Polysemy and semantic relations in Italian spatial prepositions*

Polisemia y relaciones semánticas en las preposiciones espaciales italianas

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Abstract

The objective of this paper is to offer an account of the polysemy patterns in Italian spatial prepositions. It is shown that prepositions can be partitioned into three morphological types displaying decreasing polysemy: simple prepositions (e.g. *a*); complex prepositions (e.g. *dietro a*); locutional prepositions (e.g. *nei pressi di*). It is then shown that polysemous and monosemous prepositions can stand in semantic relations, e.g. hyponymy (e.g. *sopra a* and *in cima a*). Evidence is offered via a triangulation of corpus data and on-line elicitation tasks with participants, and via the joint use of the definition and coordination tests for polysemy. The theoretical analysis offers an account of the morphological and syntactic structures underpinning each preposition type. Their polysemy and semantic relations are then modelled via the 'semantic maps' method. The main conclusions are as follows: complex and locutional prepositions can denote specific if not unique 'places' with respect to the ground; simple prepositions can denote sets of places possibly shared with locutional prepositions. The paper thus offers a novel systematic account of polysemy in Italian prepositions, and offers evidence that semantic relations (hyponymy, overlap, monosemy) can emerge from these forms of polysemy.

Key Words: Multiple senses, semantic relations, morphology, semantic maps.

Resumen

El objetivo de este artículo es ofrecer un análisis de los patrones de polisemia en las preposiciones espaciales italianas. Se demuestra que estas pueden dividirse en tres tipos morfológicos mostrando una polisemia decreciente: preposiciones simples (p. ej., *a*); preposiciones complejas (p. ej., *dietro a*); locuciones preposicionales (p. ej., *nei pressi di*).

Luego se muestra que las preposiciones polisémicas y monosémicas pueden estar en relaciones semánticas, p. ej., hiponimia (p. ej., *sopra a* y *in cima a)*. Se brinda evidencia a través de la triangulación de un corpus de datos y tareas en línea con participantes, y mediante el uso conjunto de las pruebas de definición y coordinación para la polisemia. El análisis teórico ofrece una revisión de las estructuras morfológicas y sintácticas que sustentan cada tipo de preposición. Además, sus relaciones polisémicas y semánticas son modeladas a través del método de 'mapas semánticos'. Las principales conclusiones son las siguientes: las preposiciones complejas y las locuciones preposicionales pueden denotar 'lugares' específicos, si no únicos, con respecto al suelo; las preposiciones simples pueden denotar conjuntos de lugares posiblemente compartidos con locuciones preposicionales. El artículo ofrece así un novedoso análisis sistemático de la polisemia en las preposiciones italianas, y ofrece evidencia de que relaciones semánticas (hiponimia, superposición, monosemia) pueden surgir a partir de estas.

Palabras Clave: Sentidos múltiples, relaciones semánticas, morfología, mapas semánticos.

INTRODUCTION

'Polysemy' is usually defined as the property of a lexical item to have distinct but related senses (Riemer, 2005). Polysemy has been studied in lexical categories (nouns, verbs, adjectives), but studies on 'Spatial Prepositions' present a still incomplete picture. The polysemy of prepositions is considered their key semantic property, in cognitive and typological frameworks (Tyler & Evans, 2003), and two orthogonal lines of research act as established approaches to this topic. One line involves book-length, language-specific explorations (e.g. French: Vandeloise, 1991; English: Tyler & Evans, 2003). Most works, instead, focus on the study of polysemy in one or few related prepositions (e.g. English 'over': Lakoff, 1993). Except for French, such works are sparser across Romance languages. A poignant case is Italian, a language whose prepositions' polysemy has only begun to be investigated recently (e.g. Bjelobaba, 2018). Some illustrative examples are in (1)–(4):

(1) *I   bambini si   siedono/vanno   a-lla   scrivania.*
    The   children SELF   sits/go   a-the   desk
    'The children sit at/go to the table.'
(2) *La   ragazza si   siede   dietro   a-l   tavolo.*
    The   girl   SELF   sits   DIE   a-the   table
     'The girl sits behind the table.'
(3) *I   piccioni volano in   cima   a-lla   montagna.*
    The   pigeons fly   in   top   a-the   mountain
    'The pigeons fly on top of the mountain.'
(4) *I   piccioni   volano   sopra   a-lla   montagna.*
    The   pigeons   fly   sop   a-the   mountain
    'The pigeons fly above/on top of the mountain.'

Let us introduce some key notions, before we tackle the examples. First, the complement NP of a preposition denotes the landmark object or *ground* of the spatial relation that the preposition denotes. The Noun Phrase (NP) denoting the located entity is known as the *figure*, instead (Talmy, 2000). The resulting inflected preposition also undergoes 'syntactic doubling', viz. (1) (i.e. from *a* and *la* we have *a-lla*: Rizzi, 1988). PPs generally occur in 'Basic Locative Constructions' (BLCs, Levinson & Wilkins, 2006), the minimal sentences that can be full answers to *where*-questions. Second, we follow Leipzig Glossing rules (Croft, 2003), with one innovation. We gloss each preposition by using small capital fonts (e.g. 'a' for *a*). Section 3 illustrates which senses constitute these glosses via idiomatic English.

Consider now (1). The preposition *a* can combine with either a 'locative' or 'static' verb (*siedono* 'sit'), denoting the location of a non-moving figure, or with 'directional' or 'dynamic' *vanno* 'go'. Locative verbs (e.g. *siedono*) select a locative sense for the prepositions they combine with; directional verbs (e.g. *vanno*) select a directional sense (Zwarts, 2005). Thus, Italian prepositions and their locative/directional alternation, typical of verb-framed languages (Talmy, 2000), are a first sign of their polysemy.

A more specific form of polysemy emerges in (2) and the preposition *dietro a*, which can capture two distinct senses. Depending on a speaker's position with respect to the ground, *dietro a* can refer to the intrinsic back side of the car, or front side if the speaker is facing the car. The point of view of a speaker can affect which of the two senses is under discussion (Levinson & Wilkins, 2006). The sentence in (3) shows that prepositions may even be 'monosemous', i.e. carry one sense: *in cima a* only seems to refer to the 'top' location of the mountain that the pigeons can reach. *Sopra a* in (4) can describe the pigeons flying either on a mountain's top, or at a farther distance from it.

Crucially, these facts suggest that the polysemy of prepositions connects distinct items into networks of sense relations. For instance, *in cima a* and *sopra a* seem to stand in a hyponym relation, since they can be used to describe the same type of spatial relation. For instance, *a* seems to cover a 'general' sense in (1) *qua* a simple preposition, but more 'specific' senses when it is part of complex prepositions (e.g. *dietro a* in (2), *in cima a* in (3), *sopra a* in (4)). These initial examples suggest that three aspects require an analysis. First, there seems to be a relation between decreasing polysemy and increasing morphological 'complexity', defined here as the presence of multi-morphemic structures for prepositions (cf. *a* vs. *in cima a*: Lehmann, 1985). Second, the existence of monosemous prepositions such as *in cima a* seems a novel datum: prepositions are generally considered polysemous (Tyler & Evans, 2003). Third, prepositions and their semantic relations (e.g. hyponymy) are seldom analysed, though there is evidence that these relations organize their semantic domain (Levinson & Meira, 2003).

The first objective of this paper is to offer empirical evidence regarding the polysemy of Italian prepositions, and the semantic relations organizing their senses (i.e. monosemy, hyponymy, overlap). By reaching this objective, we also show that their increasing morphological complexity corresponds to decreasing polysemy. Our methodology is based on two experiments: a corpus-based study and a subsequent elicitation task study. The second objective is to propose a theoretical account based on a 'semantic maps' model (Haspelmath, 2003). Via this model, we show that Italian prepositions can share or include senses via their ability of denoting more than one place, i.e. being polysemous. We therefore offer a unified account of polysemy and semantic relations in prepositions.

1. Theoretical framework

1.1. Theories of polysemy

Polysemy is a controversial concept, and several works and research traditions propose different though closely related definitions. A red thread connecting these traditions is the assumption that polysemy involves a many-to-one relation between form and sense that can be encapsulated via the following theory-neutral definition. If a vocabulary item *a* has several, related senses (e.g. *s*, *s'*), then *a* is polysemous (Apresjan, 1974; Cruse, 2004; Riemer, 2005; Murphy, 2010.). These senses must be independently attested in the lexicon: one must find items *β*, *γ* that respectively cover senses *s*, *s'*. As (3)–(4) show, *sopra a* is polysemous because *in cima a* covers one of its possible senses.

Most proposals identify three types of polysemy: 'regular', 'irregular', and 'inherent' or 'logical' polysemy. Regular polysemy involves senses that are distinct, but not mutually exclusive. One can consider 'mouth' as polysemous because it can describe a body fissure (e.g. 'the dog's mouth') or an entrance to a location (e.g. 'the mouth of a river': Riemer, 2005). Irregular polysemy involves the emergence of novel senses via processes of metaphor and metonymy, one case being the emergence of temporal senses in prepositions (e.g. 'at five o'clock': Lakoff, 1993). Logical polysemy holds when an item's senses form mutually exclusive types. For instance, 'lunch' can describe a process (e.g. 'lunch took forever') and an edible entity (e.g. 'lunch was delicious': Vicente, 2018).

Regular and irregular polysemy are usually studied in lexical and semantic typology frameworks (Haspelmath, 2003; Kearns, 2006). Logical polysemy is well-studied in formal (i.e. model-theoretical) frameworks such as the 'Generative Lexicon' (Pustejovsky, 1995) or 'Type-Logical Calculus' (Asher, 2011). In the Generative Lexicon approach, vocabulary items receive rich semantic representations via 'qualia' structures, which represent the possible sense types associated to an item. Type-Logical Calculus takes a similar stance, and both frameworks assume that polysemy can be a layered phenomenon. Logical polysemy thus captures whether and how items

can be polysemous by carrying different sense types (cf. the 'lunch' example); regular polysemy, whether they carry different distinctive senses within types. Here, we assess whether Italian prepositions carrying the spatial, logical type can also have distinct senses, thus also displaying forms of regular polysemy (Chung, 2011, on Korean prepositions).

Polysemy is usually contrasted with 'monosemy', 'homonymy', 'vagueness', and 'underspecification' (Kearns, 2006). Homonymy involves multiple 'unrelated' senses for items. Thus, we do not discuss it further. Monosemy holds when an item only captures a single sense (Asher, 2011). Vagueness involves context dependency for the interpretation of vocabulary items (e.g. the exact value associated to 'tall'). Lexical/semantic underspecification involves the co-existence of distinct senses for vocabulary items within a sentence (e.g., 'uncle' in 'this is my uncle': Asher, 2011). As our introduction has shown, monosemy plays a crucial role in our study. Vagueness and underspecification, instead, have minor roles that we discuss once we tackle the data.

The key tests to evaluate polysemy are the 'definition', 'co-predication', 'ellipsis', and 'coordination' tests (Kearns, 2006; Asher, 2011; Vicente, 2018). The definition test can be encapsulated in this manner. If the senses of a vocabulary item *a* involve overlapping but distinct definitions to capture their use in different extra-linguistic contexts, then the item is polysemous. The co-predication test holds when the coordination of predicates with different senses is acceptable (e.g. 'the girls open and read the message'). The ellipsis test holds when an item's omission determines that its sense is the same as its licensing antecedent (e.g. 'play in Luigi plays the piano and so does Peach'). These tests usually apply to verbs, so we decided not to use them in our experiments.

The coordination test can be divided into two variants. In the first variant, a vocabulary item heads two conjoined arguments (e.g., 'Mario plays rugby and the piano'). In the second variant, an item acts as a head in each conjunct, thereby carrying a distinct sense (e.g. 'in' in 'the boys are resting in the house and in the field'). In both cases, each of the head's arguments selects a distinct sense for the head, and the two senses coexist in the coordinated phrase. Senses must be distinct when regular polysemy is involved, and possibly zeugmatic in logical polysemy (Vicente, 2018). Both the definition and coordination test played a role in our study; we defer this discussion to Section 2, however.

1.2. Italian prepositions: Their polysemy and grammatical properties

The few works investigating the polysemy of Italian prepositions seem to mostly focus on single prepositions or sets of sense-related vocabulary items. For instance,

Taylor (1988) argues that the polysemy patterns involving *su*, *sopra* and *al di sopra* can be modelled via clusters of related semantic features (e.g. '+vertical'). While *su* is taken to carry a '+contact' feature, *sopra a* and *al di sopra* carry a '-contact' feature. A similar analysis is found in Brala-Vukanovic (2000). This work proposes that *a*, *su* and *in* to their (apparent) English counterparts *at*, *on* and *in* cover different sets of senses. Talmy (2000) also briefly mentions the locative/directional alternation in Italian. Luraghi (2009, 2011) investigate the polysemy of Italian *da* and connect it to its cognate *di*. These works shows that *da* can cover seven senses involving a core 'separation' sense (e.g. motion from the ground). These senses are modelled via a 'sense network', i.e. a collection of senses radiating from a prototypical sense (Lakoff, 1993).

The recent Ursini (2017) studies the polysemy of a cluster of Italian prepositions via an experimental study on the acceptability of sentences including coordinated ground NPs. For instance, the work shows that for the sentence *I piccioni volano sul palco e sulla collina*, 'the pigeons fly on the stage and over the hill', participants could access two distinct senses for *su*. However, the work only explores a restricted group of prepositions. Bjelobaba (2018) offers an account of a sub-set of well-known prepositions (cf. the lists in (7)–(8)). The work also suggests that some preposition pairs can stand in hyponymy relations when one preposition has a more specific sense than its paired preposition (e.g., *dietro (a)* 'behind' and *alle spalle di* 'at the back of'). However, this work leaves open two questions. The first is whether this relation can extend to all Italian prepositions. The second is whether polysemy is attested in other preposition types (e.g. *in cima a* in (3)).

Overall, most works offer thorough evidence of the polysemy of some Italian prepositions. They also offer preliminary proof that senses may overlap across different networks, or are hierarchically related. However, more thorough evidence is needed that shows how these relations organize this category. Before we offer such evidence, we must discuss their morpho-syntactic properties and their relevance for our study.

Reference grammars distinguish prepositions into 'simple' and 'complex' prepositions (e.g. Rizzi, 1988). This distinction is based on 'Ground NP ellipsis', i.e. the ellipsis of the ground NP and possibly its governing preposition. This operation leaves a preposition's segment as a pronounced item or 'remnant' (Boone, 2014). Crucially, only complex prepositions can undergo ellipsis, and leave a part of their constituting morphemes as a remnant denoting a specific location (cf. (5)–(6)). Complex prepositions include three sub-types, which respectively include *a* as an obligatory, optional or blocked head. The proposed lists of prepositions are in (7)–(8) (Rizzi, 1988: 496):

(5) *Mario   va   a(*-lla   scrivania.)*
    Mario   goes   a(-the   desk)
    'Mario goes to (*the desk.)'

(6) *Mario   va   dietro   (a-lla   scrivania.)*
    Mario   goes   die   (a-the   desk)
    'Mario goes behind (of the desk.)'

(7) **Simple Prepositions=**{*a* 'at, to', *da* 'from, to, at', *di* 'of, from', *in* 'in', *per* 'through, across', *tra/fra* 'between', *su* 'on, to', *giù* 'down'}

(8) **Complex Prepositions**={*accanto a* 'beside', *addosso a* 'against', *attraverso (a)* 'through', *davanti/dietro a* 'ahead of/behind', *dentro (a)* 'inside', *intorno a* 'around', *lungo (a)* 'along', *sopra/sotto (a)* 'above/below', *presso (a)* 'next to', *verso* 'towards',…}

This work neither discusses the syntactic distribution of prepositions, nor it mentions *in cima a* and other (more) complex prepositions only in passing. Luckily, the recent Franco (2016, 2018) offer recent, through analyses of the grammatical properties of this category. These works follow the so-called 'Cartography' framework. They propose that prepositions project a functional head per distinct morpheme, and a one-to-one relation between morphemes and sense types. For instance, Franco (2016) suggests that the morpheme *pressi* in the preposition *nei pressi di* selects a sense describing a figure to be 'proximal' the ground. Instead, *a* establishes that a spatial relation holds between figure and ground. Franco (2018) observes that *su*, *giù*, *per* and *tra/fra* have a distribution closer to complex prepositions. These prepositions feature *di* as an obligatory mediating preposition when the ground NP is a pronoun (cf. *loro* 'them' (9)), or a context-sensitive indexical (e.g. *qui* 'here' in (10)). Thus, this work suggests that Italian simple prepositions amount to the set in (11), and 'novel' complex prepositions to the set in (12):

(9) *Mario   va   verso/tra/su/*a   di   loro.*
    Mario   goes   ver/tra/su/a   di   them
    'Mario goes towards/among/onto/to them.'

(10) *Mario   va   per/su/giù/*in   di   qui/li.*
    Mario   goes   per/ su/giù/in   di   here/there
    'Mario goes through/up/down/into here/there.'

(11) **Simple prepositions=**{*a, da, di, in*}

(12) **Complex Prepositions**={*accanto a*, *addosso a*, *davanti a*, *intorno a*, *sopra (a)*, *sotto (a)*, *presso (a)*, *dietro (a)*, *verso*, *per (di)*, *tra/fra (di),* …}

If we consider this novel partition accurate, we can reconstruct our first prediction about Italian prepositions and their polysemy. The small set of simple prepositions in (11) should involve rich forms of regular polysemy; instead, the broader set of complex prepositions in (12) should involve increasingly restricted forms. Simple and

complex prepositions would thus be connected via hyponym relations, mediated via *a* and *di* as head prepositions. Crucially, this work also shows another clear empirical void: previous works do not discuss the full range of Italian prepositions, thereby not investigating the properties of multi-morphemic or 'locutional' prepositions (e.g. *in cima a*: Ganfi & Piunno, 2017). The next sections thus address how we investigated these properties in simple, complex and locutional prepositions, and connected them to their polysemy.

2. Methodological framework

In our first experiment, we queried the PAISÀ corpus of contemporary Italian (Baroni & Bernardini, 2016) to determine which prepositions belong to complex or locutional types (e.g. *presso a* 'next to' vs. *nei pressi di* 'in the proximity of'). We collected tri-grams starting and ending with simple prepositions (e.g. *a+X+di*, *in+X+di*). We used lemmas so that inflected prepositions were included in the findings (e.g. *a-l*), and were part of BLCs. We verified the spatial senses of each token by checking their dictionary entries, or those of the attested noun, in Gabrielli (2015). For instance, we treated *ai piedi di* 'at the feet of' as a potential preposition by verifying that one of the definitions for the noun *piedi* includes its use in this preposition. We also verified that either a singular or a plural form was attested (e.g., that singular *al piede di* was not attested: Franco, 2016).

Second, from these results we devised an off-line elicitation task involving native speakers. Three reasons motivated this choice. First, the task could confirm that monosemous prepositions only carry one sense. Second, the task could allow us to identify each sense for a preposition by controlling the contexts of use. Third, it was impractical to infer semantic relations by querying again the corpus and analyse thousands of sentences for each token (Baroni & Bernardini, 2016). Thus, this task offered us a more time-efficient option to verify the polysemy of these prepositions.

The task worked as follows. Native speakers of Italian (N=30, age range 21;0–51;2 years) were recruited as unpaid informants. These informants equally represented each gender, and had at least a senior high school diploma. Though participants acknowledged that they could speak their local dialect, they also acknowledged that they would mostly do so only in informal contexts; dialectal influences were thus negligible. Participants were asked to evaluate if the test sentences could describe matching scenarios and spatial configurations. Participants could choose one value from a 5-point Likert scale, '1' being unacceptable, '5' being perfect, and could add clarifying comments below each sentence. We follow recent studies on grammaticality and acceptability judgements (e.g. de Clerq & Haegeman, 2018) by offering average scores and specific values below each sentence. Thus, the notation 'average: 4.80, scores: 1^0 2^0 3^0 4^2 5^8' means that 2 participants answered '4', 8 participants answered '5', and the average was a near perfect score, '4.80'.

The scenarios matching each test sentence would involve pictures accompanied with a short description. The pictures were based on the 'Topographic Relation Picture Series' and the related task (TPRS: Bowerman & Pederson, 1992). This task aims to elicit descriptions of geometrical/functional (e.g. 'inclusion') configurations in speakers of a language. The collected answers can be used to study how speakers can differ in selecting prepositions to express possible spatial configurations, and whether general patterns can be attested across speakers (e.g. one item may emerge as more prototypical).

Since participants answered a written questionnaire, we modified the task as follows. First, we also covered relations that can be mostly ascribed to the projective type (e.g. 'front', 'left'). Second, we used pictures in which more than one ground was present, to test if participants would accept sentences based on the coordination test. Third, we also used the task to test hyponym relations by asking participants to evaluate whether different prepositions could be used in the same context. For instance, participants would observe a scenario involving some pigeons flying over and possibly reaching the top of a mountain (viz. (3)–(4)). Participants would accept *in cima a* and *sopra* in a scenario in which the pigeons reached the 'top' location. They would also accept *sopra* in a scenario with the pigeons being at a farther distance from the mountain. We thus considered such answers as evidence that the two items stand in a hyponym relation. To avoid positive bias factors, we ensured that sentences testing hyponym relations were never presented consecutively (e.g. (3) and (4) were the fifth and twelfth sentence in the whole test). Let us finally note that we report sentences on which participants offered near-optimal answers (i.e. scores 3.80 or higher, cf. de Clerq & Haegeman, 2018), which thus would offer the strongest evidence for polysemy.

3. Results

The goal of this section is to present the results of our first and second experiments (Sections 3.1–3.4), and then offer an account of these results (Section 3.5). The account is based on the 'Semantic Maps' model, which is fully motivated and presented once a clear discussion of the data on polysemy and sense relations is offered.

3.1. First experiment: Corpus data

The study confirmed that Italian includes a rich set of locutional spatial prepositions, as indirectly suggested in Ganfi and Piunno (2017). *Di* and *a* emerged as the most frequent prepositions heading these items. *In*, *su* and *a* were the most common 'markers', i.e. simple prepositions preceding nouns (e.g. *nei pressi di*, *sulla testa di* and *alla testa di*). Although rare, *per* and *tra/fra* could also act as markers (*e.g. per il centro di*, *tra i sobborghi di*). We identified 45 items displaying these properties, although a

higher number can probably be identified. We identified two sub-sets of 'novel' locutional prepositions: the first lacking an initial inflected preposition (e.g. *in cima a*), the second including it (e.g. *nei pressi di*). We propose two non-exhaustive lists in (13)–(14):

(13) **Locutional Prepositions, Class I**={*di fronte a* 'in front of', *a sinistra/destra di* 'to the left/right of', *in cima/fondo a* 'on top/at the bottom of', *a sud/nord/ovest/est di* 'South/North/West/East of', *a fianco di* 'to the side of',…}

(14) **Locutional Prepositions, Class II**={*nei pressi di* 'in the proximity of', *alla sinistra/destra di* 'at the left/right of', *alla testa di* 'at the head of', *ai piedi di* 'at the feet of', *alla fine/inizio di* 'at the end/beginning of', *al lato di* 'at the side of',…}

The Class I sub-type includes two simple prepositions: one acting as a head of the preposition, and the other as a marker of a 'spatial noun'. Spatial nouns are defined as nouns grammaticalised to the prepositional domain and denoting locations defined via parts of objects or the environment (Levinson, 1994; Levinson & Wilkins, 2006). In both Class I and II locutional prepositions, they represent the third distinct morpheme constituting a preposition (cf. also Franco, 2016, 2018). Instead, Class II prepositions always include inflected markers (e.g. *sulla*, *alla, nella*), and may include plural nouns (e.g. *pressi* lit. 'proximities', *piedi* 'feet'). Once we collected these novel data, we proceeded to test the polysemy (monosemy) of prepositions.

3.2. Second experiment: Simple prepositions

We now discuss the data obtained via the use of the definition and coordination tests. Our reasons for combining these tests were as follows. It is known that the definition test may lead researchers to postulate an excessive number of senses, when one cannot clearly distinguish contexts of use (Tyler & Evans, 2003). One can avoid this pitfall by using the coordination test, at least when regular and inherent polysemy types are involved. However, if senses are not fully distinct in context, participants may offer conflicting answers (Kearns, 2006). For these reasons, we opted to use both tests whenever the senses of target prepositions made this combination possible. Note that the coordination test data partially replicate Ursini (2017)'s results on simple prepositions, but via a distinct group of participants and different test sentences. We begin our discussion of the data from simple prepositions: *a*, *da*, *di* and *in*. Consider the examples regarding *a* in (15)–(16):

(15)   *I*   *bambini*   *vanno*   *a-lle*   *macchine ed*   *a-lle*   *panchine.*

The   children   go   a-the   cars   and   a-the   benches

    a. 'The children go into the cars and to the benches.'

    b. 'The children go behind the car and in front of the benches.'

    c. …

    (Average value: 4.26; scores: 1^1 2^0 3^4 4^{10} 5^{15})

(16)   **I*   *bambini*   *vanno*   *a-lle*   *macchine e*   *le panchine.*

The   children   go   a-the   cars   and   the benches

    a. 'The children go into the cars and to the benches.'

    b. 'The children go behind the car and in front of the benches.'

    c. …

    (Average value: 1.9; scores: 1^{14} 2^9 3^4 4^2 5^3)

As (15) shows, *a* can have a directional sense that includes the car's 'interior' as a destination, but also an 'external' directional sense (i.e. (15a)). The children can be inside the cars after reaching them, but can only be next to the benches, since benches lack 'internal' parts. However, participants considered acceptable to describe a scenario in which children reached locations 'in front' of the cars and 'in front' of the benches, these locations being distinct (cf. (15b)). More in general, participants accepted *a* as a preposition that could describe the figures as occupying different, apparently contrasting locations at the same time. In all of these cases, prepositions that are more specific in their senses were considered also acceptable in these scenarios.

Another important result stemming from (15)–(16) is that participants found coordinated NPs (i.e. sentences based on the first coordination test) unacceptable. Most speakers commented that the presence of *a* in both conjuncts in (15) made it clear that the children were reaching two distinct locations. Its absence in (16) rendered the sentence hard to understand, and speakers generally struggled to accept it as well-formed. This was a result for all sentences involving the first coordination test structure. Thus, from here onwards we only present data involving the second test structure.

We now turn to *da* and *di*. For *da*, we concentrate on two of its seven putative senses, those covering 'goal' and 'source' motion (cf. (17)–(18)): Luraghi, 2009, 2011). We use the definition test, as participants found problematic sentences involving the coordination test and its use for this preposition. As the scores show, participants found the use of *da* to capture these senses unproblematic, in the opportune contexts. Instead, (19) shows that *di* can be the head of complex prepositions; (20) shows that it can also take conjoined prepositions as its arguments, as in *di fronte ed a destra*. Furthermore, (21) shows that *di* can also cover a 'route' sense when it merges with indexicals (e.g. *qui* 'here'). That is, *di*'s sense describes a figure as moving and following

a trajectory that may cover several locations defined with respect to the ground (Jackendoff, 1983, 1990; Zwarts, 2005):

(17) *I   bambini   sono   da-lla   nonna.*
The   children   are   da-the   grandmother
'The children are at grandma's place.'
(Average value: 4.66; scores: 1^0 2^0 3^0 4^{10} 5^{20})

(18) *Il   treno   arriva   da   Milano.*
The   train   arrives   da   Milano
'The train arrives from Milan.'
(Average value: 4.83; scores: 1^0 2^0 3^0 4^5 5^{25})

(19) *Marco   si   siede/va   a   destra   de-l   tavolo.*
Marco   self   sits/goes   a   right   di-the   table
'Marco sits/goes to the right of the table.'
(Average v. *siede*: 4.83; sc.: 1^0 2^0 3^0 4^5 5^{25}; Average v. *va*: 4.90; sc.: 1^0 2^0 3^0 4^3 5^{27})

(20) *I   bambini   si   siedono di fronte ed   a destra de-l   divano.*
The children   self   sit   di front and   a right di-the   sofa
'The children sit in front and to the right of the sofa.'
(Average value: 4.00; scores: 1^4 2^0 3^4 4^6 5^{16})

(21) *Il   ragazzo passa   di   qui.*
The   boy   passes di   here
'The boy passes through here.'
(Average value: 4.93; scores: 1^0 2^0 3^0 4^2 5^{28})

Overall, *di* can have a perhaps limited distribution as a simple preposition with a 'general' sense. However, *di* can combine with spatial nouns to capture more 'specific' senses (i.e. *di* with *di fronte a* and *a destra di*). In a similar manner, *in* also displays more restrict forms of polysemy. First, *in* can alternate between directional and locative senses (translated as 'into', 'in', cf. (22)). Second, it can be used to convey 'inclusion' in convex and 'concave' grounds, e.g. a city being 'in' a country (cf. Rizzi, 1988, viz. (23)). Third, *in* can occur as a marker, examples being *nel mezzo di* 'in the middle of' and *nei pressi di* 'in the surroundings of' as coordinated prepositions. Though 6 participants found this sentence unacceptable, the acceptance rate was still near-ideal (cf. (24)):

(22) *Gli   orsi   dormono/vanno   ne-lla   caverna.*
The   bears   sleep/go   in-the   cave
'The bears sleep in/go into the cave.'
(Average v.: 4.93; sc.: 1^0 2^0 3^0 4^5 5^{25}; Average v.: 4.90; sc.: 1^0 2^0 3^0 4^3 5^{27})

(23) *Pechino è in Cina.*
Beijing is in China
'Beijing is in China.'
(Average value: 4.93; scores: 1^0 2^0 3^0 4^2 5^{28})

(24) *Gli spettatori siedono ne-l mezzo de-lla piazza*
e ne-i pressi de-l palco.
The spectators sit in-the middle di-the square
and in-the surroundings di-the stage
'The spectators sit in the middle of the square and in the proximity of the stage.'
(Average value: 3.90; scores: 1^6 2^0 3^1 4^7 5^{16})

In the case of *nel mezzo di* and *nei pressi di*, *mezzo* 'middle' and *pressi* 'proximity' denote locations defined via parts of the ground that the figure(s) could occupy. Participants commented that for both prepositions, the specific contribution of *in* was to describe the figures as occupying a specific location. They indirectly confirmed that *in* is polysemous, although its senses are closely related to a notion of 'inclusion' (cf. also Brala-Vukanovic, 2000; Bjelobaba, 2018). Let us now turn to complex prepositions.

3.3. Second experiment: Polysemous complex prepositions

We begin our discussion with novel complex prepositions: *per*, *tra/fra*, and *su/giú*, the latter pair partially covered in Bjelobaba (2018). We discuss *per* together with the two allomorphs *tra/fra*, since these prepositions cover a set of (related) 'route' senses. Hence, these prepositions become semantically related to the complex prepositions *attraverso a*, *lungo a* and *intorno a*, which cover more restricted sets of senses. Consider (25)–(30):

(25) *I contadini camminano per i campi.*
The peasants walk per the fields
'The peasants walk across the fields.'
(Average value: 4.93; scores: 1^0 2^0 3^0 4^2 5^{28})

(26) *Le macchine sono parcheggiate per la piazza e per*
la strada.
The cars are parked per the square and per
the street
'The cars are parked around the square and along the street.'
(Average value: 3.96; scores: 1^4 2^0 3^4 4^7 5^{15})

(27) *Il cantante si siede tra/fra i due gruppi di*
spettatori.
The singer self sits tra the two groups di
spectators

'The singer sits between the two groups of people.'
(Average value: 4.60; scores: 1^0 2^0 3^2 4^8 5^{20})

(28)

I	contadini	camminano	fra	i	campi	e	fra
le macchine.							
The	peasants	walk	tra	the	fields	and	tra
the cars							

'The peasants walk through the fields and among the cars.'
(Average value: 4.13; scores: 1^2 2^0 3^6 4^6 5^{16})

(29)

Mario	passa	attraverso	i	campi	e	le	gallerie.
Mario	passes	trav	the	fields	and	the	tunnels

'Mario passes across the fields and through the tunnels.'
(Average value: 4.26; scores: 1^0 2^0 3^7 4^8 5^{15})

(30)

Le	macchine	sono	parcheggiate	lungo	la	piazza	e
lungo	la	strada.					
The	cars	are	parked	lun	the	square	and
lun	the	street					

'The cars are parked around the square and along the street.'
(Average value: 4.16; scores: 1^0 2^0 3^{10} 4^5 5^{15})

In (25), one of *per*'s directional senses is selected, which we render via English 'across'. Most but not all participants instead accepted (26) as describing cars being parked around the ground's perimeter, and along a given street. Instead, (27)–(28) show that participants mostly accepted *tra* and *fra* as describing location 'among' or 'between' different locations: these two prepositions cover both subtly distinct senses. A more restricted form of polysemy is attested for *attraverso* in (29), which participants found to be the only complex preposition acceptable with a coordinated NP. Participants accepted this preposition as describing Mario crossing some fields and then entering and exiting a tunnel, conceived as a 'convex' location. Similarly, participants accepted *lungo* in (30) as describing cars being parked 'around' the square and 'along' the street. These and other complex prepositions can thus cover sense sets related to 'convexity' and/or 'shape' restricted dimensions of polysemy.

Consider now *su*. Participants acknowledged that this preposition can participate in the directional/locative alternation (cf. (31)). Most participants accepted that *su* can capture distinct 'vertical' senses involving 'top' parts of a ground (cf. (32)). Thus, *su* overlaps in distribution with *sopra(a)*, which can be used to describe figures being located at different distances from the ground (cf. (33): Taylor, 1988; Bjelobaba, 2018). Participants also confirmed that the symmetrical patterns hold for *giú* and *sotto* (cf. (34)):

(31) *Il   ragazzo siede   su-l   divano.*
      The   boy   sits   su-the couch
      'The boy sits on the couch.'
      (Average value: 4.93; scores: 1^0 2^0 3^0 4^2 5^{28})

(32) *I   piccioni volano   su-l   palco   e   su-lla   collina.*
      The   pigeons fly   su-the stage   and   su-the   hill
      'The pigeons fly on the stage and on top of the hill.'
      (Average value: 3.86; scores: 1^5 2^0 3^4 4^6 5^{15})

(33) *I   piccioni volano sopra   il palco e   sopra   la   collina.*
      The pigeons   fly   sop   the stage and   sop   the   hill
      'The pigeons fly over the stage and on top of the hill.'
      (Average value: 4.06; scores: 1^3 2^1 3^4 4^6 5^{16})

(34) *I   delfini   nuotano sotto   la   nave   e   sotto   il
      pelo   dell'   acqua.*
      The   dolphins   swim   sot   the   ship   and   sot   the
      border di-the water
      'The dolphins swim below the ship and under the water surface.'
      (Average value: 4.00; scores: 1^4 2^0 3^4 4^6 5^{16})

Thus, 'distance' acts as a semantic dimension of polysemy in these prepositions, which can therefore cover overlapping sets of senses. By 'distance', we refer to the possibility that a figure can be close to or far from a ground, i.e. at a 'proximal' or 'medial/distal' distance from it. A similar pattern is attested for *presso (a)*, *verso*, *vicino a* and *lontano da*. These prepositions can denote proximal/non-proximal values, depending on the size of the ground and the axes involved in this relation. Thus, vagueness plays a role (cf. Franco, 2016, on *presso a*) in how the precise 'distance' senses are distinguished.

We now turn to the last, distinct dimension of polysemy, which involves the notion of 'reference system'. Complex prepositions denoting axes or 'projections' of the ground can cover the intrinsic, relative or absolute perspective by which a direction is computed (Levinson & Wilkins, 2006). We return to this aspect, foreshadowed via (2), by discussing coordinated *dietro a* in (35):

(35) *I   bambini   vanno   dietro a-lle   macchine e   a-i
      trattori.*
      The   children   go   die   a-the   cars   and   a-the
      tractors
      'The children go behind the cars and in front of the the tractors.'
      (Average value: 3.96; scores: 1^5 2^1 3^0 4^8 5^{16})

Most participants accepted *dietro alle macchine e ai trattori* in a scenario in which cars and tractors were facing the same direction. Thus, children were understood to be located behind the cars (intrinsic sense), but in front of the tractors (relative sense). Hence, 'reference' is a third semantic dimension that can determine the polysemy of complex prepositions. From these data we obtain the list of polysemous prepositions in (36):

(36) **Polysemous Complex Prepositions**:= {*a sinistra di*, *a destra di*, *attraverso (a)*, *dietro (a)*, *di fronte a*, *giú*, *intorno a*, *lungo (a)*, *per*, *presso (a)*, *sopra (a)*, *sotto (a)*, *su*, *tra/fra*, *verso*, *a fianco di*, *al lato di*}

This novel list suggests that most but not all the complex prepositions from (12) seem to be polysemous. Exceptions are *addosso a* 'against', and *davanti a* 'ahead of'. We conjecture that in virtue of denoting only proximal distances along one axis, they cannot have more than those single senses. *A fianco di* 'next to' and *a lato di* 'to the side of' cover proximity senses. However, they may be used to describe a figure to be next to either the 'left' or the 'front' side of a ground. Thus, they display more restricted forms of polysemy than simple prepositions, and unlike potentially monosemous prepositions.

3.4. Second experiment: Monosemous prepositions

Our central, novel finding for this category was that most Class I locutional prepositions, and *all* Class II locutional prepositions (i.e. those including articles, e.g. *nei pressi di*) are monosemous. Examples are *in cima a* and *a nord di* for Class I, and *nei pressi di*, *nel mezzo di* and *alla sinistra di* for Class II. For instance, participants invariably confirmed that *in cima a* denotes the topmost location of a possibly elevated ground (cf. (37)). Instead, *a nord di* only denotes a given polar coordinate (cf. (38)). Class II *nei pressi di*, *nel mezzo di* and *alla sinistra di* respectively denote a specific location defined via an intrinsic part of the ground. We illustrate their monosemous nature via (39)–(41):

(37) *I   bambini sostano   in cima   a-lla   collina   e   a-lla*
     montagna.
     The   children rest   in top   a-the   hill   and   a-the
     mountain
     a. 'The children rest on top of the hill and the mountain.'
     b. #'The children rest on top of the hill and over the mountain.'
     (Average v. *a*: 4.20; sc.: 1^0 2^0 3^5 4^5 5^{20}; Average v. *b*: 1.33; sc.: 1^{20} 2^{10} 3^0 4^0 5^0)

(38) *I   bambini vanno   a   nord   de-lla   collina   de-l   fiume.*
     The   children go   a   north   di-the   hill   and di-the   river
     a. 'The children go north of the hill and the river.'
     b. #'The children go north of the hill and over the river.'
     (Average v. *a*: 4.03; sc.: 1^2 2^0 3^8 4^5 5^{15}; Average v. *b*: 1.33; sc.: 1^{20} 2^{10} 3^0 4^0 5^0)

(39) I   bambini   vanno   ne-i   pressi   de-lle   macchine

e   de-i   trattori.

The   children   go   in-the   surroundings di-the   cars

and   di-the   tractors

a. 'The children go near the tractors and the cars.'

b. #'The children go near the tractors and close to the cars.'

(Average v. *a*: 3.90; sc.: 1^3 2^0 3^8 4^5 5^{14}; Average v. *b*: 2.33; sc.: 1^5 2^{10} 3^{15} 4^0 5^0)

(40) I   bambini vanno   ne-l   mezzo de-lla   piazza e   de-lla

via.

The   childrengo   in-the   middle di-the   square   and   di-the

road

a. 'The children go in the middle of the square and the road.'

b. #'The children go in the middle of the square and at the end of the road.'

(Average v. *a*: 4.16; sc.: 1^1 2^0 3^8 4^5 5^{16}; Average v. *b*: 1.83; sc.: 1^{10} 2^{15} 3^5 4^0 5^0)

(41) I   bambini   vanno   a-lla   sinistra de-lle   macchine e

de-i   trattori.

The   children   go   a-the   left   di-the   cars   and

di-the   tractors

a. 'The children go in front of the cars and of the tractors.'

b. #'The children go to the left of the cars and to the right of the tractors.'

(Average v. *a*: 4.03; sc.: 1^2 2^0 3^8 4^5 5^{15}; Average v. *b*: 2.16; sc.: 1^5 2^{15} 3^{10} 4^0 5^0)

In (37)–(41) we mark translations involving two distinct senses for a preposition as uninterpretable, via the symbol '#' (e.g. (38b)). We then have two pairs of values and scores in the last lines: one for the acceptable senses/interpretations (left side), and one for the unacceptable senses/interpretations (right side). For instance, participants easily accepted that *in cima a* has the 'on top of' sense proposed in (37a) (cf. the average value 4.20). However, they rejected the case that this preposition also had an 'over' sense as in (37b) (cf. the average value 1.33). In other words, *in cima a* only covered a 'proximal' sense referring to place along the vertical, positive axis, unlike *sopra a* or *su*. These data therefore show that these prepositions are monosemous: only sense emerges when coordinated PPs are used. We list some monosemous prepositions in (42):

(42) **Monosemous Prepositions**:={**Complex**={*accanto a*, *addosso a*, *davanti a*,…}, **Locutional Prepositions, Class I**={*in cima/fondo a*, *a sud/nord/ovest/est di*,…}, **Locutional Prepositions, Class II**={*nei pressi di*, *alla sinistra di*, *alla destra di*, *nel mezzo di*,…}}

By confirming the existence of monosemous prepositions, we obtain three important results. First, we show that assumptions about the paradigmatic polysemy of spatial senses in prepositions are perhaps too strong (Tyler & Evans, 2003).

Second, we confirm that our study individuated those senses justifying the analysis of other prepositions as polysemous, i.e. as covering senses captured by other items in a language (Apresjan, 1974; Vicente, 2018). Third, we can also confirm that prepositions can stand in hyponym relations, via their shared contexts of use (Bjelobaba, 2018), with increasing degrees of morphological complexity signalling decreasing ranges of polysemy.

Overall, our experiments offered four key results supporting our predictions. First, Italian also includes a set of monosemous locutional prepositions (e.g. *alla sinistra di*), along with simple and complex prepositions. Second, simple prepositions are richly polysemous; complex and locutional prepositions can be either polysemous (e.g. *su*) or monosemous (e.g. *nel mezzo di*). The semantic dimensions of 'convexity', 'distance' and 'reference' (system) determine the restricted polysemy of complex prepositions (respectively *attraverso (a)*, *sopra (a)*, *di fronte a*). Third, there is a clear relation between morphological complexity and decreasing polysemy. This relation is mediated via spatial nouns and (possibly) inflected preposition/markers (e.g. *dietro* vs. *in cima* vs. *nei pressi di*). The fourth key result can be discussed by looking at prepositions' semantic relations.

First, monosemous prepositions invariably cover one sense that other polysemous prepositions also cover. Examples include the triplets *in cima a*, *su* and *sopra (a)*; *di*, *giú*, *sotto* and *in fondo a*; *per* and *attraverso (a)* and *lungo (a)*. Other examples include *di fronte a* and *davanti a*, *presso a* and *nei pressi di*, and so on. In these cases, hyponymy relations hold between pairs (triplets) of prepositions, with monosemous items representing the basic hyponyms. We offer a non-exhaustive list of hyponym relations in (43); hyperonyms are the elements on the right edge of sequences (e.g. *sopra a*):

(43) **Hyponym Relations**:={<<*in cima a*, *su*>, *sopra a*>, <*davanti a*, *di fronte a*>, <<*dentro*, *nel mezzo di*>, *in*>, <<*giú*, *in fondo a*>, *sotto a*>, <*alla sinistra di*>, *a sinistra di*>, <*attraverso a*, *per*>, <<*a sinistra*, *a destra di*>, *a fianco di*>,…}

Second, simple prepositions *a* and *di* seem to cover more senses, with *di* apparently restricted to prepositions denoting locations defined via parts of the ground (e.g. *a sinistra di*, *al centro di*). Thus, they share some but not all senses, and stand in an overlap relation (cf. also *a* and *da*). At the same time, *a* and *di* act as hyperonyms to most complex prepositions, *qua* heads introducing a 'general' spatial relation that is restricted via the sense of a spatial noun. We therefore conclude that our findings shed light on a broader set of prepositions and their semantic relations than those discussed in previous works (e.g. Luraghi, 2009, 2011; Ursini, 2017; Bjelobaba, 2018). We thus have reached our first objective: an overview of the data. We move to our second goal: a formal account that provides a visual rendition of these semantic relations.

3.5. Semantic maps: Basic assumptions & Models of sense relations

The goal of this section is to motivate and offer an account of the semantic data based on the notion of 'semantic maps', visual representations of meanings and/or functions/senses. Within typology, a method to account semantic variation involves semantic maps (Croft, 2001; Haspelmath, 2003). Semantic maps have two components: conceptual spaces (or models: Croft, 2001), and lexical matrices. Conceptual spaces represent cognitive, possibly non-linguistic concepts that languages can express (e.g. colour: Regier, Naveen & Majid, 2013). Lexical matrices present senses attested in a language, and then assigned to each item in a category. Conceptual spaces are represented as either connected graphs (Haspelmath, 2003), or as Euclidean spaces (Croft & Poole, 2008). Both formats represent how connected senses form semantic spaces.

Cognitive Linguistics approaches are often contiguous to these analyses. Most proposals use Idealized Cognitive Models, detailed maps for representing sense networks of single prepositions (e.g. Lakoff, 1993; Tyler & Evans, 2003; *inter alia*). A 'prototypical' sense (e.g. 'enclosure') can be refined via the addition of further senses (e.g. 'enclosure and support'). Networks, in turn, form radial categories, with senses being derived from the prototypical sense via the addition or omission of senses. Thus, prepositions' senses form possibly intertwined sub-domains of a general semantic space.

These approaches to polysemy converge in assuming that polysemous items include senses organized into compact structures. The semantic maps model and cognitive frameworks eschew the existence of prototypical senses, but otherwise represent polysemy via network senses. Similarly, semantic maps models assume that senses are inherently distinct. Cognitive approaches do not specify the nature of relations between prototypical sense and other senses. Thus, each approach has its own *pros* and *cons*.

We propose to overcome this theoretical *impasse* by using a combination of the two perspectives. First, we use 'Image Schemas', which act as visual, diagrammatic representations of how participants conceptualize perceptual information (e.g. Lakoff, 1993; Tyler & Evans, 2003; Zwarts, 2005). For our specific purposes, image schemas visually represent the spatial configurations that prepositions denote. Prepositions' senses can be distinguished as functions that determine these configurations.

To make the notation formally explicit, we use circles to represent spatial locations or places, directed lines ('vectors') to represent axes/projections, and sequences of lines ('paths') to represent directions (Lakoff, 1993; Tyler & Evans, 2003). Image schemas can be construed via the integration of these basic visual and geometrical

elements. For instance, 'inclusion' can be represented as a configuration in which the figure's location and the ground's internal space, represented as circles partially or entirely overlap. We then integrate these single schemas (e.g. 'part-of', 'goal') into a unified schema, as proposed in typological works (e.g. Levinson & Wilkins, 2006).

We thus represent a ground as a complex object and the centre of a spatial map. A rich set of places, axes, and paths can be defined via the ground's parts. The use of circles in schemas clarifies that spatial nouns *in* prepositions denote places, while spatial nouns in isolation denote the corresponding parts/sides (e.g. *di fronte* vs. *il fronte*). Monosemous prepositions can be conceived as prepositions only denoting single places, which are the 'atomic' elements making up this space. Polysemous prepositions instead can describe several spatially connected places or projections on the map. We label 'regions' sets of connected places, and 'axes' sets of connected projections. Consider thus Figure 1:
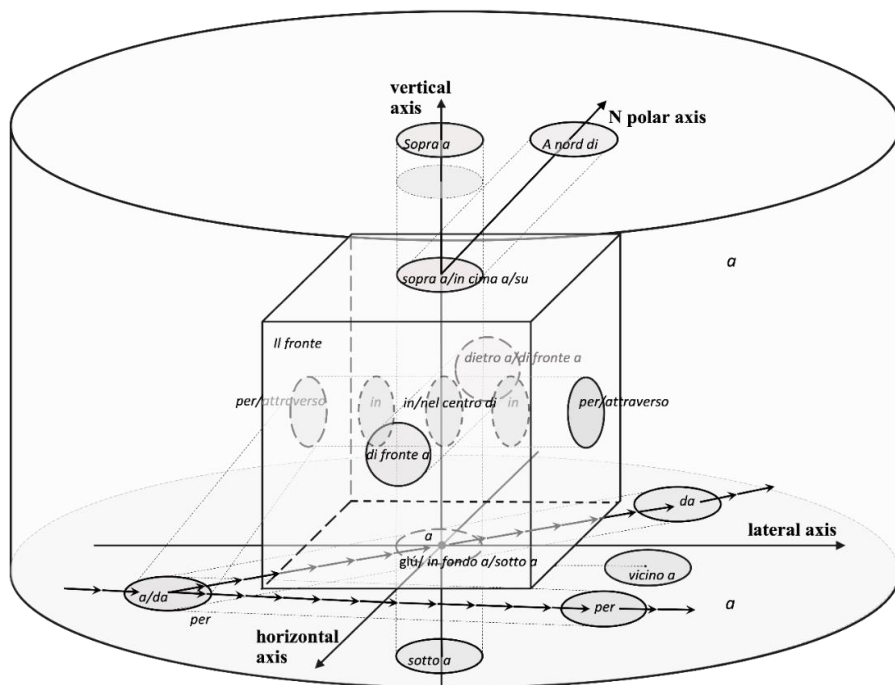

Figure 1. Semantic map for Italian Spatial Prepositions. Each circle represents a place a preposition can denote; each vector the axis going through this place. NPs such as *il fronte* denote parts of the ground defining these locations. For each complex preposition, it is also possible to represent their directional sense. The lower-left place acts as a starting point for a figure reaching any of the places defined with respect to the ground (e.g. the circle/place marked as *sotto a*). We do not explicitly represent all these senses only to avoid that figure 1 would be 'overloaded' with visual information.

Semantic relations are represented as spatial relations holding between these types of locations. For instance, *di fronte a* denotes two places, a 'front' and a 'back' one (cf. the label in Figure 1), and thus covers the 'front' and 'back' senses forming the 'horizontal axis' sub-domain. Overlap relations correspond to regions or axes that prepositions can jointly denote. For instance, the 'goal' path starting from the lower-left (external) place of the ground and reaching its 'bottom' place is labelled via *a* and *da*. Both prepositions can be used to refer to this path, depending on the type of ground they combine with. Instead, hyponym relations correspond to inclusion relations between locations (e.g. the 'top' place being part of the places that *in cima a* and *sopra a* denote).

Let us now analyse specific sense relations emerging from our map(s). As Figure 1 shows, the senses of simple *a* are represented as a 'halo' encompassing all possible regions and axes, irrespective of the distance. This is consistent with *a* also acting as a head in complex prepositions such as e.g. *addosso a*, *vicino a*, thereby acting as a 'general' hyperonym to other Italian prepositions. Instead, *da* represents a mostly 'directional' preposition. Thus, its possible senses involve paths that can either originate from, or go to the ground. An indirect prediction is that *da* can also have a 'route' sense; it can describe a figure going 'into' and then 'out of' the ground (Luraghi, 2009, 2011).

The map also shows that *di* covers senses denoting places. *Di* frequently occurs as a head in monosemous place prepositions (e.g. *al centro di* 'at the centre of'), but also as a marker (e.g. *di fronte a* 'in front of') or even as a head of the two polysemous projective prepositions *a sinistra/destra di* 'to the left/right of'. For the most part, however, its senses denote a region formed via the possible places of a ground, external and internal alike. The preposition *in* instead covers senses that denote internal regions of the ground, represented as shaded places labelled via prepositions *in* and *al centro di*.

With regard to relations, the map shows that *a*, *da* and *di* overlap on the 'goal' sense, since they can all denote paths reaching the ground. To an extent, the map also shows that *di* and *in* also are hyponyms of *a*, since they denote more restricted (or 'smaller') regions included in *a*'s 'bigger' halo (cf. also Brala-Vukanovic, 2000). Note here, however, that we visually represent the polysemy of these prepositions by showing how their schemas denote sets of locations defined with respect to the ground. This fact holds whether they are regions (i.e. sets of places) or axes (i.e. sets of projections).

Let us now discuss polysemous complex prepositions. As figure 1 shows, complex prepositions and (some) locutional prepositions display restricted forms of polysemy, which involve the semantic dimensions of 'convexity', 'distance', and 'reference'. Again, *sopra a* can cover senses denoting vertical, upward regions that can be either at a 'proximal' or 'distal' distance. *Di fronte a*, in the opportune contexts, can also refer to

regions 'behind' the ground. The same reasoning applies to spatial nouns and markers forming a distinct unit, for those items that involve polysemy (i.e. *di fronte*, *a fianco*, *al lato di*). It also applies to novel complex prepositions *per*, *su*, and *tra/fra*, though these prepositions also display less restricted forms of polysemy. Furthermore, the directional senses of these prepositions can be represented by having the 'edge' of a path to reach any of these locations. Hence, complex prepositions model specific regions of *a* and its 'general' halo, whether this halo covers regions as static 'locations' or dynamic 'goals'.

Monosemous items complete our discussion. As Figure 1 shows, these prepositions have highly specific senses; hence, they only denote single axes or single places. Crucially, most monosemous prepositions belong to the class II morphological type. Hence, they include an overt inflected preposition and a spatial noun (e.g. *nel* and *mezzo* in *nel mezzo di*; *alla* and *sinistra* in *alla sinistra di*). A possibility is that the definite article may determine the uniqueness of the place that they denote (cf. *il fronte*). This rule allows exceptions (cf. class II locutional *al lato di*), possibly because these prepositions are undergoing a process of lexicalisation (Franco, 2016). Therefore, rich morphological structure seems to invariably signal monosemous status.

These results permit us to explain how hyponym relations are represented in the map. For instance, while *in cima a* denotes only the 'top' place of a ground, *su* can denote a region including this place and proximal, but non-adjacent places. Insofar as a figure is supported by a ground, their exact distance is not crucial. *Sopra (a)* blurs this distinction, so it denotes a region also encompassing distal values. This preposition does not presuppose that figure and ground are in contact (cf. also Taylor, 1988). A symmetrical argument can be made for *giú, in fondo a* and *sotto a*, as the map shows. Therefore, our map represents senses of related prepositions via the places/regions they denote, and the hyponym relations that emerge among these senses as relations between these regions.

4. Discussion

Two key results emerge from our account. First, our account permits us to represent semantic maps integrating three dimensions of analysis: spatial schemas, polysemy, and semantic relations. By representing spatial senses via the places/axes they denote with respect to a ground, we give a visual rendition of what types of relations they can form. Our maps extend the results of previous approaches on the polysemy of Italian prepositions (e.g. Taylor, 1988; Luraghi, 2009, 2011; Bjelobaba, 2018), because they explicitly represent hyponymy and overlap relations among senses. They also show that increasing morphological complexity and decreasing polysemy are directly related. The more structure a preposition involves (from simple to complex and then to locutional prepositions), the more restricted the covered

senses are. This result captures the intuition that form and meaning are connected, in prepositions (Lehmann, 1985).

Second, our account offers maps that respect the connectedness condition (Haspelmath, 2003; Croft & Poole, 2008): the senses that each preposition covers are directly connected. This is the case because we blur the distinction between geometric and semantic representation. For instance, the two possible senses of *di fronte a* (intrinsic and relative 'front') can be considered opposites. One can use this preposition to refer to a location coinciding with either the 'back' or the 'front' of the ground. Monosemous prepositions also find representations as items only having one sense, related via hyponymy to polysemous prepositions. Therefore, these results also expand on previous research on sense relations in adpositions (Levinson & Meira, 2003). This is the case because sense relations organise prepositions into a mini-lexicon that partitions the semantic domain of space into precise maps. With these results in mind, we turn to the conclusions.

CONCLUSIONS

The objective of this paper has been to offer an overview of the polysemy patterns in Italian spatial prepositions (e.g. *a*, *sopra (a)*, *in cima a*). We also have shown that the degree of polysemy that prepositions display is inversely related to their morphological complexity. A consequence of this fact is that some locutional prepositions display form of monosemy for their spatial senses (e.g. *in cima a*), a novel and theoretically significant fact. We have captured these patterns via a semantic maps model that integrates the representation of spatial schemas with sense networks into a novel model that also capture sense relations (e.g. hyponymy, overlap, monosemy). One could furthermore integrate our account with Generative Lexicon proposals and their accounts of prepositions (e.g. Chung, 2011). However, we leave an extension of these results for future research.

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