *is a type* (Cartesian product type)
4. *If a is a type,* $\cup a$ *is a type* (Boolean sum type)
5. *If* $a \rightarrow b$ *is a type and b is a type, then* $(a \rightarrow b) \times a \vDash b$ (Function application)
6. *If* $a \rightarrow b$ *is a type and* $b \rightarrow c$ *is a type, then* $(a \rightarrow b) \times (b \rightarrow c) \vDash a \rightarrow c$ (F. comp.)
7. *Nothing else is a type* (Closure property)

While rule 1 defines the basic semantic type of situations, rules 2 and 3 define complex types via *function abstraction* and the (Cartesian) *product* type, denoted as "$\times$". The product type should be interpreted as forming a pair of values (in this case, situations) that are taken in a certain order, when the corresponding features are bundled together.[19] Hence, functions, relations, bundled (semantic) feature sets or *properties* are part of our domain of interpretation (Szabolcsi 1997; Harbour 2007).

Rule 4 allows us to represent the polysemy of lexical items in a principled way. This rule says that a sum situation is constituted of the union of several situations. In our specific case, we can say that a sum situation involving locations amounts to the sum of possible locations that a polysemous SSP can denote. For instance, *en* can denote an internal or external location defined with respect to the ground, as well as other possible locations (e.g. front, back). We make this notion precise in section 4.2.

Rule 5 shows how these types interact via function application, the semantic counterpart of the forward application rule (Moortgat 2011, §2.2-2.3). We represent this semantic ternary relation via "$\vDash$" (reads: "verifies" or "derives"), the semantic counterpart of our proof relation "$\vdash$". Rule 6 is the counterpart of the cut rule, and says that two functions can be composed together, if they share the same argument. Rule 7 says that no other operations can form and derive semantic types. A set of types generated by these definitions is the set $TYPE=\{s, s \rightarrow s, s \rightarrow (s \rightarrow s), s \times s, \cup s, ...\}$. This set includes at least the types of referents, functions, relations and features' sets/properties, as well as polysemous terms. As for morphological types, this set can be seen as the minimal type set that can account our data.

We now turn to interpretive matters. We implement a simple form of *λ-calculus* to represent our functions and relations (Gamut, 1991). Since we are working with

[19] Note here that the Cartesian product is also not commutative, since the pair $<a,b>$ is not the same as the pair $<b,a>$. At the level of types, we can capture the fact that suppressed arguments in our derivations involve arguments taken in a certain order. See Landman (1991: ch.1-2) for discussion.

Boolean algebras, we can define one basic relation over the elements of the domain: the *part-of* relation. This relation is usually represented as "$a \subseteq b$", 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 other words, if a situation a is part of a situation b, then their intersection will correspond to a, the sub-set situation, and their union to b, the super-set situation. As we implement Quine's innovation for our situations, mereological sum (product) and set union (intersection) reduce to the same operations (cf. Szabolcsi 1997, 2010: ch.1). Note that, via the part-of relation we also have access to the identity relation "=". The role of this relation will become clear in our discussion of the MP and DegP data.[20]

We can thus represent complex or *structured* situations simply as: "$\lambda x.\lambda y.s{:}(x \subseteq y)$". This reads: a situation is instantiated by a relation between two referents, yet to be specified. We import this notation from various analyses that treat implicit arguments as structured model-theoretic objects (e.g. von Fintel 1994: ch.1; Landman 2000; Cooper 2005; Kamp, van Genabith & Reyle 2011). Our notation has two advantages. First, it captures the idea that the sense of a phrase, a saturated situation, corresponds to the combination of the senses of its constituting elements. Second, it is slightly more "compact" than standard event semantics notation (e.g. Gehrke 2008), allowing us to explicitly represent polysemous situations and the relations they instantiate. We temporarily treat s as a free variable, and explain how it is bound once we discuss the data in section 4.2.

We can now define an *isomorphism* as a general instance of the *interpretation function*, which maps morphological types onto semantic ones, shown in (73):

(73) MORPHOLOGY⇒SEMANTICS ⇒INTERPRETATION[21]

$$
\begin{array}{ll}
\boldsymbol{p\bullet p} \Rightarrow s \times s & \Rightarrow s \times l \; (=s_l,),\; s \times d \; (=s_d) \\
\boldsymbol{\sqcup p\bullet p} \Rightarrow \cup s \times s & \Rightarrow \cup s_s,\; \cup\{a,b\}_s \\
\boldsymbol{p/p/p} \Rightarrow s \rightarrow (s \rightarrow s) & \Rightarrow \lambda x.\lambda y.s{:}(x \subseteq y)_s \\
\boldsymbol{\sqcup\, p/p} \Rightarrow s \rightarrow (\cup s) & \Rightarrow \lambda x.s{:}(x \subseteq \cup c)_{s \rightarrow \sqcup s}
\end{array}
$$

Our isomorphism connects the rules offered in (54) with those in (73). Product types $\boldsymbol{p\bullet p}$ are interpreted as situations with ordered type pairs. Therefore, product types can be used to represent sub-types, too. For instance, locations can be defined as situations mapped onto the sub-type l (i.e. $s \times l$ or s_l), individuals as situations mapped onto the sub-type d (i.e. s_d), and so on. Join phrases $\boldsymbol{\sqcup p\bullet p}$ denote sum situations, so an SSP such as *en* denotes the sum of locations $\cup l_s$, which can also be represented as $\cup\{a,b\}_{s.}$. Heads denote relations with type restrictions on their arguments. Thus, a head such as *de* can take *en frente* as an argument, or any other SSP with a matching type. Our affix-like types $\boldsymbol{\sqcup p/p}$ are then interpreted as parametric functions that take locations as their arguments, and map them onto sum locations. The precise role of these types will become clear when we discuss the *a*- and *de*- data.

The mapping we propose captures the intuition found in TLS that, once we can derive a (morpho)-syntactic structure via a logical proof system, then we can directly derive its interpretation in a model of discourse. From morpho-syntactic structures, we can straightforwardly derive and predict semantic interpretations. We offer a sample

[20] Since our types form a Boolean algebra, it is also possible to establish a part–of relation over types. This relation on types permits us to explain why SSPs such as *a* and *hacia* seem to partially overlap in their sense(s) distribution, as we discussed in section 2. We discuss this point in section 4.2.

[21] The order of semantic types mirror the order of syntactic types in slash categories. Thus, ***a/b*** corresponds to the semantic type $b \rightarrow a$. Thus, semantic residual rules also mirror syntactic ones.

semantic derivation of (59) in (74) to illustrate this principle, with the operations *interpretation* (Int) and *function application* (FA) as semantic matches of LS and MI:

(74) a. *Pazu loves Chitta*

b. *t.* $[[\text{ Pazu}_{\boldsymbol{p}}]]\vDash p_s$ (Int)

t+1. $[[\text{ loves}_{\boldsymbol{p/p/p}}]]\vDash\lambda x\ \lambda y.s{:}\boldsymbol{love'}(x,y)_{s\to(s\to s)}$ (Int)

t+2. $[[\text{ Pazu}_{\boldsymbol{p}}]]\times[[\text{ loves}_{\boldsymbol{p/p/p}}]]\vDash\lambda x\ \lambda y.s{:}\boldsymbol{love'}(x,y)_{s\to(s\to s)}(p_s)= \lambda y.s{:}\boldsymbol{love'}(p,y)_{s\to s}$ (FA)

t+3. $[[\text{ Chitta}_{\boldsymbol{p}}]]=c_s$ (Int)

t+4. $[[_{\boldsymbol{p/p}}[\text{ Pazu}_{\boldsymbol{p}}]\text{ loves}_{\boldsymbol{p/p/p}}]]\times[\text{ Chitta}_{\boldsymbol{p}}]]\vDash\lambda y.s{:}\boldsymbol{love'}(p,y)_{s\to s}(c_s){:}=s{:}l(p,c)_s$ (FA)

The "[[.]]" represents the interpretation function. We translate *loves* as a relation *s:**love'**(x,y)*, a situation in which two referents stand in a "love" relation. This simple translation for verbs suffices, as we are not concerned with their precise interpretation. Hence, the interpretations of *Pazu* and *Chitta*, which correspond to the referents *p* and *c*, become the arguments of the relation that *loves* denotes, via function application. We turn now to the analysis of the data.

4.2. The Proposal: Studied Polysemy and Compositionality

The goal of this section is to present a semantic assignment for our data (section 4.2.1), and show how it can account the data (sections 4.2.2, 4.2.3). We discuss our results, and make some general considerations about our analysis (section 4.3).

4.2.1. The Proposal: The Semantic Type Assignment

In this section, we introduce the semantic assignment, and the type of semantic structures that we use to account the data. Our account is centered on one central assumption. Polysemous SSPs, *qua* items assigned a sum type, are polysemous in virtue of denoting sums of distinct locations. Thus, by assuming that an SSP such as *en* denotes a sum location, we assume that a figure can be in front of, or behind, or in, or outside (and so on) a given ground. In other words, an SSP is polysemous when it can denote a set of equally plausible locations that a figure can occupy, with respect to a ground. This is consistent with cognitive and formal approaches to the semantics of SSPs (e.g. Evans & Tyler 2004, Evans 2009; Vandeloise 2010; Zwarts 2004, 2010b; Chung 2011).[22] However, our use of sum types improves on previous analyses on precision. It captures the fact that any sense can be directly accessed and conjoined, depending on the syntactic and semantic context in which an SSP is merged.

We can now make precise our treatment of the spatial senses of SSPs. We model locations as forming a Boolean algebra $*L=<L,\subseteq>$ (cf. Asher & Sablayrolles 1995; Nam 1995; Kracht 2002; Eschenbach 2005). This reads: a set of locations is ordered by the part-of relation "$\subseteq$". This algebra can be seen, in turn, as a sub-structure of the algebra of situations $*S=<S,\subseteq>$ .We have a power-set of locations with a part-of/topological relation defined over them. If we assume that our algebra has 8 atomic locations, we can represent a three-dimensional, Euclidean space defined with respect to three dimensions (a "front" and a "back" locations can define a horizontal axis), and an "internal/external" distinction. With 8 atoms, our structure would contain $2^8=256$ possible locations, in its domain. With 10 atoms and the possibility to capture

[22] This analysis also underscores the formal similarities of sum and disjunction connectives, in a Boolean setting. This fact will become obvious when we analyze examples involving underspecification, in section 4.2.2.

cardinal (i.e. North/South) locations, we have $2^{10}=1024$ locations. Even a simple model of space can generate a rich structure of possible locations and their relations.

Analyses including richer sets of atoms are possible, and empirically more accurate (cf. Levinson & Meira 2003; Levinson & Wilkins 2006: ch.1; Zwarts 2010a; see also Zwarts & Winter 2000: 178-179). If we consider that Boolean SSPs can denote sum locations (e.g. *enfrente y encima de*), then the apparent wealth of locations that SSPs can denote seems justified. This is the case, even though only some of these locations fall in the denotation of simple SSPs. Precise numbers and lexicalization patterns are not our concern, although our proposal is consistent with other works on this topic (cf. Zwarts & Winter 2000: 190-191).[23] Therefore, we now have a structure that permits us to make formally precise the descriptive "network sense" notion. In our account, a network sense is the sub-algebra of locations that a single SP can denote. Thus, this analysis also permits us to account the second pattern data, as it will become clear once we analyze the data.

Aside an algebra of locations, we define an algebra of ordered pairs of locations or *vectors*, to account the senses of projective SSPs (e.g. *encima*). We thus enrich our ontology with the product type $l\times l$ for vectors (cf. Zwarts & Winter 2000; Morzycki 2004, 2005, 2006; Bohnemeyer 2012). Via this definition, a (semi-)axis is defined as a vector that connects a certain part of the ground with a point set to infinity. Thus, SSPs such as *enfrente* and MPs such as *diez metros* denote ordered sets of points (vectors), which we represent as pairs of beginning and ending points, in our system.

The pre-theoretical intuitions behind these complex theoretical assumptions can be defined as follows. In our analysis, SSPs capture our understanding of space and spatial relations by "describing" locations and the relations between these locations: their sense networks. Polysemous SSPs can thus describe several connected locations, although they can do so in different combinations and forms: sense networks vary in the senses they include. For instance, *en* and *a* denote slightly different sets of (connected) locations that a figure can occupy. Again, *a* in its (limited) locative sense cannot denote an internal location for the figure, whereas *en* can. Therefore, the sense networks of SSPs amount to the related several locations and directions (vectors) that SSPs can denote.

Before we make these aspects compositionally precise, we need to discuss the semantic interpretation of the residual rule, offered in (75):

(75) *Residual rule:* $(a\times b)\rightarrow c\vDash a\rightarrow b\rightarrow c$ *and* $a\times b\vDash a\rightarrow b$;

In words, the interpretation of the residual rule says that a function that takes an argument of a certain type can be turned into a relation by adding an argument slot (i.e. we have $\lambda x.f(x,k)\vDash\lambda x.\lambda y.f(x,y)$). If the residual rule applies to a saturated function (i.e. an argument), then the function can be retrieved, instead (we have $f(k)\vDash\lambda x.f(x)$).

The role of the semantic interpretation of the residual rule will become clear in the next section. Before discussing the data, we offer our type assignment for a sub-set of our lexical items in (76), and their type-driven interpretation in (77):

[23] The richness of possible locations within our domain L bears on the topic of whether SPs are a functional or lexical category, although indirectly so (cf. Zwarts 2010b). Two other questions are how and why one can choose the locations that form L. Works such as Levinson & Meira (2003) suggest that spatial primitive concepts have non-linguistic, cognitive underpinnings, with their numbers across languages justifying a "semi-lexical" perspective. Both questions do not need to be addressed here, as our analysis can account the data irrespective of the answers that we can offer to such complex matters.

(76) a. $s{\times}s$≔{*Mario, coche, diez metros, frente, dentro, detrás, Norte, la estación, la via,…*}
b. $\cup s{\times}s$≔{ *en, a, sobre, bajo, alante,…*}
c. $s{\times}s{\rightarrow}s{\rightarrow}s{\times}s$≔{*estar, ir, sentar, y, entrar, Deg*}
d. $\cup s{\times}s{\rightarrow}s{\rightarrow}s$≔{*P, de*}
e. $s{\rightarrow}\cup s$≔{*en-* , *a-*, *de-*}
(77) a. [[Mario]]$\vDash m$, [[Coche]]$\vDash c$, [[Diez metros]]$\vDash 10mts$, [[frente]]$\vDash fr$,
b. [[en]]$\vDash \cup l=\{i, e,\ldots\}$, [[bajo]]$\vDash bj=\cup\{-on,-ab\}$, [[al]]$\vDash \cup l'=\{e, o,\ldots\}$
c. [[estar]]$\vDash \lambda x.\lambda y.\exists s{:}(x{\subseteq}y)$, [[entrar]]$\vDash \lambda x.\lambda y.{+}a\text{-}cm(s){:}\mathbf{go'}(x,y)$,
[[y]]$\vDash \lambda x.\lambda y.e{:}(x{\cap}y)$, [[Deg]]$\vDash \lambda x.\lambda y.s{:}(x{=}y)$
d. [[P]]$\vDash \lambda\, x\lambda y.s.(x{\subseteq}y)_{s\rightarrow(s\rightarrow s)}$ [[de]]$\vDash \lambda x.\lambda\, y.s{:}(x{\subseteq}y)_{s\rightarrow(s\rightarrow s)}$
e. [[en-]]$\vDash \lambda y.(y{\subseteq}\cup l)_{\cup s\rightarrow s}$, [[a-]]$\vDash \lambda y.(y{\subseteq}\cup l')_{s\rightarrow \cup s}$

The interpretation of DPs in (76a) amounts to an individual/referent of type *d* of individuals (a sub-type of *s* given $d{\subseteq}s$), so that *Mario* will denote the individual *m*. MPs and Axpart SSPs such as *diez metros* and *frente* denote referents belonging to the type $l{\times}l$ and l of vectors and locations, respectively. *Qua* sub-types of *s*, we lump their interpretation with that of individuals/referents. Thus, our phrasal elements are assigned to specific sub-types of situations, depending on their syntactic status and morphological features that they carry.

The interpretation of polysemous, simple SSPs such as *en* is presented in (76b). These elements of type $\cup s{\times}s$ can be interpreted as sum locations, in turn identified with the locations making up this sum. For instance, the (sum) location that *bajo* denotes is the sum of locations in the non-adjacent, vertically negative region of a ground (i.e. $bj=\cup\{-on,-ab\}$). Our "structured" situations are akin to *qualia* in GL (Pustejovsky 1995), records in Cooper (2005) or type structures in TLC (Asher 2011). However, our notation captures this complexity only in part, since we do not need to focus on the finer-grained details, in our analysis. For our purposes, it suffices to have a principled system whereby the locations making up a sum locations can be directly accessed. Instead, *en* and *a* differ with respect to the inclusion of an "internal" location *i* in the denotation of *en*, location that *a* lacks, as discussed in section 2.1.

We move to the other lexical items. The interpretation of *estar* in (76c) is based on recent treatments of this copula as a "basic" relational element (Maienborn 2005; Ursini 2011; Gumiel-Molina & Perez-Jimenez 2012; Gumiel-Molina, Quiben & Perez-Jimenez 2014). For simplicity, we assume that the situation variable of this relation is bound via an existential quantifier. Hence, *estar* denotes at least one situation in which some relation between individuals and/or locations holds.

Similarly, *entrar* receives a simplified interpretation as a situation in which a relation of (directed) movement holds between figure and ground/destination. We also enrich the semantics of SSPs with a very simple method to distinguish between locative, directional and ambiguous readings. We assume that a feature *a-cm*, short for asymmetric cumulativity, can act as an operator that binds the situation variable (Ursini 2015a). This operator captures the intuition that directional readings of SSPs involve sequences of locations that a figure covers: "paths", or indexed (sequences of) vectors (cf. Zwarts 2008). We can then distinguish between positive and negative values for this operator: whether the situation that a verb or an SSP describes has an a-cumulative denotation or not. We represent these distinctions as *+a-cm(s)* and *–a-cm(s)*, in our denotations, or as positive and negative features, respectively (cf. Harbour 2007). This assumption plays a role in our analysis of the locative/directional alternation, our first polysemy pattern.

Our other interpretations for heads follow a similar tack. The interpretation of *y* follows a standard treatment as a generalized conjunction (Partee & Rooth 1983; Keenan & Faltz 1985; Winter 1995, 2001a). Thus, rather than the simple intersection of two situations, *y* denotes a "larger" situation in which two situations are included. For DegPs (and MPs), we employ standard assumptions (Winter 2001b, 2005, Kennedy 2007). Thus, *ten meters* denotes the length of a given vector connecting figure and ground, and a Deg head its underlying "spatial scale". Our SSP heads receive a parallel analysis.

We treat *de* and (P), in (76d), as denoting the part-of relation, restricted to locations. Thus, *enfrente del coche* denotes a certain frontal location is part of the algebra of locations defined with respect to a given car. The interpretations of *en-*, *a-* and *de-* as prefixes warrant a specific entry, as (76e) shows. Their interpretation is based on a morphological type that is derived from the basic type of phrases (e.g. *en*). We return to this point in the next section.

On this note, we must make a small but important theoretical clarification before we proceed to the analysis. Our strategy is based on an "underspecification" account of polysemy, since the connected senses of polysemous terms are not explicitly represented in derivations (cf. Fábregas 2015). Consequently, we discard an approach based on over-specification (i.e. all senses are listed as meets/conjunctions of senses). This approach would involve the representation of all the senses of SPs accessible in context, even after the compositional interaction of an SP with its argument.[24] Thus, it would make the analysis of zeugma/Boolean constructions problematic, as it would not capture the compositional properties of these data. This point will become clear once we discuss the data in more detail.

4.2.2. The Proposal: The Polysemy of *En, A, de*

We can now present the interpretation of our derivations from section 3.2.2. We pair this discussion with a discussion of the other examples we analysed in section 2.1 covering *en*, *a* and *de*. We thus combine more thorough derivations that are isomorphic to the syntactic derivations, with more compact, "semantics-only" analyses of the data we have discussed. In this way, we can shed light on how the three polysemy patterns emerge, and can be accounted for. We start from (62), and its interpretation in (78). For reasons of space, we simplify the semantic types in the derivations. Lexical items are typed from $s \times s$ to s, which in turn mostly stand proxy for $l \times l$ and l, respectively. Consider (78), first:

(78) *t.* [[Diez metros]]$\vDash 10mts_s$ (Int)
t+1. [[Deg]]$\vDash \lambda x.\lambda y.s{:}(x=y)_{s\to(s\to s)}$ (Int)
t+2. [[Diez metros]]×[Deg]]$\vDash (10mts_s)\lambda x.\lambda y.s{:}(x=y)_{s\to(s\to s)}=$
$\lambda y.s{:}(10mts=y)_{(s\to s)}$ (FA)
t+3. [[en]]$\vDash (\cup l)_{\cup s}$ (Int)
t+4. [[Diez metros Deg]]×[en]]$\vDash \lambda y.s{:}(10mts=y)_{(s\to s)}\times(\cup l)_{\cup s}=$
$s{:}(10mts=\cup l)_s$ (FA)
t+5. [[frente]]$\vDash fr_s$ (Intt)
t+6. [[Diez metros Deg en]]×[[frente]]$\vDash s{:}(10mts=\cup l)_s\times(fr_s)=$

[24] In an over-specification account, the possible senses of a functor would jointly apply to an argument (e.g. we would have $f(x)\cap g(x)$). However, if one sense would be null (i.e. we would have $f(x)=\emptyset$) , then the whole sense of an expression would be null, too. The rest of section 4.2 explains why this is *not* the case. The choice for a sum type acted as an assumption that we would implement this approach (cf. also Heylen 1999: ch.2-3).

$s{:}(10mts{=}(\lambda y.y{\subseteq}Ul)_{s\to Us}(fr)_{s}){=}s{:}(10mts{=}(fr{\subseteq}Ul))_{Us}$ (FA: residual)

$t{+}7$. [[de]]$\vDash\lambda x.\lambda y.s'{:}(x{\subseteq}y)_{Us\to(s\to s)}$ (Int)

$t{+}8$. [[Diez metros Deg enfrente]]×[[de-]]$\vDash$

$s{:}(10mts{=}(fr{\subseteq}Ul))_{Us})\lambda x.\lambda y.s'{:}(x{\subseteq}y)_{Us\to(s\to s)}{=}$ (Associativity)

$\lambda y.s'{:}(s{:}(10mts{=}(fr{\subseteq}Ul)){\subseteq}y)_{(s\to s)}$ (FA)

$t{+}9$. [[-l]]$\vDash\lambda x.\iota(x)$ (Int)

$t{+}10$. [[Diez metros enfrente de-]]×[[-l]]$\vDash$

$\lambda y.s'{:}(s{:}(10mts{=}(fr{\subseteq}Ul)){\subseteq}y)_{(s\to s)}\times\lambda x.\iota(x)_{s\to s}{=}$

$.\lambda y.s'{:}(s{:}(10mts{=}(fr{\subseteq}Ul)){\subseteq}\iota(y))_{(s\to s)}$ (F. composition)

$t.{+}11$. [[coche]]$\vDash c_s$ (Int)

$t{+}12$. [[Diez metros Deg en frente del]]×[[coche]]$\vDash$

$\lambda y.s'{:}(s{:}(10mts{=}(fr{\subseteq}Ul){\subseteq}\iota(y))_{(s\to s)}(c_s){=}$

$s'{:}(10mts{=}(s{:}(fr{\subseteq}Ul){\subseteq}\iota(c)))_s$ (FA)

The rather lengthy but hopefully clear derivation reads as follows. For the Deg head, we assign it the semantics of positive Deg heads in adjectival phrases (e.g. Winter 2005). A silent Deg head denotes an identity relation between distinct sets of vectors. The MP *diez metros* denotes a set of vectors of a given length, the SSPP *enfrente de* a set of vectors in a given (frontal) direction. The contribution of the Deg head, then, is to identify which frontal vectors are ten meters in length (steps *t+2*, to *t+6*).[25] The interpretation of the residual rule has the effect of re-interpreting a sum of locations as the starting points of a set of frontal vectors. Thus, the polysemy of *enfrente* corresponds to its ability to denote such a "frontal" vector space (i.e $s{:}(fr{\subseteq}Ul)$: Zwarts & Winter 2000; Svenonius 2008; Bohnemeyer 2012). In other words, we reconstruct a vector-based account via the compositional contribution of the morphemes making up an SSP. We also capture the subtle form of polysemy that *enfrente* and similar complex SSPs display, as related to the polysemy of simple SSPs (here, *en*). This is a small but welcome result, as it suggests that our approach is already on the right track.

One further aspect concerning this example is how the contribution of the interpretation of *del* comes about, in steps *t+8* to *t+10*. As the steps show, *de-* is first merged with the rest of the DegP. Then, *enfrente* is merged with *de* via associativity, and the set of vectors it denotes becomes one argument of the relation that *de* denotes. The definite article is added via function composition, adding a condition of uniqueness/definiteness on the ground, as per standard assumptions (e.g. Schwarzschild 1996: ch.2). Aside this difference on how and when this contribution comes about, our semantic analysis of definite articles is standard.

The interpretation of *enfrente*, and thus of complex SSPs involving *de*, suggests that a "weak" form of polysemy can be motivated for this category, as a possibility for this SSP to denote distinct locations. This interpretation seems to find support in several experimental studies. According to Carlson (2010a, b), English speakers usually interpret projective SPs as denoting different possible orientations defined with respect to an axis. Thus, a figure that is "in front" of a ground can occupy different positions that can be defined with respect to the frontal part of a ground. Similar experimental support can be found for other projective (English) SPs, as discussed in Carlson (201b: 158-162). This experimental support can be seen as

[25] Note that, in step *t+3*, *en* is interpreted as an argument of the silent Deg head via accommodation, since the type Us can be treated as a (symmetrical) sub-type of $s{\times}s$. The next derivation, however, shows why *en* as a simple SSP cannot merge with an MP, without the sentence being uninterpretable.

indirect support for our analysis of Spanish SPs, since the syntactic and semantic differences seem minimal. By assuming that *in front* and *enfrente* have the same underlying interpretation, we can sthen propose that our analysis can also capture their subtle type of polysemy. Thus, we now have a preliminary analysis of the sense networks of one SSP, from which we can build our analysis of other SSPs and their sense networks.

We can now tackle our example (4)/(64) involving *en*. Via this example, we begin to address the directional/locative alternation, our first pattern. For this purpose, we offer a full sentential derivation, which is shown in (79b):

(79) *t*. [[Mario]]$\vDash m_s$ (Int)

t+1. [[está]]$\vDash \lambda x.\lambda y.\exists s{:}(x\subseteq y)_{s\to(s\to s)}$ (Int)

t+2. [[Mario]]×[[está]]$\vDash \lambda x.\lambda y.\exists s{:}(x\subseteq y)_{s\to(s\to s)}(m_s)=\lambda y.\exists s{:}(m\subseteq y)_{(s\to s)}$ (FA)

t+3. [[en el]]$\vDash \cup l_{\cup s}$ (Int)

t+4. [[Mario está]]×[[en-]]$\vDash \lambda y.\exists s{:}(m\subseteq y)_{s\to s}(\cup l_{\cup s})=\exists s{:}(m\subseteq \cup l)_s$ (FA)

t+5. [[(P)- el]]$\vDash \lambda\ x\lambda y.s{:}(x\subseteq\iota(y))_{\cup s\to(s\to s)}$ (Int)

t+6. [[Mario está en]]×[(P) el]]$\vDash \exists s{:}(d\subseteq \cup l)_s\lambda\ x.\lambda y..s{:}(x\subseteq y)_{\cup s\to(s\to s)}=$
$\exists s{:}(m\subseteq((\cup l_{\cup s})\times\lambda x.\lambda y.s{:}(x\subseteq\iota(y))_{\cup s\to(s\to s)})=$
$\exists s{:}(m\subseteq\lambda y.s'{:}(\cup l\subseteq\iota(y)))_{(s\to s)}$ (FA: Ass.)

t+7. [[coche]]$\vDash c_s$ (Int)

t+8. [[Mario está en P el]]×[[coche]]$\vDash \exists s{:}(m\subseteq\lambda y.s'{:}(\cup l\subseteq\iota\ (y)))_{(s\to s)}(c_s)=$
$\exists s{:}(m\subseteq s'{:}(\cup l\subseteq\iota(c)))_s$ (FA)

Thus, *Mario está en el coche* denotes a situation in which Mario can occupy any location defined as part of the car's space. The relation $\cup l\subseteq\iota(c)$ is equivalent to the sum of the more specific relations $(i\subseteq\iota(c))\cup(e\subseteq\iota(c))\cup...$), due to the *distributivity* property of Lattices (Szabolcsi 1997, 2010: ch. 1). That is, if a sum of locations is part of the space defined with respect to a ground, then each location making up this sum will also be related to the ground. This entails that Mario can occupy the internal part/location of the car, or a location defined as external, or a location defined as frontal, and so on. Each of this possible, more specific relations falls within the semantic range of the relation that *en el coche* denotes. Hence, although the SSPP *en el coche* is syntactically assigned a specific type, its interpretation can still be underspecified, as we discussed for (3)/(63) (Pustejovsky 1998).

Hence, although syntax determines that polysemy is resolved at the SSP phrase level, the network sense of *en* can lead to the compositional computation of distinct senses of a sentence. Importantly, since *en* does not denote a set of vectors, we also predict that it cannot combine with MPs, when part of an SSP such as e*n el coche*. The subtle difference, in this case, is that the type of *enfrente* is $l\times l$, since it involves a relation between (ordered) location, and that this type percolates at the phrasal level (cf. Carpenter 1992). The use of the identity relation for the semantics of the Deg head entails identity of values *and* their types. Thus, only projective SSPs such as *enfrente* can merge with MPs. We thus reconstruct another important result of vector semantics analyses. We also offer an account of the interplay of part of an SSP's sense network with other categories, shedding light on the second pattern.

We continue our discussion by addressing the semantics of Boolean SSPs. We focus on (5)/(64), and offer its compressed interpretation in (80b). From this point onwards, we start using alphabet letters to mark situations (e.g. *a*, *b, c*, *d*), and we drop the ι operator to mark the definiteness of ground referents. Our interpretation of *está sentado* in (80b) is a simplified one, since we assume that it denotes at least one situation in which Mario and Peach are sitting. Consider our analysis:

(80) a. *Mario está sentado en la mesa y Luigi en la cama*

b. *k.* [[Mario está sentado en P la mesa]]$\vDash \exists s{:}\mathbf{sit'}(m\subseteq a{:}(Ul\subseteq ms))_s$ (Int)

k+1. [[y]]$\vDash \lambda x.\lambda y.s{:}(x\cap y)_{s\rightarrow(s\rightarrow s)}$ (Int)

k+2. [[en P la mesa]]×[y]]$\vDash(\exists s{:}\mathbf{sit'}(m\subseteq a{:}(Ul\subseteq ms)))_s\lambda x.\lambda y.s{:}(x\cap y)_{s\rightarrow(s\rightarrow s)}=$
$\lambda y.s{:}(\exists s{:}\ \mathbf{sit'}\ (m\subseteq a{:}(Ul\subseteq ms))\cap y)_{(s\rightarrow s)}$ (FA)

k+3. [[Luigi (e) en P la cama]]$\vDash \exists s{:}\mathbf{sit'}(lu\subseteq b{:}(Ul\subseteq cm))_s$ (Int)

k+4. [[Mario está sentado en P la mesa y]]×[[Luigi (e) en P la cama]]$\vDash$
$\lambda y.s{:}(\exists s{:}(m\subseteq a{:}\mathbf{sit'}(Ul\subseteq ms))\cap y)_{(s\rightarrow s)}\times(\exists s{:}\mathbf{sit'}(lu\subseteq b{:}(Ul\subseteq cm))_s)=$
$s{:}(\exists s{:}\mathbf{sit'}(m\subseteq a{:}(Ul\subseteq ms))\cap(\exists s{:}\mathbf{sit'}(lu\subseteq b{:}(Ul\subseteq cm))_s$ (FA)

The interpretation in (80) says that the complex location under discussion is a location that comprises Mario's sitting location "at" the desk and Peach's sitting location "in" the bed. The two crucial steps, in this case, are *k* and *k+3*, as they illustrate how the polysemous interpretation of *en* can be reduced to a more specific interpretation. In the case of *en la mesa*, the interpretation of this SSP is based on the fact that the desk lacks internal parts that could "contain" Mario. A bed can contain such an "internal" location (e.g. under the sheets), so Peach can sit "in" this location. Via distributivity and the standard interpretation of conjunction, we obtain the two intended interpretations of *en* in this Boolean SSP. Hence, *en la cama* appears to be underspecified, because its interpretations for each instance turn out to be compositionally distinct. We thus have an initial account of the emergence of Boolean SSPs interpretations, our third polysemy pattern in SSPs.

We can now move to the second type of Boolean SSPs, those involving ground DP conjuncts. Consider (8)/(66a), repeated in (81a), and its interpretation in (81b):

(81) a. *en la estación y la via*

b. *k.* [[en P]]×[[la estación]]$\vDash\lambda y.s{:}(Ul\subseteq y)_{s\rightarrow s}\times(st_s)=s{:}(Ul\subseteq st)_s$ (Int)

k+1. [[y]]$\vDash\lambda x.\lambda y.a{:}(x\cap y)_{s\rightarrow(s\rightarrow s)}$ (Int)

k+2. [[en P la estación]]×[[y]]$\vDash s{:}(Ul\subseteq st)_s)\lambda x.\lambda y.a{:}(x\cap y)_{s\rightarrow(s\rightarrow s)}=$
$\lambda y.a{:}(Ul\subseteq s{:}(st\cap y))_{s\rightarrow s}$ (FA: Associativity)

k+3. [[la calle]]$\vDash cl_s$ (LS)

k+4. [[en P la estación y]]×[[la calle]]$\vDash\lambda y.a{:}(Ul\subseteq s{:}(st\cap y)_{s\rightarrow s}\times(cl_s)=$
$a{:}(Ul\subseteq s{:}(st\cap v))_s=a{:}(b{:}(Ul\subseteq st)\cap c{:}(Ul\subseteq cl))_s=a{:}(b{:}(o\subseteq st)\cap c{:}(o\subseteq cl))_s$ (FA)

When *en* merges with the conjunct DP *la estación y la calle*, a relation between a sum location and two conjoined grounds is established. Via distributivity, this relation distributes over these distinct but conjoined spatial relations, here identified via the situations *b* and *c*. That is, the specific semantics of the two grounds restrict each relation, selecting the possible locations that the figure(s) can occupy. For instance, a station has an external location *o* (for *out*) that can act as a parking spot for the cars, and so does a street. However, a parking location can also be inside the station, or below the station, and so on. Hence, the interpretive mechanism that resolves polysemous readings in basic sentences such as (81) can also compute the distinct senses of *en*, with respect to each of the conjunct DPs. We now have a fuller account of our Boolean SSPs, which in turn rests on an analysis of the sense network of *en* as involving several equally possible locations for one or more figures. In other words, we already have a unified account of the second and third patterns.

We can now address the first polysemy pattern via (9), the first example involving a directional verb. For SSPs, we assume that this layer of polysemy is represented as $\pm a\text{-}cm(s)$, a shorthand for $s{=}\cup\{+a\text{-}cm(s),\text{-}a\text{-}cm(s)\}$: an SSP can denote either a directional reading or a locative reading. We can now easily account the emergence of a specific reading in our examples involving SSPs, one example being those including *en*. We repeat (9) as (82a), and offer a compressed derivation in (82b). We use another simplified interpretation for *entra*, as we treat this verb as simply denoting a situation of "generic" motion:

(82) a. *Mario entra en el coche*
b. *k.* [[Mario entra]]$\vDash\lambda y,+a\text{-}cm(s){:}\mathbf{go'}(m,y)_{s\to s}$ (Int)
k+1. [[en (P) el coche]]$\vDash\pm a\text{-}cm(s'){:}(\cup l\subseteq c)_s$ (Int)
k+2. [[Mario entra]]$\times$[[en el (P) coche]]$\vDash$
$+\lambda y,+a\text{-}cm(s){:}\mathbf{go'}(m,y)_{s\to s}\pm a\text{-}cm(s'){:}(\cup l\subseteq sc)_s=$
$=\cup\{+a\text{-}cm(s){:}\mathbf{go'}(m,+a\text{-}cm(s'){:}(\cup l\subseteq sc),$
$+a\text{-}cm(s){:}\mathbf{go'}(m,\text{-}a\text{-}cm(s'){:}(\cup l\subseteq sc)=\emptyset)\}_s$ (FA)

The semantic interplay of *entra* with the ambiguous *en el coche* amounts to the computation of two possible readings, one of which involves an empty situation. This situation is derived as a situation in which Mario moves in direction of the car's internal part, without ever reaching it (i.e. *entra* is a-cumulative). Thus an a-cumulative reading creates a situation with contradictory properties, which corresponds to our empty situation. The net result is that via our compositional analysis of polysemous readings, we can account the ambiguity of SSPs with respect to the locative/directional alternation.

Our analysis of the interpretation of *entrar* only purports to represent how this dimension of polysemy is resolved compositionally, at a VP level. A similar reasoning can be applied to (10), which involves the located motion verb *nadar*. A minimal difference is that *nadar* can be conceived as a cumulative, but symmetrical verb of motion. As observed in Romeu (2014: ch. 6), a more fine-grained analysis of event structure and its mapping onto the sentential domain, such as Ramchand (2012), would elegantly capture these data. For our purposes, though, this analysis seems to accurately capture our data and the first polysemy pattern, too.

We now focus on a semantic-only analysis of (11)-(13), which shows how specific senses of *en* are accessed in context. For this purpose, we extend our compact way of representing sum locations to grounds and their corresponding interpretations. We represent the individual referent that a ground DP denotes as a complex sum of its constituting parts. For each part, we associate a location that they occupy, or that they enclose (cf. also Chung 2011). For instance, *pierna* can be interpreted as a ground DP. Note, then, that the internal part/location of this ground DP cannot act as an enclosing location for a figure, there is no "in" location defined with respect to a leg. A leg as a location has some sub-locations, but not others.

A simple way to capture this fact is by using an identity relation to capture this structural relation: we have $lg{=}\cup\{e, f, b,\ldots, \neg i\}$.[26] This relation explicitly states that a leg, or rather the location it occupies, includes other parts as locations (e.g. a frontal part *f*), but lacks an internal location *i*. We represent this latter fact by having a

[26] Note that grounds should be accommodated to entities of type $\cup s{\times}s$: they correspond to the interpretation of our polysemous simple SSPs. We trade formal precision for clarity of prose, in this case.

"negative" location $\neg i$. This is an abuse of notation that has one key advantage: it allows us to explicitly represent the fact that a leg does not have an internal part. We repeat (11) as (83) to illustrate this point:

(83) a. *La tirita está en la pierna*

b. $k.\ \exists s{:}(ba \subseteq s'{:}(\cup l \subseteq lg))_s = \exists s{:}(d \subseteq s'{:}(\cup l \subseteq \{e, f, b, \neg i\}))_s =$
$\exists s{:}(d \subseteq s'{:}(\cup l \subseteq e) \cup (\cup l \subseteq f) \cup ((b \subseteq \neg i) = \emptyset)))_s$ (FA)

Our derivation reads as follows. When *en* is merged with *la pierna* and the range of possible spatial relations is computed, the relation $(b \subseteq \neg i) = \emptyset$ states that no internal region of the leg can act as a location for the Band-Aid. Crucially, the interpretive mechanism by which this reading is excluded is the same as those excluding directional/locative readings, but the difference lies in which syntactic level it is defined at. While the interpretation of an SSPP as either having a directional or locative reading is determined at a VP level, its specific spatial reading is computed at an SSPP level. Note that this interpretation can still be underspecified, since the Band-Aid can be understood to be attached to the leg, possibly on the frontal "side" of this ground (cf. again Pustejovsky 1998). The way underspecification emerges in this example is tighly connected to the polysemy of lexical items (here, *en*).

By this point, we can move to the discussion of (14)-(16), thus using the syntactic derivation offered in (67) for the SSPs *al/en el norte de*. Recall that *en el* or *al* can merge with *norte de España* and other SSPPs including absolute coordinates. However, depending on whether the relation they define is one of inclusion or proximity/direction, either *en* or *al* can be merged, lest the sentence be uninterpretable. Again, we can capture this fact by proposing that *a* differs in its interpretation from *en* by lacking an internal location *i* in its denotation (cf. Romeu 2013). We represent the corresponding sum location as $\cup l'_{\cup l \times l}$, and show how this simple assumption can account our data via the compressed derivations in (84):

(84) a. *Bilbao está en el/#al norte de España*

b. *t+9.* [[en el norte de]]×[España]]$\vDash \lambda y.s{:}((nt \subseteq \cup l) \subseteq y)_{(s \to s)} \times (es)_s =$
$s'{:}((nt \subseteq \cup l) \subseteq es))_s$ (FA)

t+10. [[Bilbao está]]×[[en el norte de España]]$\vDash$
$s{:}(bi \subseteq s'{:}((nt \subseteq \cup l) \subseteq es))_s$ (FA)

c. *t+9.* [[al norte de]]×[España]]$\vDash \lambda y.s{:}((nt \subseteq \cup l') \subseteq y)_{(s \to s)} \times (es)_s =$
$.s'{:}((nt \subseteq \cup l') \subseteq es)_s$ (FA)

t+10. [[Bilbao está]]×[[al norte de España]]$\vDash$
$\lambda y.\exists s{:}(bi \subseteq s'{:}((nt \subseteq \cup l') \subseteq es))_s =$
$\exists s{:}(bi \subseteq s'{:}((nt \subseteq \cup l') \subseteq es))_s = \exists s{:}(bi \subseteq s'{:}(\neg(nt \subseteq i) \subseteq es))_s$ (FA: der. cr.)

If *al* merges with *norte de España*, then the interpretation of (84b) can include a situation in which Bilbao is defined as not being part of Spain (i.e. "in" Spain), a relation we approximate as $s'{:}(\neg(nt \subseteq i) \subseteq es)$. In a situation *s'*, there is no northern, internal region/location that Bilbao can occupy, contrary to facts. This is not the case when *en* merges with *norte de España*, as (84c) shows. In this case, the notion of uninterpretability overlaps with that of falsehood, in a manner similar to GL treatments (e.g. Pustejovsky 2013). A false sentence is sentence that lacks a possible interpretation in a model. A model, in turn, (indirectly) represents our encyclopaedic knowledge of the world as linguistic knowledge. If a sentence cannot find an interpretation in the model, then it describes a false fact, e.g. that Bilbao is to the North of Spain and its borders. Consequently, the polysemy of *a* may led to unacceptable interpretations, when compositionally resolved within an SSPP.

Since now we can account the examples involving *en* but also *a* (i.e. (7)-(22)), we can focus on the specific semantic aspects of the examples involving *a* (i.e. (23)-(30)). We discuss the third key property of *a:* its ability to partially "overlap" in sense with other SSPs such as *hacia*. Consider (23)-(25), repeated here as (85a)-(87a):

(85) a. *Mario va #diez metros a la playa*
b. $s{:}(10mts_{s\times s}=s{:}(\cup l'\subseteq pl)_{s})$ (type mismatch: derivation crashes)

(86) a *Mario va diez metros hacia la playa*
b. $s{:}(10mts_{s\times s}=s{:}(\cup h'\subseteq pl)_{s\times s})$ (FA)

(87) a.*Mario está/va #diez metros junto a Luigi*
b. $s{:}(10mts_{l\times l}=s{:}(j\subseteq pl)_{s})$ (type mismatch: derivation crashes)

Recall once more that *a* mostly distributes with directional verbs, thus it carries an *–a-cm* feature/operator that can bind a situation variable. Since *a* denotes a sum of locations, hence being of type *l*, it cannot merge with MPs. SSPs such as *hacia*, which instead find their denotation in the vectors' type, i.e. $l\times l$, can instead merge with MPs. The situation/location $\cup h'$ represents the sum of vectors that *hacia* denotes, as vectors in the direction of, but not ending at the ground. Thus, while (85a) is uninterpretable because it involves a type mismatch, (86b) is interpretable because it involves an SSP with the correct type. Note here that we translate *hacia* as a polysemous SSP, an analysis that we fully motivate once we discuss the *hacia* examples in more detail.

In (87b), *a* has the role of *a* as a head introducing a relation on locations. Recall that, via the residual rule, *a* can become a head, and denote a relation (i.e. we have $\lambda x..\cup l'\subseteq(x)_{l\rightarrow l}$ for *a* as an affix, and $\lambda x.\lambda y.s.(x\subseteq y_{l\rightarrow(l\rightarrow l)})$ for *a* as a head). Since its type is preserved when the residual rule is applied, *a* can only take SSPs denoting locations or "regions". The semantic role of *junto*, then, is that of adding a location *j* in which Mario is located. We can thus account the fact that *junto a* cannot merge with MPs, lest a sentence be uninterpretable. Interestingly, in doing so the spatial content of *a* is abstracted over via the second λ-operator (i.e. λy). In words, when *a* is reinterpreted as a head, it loses its lexical content, but not its functional type.[27] In its prefix function, however, it retains its original semantic content.

Thus, the sense overlap for pairs such as *a* and *hacia* can be also accounted for. Both SSPs can denote a "position" that Mario reaches, after moving. However, the senses of these SSPs belong to different types (*l* and $l\times l$, respectively): they denote sums of locations and pairs of locations as their constituting elements. For instance, while *a* can include a location *o* in its denotation, *hacia* denotes a vector (set) $o\times o$ that starts from this location. Thus, *a* can describe Mario being in a location that is defined as a "destination", when *hacia* is involved. Hence, location and vector readings for SSPs are related, if only via their types (cf. Cresswell 1978; Zwarts & Winter 2000: 179-181; Asher 2011. ch.3 on type relations). The descriptive notion of "overlap" relation between senses captures the fact that speakers access these sense networks

[27] This pattern might be conceived as related to more general form of grammaticalization, more specifically *semantic bleaching*: a morpheme loses its semantic content, and acquires a functional role (Heine 1993). We leave aside a further discussion, as it would lead us too far afield.

and their denotations as involving the same constituting elements, although these elements are combined in different ways.

By this point, we can account all the *a* data barring the sentential examples (i.e. (16)-(30)). We can concentrate on the *de* data, hence expanding our analysis to (31)-(36). For this purpose, we can offer an interpretation of our last syntactic derivation (69b), repeated here as (88b). Recall that *de* can include Boolean SSPs in specifier position, a fact suggesting that *de* can be polysemous in an "indirect" way, since they can denote various types of spatial relations. Consider (88b):

(88) a. *Los hombres están sentados/van dentro y detrás del coche*

b. *t.* $[[\text{ dentro y }]]\times[[\text{detrás }]]\vDash\lambda y.s(in\subseteq\cup l)\cap y)_{s\to s}(bh\subseteq\cup l))_s=$
$f{:}(in\cap bh\subseteq\cup l)_s$ (FA)

t+1. $[[\text{ de }]]\vDash\lambda x.\lambda y.s.(x\subseteq y)_{\cup s\to(s\to s)}$ (Int)

t+2. $[[\text{ dentro y detrás }]]\times[[\text{ del }]]\vDash(f{:}(in\cap bh\subseteq\cup l)\times(\lambda x.\lambda y.s.(x\subseteq y)_{\cup s\to(s\to s)})=$
$\lambda y.s.(f{:}(in\cap bh\subseteq\cup l)\subseteq y)_{s\to s}$ (FA)

t+3. $[[\text{ coche }]]\vDash c_s$ (Int)

t+4. $[[\text{ dentro y detrás del }]]\times[[\text{ coche }]]\vDash\lambda y.s.(f{:}(in\cap bh\subseteq\cup l)\subseteq y)_{s\to s}(c_s)=$
$s.(f{:}(\,in\cap bh\subseteq\cup l)\subseteq c)_s$ (FA)

In (88b), we use *in* to represent the 'inside' location that *dentro* denotes, and *bh* the 'behind' location that *detrás* denotes. The derivation in (88b) shows that the interpretation of this type of Boolean SSP amounts to a location in which the internal and the posterior locations are defined with respect to a given car. Note that *dentro* and *detrás* are Axpart Ps, thus their denotations are of type *lxl*, i.e. vectors. Thus, they are merged via type accommodation (cf. footnote 25), and denote products or "combinations" of internal and posterior locations that the men can occupy (i.e. we have $in\cap bh\subseteq\cup l$).

This Boolean SSP can compose with *de*, which requires a first argument of type $\cup s$, via accommodation (cf. footnote 27). This interpretation captures the idea that each of the men involved in this scenario can be in one location or another, and possibly in both. In this case, distributivity can be defined as the relation that emerges between the SSPP as a predicate-like element and a plural DP in subject position. We reconstruct a result of generalized conjunction approaches (Partee & Rooth 1983; Winter 2001: ch.3) for a set of data that, in our understanding, has not been addressed in this theory.

A further specific consequence of this analysis is that the semantic type of the conjuncts making up a Boolean SSP always coincides with a situation/location, irrespective of its conjuncts. Thus, it is possible to coordinate SSPs denoting regions/locations and vectors, since they would be mapped to an intermediate type including both. This is the case in (35), repeated here as (89a):

(89) a. *Los hombres están sentados dentro y al medio de la caverna*

b. $[[\text{ dentro y al medio de la caverna }]]\vDash s{:}(f{:}((in\subseteq\cup l)_{s\times s}\cap md_s)\subseteq cv)_s$ (FA)

In this case, *in* and *md* represent the internal and central (median) locations of the cave that the men occupy, respectively. The two conjuncts *dentro* and *al medio* are assigned type l and $l\times l$. Recall now that their conjunction coincides with the Boolean meet operation, which can access a common type to both conjuncts. The meet of types l and $l\times l$ is l: locations and vectors as sequences of locations are both constituted of locations. Thus, the whole Boolean SSP is accommodated to the type of *al medio de*, denoting a "middle" location that can be conceived as a "part" of a set of 'inside' vectors. By employing this analysis, we also avoid a problem found in vector semantics analyses (e.g. Zwarts & Winter 2000, Bohnemeyer 2012). Since a "vector-only" analysis would require a product of a vector and a "null" vector (a location) to also be null, it would not assign an interpretation to this example. Thus, our analysis seems to reconstruct the empirical results of vector semantics, while at the same time avoiding some of its pitfalls. This is yet another indirect, but certainly welcome result.

We now have an account of all of our examples in (29)-(34), barring the discourse examples in (24)-(25). We can offer an account of the locative/directional alternation, of the sense networks of *en*, *a* and *de*, and of how the senses of Boolean SSPs of any types can be combined, regardless of their morpho-semantic type. In other words, we have an account of our three polysemy patterns for *en*, *a* and *de.* We can thus discuss the other examples at stake.

4.2.3. The Polysemy of *Desde, Hacia, Hasta, Por, Para, Entre, Sobre & Bajo*

As the examples we discussed in section 2.1.4 suggest, the types of interpretations that can arise when these SSPs are involved are the same that we discussed in the previous section. Thus, in this section we discuss how our semantic analysis applies to these SSPs, and address how our discourse examples can be analysed, too.

We start by repeating (69) as (90a), and analysing the polysemy of *hasta*. Recall that *hasta*, *qua* a polysemous SSP of type $\cup s$, can include two senses corresponding to English 'to' and 'into', which can emerge in Boolean SSPs. We represent these two senses in a simplified form, via the locations o and i that the figures reach, when they move in direction of the grounds. The location ht, then, is the sum location that these two senses make up, before disambiguation occurs (i.e. we have $ht{=}\cup\{i,o\}$). The compressed derivation is (90b):

(90) a. *Los hombres vuelven hasta la caverna y la playa*

b. $t.$ [[hacia la caverna y]]$\times$[[la playa]]$\vDash\lambda y.s{:}(ht\subseteq(cv\cap y))_{s\to s}\times(b_s)=$ $s{:}(ht\subseteq(cv\cap b))_s=s{:}(b{:}(o\subseteq st)\cap c{:}(o\subseteq b))_s$ (FA)

The derivation in (90b) shows that the merge of a second ground DP, and the formation of Boolean SSP, can trigger the emergence of two distinct but co-existing interpretations for *hacia*. That is, the men can go into the cave and to the beach, or *vice versa*. The minimal difference between *hasta* and *en*, then, is that *hasta* has a "smaller" sense network. It can alternate between a 'to' and a 'into' senses, taken to be senses denoting a figure arriving at a ground and inside a ground, respectively. Aside the *hasta* data, this account can be extended to the *desde* and *hacia* data. This entails that we have an account of the examples in (40)-(46).

We now discuss some more data that are not directly connected to our syntactic derivations, in the guise of examples including *para* and *entre*. Recall from section 2.1.4 that *para* can also act as a hyperonym of *hacia* and *hasta*, and can merge with MPs. When this happens, only the 'towards' or *hacia* sense is selected, since only this sense is compatible with that of MPs. We offer an interpretation of (48), repeated here as (91a), to illustrate the point. We assume, for simplicity, that *para* denotes the sum of the external locations o for its 'to' sense (viz *hasta*), and of the 'near' locations n. Its 'towards'sense includes getting closer or near a ground, but not reaching it, hence this type of analysis (Zwarts 2005, 2008). We have the identity $para{=}\cup\{o,n\}$, in (91b), to represent this fact:

(91) a. *Mario camina un kilómetro para el centro de la ciudad*
b. $s{:}(1kmt{=}\pm a\text{-}cm(s'){:}(pr{\subseteq}cc))_{s\times s}=$
$s{:}(1kmt{=}\text{-}a\text{-}cm(s')({:}o{\subseteq}cc))\cup(1kmt{=}a\text{-}cm(s'){:}(n{\subseteq}cc))=$
$\{\emptyset\cup{+}a(s'){:}(1kmt{=}n{\subseteq}cc))\}_{s\times s}$ (FA)

The interpretation in (91b) reads as follows. While the locations that the 'to' sense denotes are non-cumulative (they are atomic external locations), those that the 'towards' sense denotes are cumulative. This property entails that at least one of the "paths" that are 'towards' the centre of the city are one kilometre in length. Thus, the *un kilómetro* can be identified with one of the situation in the denotation of the cumulative reading, whereas the same identity cannot be established when the non-cumulative reading is involved. Since only the 'towards' sense provides a non-trivial scale of length, it is the only sense that can compose with that of *diez metros* (cf. Morzycki 2005; Winter 2005; Zwarts 2008; Ursini & Akagi 2013b). In other words, MPs can disambiguate polysemous SSPPs via the specific senses they select, within the same sub-type of SSP: here, the type $l\times l$ of vectors. We thus have an account of (47)-(49), and of the polysemy patterns observed for the *por* and *para* examples.

Another set of data that our analysis can easily capture is the distribution of the *entre* and *sobre*/*bajo* senses. Recall that *entre* can alternate between the senses corresponding to 'between' and 'within', depending on whether this SSP takes a Boolean SSP as a ground DP. We repeat (50a) as (92a) without the locative *estar*, and (51a) as (93a), to illustrate how these senses can be derived:

(92) a. *Mario va entre las murallas*
b. $s{:}(tr{\subseteq}\cup\{m,m'\})_{s\times s}=s{:}(tr{\subseteq}m)\cup s'{:}(tr{\subseteq}m'))_{s\times s}$ (FA)

(93) a. *Mario está un metro entre Peach y Luigi*
b. $s{:}(1mt{=}s{:}(tr{\subseteq}(p{\cap}l)))_{s\times s}=a{:}(1mt{=}s{:}(tr{\subseteq}p){\cap}s'{:}(tr{\subseteq}l)))_{s\times s}$ (FA)

The interpretation in (92b) consists of a situation in which Mario goes to a location situated at a roughly equal distance from any part of the city walls. While this intermediate location is simply represented as *tr*, two possible parts of the walls with respect to which Mario is located are represented as *m* and *m'*. The city walls as a single entity, then, are simplistically represented as the sum $\cup\{m,m'\}$ of its two parts, Thus, Mario is at a certain distance from *m*, from *m'*, or from both. The interpretation in (93b) captures this location as being defined at a given distance with respect to two "grounds", Peach and Luigi. The fact that in (93b) the MP *un metro* can merge and compose with *entre* reveals that its senses denote a set of vectors (cf. also Zwarts & Winter 2000: 195-6). Mario's position in both cases can be interpreted as being on a virtual vector connecting two other locations, whether they be other individuals or parts of a given ground. The emergence of both readings is a natural consequence of our analysis, and gives us an account for (50)-(51).

A similar result can be obtained when we analyse the interplay of *bajo* and *sobre* with MPs. In this case, we assume that *bajo* can denotes the 'under' location *un*, and 'below' location *bl*, which can denote sum locations (i.e. we have $bajo{=}\cup\{un,bl\}$). That is, *bajo* can denote a lower locations close to the ground ('under') or any other such locations ('below'). We offer an interpretation of (54), repeated here as (94a):

(94) a. *Los pájaros vuelan un kilómetro bajo la nube y el avión*
b. $a{:}(1kmt{=}s{:}(bj{\subseteq}(p{\cap}l)))_{s\times s}=a{:}(1kmt{=}s{:}(ur{\subseteq}p){\cap}s'{:}(tr{\subseteq}l)))_{s\times s}$ (FA)

The key aspect of this interpretation is that the MP *un kilómetro* denotes a certain distance defined with respect to both the cloud and the plane. Thus, it selects the sense of *bajo* that denotes an open scale of distance. (i.e. having +*a-cm* value). Since we only focus on this possible interpretation, we omit these operators from our derivation. The same reasoning can be applied to the *sobre* examples. As in the case of *en* and *enfrente*, an MP can select a given sense from a network sense of SSPP in a compositional way.

We now have an account of all SSPs data in (3)-(53), with the exception of our discourse examples in (26)-(27). For this purpose, we need to take in consideration the fact that both *a* and *de*, in their role as the prefixes *a*- and *de*-, have a slightly different type of interpretation, based on their syntactic properties. For *a* we assume that the residual rule derives its prefix distribution from its phrasal from. From type $\boldsymbol{\sqcup a \bullet b}$, we have type $\boldsymbol{\sqcup a/b}$. The semantic typing undergoes a corresponding change: from $\cup a \times b$ we have $a \rightarrow \cup b$. For *de*-, we assume that the residual rule derives its head distribution from its prefix form. From type $\boldsymbol{a \bullet b/\sqcup c}$, we have type $\boldsymbol{a/b/\sqcup c}$. Thus, the type that *a*- an *de*- denote is the type $s \times s \rightarrow \cup s$. That is, a function that takes a location as an input and returns a sum location as an output. For the sake of clarity, we simplify this type to $s \rightarrow \cup s$, as nothing crucial hinges on this simplification.

As a consequence, *a*- is interpreted as $\lambda y.(y \subseteq \cup l')_{s \rightarrow \cup s}$, while *de*- is interpreted as $\lambda y.(y \subseteq c)_{s \rightarrow \cup s}$. In words, while *a*- establishes a relation between a set of locations and an "external" location l', *de*- establishes a relation between a set of locations and a given ground c. We illustrate the differences in interpretation between the two sentences and matching discourse examples by first interpretations of *alante* and *delante* in (95)-(96):

(95) t. [[a-]]$\vDash \lambda y.(y \subseteq \cup l')_{s \rightarrow \cup s}$ (Int)
$t+1$. [[-lante]]$\vDash fr_s$ (Int)
$t+2$. [[a]]×[[-lante]]$\vDash \lambda y.(y \subseteq \cup l')_{s \rightarrow \cup s}(fr)_s) = (fr \subseteq \cup l')_{\cup s}$ (FA)
(96) t. [[de]]$\vDash \lambda y.(y \subseteq (c))_{s \rightarrow \cup s}$ (Int)
$t+1$. [[-lante]]$\vDash fr_s$ (Int)
$t+2$. [[de]]×[[-lante]]$\vDash \lambda y.(y \subseteq (\cup l))_{s \rightarrow \cup s}(fr)_s = (fr \subseteq (\cup l)_{\cup s}$ (FA)

The interpretive difference between *alante* and *delante* can be defined as follows. *Delante* denotes a frontal position with respect to a given ground, while *alante* denotes a frontal position defined with respect to an unspecified (sum) location $\cup l'$: the implicit ground in a context. While the sense of *delante* does not refer to that of a previously mentioned ground, the sense of *alante* does. Thus, *alante* can (and must) be merged when this anaphoric component of its sense is respected. Without an SPP that has already established which location is the ground, *alante* cannot denote the frontal, external part of this ground. This fact can be shown via a derivation of (71d), repeated here as (97a):

(97) a. *Mario está detrás de la casa. Luigi está a-lante *(de la casa)*
b. t. [[Mario está detrás de la casa]]$\vDash \exists s{:}(m \subseteq n{:}(bh \subseteq h))_s$ (FA)
$t+1$. [[Luigi está alante]]$\vDash \exists a{:}(l \subseteq s'{:}(fr \subseteq \cup l'))_s$ (FA)
$t+2$. [[Mario está detrás de la casa]]$\vDash \exists s{:}(m \subseteq n{:}(bh \subseteq (h = l'))_{s \times \cup s}$ (TI)
$t+3$. [[Luigi está alante]]$\vDash \exists s{:}(l \subseteq s'{:}(fr \subseteq \cup l'))_{\cup s \times s}$ (TI)
$t+4$. [[Mario está detrás de la casa]]×[[Luigi está alante]]$\vDash$
$\exists s{:}(m \subseteq s'{:}(bh \subseteq (h \subseteq l'))_{s \times \cup s} \times \exists s{:}(l \subseteq s'{:}(fr \subseteq \cup l'))_{\cup s \times s} =$

$$\exists s{:}(m{\subseteq}s'{:}(bh{\subseteq}(h{\subseteq}\cup l'))\times(l{\subseteq}s'{:}(fr{\subseteq}(h{\subseteq}\cup l'))))_{s\times s} \qquad \text{(F. Composition)}$$

In words, the first sentence denotes a situation in which Mario is behind the house, defined as the ground location. The second sentence denotes a situation in which Luigi is in front of some location (steps *t+1* and *t+2*). By this point, discourse and anaphoric relations must still be established (i.e. cohesion and coherence of the text). Thus, it has not been established that *alante* denotes the frontal position of the house mentioned in the first sentence. The two sentences are then enriched with features that have been used when deriving their structure and interpretation (steps *t+3* and *t+4*). Type Introduction (TI), the semantic counterpart of Product Introduction (PI), is used for this purpose. For the first sentence, the house is interpreted as being the ground under discussion (i.e. the relation $h{\subseteq}\cup l'$: step *t*+3). For the second sentence, the global situation *a* is identified with the first global situation *s*. These steps correspond to the computation of coherence relations, as standardly assumed in theories of discourse semantics (c.f. Kamp, van Genabith & Reyle 2011; Kehler 2011).

Via the cut rule, the two sentences are connected into one mini-text. At a semantic level, anaphoric relations between matching elements are established, via function composition. The net interpretive effect is that the frontal, external position that Luigi occupies is defined as being the frontal, external location of the house introduced in the first sentence. The two sentences describe two distinct relations and individuals, but these relations are based on the same house as a ground, hence they are logically (and semantically) connected.

Our analysis can also account why only *alante* can merge in discourse contexts. Notice again that *delante* introduces the ground referent (in this case, *h*). If *delante de la casa* would be merged in the second sentence, we would have the relation $s{:}(bh{\subseteq}(h{\subseteq}\cup l'))\times(fr{\subseteq}h{\subseteq}l))_{s\times s}$ to hold. This relation can license the identity $fr{\subseteq}(h{\subseteq}\cup l')))_{s\times s}$, which reads: a frontal location is part of an unspecified ground, which is part of the house as a location. The whole text would receive a paradoxical interpretation (akin to "Luigi is in front of a front position"), which is not what the mini-text conveys.[28] In other words, *alante* does not block the merge of the ground DP. However, it signals that a different coherence relation can (and must) be computed, to render a sentence and mini-text interpretable (Kehler 2011; Ward & Birner 2012). Our analysis captures this fact in straightforward manner.

The upshot of this context-sensitive analysis is that we have the beginning of a treatment of spatial anaphoric relations, defined with respect to SSPs. This treatment is similar to DRT's analysis, since it is based on establishing the identity of referent via their individuating properties (cf. Kamp, van Genabith & Reyle 2011: ch.5). It is also consistent with other analyses of anaphoric relations, including type-logical ones (Jăger 2001, 2005), or those found in GL and TCL (Pustejovsky 1995: ch.4; Asher 2011: ch.6). More importantly, our account of discourse examples involving the *a-* and *de-* series reaches two welcome results. First, it extends our analysis of polysemy in SSPPs at a sentential/inter-sentential level; second, it is consistent with standard theories of discourse semantics.

[28] This is the case, as the general relation $((a\rightarrow b)\rightarrow a)\rightarrow b$ (i.e. a *modus ponens*) can be defined for the Cartesian product as well. In an inherently dynamic system like ours, the introduction of elements in an interpretation can trigger unacceptable anaphoric relations, which render a discourse incoherent. Note that our approach differs from e.g. DRT's approach, in that we reason with (part-of) relations among locations, rather identity relations *qua* anaphoric relations. We leave a more accurate discussion of these matters aside, as they are not crucial

We conclude by addressing one semantic datum that involves the *a-* series: its inability to distribute with MPs. As our derivation in (97) shows, the type of the SSPs belong to the *a-* series is $\cup l$, rather than $l \times l$. Thus, it lacks the type that allows an SSPP such as *afuera*, in (27), repeated as (98a), to distribute with *diez metros*. The interpretation is shown in (98b):

(98) a. *Mario está un metro dentro de la casa. Luigi está #diez metros afuera*
b. $s{:}(10mts)_{s\times s}{=}s'{:}(\,(ot\subseteq\cup l')_{\cup s}{=}\#$ (Type mismatch, derivation crashes)

The key aspect of this derivation is that the constraint that *a-* introduces as a prefix is a reflex of its semantic properties as a phrasal element. Since the residual rule changes valence but preserves all the other properties of this lexical item, our analysis can predict the emergence of these patterns. In other words, *a* cannot compose with MPs, whether it occurs as a head, prefix or simple SSP. Thus, in predicting patterns that seem peripheral to the central problem of the polysemy of SSPPs, our analysis can also account all the single problems involved in each polysemy pattern. With this final welcome result, we have an account for all of the SSPs examples in (3)-(53). We can move to the general discussion.

4.3. The Proposal: a Semantic Discussion

Before we move to our conclusions, it is worth summarizing the results of this section. We discuss three general results of our analysis.

The first result is that we can account each of the three polysemy patterns we have discussed. We have offered a unified account of the locative/directional alternation, the structure and properties of sense networks, and the specific readings emerging in Boolean SSPs. We can do so by defining a semantic interpretation that is transparently mapped from our morpho-syntactic derivations. We can also do so by reconstructing several results from previous literature via standard assumptions about partial orders and situations (e.g. Nam 1995's mereology of regions, Zwarts & Winter's 2000 vector semantics, DRT's treatment of anaphoric relations). In this way, we also make formally precise an intuition found in cognitive linguistics approaches (e.g. Evans & Tyler 2004a, b) but also formal approaches (e.g. GL: Pustejovsky 1995, Chung 2011). SSPs do not denote single senses, but sense networks. These are defined as structures of senses that start at the basic level of sums, and can be structured via their compositional interaction with other parts of speech. This is a welcome result, as it amounts to reaching our core explanatory goals for this paper.

The second, general result is that within our approach, then, we can give a systematic and homogenous analysis of how polysemy as a semantic phenomenon can be analyzed in a principled manner. Our analysis seems to account all the SPPs data and some aspects of polysemy in DPs, but nothing prevents that the analysis could be extended to other categories. At the same time, we can avoid certain pitfalls that cognitive linguistics approaches simply cannot avoid (e.g. Evans 2015 and references therein). Since our approach goes beyond usage-based patterns and definitional analyses, it can explain why MPs and Boolean SPs can merge and compose with some, but not all SSPs. In these frameworks, these and other data would simply remain uncounted for. As matters stand, each of our three patterns (locative/directional alternation, sense networks, Boolean SPs as instances of the zeugma test) can be accounted, if not predicted in our account. In other words, our minimalism-oriented account of the polysemy of SSPs seems superior to cognitive linguistics/usage-based accounts.

The third key result is that our formal apparatus is overall slender than the apparati found in GL or TLC (Pustejovsky 1995; Cooper 2005; Asher & Pustejovsky 2010; Asher 2011), and other formal theories of polysemy. Nevertheless, we reconstruct lexical polysemy as the ability of lexical items to denote multiple senses, and the objects that individuate these senses. This is in line with the previous approaches to polysemy we have discussed, from LCCM to GL and is founded on the empirical data we discussed. We have discussed Boolean SSPs data, *qua* an instance of data conforming to the zeugma test (Chung 2011). This is considered a fairly accurate predictor of the polysemy of a lexical item (again, Riemer 2005: ch. 4-5). As far as we extend this analysis to include a treatment of MPs and DegPs, as well as Boolean SPs, the emergence and resolution of polysemy pattern at a phrasal level can be easily accounted for. Furthermore, our analysis can account the discourse coherence patterns involving the *a*- and *de*- series of SSPs with the same set of core assumptions. Therefore, it offers a further empirical argument for its validity.

A corollary of this result is that our semantic analysis seems close to recent analyses of polysemy in affixes. As Fábregas (2015) discusses, the choice of an underspecification approach to polysemy seems to preserve the compositional interaction of one item (verbal affixes, in his study) with other parts of speech. In our discussion, two arguments for this approach seem to emerge. First, by assuming that simple SSPs have underspecified representations for senses, their compositional behavior is accounted. Second, the interpretational patterns of *de*- and *a*- as affixes also finds a natural account. Under an over-specification approach, these subtle results would not be captured. For instance, *la tirita está en la pierna* in (82) would receive an interpretation in which a figure could be both attached on and inside the leg at the same time, since both senses would be represented at once. Such a reasoning would apply to all of our other examples. In other words, the over-specification approach would make predictions not in line with the data we discussed so far, unlike our approach. With this welcome result in hand, we can offer our conclusions.

5. Conclusions

In this paper we have offered an account of the polysemy of SSPs, centered on the analysis of Boolean constructions (e.g. *en la estación y la via*). We have discussed how our analysis of the morpho-syntactic and semantic properties of SSPs (e.g. *en*, *a*, *por* and several others) can be accounted for by having a theory of the structure and properties of SSPs' network senses. We have shown that polysemy can be treated as a grammatical phenomenon, and discussed three key sets of data that pertain to the polysemy of SSPs. Our results are defined as follows.

First, we have looked at their ability to alternate between directional and locative readings (*estar/ir en el coche*). Second, we have looked at the subtle differences in interpretation among SSPs (e.g. *en la cama*, *a la playa*) that can emerge. Furthermore, we have seen how these differences are connected to distinct licensing patterns, such that *diez metros en la playa* is not acceptable but *diez metros enfrente* is, although both include *en*. Third, we have seen how we can account different types of Boolean SSPs and their role as crucial evidence for the polysemy of SSPs (e.g. *dentro y detrás del coche*). Thus, we have answered our initial question on how to account the polysemy of SSPs, thereby reaching our original goal. This is a welcome result.

It is obvious, by this point, that our paper can also be seen as a point of departure for further studies on the nature of polysemy. Our analysis is close in spirit to accounts such as GL, although it is grounded in a different architecture of grammar (roughly, DM plus TLS). In this regard, we can say that our paper offers evidence this architecture can be extended to cover polyseymy, offering support for its empirical adequacy on a set of data usually considered the exclusive province of cognitive linguistics-based approaches (cf. Evans 2015).

The overarching argument that we propose, then, is that the polysemy of SSPs, and probably polysemy in general, is accurately accounted for in our minimalist architecture, *qua* a theory of grammar. Accounts that do not treat polysemy in this way, restoring to notions of usage and frequency, would stumble on most, if not all of our data. This seems also another welcome result, which furthermore casts some shadows on the basic arguments offered in favour of cognitive linguistics/construction grammar approaches.

Our paper does not obviously exhaust the topic of polysemy, for our analysis could certainly be extended to other languages (e.g. English) and categories (e.g. NPs, VPs). Recall, also, that we concentrated on one variant of the zeugma test, leaving ellipsis-based examples aside. However, we defer such extensions of our analysis to future works, as our results seems to be on the right track, to reach this future goal.

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