

Spatial anaphors in Mandarin: How grammar principles inform discourse structure

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The first goal of this paper is to present data pertaining to the distribution of categories acting as spatial anaphors in Mandarin, i.e. elements that can refer to locations. The paper shows that so-called compound localisers (e.g. *qian-mian* literally ‘front side’) but not simple localisers (e.g. *qian* ‘in front’) can establish anaphoric relations and can license ground NP ellipsis, in discourse-bound contexts. It is shown that this is the case because compound localisers are full-fledged anaphoric NPs, whereas simple localisers are clitic-like (phrasal) affixes to other NPs. The second goal is to account these patterns via a Type-Logical formalism. The key proposal is that compound localisers can carry features licensing the formation of anaphoric relations via feature-matching operations, and can thus license ellipsis patterns in discourse. It is thus shown that via this proposal, one can account intra-sentential (‘grammatical’) and inter-sentential (‘discourse’) structures via a single derivational engine, while also accounting novel ground NP ellipsis data. The paper then discusses the consequences for a general theory of spatial categories and the grammar-discourse distinction.

KEYWORDS: Mandarin, prepositions, localisers, ground NP ellipsis, anaphoric relations.

1. Introduction

There is a wealth of works investigating the properties of spatial case morphemes. These are usually defined as categories that introduce spatial relations among two or more entities in discourse. Examples include adpositions (e.g. English prepositions *in* and *to*) and case markers (e.g. locative *-ey* in Korean), across languages (Levinson & Wilkins 2006; Cinque & Rizzi 2010). In many languages, spatial case morphemes display flexible categorial properties, one well-studied example being Mandarin (e.g. Chao 1968; Xu 2008a). It is well known that Mandarin prepositions can also act as co-verbs, parts of speech that are akin to copular predicates. Mandarin prepositions capture spatial relations also via the contribution of *fangweici* or ‘localisers’, a category usually introducing reference to specific locations or directions (e.g. Huang *et al.* 2017: 169-170). We illustrate these basic patterns via (1-5):¹

- (1) *Peng* *zuo* *zai* *zhuozi* *qian*.
 Peng sit at table front
 ‘Peng is sitting in front of the table.’
- (2) *Peng* *zai* *zhuozi* *qian*.
 Peng be_at table front
 ‘Peng is in front of the table.’
- (3) *Peng* *zai* *Guangzhou*.
 Peng be_at Guangzhou
 ‘Peng is in Guangzhou.’
- (4) *Zhuozi* *hou/de* *hou-mian*/*∅ *hou-mian*
 table back/POSS back-side/∅ back-side
 ‘The back (side) of the table’
- (5) *Peng* *zai* *zhuozi* *de* *hou-mian*.
 Peng be_at table POSS back-side
 ‘Zhangsan is at the back side of the table.’

Let us introduce some terminology. The ground NP introduces the discourse entity acting as a landmark object, or ground (e.g. *zhuozi* in (1)). The figure NP introduces the entity being located (e.g. *Peng* in (1): Talmy 2000: ch. 1).² We use these labels for the discourse entities or referents that these NPs introduce in discourse (Kibrik 2013: ch. 2). As (1-2) show, the preposition *zai* and the localiser *qian* ‘(in) front’ seem to form a discontinuous constituent. Some have analysed discontinuous preposition and localiser structures as ‘circumpositions’ (e.g. Chao 1968; Koopman 2000). Furthermore, *zai* can act as a co-verb in a sentence, as (2-3) show. Localisers are obligatory unless the ground NP is a toponym: this sub-set of NPs can render a localiser optional (cf. *Beijing* in (3): Peyraube 1980; Xu 2008a).

The distribution of prepositions and localisers has been amply investigated, although a curious dichotomy emerges from the theoretical literature. For instance, Djamouri *et al.* (2013) suggest that only simple (i.e. mono-morphemic) localisers (‘postpositions’, in their analysis) can form a full-fledged P(reposition)P(hrase) with a preposition as a head. Compound localisers are treated as a distinct category of ‘spatial nouns’, i.e. nouns referring to parts, sections or sides of objects (cf. Chappell & Peyraube 2008). Therefore, most previous studies on spatial categories in Mandarin ignore compound localisers’ role in (5) and related sentences. However, (4-5) show that this view is problematic. Without a preposition to head a PP, a ground NP and localiser form a complex NP that refers to the back part of a table, *zhuozi hou* ‘the back of the table’. The same relation between ‘part’ and ‘whole’ of the table can be captured via

the possessive NP *zhuozi de hou-mian*. This construction features *de* as a possessive marker and the compound localiser *hou-mian*, with *de* being obligatory (cf. (4)).

Therefore, (5) shows that compound localisers can occur in Basic Locative Constructions (BLCs). These are defined as constructions that can be standardly offered as answers to *where*-questions (Levinson & Wilkins 2006: ch. 1; Ameka & Levinson 2007). When one compares (5) against (1-3) as examples of BLCs, it becomes clear that either type of localiser can be part of a PP and the BLC including it. This is the case whether a preposition only heads a PP, or may act as the co-verb heading a BLC. Further proof that simple and compound localisers dovetail in their distribution as part of PPs comes from another understudied phenomenon: ground NP ellipsis. This is defined as the omission of the ground NP and possibly its governing head in referential/anaphoric contexts (Boone 2014: ch. 2). In Mandarin, this ellipsis form is sensitive to structural constraints between anaphors and their antecedents, as (6-7) show:

(6) **Peng zai (zhuozi) qian.*
 Peng be_at (table) front
 'Peng is front (the table).'

(7) *Peng zai zhuozi zuo/de zuo-mian.*
 Peng be_at table left/POSS left-side
Zhangsan zai (zhuozi de) you-mian.
 Zhangsan be_at (table POSS) right-side
 'Peng is to the left of the table. Zhangsan is to the right (the table).'

In Mandarin, if the identity of the elided ground NP causes a simple localiser to become the remnant (pronounced constituent) of a PP, then a sentence becomes ungrammatical (cf. *(zhuozi) qian* in (6), *qian* being the remnant). If a first sentence acts as the linguistic context of a second sentence, then ground NP ellipsis becomes possible. For instance, it can target the ground NP and the *de* head in *de*-phrases (i.e. *zhuozi de* in (7)). This is the case whether the PP acting as an antecedent in the first sentence includes a simple or compound localiser (cf. *qian/de qian-mian* in (7)). The remnant signalling this anaphoric relation, however, should invariably be a compound localiser (e.g. *you-mian* in (7)). Overall, these data suggest that the distribution of simple and compound localiser types must follow a unified phrasal, sentential, and discourse-bound account of this category and its understudied properties. This because they seem to clearly determine licensing conditions for intra- and inter-

sentential ground NP ellipsis. Previous works on these constructions, however, do not offer such an account.

The first goal of this paper is to offer an overview of previous works, therefore motivating the presentation of novel data regarding this ellipsis pattern (sections 2-3). The second goal is to offer an account based on a Type-Logical formalism (Barker & Shan 2014: section 4) that derives intra- and inter-sentential data via a unified set of assumptions. Section 5 compares this account with previous analyses of Mandarin prepositions and localisers. It then discusses how the account can be integrated into different architectures of grammar addressing discourse anaphors (e.g. HPSG, Minimalism). Section 6 concludes.

2. Previous data and accounts

Mandarin includes 66 attested prepositions (Huang *et al.* 2017). It is generally acknowledged, however, that a ‘core’ set of prepositions carries the principal spatial functions/senses. We propose this list in (8) (cf. Djamouri *et al.* 2013; Zhang 2017):

- (8) Spatial Prepositions = {*zai* ‘at’, *dao* ‘to’, *cong* ‘from’, *dang* ‘at’, *dui* ‘in the direction of’, *li* ‘away’, *wang* ‘in the direction of’, *xiang* ‘in the direction of’}

There is a vast literature addressing the properties of this category (e.g. Chao 1968; Li & Thompson 1974; 1981: 381-387; Peyraube 1980). Hence, theoretical controversies about their status abound. Some works have suggested that prepositions are not a type of co-verbs, as they do not participate in serial verb constructions (Li & Thompson 1981: ch. 20; Aikhenvald & Dixon 2006: ch. 3; Basciano 2010) or ‘V-not-V’ constructions (i.e. rhetorical questions) (Yin 2003; Huang 2009; Basciano 2010; Zhang 2017). The recent Huang *et al.* (2017: 171-174) however shows that (at least) *dao*, *xiang* and *wang* commonly occur in these constructions, even if other prepositions are more rarely attested in them. Thus, prepositions may act as the central predicative elements in BLCs, the ‘minimal’ heads of their corresponding clauses.

Mandarin also includes over 80 localisers (Huang *et al.* 2017: Appendix VII). Most works, however, consider localisers as parts of speech allowing specific reference to locations, moments in time or causal relations (e.g. Chappell & Peyraube 2008: 5). Like other prepositions across languages, localisers seem to be polysemous (‘poly-functional’, in Huang *et al.* 2017). Thus, several works restrict their attention to a core of localisers with clear ‘core’ spatial senses, when they focus on their

distribution in spatial PPs. We list these localisers in (9) (cf. Djamouri *et al.* 2013: 72; Huang *et al.* 2017: 217; Zhang 2017: 170):

- (9) Spatial Localisers = {*li* ‘in’, *wai* ‘out’, *shang* ‘on’, *xia* ‘down’, *qian* ‘front’, *hou* ‘behind’, *zuo* ‘left’, *you* ‘right’, *pang* ‘beside’, *nei* ‘inside’, *bei* ‘North’, *xi* ‘West’, *dong* ‘East’, *nan* ‘South’, *zhong* ‘middle’, ...}

As foreshadowed in the introduction, localisers seem categorially ambiguous. They can occur as nominal elements referring to parts of objects and their corresponding locations (e.g. *shan shang* ‘the top of the mountain’: Hagège 2010: 108-110). Bi-syllabic localisers combining monosyllabic items abound (e.g. *dong-bei* ‘North-East’), and often capture distinct senses from their constituting items (e.g. *zuo-you* ‘around’, lit. ‘left-right’). Compound bi-syllabic forms with prefixes *yi-* and *zhi-* can be formed with most localisers (e.g. *yi-wai* ‘beyond’). We do not discuss their properties here, however, as they would lead us too far afield. Overall, prepositions seem to capture the directional/locative alternation; localisers, the location that a figure is occupying (e.g. Sun 2006, 2008; Lin 2013). They thus jointly define PPs’ ability to define the spatial content of a sentence.

The analysis of localisers as key parts of PPs and therefore of BLCs is however a controversial matter, especially in formally oriented works (e.g. generative approaches). Works tend either to assume that simple localisers are postpositions and compound localisers NPs are not part of PPs, or that localisers are nominal-like elements. An adpositional line of analysis, exemplified via (10), treats simple localisers as postpositions: adpositions heads following their ground NP (Tai 1973; Hagège 1975; Ernst 1988; McCawley 1989, 1992; Li 1985, 1990). Instead, Troike & Pan (1994) offers a generative analysis in which localisers are postpositions occurring in the specifier position of PPs (cf. (11)). Works suggesting that localisers are phrasal (NP) clitics offer two arguments supporting this view (cf. Liu 1994, 1998; Huang 1985, 1988, 1989; Xu 2012; Lin 2013; Ursini *et al.* 2020). First, localisers cannot occur without a ground NP to which they attach (cf. (6)). Second, they cannot consequently receive tone, since they are phonologically dependent on the ground NP (cf. (12) for the resulting structure).

The general proposal in Djamouri *et al.* (2013) builds on early insights on the extraposition of PPs (e.g. Huang 1982: ch. 4) and treats localisers as postpositions projecting a ‘Place’ head and forming a ‘Place’ P(hrase). Prepositions, instead, project a ‘Path’ head and form a PathP (cf. (13)). The cartographic account in Wu (2015) proposes that localisers realize the ‘Axpert’ category and prepositions the ‘Place’ category.

The attested constituent order is obtained by assuming that the ground DP moves to the specifier position of the A_{xpart} head (cf. (14)):

- (10) [PP [P *zai* [PostP [NP *zhuozi*] *qian*]_{Post}]]]
 (11) [PP [P *zai* [NP *zhuozi*]] [PostP *qian*]]
 (12) [PP *zai* [LocP [NP *zhuozi*] -*qian*]_{LocP}]]
 (13) [PathP *zai* [PlaceP [NP *che-zi*] *qian*]]
 (14) [PlaceP *zai* [A_{xpart}P [DP *che-zi*]] [*qian* [DP t_i]]]]

Thus, all the accounts converge in treating simple localisers as forming a syntactic unit (i.e. a phrase) with ground NPs. They however differ on how they analyse the categorial status of localisers, and thus organise their analysis of PPs. For the most part, these accounts exclude compound localisers *qua* inherently nominal elements. As the data in (1-7) suggest, however, postpositional analyses become problematic in a fuller range of syntactic contexts, for they create an unmotivated distinction between simple and compound localisers.

To avoid such artificial distinctions, typologically oriented works have analysed the two types of localisers as members of the ‘place words’ nominal category (Li 1985, 1990; Peyraube 2003).³ Three key arguments are offered for this analysis. First, the presence of low and falling tones supports their analysis as affixes to ground NPs (Peyraube 1994, 2003; Ceccagno & Basciano 2008). Second, compound localisers are derived via the suffixation of five well-established nouns re-interpreted as suffixes: *tou* ‘head’, *mian* ‘side’, *bian* ‘side, face’, *fang* ‘place, region’ and *bu* ‘part’ (Huang *et al.* 2017: 173-174). Third, localisers seem also to have pro-form properties (Alleton 1973; Rygaloff 1973; Hagège 1975, 2010). If a localiser such as *hou* ‘back’ refers to a back part and its corresponding location, then it presupposes the existence of a ground that has a back part. Thus, typological works consider the data in (1-5) as part of a single empirical domain, but do not offer detailed structural analyses as the ones in (10-14). Hence, they do not analyse sentential and discourse examples such as (1-7).

The structural relations between prepositions and localisers have been analysed in detail. Several works have suggested that these two categories form a discontinuous circumposition (Chao 1968; Huagne 1975; Li & Thompson 1981; Liu 2003, 2008; Lü 2006; Sun 2006, 2008; Lü 2018). Some generative works have built an analysis of Mandarin PPs upon the classic bi-partite analysis of adpositions found in Jackendoff (1983, 1990) (cf. also Wunderlich 1991; Kracht 2002; LeStrade 2010).⁴ Thus, Zhang (2002) suggests that prepositions project a ‘Location Relation’ (LR) head, and localisers a ‘Place Value’ (PV) head. Localisers take a ground NP as their Reference Entity or RE argument. This phrase then moves to a specifier position of the LR head, hence leaving a trace in its original position.⁵

To explain how this analysis differs from the classic bi-partite analysis, we offer the structure of English *from under the sofa* (cf. Jackendoff 1983) and Mandarin *zai chezi shang* in (15-16), respectively. Instead, (17) represents a case in which the ground NP is a toponym:

(15) [_{PathP} *from* [_{PlaceP} *under* [_{DP} *the sofa*]]]

(16) [_{LR} *zai* [_{PVP} [_{RE} *chezi*]_i *shang* [_{t_i]]]}

(17) [_{LR} *zai* [_{PVP} [_{RE} *e*] *Beijing*_i [_{t_i]]]}

Under this account, place names correspond to ground NPs moving to a PV position, given their ability to refer to (specific) locations without localisers (cf. also Huang 2009; Huang *et al.* 2009). The specifier of the PV Phrase remains empty because the place name does not move to this position, viz. the ‘*e*’ category in (17). Crucially, Djamouri *et al.* (2013) offers a similar proposal, which however assumes that that a localiser projects a Place head branching to the right. Therefore, it avoids the postulation of movement operations, present in the cartographic Wu (2015) (cf. (13) vs (14)). Furthermore, this discussion shows that the flexible status of prepositions as co-verbs remains unaddressed, for these proposals mostly focus on PPs in isolation. Thus, a full account of discourse data (e.g. (6-7)) remains outstanding, as generative frameworks generally do not address this type of data.

The empirical gaps in the study of these categories also involve the analysis of *de*-structures including compound localisers. The recent Zhang (2017) proposes that ground NPs and localisers, which cannot receive stress, form a nominal compound referring to a ground’s specific part (e.g. *jia-li*, lit. ‘house-in’). When suffixed, localisers become relational nouns (e.g. *li-mian* ‘inside, interior’). *Modulo* suffixation, they may also occur in nominal contexts, one example being the subject position in *you* (i.e. ‘there’) predicative structures (e.g. *li-mian you yi-zhi mao* ‘there is a cat inside’: Zhang 2017: (10a)). In Djamouri *et al.* (2013: 72), the resulting structure is analysed as involving a specific phrase, labelled as ‘deP’ and considered a sub-type of NP (cf. (18)):

(18) [_{deP}[_{NP} *che-zi*] [_{de} [_{NP} *qian-mian*]]]

As discussed in the introduction, this work also does not consider *de*-phrases as part of PPs, even though it acknowledges their ability to convey a certain type of spatial information. Thus, the work also leaves open the question of how both types of localisers can be involved in ground NP ellipsis, when they license the formation of anaphoric relations.

Overall, previous proposals explore some of the properties of Mandarin prepositions and localisers, and underscore their ‘liminal’,

flexible distribution and status (cf. Libert 2013). Nevertheless, they invariably tend to overlook the role of compound localisers in PPs, thus forsaking a wider account of this category. Our initial data in (1-7) suggest that this view is too narrow, especially once one considers the ground NP ellipsis and anaphoric data. This is the case because the grammatical (i.e. intra-sentential) properties of localisers seem to affect their discourse (i.e. inter-sentential) properties, our key example being ground NP ellipsis. A full-fledged account of the data, then, is still outstanding. Before we offer such an account, however, we must offer a full overview of the relevant data. To this, we turn.

3. Novel data

In this section, we offer an overview of ground NP ellipsis patterns and the role of localisers in establishing the anaphoric relations licensing these patterns. Our data are based on an elicitation task that had the following characteristics. Participants (N=35) were asked to evaluate whether the examples at stake could describe certain extra-linguistic scenarios (e.g. that the children made the house's exterior beautiful, cf. (19)). Participants could choose answers based on three values: 'acceptable' (*kěyǐ jiēshòu*, in Mandarin), 'unacceptable' (*bùnéng jiēshòu*) and 'tolerable' (*shuō dé tōng*). The first answer would describe examples that could aptly describe a scenario and, mostly importantly, would be grammatically well-formed; the second answer would describe ill-formed examples. The third answer would thus describe examples that would not raise any clear-cut intuitions. Participants were invited to leave feedback on their answers, when deemed necessary.

Overall, the evidence regarding intra-sentential data corroborates previous works offering (mostly) corpus evidence on this pattern (e.g. Huang *et al.* 2017; Zhang 2017), but from an elicitation perspective. The evidence regarding inter-sentential data is entirely novel, and as such fills an empirical void on this topic (cf. section 3.2). By using elicitation data, we could control the extra-linguistic context, and therefore speakers' ability to retrieve the identity of the ground referent in context. We tested examples including each of the localisers in (8) and each of the (possible) spatial nouns derived from the five suffixes (see Huang *et al.* 2017: 174). Here we only report a small sample of the overall data, for the sake of conciseness. We considered 'acceptable' examples on which more than 80% of participants offered such an answer. Nevertheless, we discuss cases of intra-speaker variation as we proceed.

3.1. Intra-sentential data

As discussed in the introduction, there is clear evidence that all types of localisers can occur in BLCs as part of a PP introducing a spatial relation between figure and ground. However, Zhang (2017) further discusses five syntactic contexts that show how ground NPs and localisers, as a single constituent, can occur in the same position of ‘bare’ NPs. BLCs coincide with the first context. The second context involves *dui* ‘for’ as a marker for benefactive/malefactive arguments (e.g. *zhe dui xue xiao lai shuo hen gui* ‘this is expensive for the school’). Since *dui* occurs in contexts that do not involve spatial senses, we can safely leave this marker aside. The other three key contexts involve *ba*-structures, passive sentences involving *bei*-structures, and attributive structures involving the verb *kanqilai* ‘seem’. Crucially, some works propose that *ba* and *bei* may be considered items oscillating between prepositional and co-verb distribution (e.g. Kit 1992, 1993; Zhang 2017). It is however known that their precise status is a matter of controversy (cf. Huang *et al.* 2009: ch. 5-6). Here we choose a preposition/co-verb analysis, as our data support this view.

Let us first look at causative structures involving the direct object marker *ba*. In Zhang (2017), ground NPs and localisers are treated as forming a single unit. Thus, Zhang (2017: 121) proposes that a sentence such as *haizi-men ba jia-li nong de hen haokan* ‘the children made the house’s inside beautiful’ involves a ground NP suffixed via a localiser, *jia-li*, which is interpreted as referring to a given house. Our informants confirmed that this conclusion could be generalised to any ground NP and localiser. Hence, in these *ba*-structures one can find simple localiser *wai* to follow the ground NP (cf. (19)) but also compound localisers *zuo-bian* and *qian-mian*, introduced via the head *de* (cf. (20-21)).⁶

- (19) *Haizi-men ba fangzi wai nong-de hen hao-kan.*
 child-PL BA house out make-DE very good-look
 ‘The children made the house’s exterior beautiful.’
- (20) *Haizi-men ba fangzi de zuo-bian/*zuo nong-de hen hao-kan.*
 child-PL BA home POSS left-side/left make-DE very good-look
 ‘The children made the left side of the house beautiful.’
- (21) *Haizi-men ba fangzi de qian-mian/*qian nong-de hen hao-kan.*
 child-PL BA house POSS front-side/front make-DE very good-look
 ‘The children made the front side of the house beautiful.’

Let us mention that we used the noun *fangzi* ‘house’ in the test, rather than Zhang’s (2017) *jia* ‘home’. Cross-linguistically, nouns referring to salient locations (e.g. English *home*) tend to pattern with toponyms, in syntactic distribution display properties closer to toponyms (Hagège 2010: 108-

120; Aguilar-Guevara & Zwarts 2010).⁷ While *jia-li* triggers this effect, other ground NPs prevent it, and therefore allow us to study the contribution and role of localisers. Informants acknowledged that by involving nouns/NPs referring to type locations, the sentences in (19-21) could describe locations defined with respect to the house that some children made beautiful. This was the case irrespective of the localisers' type, thereby confirming that ground NPs and localisers form a single syntactic unit.⁸

Let us now discuss *bei* as a passive marker, the second target syntactic context. When the ground NP becomes the subject of passive sentences, it can occur with any type of localiser. In these cases, it is more opportune to talk about the landmark as the theme of a spatial relation, i.e. the referent being described as undergoing some change/process (cf. Talmy 2000: ch. 1). The non-spatial preposition *bei*, which acts as a co-verb in these contexts, syntactically marks this passive voice structure. We illustrate this pattern via (23-25):

- (23) *Fangzi nei bei haizi-men nong-de luanqibazao.*
 house inside BEI child-PL make-DE messy
 'The house's interior was made messy by the children.'
- (24) *Fangzi de nei-bu/*li bei haizi-men nong-de luanqibazao.*
 house POSS in-part/in BEI child-PL make-DE messy
 'The interior part of the house was made messy by the children.'
- (25) *Fangzi de wai-bian/*wai bei haizi-men nong-de luanqibazao.*
 house POSS out-side/out BEI child-PL make-DE messy
 'The exterior side of the house was made messy by the children.'

Although these structures involve a passive voice, they preserve the figure/theme NP's ability to refer to locations via two different structures. The first involves simple localisers (e.g. *nei* in (23)); the second, *de* and compound localisers (e.g. *nei-bu* in (24)). Therefore, this structure also confirms that any type of localiser can form a syntactic unit with a ground NP.

The third target syntactic property involves the verb *kanqilai* 'seem', which offers evidence on how ground NPs and localisers can become syntactic 'subjects' in predicative constructions. Consider (26-28):

- (26) *Fangzi hou kanqilai hen re'nao.*
 house back seem very lively
 'The house's posterior looks very lively.'
- (27) *Fangzi de li-bian kanqilai hen re'nao.*
 house POSS in-side seem very lively
 'The interior side of the house looks very lively.'

- (28) *Fangzi* *de* *qian-bian kanqilai* *hen* *re'nao*.
house POSS front-side seem very lively
'The front side of the house looks very lively.'

These examples confirm that ground NPs can combine with any type of localiser to form a single syntactic unit, which can then act as the subject of the verb *kanqilai*. Thus, simple localiser *hou* is acceptable in this structure (cf. (26)), but so are compound localisers *li-bian* and *qian-bian* (cf. (27-28)). Even in this structure type, localisers display the properties of adnominal phrases attaching to ground NPs. Note that a minimal difference between localiser types lies in their senses. For instance, the simple localiser *li* may be glossed as 'in', but more in general it can be used to describe a relation of 'inclusion'. The compound localiser *nei-bu* can be literally glossed as 'inside-part', as it refers to the interior part that a figure can occupy. As our focus is on syntactic structures, these semantic differences can be left aside.

Overall, these data allow us to draw three key conclusions. First, simple localisers act as affix- or clitic-like modifiers of ground NPs, as argued in the clitic analysis of Liu (1998); Zhang (2017); Ursini *et al.* (2020). This fact presupposes that the presence of a ground NP seems necessary for their occurrence in a PP: a 'host' NP must be present, for simple localisers to attach to it. Second, compound localisers act like full-fledged NPs, one of the two arguments of a *de* head (the other being the ground NP). Therefore, compound localisers seem to differ from simple localisers with respect to their syntactic status, even if both license the formation of full-fledged PPs. Third, PPs are formed via the presence of a preposition that may also act as a co-verb, and that takes a variety of 'complex NPs' (i.e. ground NPs and localisers) as their arguments. With these points in mind, we turn to the inter-sentential data.

3.2. Inter-sentential data: ground NP ellipsis and anaphoric relations

Ground NP ellipsis, as a sub-type of ellipsis, targets NPs that are 'given' in discourse (Merchant 2001: ch. 2, 2004; Svenonius 2006, 2010; Boone 2014: ch. 2). In English and other European languages, this ellipsis can occur in referential and anaphoric contexts. In referential contexts, the extra-linguistic ('external') context licenses the interpretation of the elided NP. In anaphoric contexts, the linguistic ('internal') context licenses this form of ellipsis. This ellipsis can occur because a PP acting as a complex anaphor finds an antecedent PP in a previous sentence, thereby forming an anaphoric relation. The discourse-given constituent can thus be elided (Asher & Lascarides 2003: ch. 4; Kamp *et al.* 2011:

ch. 4; Kehler 2011; Ward & Birner 2012). As foreshadowed in the introduction, Mandarin PPs block ground NP ellipsis in referential contexts. However, this only happens when simple localisers are part of these PPs. The presence of compound localisers licenses this form of ellipsis, as we show via (29-31):

- (29) **Zhangsan zai/dao le (zhuozi) hou.*
 Zhangsan be_at/go_to PF table back
 ‘Zhangsan is/goes behind the table.’
- (30) *Peng zai/dao le (zhuozi de) hou-fang.*
 Peng be_at/go_to PF (table POSS) back-direction
 ‘Peng is/has gone behind (the table).’
- (31) *Peng zuo zai *(zhuozi) qian/(zhuozi de) hou-fang.*
 Peng sit at (table) front/(table POSS) back-direction
 ‘Peng sits behind (the table).’

The presence of simple localiser *hou* ‘behind’ blocks ground NP ellipsis regardless of the preposition acting as a co-verb (cf. the *zai/dao* alternation in (29)). Once a compound localiser is used (e.g. *hou-fang*, lit. ‘back-direction’), a sentence becomes acceptable (cf. (30)). For directional prepositions such as *dao*, participants found the presence of perfect marker *le* optimal in these contexts, as it entails that the figure completed the motion event to reach the ground. If prepositions follow a lexical verb, the same patterns are indeed attested. Thus, simple localisers block ground NP ellipsis; however, compound localisers license it (cf. (31)). Let us note that some speakers considered (29) ‘acceptable’ (N=2), and some ‘tolerable’ (N=3), though most speakers rejected the example (N=30). We therefore conclude that previous observations on ground NP ellipsis (e.g. Zhang 2017) require some clarification even in referential contexts: compound localisers must be included in the discussion. Discourse contexts can offer the full picture regarding these patterns.

In anaphoric (discourse) contexts, simple and compound localisers are not equally acceptable as remnants. Compound localisers license cohesive discourses (cf. (32-33)); simple localisers trigger highly deviant structures (cf. (34)). For (34), some participants offered either ‘acceptable’ (N=2) or ‘tolerable’ (N=4) as an answer. This pattern holds whether prepositions act as co-verbs (cf. (32-34)) or prepositions following lexical verbs (cf. (35-36)). For the sake of simplicity, we focus on examples only including *zai* as a preposition/co-verb:

- (32) *Zhangsan zai zhuozi zuo. Peng zai (zhuozi de) you-mian.*
 Zhangsan be_at table left Peng be_at (table POSS) right-side
 ‘Zhangsan is to the left of the table. Peng is to the right (the table).’
- (33) *Zhangsan zai zhuozi de zuo-bian. Peng zai (zhuozi de) you-bian.*
 Zhangsan be_at table POSS left-side Peng be_at (table POSS) right-side
 ‘Zhangsan is to the left side of the table. Peng is to the right side (of the table).’
- (34) *Zhangsan zai zhuozi de zuo-fang. ??Peng zai (zhuozi) you.*
 Zhangsan be_at table POSS left-direction Peng be_at (table) right
 ‘Zhangsan is to the left of the table. Peng is to the right (of the table).’
- (35) *Zhangsan zuo zai zhuozi de zuo-bian. Peng zuo zai (zhuozi de) you-bian.*
 Zhangsan sit at table POSS left-side Peng sit at (table POSS) right-side
 ‘Zhangsan sits in front of the table. Peng sits to the right (the table).’
- (36) *Zhangsan zuo zai zhuozi de zuo-mian.??Peng zuo zai (zhuozi) you.*
 Zhangsan sit be_at table POSS left-side Peng sit be_at (table) right
 ‘Zhangsan sits to the left side of the table. Peng sits to the right (the table).’

These and the referential patterns in (29-31) strongly suggest that compound localisers display grammatical properties that simple localisers lack. Within PPs, they seem to determine the status of a ground NP as a given constituent, in a sense guiding the formation of anaphoric relations in discourse. Simple localisers lack this property, instead. Given the conclusions drawn in the previous section, we can also conclude that a strong parallelism condition arises between anaphor and antecedent PPs (cf. Merchant 2004; Boone 2014: ch. 2). When compound localisers become remnants, they do so in virtue of being distinct NP phrases within a *de*-P, in turn part of a PP. The elided material is the rest of the complex (ground) NP, whose identity can be reconstructed from the previous discourse. A simple localiser may involve identity of the ground NP, but elision would still lead to an affix-like item occurring without its host NP (cf. again (36)). Thus, localisers’ grammatical properties percolate at a discourse level, and seem to determine their anaphoric properties as well.

Crucially, these properties are also attested when discourse-bound *ba*-, *bei*- and *kanqilai*-structures are involved. We show how this is the case via (37-42):

- (37) *Haizi-men ba fangzi wai nong-de hen hao-kan.*
 child-PL BA home out make-DE very good-look
Danshi tamen ba li-mian nong-de hen luan.
 but they BA in-side make-DE very messy
 ‘The children made the house exterior beautiful. However, they made the (house) interior messy.’

- (38) *Haizi-men ba fangzi qian-bian nong-de hen hao-kan.*
 child-PL BA home front-side make-DE very good-look
Danshi tamen ba (fangzi de) hou-bian/??hou nong-de hen luan.
 but they BA (house POSS) back-side/back make-DE very messy
 ‘The children made the front side of the house beautiful. However, they made the (house) back side messy.’
- (39) *Fangzi li-mian bei haizi-men nong-de luanqibazao.*
 house in-side BEI child-PL make-DE messy
(Fangzi de) wai-bian que bei tamen nong de hen piaoliang.
 (house POSS) out-side but BEI tamen make-DE very beautiful
 ‘The house interior was made beautiful by the children. The (house) exterior was made messy by them.’
- (40) *Fangzi nei-bu bei haizi-men nong-de luanqibazao.*
 house inside-part BEI child-PL make-DE messy
Danshi bei (fangzi de) wai-bu/??wai nong-de hen piaoliang.
 but BEI (house POSS) out-part/out make-DE very beautiful
 ‘The inner part of the house was made beautiful by the children. But the exterior (of the house) was made messy.’
- (41) *Fangzi li kanqilai hen piaoliang.*
 house in seem very beautiful
*(Fangzi de) wai-mian/??/*wai kanqilai que hen luan.*
 (house POSS) out-side/out seem but very messy
 ‘The house interior looks very beautiful. The (house) exterior looks messy.’
- (42) *Fangzi de li-mian kanqilai hen piaoliang.*
 house DE in-side seem very beautiful
*(Fangzi de) wai-mian/??/*wai kanqilai que hen luan.*
 (house POSS) out-side/out seem but very messy
 ‘The interior side of the house looks very beautiful. The (house) exterior looks messy.’

In discourse contexts, ground NPs and localisers can become arguments of preposition *ba* and undergo ellipsis, when a compound localiser can become a remnant. If a simple localiser acts as the remnant, then a discourse becomes highly deviant (cf. (37-38), with (38) triggering ‘acceptable’ answers in N = 4 participants). The same pattern holds for *bei*-structures. Complex NPs including compound localisers can be promoted to agent NPs and undergo ellipsis, whereas simple localisers render discourses deviant, once more (cf. (39-40): ‘acceptable’ answers for (40) were N = 3, ‘tolerable’ answers N = 2). The same reasoning holds for complex NPs becoming subjects of *kanqilai* sentences forming discourses (cf. (41-42): ‘acceptable’ answers for both examples, N = 3). Overall, ellipsis of the NP referring to the landmark object, regardless of its thematic role, becomes possible in discourse contexts when this NP is part of a complex NP including a compound localiser and a *de* head.

Let us take stock. Our discussion shows that both localiser types must be considered constituting parts of PPs, and form complex NPs with the ground NP. However, simple localisers act as affix-like, adnominal elements: NPs attaching to the ground NP (cf. Huang *et al.* 2017; Zhang 2017). Compound localisers emerge via suffixation of simple localisers and become full-fledged NPs. They thus become the only possible remnants in ground NP ellipsis contexts, irrespective of the localiser attested in a matching anaphoric PP. As this fact holds in a variety of structures involving PPs, it confirms that either type of localiser is part of PPs. Specifically, simple localisers form Loc(aliser)Ps that block ground NP ellipsis within and outside PPs. Compound localisers are part of *de*-Ps that, however, display the properties of ‘larger’ LocPs, although they license ellipsis. We can therefore conclude that the nature of these distinct LocPs determines ground NP ellipsis patterns in sentences and discourses.⁹

We thus have reached our first goal: offering a broad overview of ground NP ellipsis data in relation to the properties of localisers. We have shown that these properties hold irrespective of the status of *zai* and other related items as either prepositions or co-verbs. We also have shown that these properties hold in a variety of sentential contexts (e.g. BLCs, *ba*- and *bei*-structures). Our data therefore show that grammatical properties of localiser types may be distinct for each type, but determine the grammaticality of sentences, and the cohesiveness of discourses, i.e. acceptability of sentential structures. Our data also show that previous accounts leaving compound localisers and discourse data aside may not be in a position to offer a full-fledged account of PPs and their categories. We address our second goal, offering a unified formal account of these properties, in the next section.

4. *The formal proposal*

4.1. *Type Logical Syntax: basic derivational assumptions*

The goal of this section is to present our account, based on Type Logical Syntax (TLS) as a derivational system (Moortgat 2010, 2011; Morrill 2011; Barker & Shan 2014; Ursini 2015; Ursini & Giannella 2016; Kubota & Levine 2020). Our central concern is to capture how the distributional properties of localisers and prepositions at a phrasal and sentential level determine anaphoric relations and the licensing of ground NP ellipsis. TLS permits us to address these matters in a systematic manner, for it offers us a rigorous derivational system that can model how formal features percolate at a discourse level. Other

formal approaches to this effect are certainly possible (e.g. Minimalist Grammars: Stabler 1997; Kobele 2012; Collins & Stabler 2016; Combinatorial Categorical Grammars: Steedman 2000, 2012; Kubota 2010; a.o.). However, they would require a certain elaboration of discourse mechanisms that TLS readily offers us (cf. Jäger 2001, 2005). Let us note that we temporarily abstract away from important questions of grammar (and discourse) architecture, leaving them for the discussion in section 5. Our current purpose is thus to show that a unified derivational account is possible and necessary to capture all the data.

In TLS, morpho-syntactic categories are mapped or assigned onto types, represented as being ‘complete’ or ‘incomplete’ information units. Complete types represent derivational units that can stand as independent constituents (e.g. NP for noun phrases as *the girl*). Incomplete types are units that must combine with other units to form a complete type. For instance, an intransitive verb such as *runs* can be assigned type NP\S, since it can combine with an NP item, *the girl*, to form a sentence of type S: *the girl runs*. We use the convention of calling NP, in the type NP\S and the standalone type NP, as the input types. We then call the resulting types output types (e.g. S, once verb and name combine). The types we need to account our data involve a certain degree of language-specific considerations. However, we address these considerations in section 4.2.

Let us now discuss the connectives that allow us to define complex types. 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 an associative, non-commutative operation: A·B is made of the ordered pair A and B. Our rules of type composition are defined in (53):

- (43)
- | | |
|---|----------------------------------|
| 1. Given a Lexicon L , $\{NP, VP\} \in L$ | (Basic type(s)) |
| 2. If x is a type and y is a type, then x/y is a type | (Type formation: division) |
| 3. If x is a type and y is a type, then $x \cdot y$ is a type | (Type formation: product) |
| 4. If x/y is a type and y is a type, then $(x/y) \cdot y \rightarrow x$; $y \cdot (x/y) \rightarrow x$ | (Function application) |
| 5. If a/b is a type and b/c is a type, then $a/b \cdot b/c \rightarrow a/c$ | (Function application: cut rule) |
| 6. Nothing else is a type | (Closure rule) |

Rule 1 introduces NP and VP as basic types. Our data show that ground NPs, simple and complex localisers as NPs and full sentences (BLCs) are key constituents. Prepositions or verbs mostly occur as the key predicates heading these constructions. For this reason, we take that sentences can be treated as ‘bare-bones’ VPs, a fact we represent via the VP type. For the analysis of our data, this perhaps simplified

view of types suffices, as we show in section 4.3. In section 5, we discuss how one can reconstruct the categories proposed in previous accounts, and what important theoretical insights this process of reconstruction can offer us. Instead, rules 2 and 3 define how more complex types are formed. While rule 2 allows the definition of the ‘functional’ (or division) types, rule 3 allows the definition of product types. Functional types represent the fact that a constituent must combine with another constituent to form a full phrase. Product types represent the fact that a constituent may be related (‘paired’) with other constituents, in the opportune context.

Rules 4 and 5 define how morphemes, phrases, sentences are combined. Rule 4 is known as forward application (Moortgat 2011: §2.1; Morryll 2011: ch. 1). Two matching types (e.g. x and x) are ‘cancelled out’, but if they do not match, a derivation is said to diverge or crash.¹⁰ The rule represents a TLS version of the merge operation in generative frameworks (e.g. Chesi 2007, 2012, 2015; den Dikken 2018: ch. 2; and references therein), as a ternary relation $Rxyz$ between two inputs x and y (head and argument) and output z (the resulting phrase).

In this TLS system, forward application operates in a ‘distributed’ manner: the product (‘ \cdot ’) of two possibly complex (i.e. division: ‘ $/$ ’) types proves the existence of a larger constituent, a result that we represent via the ‘ \vdash ’ (turn-style) connector (cf. also the system outlined in Kobele 2012). Rule 5 is known as the cut rule, and permits us to combine complex types with adjacent and matching types. It says that, if two functional types share one input and output type, they can be composed to form a complex functional type. Rule 6 says that no other rules are needed to account our data, although increasingly complex fragments of TLS may be used to cover other data and languages. Via these assumptions, we can generate the minimal type set $TYPE = \{t, t/t, t/t/t, tt, \dots\}$. Larger but finite type sets may be recursively defined, since our theory models heads which can only take up to two arguments (cf. Morryll 2011: ch. 1). However, these type templates will suffice, as we show next.

Finally, we capture the cyclicity of our derivations by introducing a pre-order as the pair of an interval set I , and an addition operation ‘ $+$ ’, i.e. $\langle I, + \rangle$. This pre-order represents an index set, which allows us to represent the sequential steps in a derivation. We use two operations, Lexical Selection (LS) and Forward Application (FA) to label the introduction of a new unit in a derivation and the combining of two units, respectively. Consider (44), a sample derivation in which we only use lexical and functional types based on the universal type t :

- (44) a. *Zhangsan loves Chun-Li*
 b. t. [*Zhangsan*_t] (LS)
 t+1. [*loves*_{v/t}] (LS)
 t+2. [*Zhangsan*_t]-[*loves*_{v/t}]-[[*Zhangsan*_t] *loves*_{v/t}]_{v/t} (FA)
 t+3. [*Chun-Li*_t] (LS)
 t+4. [[*Zhangsan*_t] *loves*_{v/t}]_{v/t}-[*Chun-Li*_t]-[[*Zhangsan*_t] *loves*_{v/t} [*Chun-Li*_t]]_t (FA)

In this derivation, the NP *Zhangsan* is combined with the transitive verb *loves*. Since the first element is assigned type *t* and the second type *t/t/t*, the combination of these elements, *Zhangsan loves*, is assigned type *t/t*, because of this derivational process. The further addition of *Chun-Li* via forward application allows the sentence *Zhangsan loves Chun-Li* to be formed, an object of type *t*, and a ‘skeletal’ VP. As it should be obvious, our derivations proceed in a top-down fashion. This approach is consistent with psychologically oriented analyses of sentence production and processing (Levelt 1989; Phillips 2006; Jarema & Libben 2007; Chesi 2007, 2012, 2015; den Dikken 2018). It also captures the intuition that the ‘flow’ of discourse involves the derivation of a sentence that can then as the context against which a second, third... sentence can be further derived. The precise implications of this assumption, however, are fully discussed in the next section.

4.2. *The account: type assignment and valence*

Our TLS account of Mandarin spatial categories can be defined as follows. For each category, we explain why we associate a vocabulary item with a type by analysing its valence. Consider our data. We have proof that ground NPs and localisers are part of a broader, nominal category. They are therefore sub-types of NPs, possibly defined via the (abstract) morphological features that they contribute to sentences. A tool to represent this fact lies in the use of features as indexes, to represent sub-types (cf. Carpenter 1992; Johnson & Bayer 1995; Heylen 1999).¹¹ If NP is a type of an NP, then NP_{*f*} is the sub-type of an NP carrying feature(s) *f* (e.g. number, person and so on). We use the feature index *l*, then, to represent the fact that a localiser phrase (a LocP, e.g. *zhuozi shang*) is a different type of NP from a ground phrase (here, *zhuozi*). The precise import of using this feature will become clear as we tackle the data. Before we do so, we must fully spell out our type assignment.

First, we assume that figure and ground NPs are assigned type NP: they are treated as bare phrases. Recall from section 2 that only place names can act as arguments of prepositions without first combining with localisers, and that other ground NPs must combine with a localiser, first. Thus, *Beijing* (or *Beijing-er*, in some dialects) and *zhuozi shang* ‘on

the table' correspond to the same (ad)nominal constituent type, a LocP (e.g. Chappell & Peyraube 2008). In our system, this entails that a localiser is a function type, taking an NP type as an input and returning an NP₁ type as an output (i.e. we have NP/NP₁). Ground NP and localiser may form a single stress unit, with the localiser acting as a clitic-like element (e.g. Zhang 2017; Ursini *et al.* 2020). Thus, the forward application output of ground NP and localiser, a LocP, can be treated as a single item of type NP₁ in derivations (e.g. *zhuozi-shang*_{NP(1)}).

Second, we assume that compound localisers involve different type assignments for their constituting elements. If *qian* and *mian* merge to form *qian-mian* 'front-side', with *-mian* acting as a suffix, then *qian* must act as a full NP. Thus, we assign type NP₁ to *qian* and NP₁/NP₁ to *-mian*. This assignment captures the fact that simple localisers change their valence when part of compound localisers. We thus have NP₁ as the output type of compound localisers, whereas we assign type NP (i.e. the 'general' type) to ground NPs. A ground NP may introduce a ground as a reference object, but localisers have the key function of restricting reference to location, whence the names. The use of distinct features for ground NPs and localisers thus reflects this fact. *De* can only combine with compound localisers because it requires NP₁ for the type of one of its arguments. Simple localisers, instead, carry the type NP₁/NP. The full-fledged set of consequences that this assumption entails is presented in the next section, however.

Third, we assume that either prepositions can be co-verbs (type VP/NP₁/NP) or 'proper' prepositions (type NP·VP/NP₁). Via the first type assignment, we capture the basic fact that a preposition such as *zai* can combine with a figure NP (e.g. *Zhangsan*) and a place name as a ground NP (e.g. *Beijing*) to form a VP as a minimal clause. Via the second type assignment, we capture the fact that *zai* acts as a head introducing a ground NP, but it lacks a 'slot' for the figure NP when in the presence of a lexical verb.

The product type NP·VP indirectly represents the fact that a preposition only needs to introduce a ground NP when the figure NP has been already combined with a verb. Thus, a preposition has the more restricted role of introducing a ground NP *qua* the oblique argument of a lexical verb. Hence, the prepositional distribution of these items is akin to 1-place heads, and their co-verb distribution to that of 2-place heads (e.g. verbs), whence their 'co-verb' label (e.g. Li & Thompson 1981). We can therefore observe that the flexibility of scope and valence of prepositions and localisers is captured by offering different but related type assignments associated to these items (cf. also Barker & Shan 2014: ch. 13).

The fourth assumption involves the role of *de* in *de*-Ps. Since this head can occur in structures and syntactic contexts beyond spatial nouns (e.g. verb structures), a certain degree of heterogeneity in its analyses is found in the literature. For instance, Zhang (1999, 2012) treat *de* as a type of classifier (i.e. ‘Cl’) head, taking two NPs as its possible arguments (e.g. *zhuozi* ‘table’ and *hou-mian* ‘back side’ in (4)). Instead, Cheng & Sybesma (2012); Djamouri *et al.* (2013); among others, suggest that it projects a distinct ‘*de*’ head, although it takes two arguments. In some works, this head is treated as a particle taking only one nominal element (i.e. a classifier: Li 2011: ch. 4; Li & Rothstein 2012). In the case of verbal structures, *de* acts as a head marking the predicative (i.e. transitive) use of a given verb, as the glosses also show (e.g. *nong-de* in (37-42)).

Since we only focus on PPs, we assume that *de* acts as a relational element and thus a 2-place head. The corresponding phrase, which we take to be a partitive-like NP, can become the argument of a preposition. Given its role in PPs, we assign the type $NP_1/NP_1/NP$ to this vocabulary item. *De* captures a relation between a ground and a location defined with respect to this ground by marking the location as ‘part of’ the ground’s space. In a sense, it involves a form of syncretism between locative and possessive relations (cf. Stassen 2013: ch. 4; for discussion). A phrase headed by *de* results into a complex NP also carrying locative information, as the we indirectly show by assigning it the *l* type. Even if not a ‘pure’ LocP, it shares with LocPs the type and ability to introduce reference to locations.

Note here that its type also represents the fact that a ground NP combines with *de* first, and then the resulting partial constituent (e.g. *zhouzi de*) combines with a compound localiser (e.g. *shang-mian*). The resulting *de*-P, in this context, acts as a LocP complement of a preposition. For its presence in verbal complexes, we assume that *de* contributes to a change in valence in verbs. To simplify matters, we offer a formal treatment of *de* as a distinct head in LocPs but consider it part of the verb *nong* in the other cases under discussion.¹²

We are now in a position to offer a compact type assignment to our vocabulary items. The types occurring in our derivations are in (45-46):

- (45) a. $NP=\{zhuozi, Zhangsan, chezi, \dots\}$; $NP_i=\{qian, qian-mian, Beijing, fangzi-li, \dots\}$
 b. $NP_1/NP=\{-li, qian, shang, \dots\}$; $NP_1/NP_i=\{-mian, -bian, -tou, -bu, -fang, \dots\}$
 c. $NP_1/NP_1/NP=\{de\}$; $NP_p/NP_1/NP=\{ba, bei\}$;
 (46) $VP/NP/NP=\{zuo, nong-de, kangqilai\}$; $VP_1/NP/NP=\{zai, dao, \dots\}$;

In (45a) and from left to right, the set of types includes NPs and compound localisers, and the set of items having the distribution of LocPs. These are simple localisers as arguments of suffixes (e.g. *qian*),

place names (e.g. *Beijing*), and suffixed ground NPs (e.g. *fangzi-li*). This type assignment shows that figure and ground NPs can be treated as NPs lacking specific features, in contrast to the sub-type *l* assigned to other ‘spatial’ NPs. The type assignment in (45b) shows that simple localisers act as suffixes of ground NPs to form a LocP (e.g. *-li*), and so do nouns acting as suffixes in compound localisers (e.g. *-mian*).

The type assignment in (45c) shows that *de* acts as a head taking two NPs, a compound localiser and a ground NP, to form a complex, partitive-like NP introducing ground a related location. The sub-type *l* on the output types marks its ‘spatial’ role. *Ba* and *bei*, *qua* non-spatial relational elements like *de*, carry a different type: NP_p/NP₁/NP. They form pairings of NPs that receive related roles within a larger sentence: figure and theme/ground when *ba* is involved, theme/ground and agent when *bei* is involved. This assignment captures the assumption in the literature that these elements introduce arguments and their relations (e.g. Kit 1992, 1993; Huang *et al.* 2009). It differs from previous proposals in treating them as 2-place heads, like prepositions/co-verbs, but highlighting their role in the formation of complex NP-like phrases, a fact we capture via the output NP_p.

The type assignment in (46) shows that *zai* and other prepositions can receive two distinct but related type assignments, and so can localisers. *Zai* can thus combine with two NPs to form a BLC (i.e. a ‘skeletal’ VP), when it acts as a co-verb. It differs from *zuo* and other verbs in its spatial nature, a fact we represent via the sub-type/feature *l* on the output type VP. By this point, it becomes clear that prepositions and localisers display a form of constrained polymorphism. Their exact type/category is context-sensitive, but the attested types co-vary, and mirror how these items can change their valence in context. 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; Barker & Shan 2014: 135-137). The 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 article in (47):

(47) *Residual rule: a/b/c-a/b/c, a/b-a/b;*

In words, the residual rule says that an affix-like unit (i.e. a 1-place head) can become a relational (i.e. 2-place) head and a phrasal item can become an affix, respectively. As an example for the first rule, we have e.g. *zai*, a preposition, to become a co-verb. As an example for the second rule, we have localisers as arguments of suffixes (e.g. *qian* in *qian-mian*) to become affix-like clitics to ground NP (e.g. *zhuozi-*

shang), respectively. Hence, the changes in valence that we observe for prepositions and localisers can be captured in a simple but principled way. Overall, the type assignment we propose can already capture two aspects that fall beyond the explanatory range of previous proposals. First, it captures the categorial flexibility of prepositions and localisers in a principled manner via the residual rule. Other proposals mostly ignore this flexibility (e.g. Djamouri *et al.* 2013; Zhang 2017). Second, it paves the way for a derivational treatment of these categories that can determine which BLCs and discourses are well-formed. This second point is fully presented in the next section.

4.3. The analysis of the data

We start by discussing how the structures of toponyms and ground NP become LocPs. For the sake of readability, we use brackets to represent sub-types in the derivations: for instance, NP(*l*) stands for NP_{*l*}. Consider (48-50), based on examples (4-5):

- (48) t. [*zhuozi*]_{NP} (LS)
 t + 1. [*hou*]_{NP(*l*)/NP} (LS)
 t + 2. [*zhuozi*]_{NP}' [*hou*]_{NP(*l*)/NP} ⊢ [[*zhuozi*]_{NP} -*hou*]_{NP(*l*)} (FA)
- (49) t. [*hou*]_{NP(*l*)} (LS)
 t + 1. [-*mian*]_{NP/NP(*l*)} (LS)
 t + 2. [*hou*]_{NP(*l*)}' [-*mian*]_{NP/NP(*l*)} ⊢ [[*hou*]_{NP(*l*)} -*mian*]_{NP} (FA)
- (50) a. t. [*zhuozi*]_{NP} (LS)
 t + 1. [*de*]_{NP(*l*)/NP(*l*)/NP} (LS)
 t + 2. [*zhuozi*]_{NP}' [*de*]_{NP(*l*)/NP(*l*)/NP} ⊢ [[*zhuozi*]_{NP} *de*]_{NP(*l*)/NP(*l*)} (FA)
 t + 3. [[*hou*]_{NP(*l*)} -*mian*]_{NP} (LS)
 t + 4. [[*zhuozi*]_{NP} *de*]_{NP(*l*)/NP(*l*)}' [[*hou*]_{NP(*l*)} -*mian*]_{NP(*l*)} ⊢
 [[*zhuozi*]_{NP} *de* [[*hou*]_{NP(*l*)} -*mian*]_{NP(*l*)}]_{NP(*l*)} (FA)
 b. t + 4. [[*zhuozi*]_{NP} *de*]_{NP(*l*)/NP(*l*)}' [[*hou*]_{NP(*l*)/NP(*l*)} ⊢* (FA, derivation crashes)

As (48) shows, a LocP involves the combination of a ground NP with a localiser having the type of spatial suffixes (i.e. NP_{*l*}/NP). Since the ground NP's type and the input (i.e. right side) type of the localiser match, the output type of a LocP is NP_{*l*}. These phrases are nominal in nature, but carry features determining their spatial sense: they refer to locations (Huang *et al.* 2009; Lin 2013). As (49) shows, when *hou* acts as an argument/phrase, it can combine with a suffix (here, -*mian*) to form the compound localiser *hou-mian*. The use of different sub-types (i.e. NP_{*l*}) captures the fact that only compound localisers can merge with *de* in *de*-phrases. The arguments of *de*-phrases must be a ground NP and

a sub-type of NPs, so phrases that do not contribute the relevant input type cause diverging (or ‘crashing’) derivations.

Before we continue, it is worth noting that *hou* carries a different type as a suffix and as a phrase, and the argument of suffix *-mian* (i.e. NP₁/NP vs NP·NP₁, simplified to NP in the derivations). However, these types are related via the residual rule (right type). In this case, the residual rule tells us that if *hou* can act as the complement NP of a suffix, it can also become the suffix of another NP. The residual rule can thus predict the distribution of localisers in their distinct contexts. It predicts their dual nature as NPs carrying ‘location’ features/sub-types, or as nominal affixes selecting certain arguments.

In (50a), the ground NP first combines with *de* (steps *t* to *t* + 2), and then with the compound localiser *qian-mian* (steps *t* + 3, *t* + 4). Since *de* requires this NP sub-type, the derivation converges. In (50b), the derivation crashes because *qian* carries a non-matching sub-type (i.e. NP₁), hence it cannot combine with *de*. Thus, our account treats simple and compound localisers as members of the same type, NP. However, it also shows that simple localisers carry the sub-type *l*, unlike compound localisers (cf. Huang *et al.* 2017; for a similar point). From this basic fact, it (type-)logically follows that their distribution in prepositional and *de*-phrases is similar but not identical, as the data show. It also follows that ground NPs and simple localisers, compound localisers and *de*-Ps all form LocPs via slightly different derivations, and can thus be different types of (spatial) complements of prepositions. Via our type assignment and derivational system, we can now offer a principled explanation for grammatical and ungrammatical sentences, as the remainder of the section shows.

We can now move to the derivation of full sentences/BLCs. We take (3) and (1) as our reference examples and offer their derivations in (51–52). When possible, we skip steps or compress constituents to maintain our derivations more readable and compact:

- (51) *t*. [*Peng*]_{NP} (LS)
t + 1. [*zai*]_{VP(I)/NP(I)/NP} (LS)
t + 2. [*Peng*]_{NP} [*zai*]_{VP(I)/NP(I)/NP} ⊢ [[*Peng*]_{NP} *zai*]_{NP(I)/NP(I)} (FA)
t + 3. [*Guangzhou*]_{NP(I)} (LS)
t + 4. [[*Peng*]_{NP} *zai*]_{VP(I)/NP(I)} ⊢ [*Guangzhou*]_{NP(I)} ⊢ [[*Peng*]_{NP} [*zai* [*Guangzhou*]_{NP(I)}]]_{VP(I)} (FA)
- (52) *t*. [*Peng*]_{NP} (LS)
t + 1. [*zuo*]_{VP/NP/NP} (LS)
t + 2. [*Peng*]_{NP} [*zuo*]_{VP/NP/NP} ⊢ [[*Peng*]_{NP} *zuo*]_{VP/NP} (FA)
t + 3. [*zai*]_{VP'NP/NP(I)} (LS)
t + 4. [[[*Peng*]_{NP} *zuo*]_{VP/NP} [*zai*]_{VP'NP/NP(I)} ⊢
[[*Peng*]_{NP} *zuo* [*zai*]]_{VP'VP/NP(I)} (FA: cut rule)

$t + 5$. [*zhuozi qian*]_{NP(i)} (LS)

$t + 6$. [[*Peng*]_{NP} *zuo* [*zai*]]_{VP·VP/NP(i)}·[*zhuozi-qian*]_{NP(i)}⁻
 [[*Peng*]_{NP} [*zuo* [*zai* [*zhuozi-qian*]_{NP(i)}]]]]_{VP·VP} (FA)

As (51) shows, when *zai* is a co-verb (i.e. it is assigned type $VP_1/NP_1/NP$), it combines with a figure and ground NP to form a skeletal VP. Furthermore, *Beijing* can be assigned the NP_1 type of LocPs, thereby combining with *zai* as an apparently ‘bare’ ground NP. We capture Huang *et al.* (2009) and other works’ assumption that place names involve a silent form of categorial derivation (cf. Xu 2008b; Huang 2009). Although they do not necessarily combine with simple localisers, they can act as LocPs, i.e. ‘bare’ complements of prepositions.

In (52) the figure NP and the lexical verb *zuo* ‘sit’ combine to form a preliminary constituent of type VP/NP : a head that requires a second argument NP to form a full VP (steps t to $t + 2$). Subsequently, when the preposition *zai* merges with the temporary constituent *Zhangsan zuo*, the cut rule establishes that they form a complex verbal structure. *Zai* thus introduces the LocP and its ground NP argument (steps $t + 3$, $t + 4$). The derivation converges once the phrase *zhuozi qian* combines with the rest of the sentence (steps $t + 5$, $t + 6$).¹³

In this context, *zai* is assigned the type $VP·NP/NP_1$ of 1-place heads. That is, *zai* acts as a head requiring that the argument of the verb *zuo* be a ground NP. The product type $VP·NP$ represents this selectional restriction, since it ‘demotes’ the VP type to a feature of the output type. The residual rule confirms that the types assigned to *zai* as a co-verb and as a preposition are related. From $VP·NP/NP_1$, we can prove the type $VP/NP/NP_1$, a fact that can be interpreted as follows. Since *zai* and other prepositions act as ‘argument selectors’ in the presence of a lexical verb, they can be promoted to co-verbs when a verb is absent. Conversely, if a verb precedes them, they just mediate the introduction of a ground NP. Note, also, that the cut rule combines the output types of *zai* and *zuo* into a single, complex output type (i.e. we have $VP·VP$). This type represents the fact that sentence involves a clause formed by compressing two possible ‘smaller’ clauses into a single structure, since *zai* and *zuo* can be verbs.¹⁴

We can now extend the analysis of *de*-Ps to sentential structures, thus showing how the presence of an ill formed *de*-P leads to ungrammaticality. From this point onwards we drop the sub-type *l* on prepositions, to increase readability. Consider (53-54), based on (5-6):

(53) $t + 6$. [[*Zangsan*]_{NP} *zai* [[*zhuozi*]_{NP} *de* [[*qian*]_{NP(i)} *-mian*]_{NP}]_{NP(i)}]_{VP} (FA)

(54) $t + 6$. [[*Zangsan*]_{NP} *zai* [[*zhuozi*]_{NP} *de*]_{NP(i)/NP}·[*hou*]_{NP(i)}⁻* (FA: derivation crashes)

As these (compressed) derivations show, a well-formed PP (e.g. *zai zhuzi de qian-mian*) can combine with a verb, and the resulting element and a figure NP, so that a well-formed VP is obtained. If this is not the case, cf. *zai zhuzi de hou* in (54), then the corresponding derivation crashes. Since only compound localisers can merge with *de*, a (BLC-type) sentence containing an ill-formed *de*-phrase will also become ungrammatical.

Via this result, we can offer an account of the other intra-sentential data. We assume that *ba* and *bei* can take a VP and a ‘complex’ NP introducing the landmark referent as their arguments (cf. again Kit 1992; Huang *et al.* 2009). We thus assume that these non-spatial prepositions also act as co-verbs in these structures. Instead, for *kangqilai*-structures we simply assume that this verb introduces a predicative structure. For simplicity, we treat adjectival phrases such as *hen renao* and *luanqibazao* as NP-type phrases, and thus *nong-de* and *kangqilai* as transitive verbs, of type VP/NP/NP. Consider the compressed derivations in (55-60):

- (55) $t+k. [[[[Haizi-men]_{NP} [ba [fangzi-wai]_{NP(p)}]]_{NP(p)} [nong-de [hen hao-kan]_{NP}]]_{VP}$ (FA)
- (56) $t+k. [[[[Haizi-men]_{NP} [ba [[fangzi]_{NP} [de [zuo-bian]]_{NP(i)}]]]_{NP(p)} [nong-de [hen hao-kan]]]_{VP}$ (FA)
- (57) $t+k. [[[[fangzi-nei]_{NP(i)} [bei [haizi-men]]_{NP(p)} [nong-de [luanqibazao]_{NP}]]_{VP}$ (FA)
- (58) $t+k. [[[[fangzi]_{NP} [de [nei-bu]_{NP(i)}]]_{NP(i)} [bei [haizi-men]]_{NP(p)} [nong-de [luanqi]_{NP}]]_{VP}$ (FA)
- (59) $t+k. [[[fangzi-hou]_{NP(i)} [kangqilai [hen renao]_{NP}]]_{VP}$ (FA)
- (60) $t+k. [[[fangzi]_{NP} [de [li-bian]]_{NP(i)} [kangqilai [hen renao]_{NP}]]_{VP}$ (FA)

The derivations involve *ba* as a vocabulary item of type $VP_p/VP/NP$. The feature *p* marks their status as a distinct, non-spatial sub-type of co-verbs/prepositions (cf. again Huang *et al.* 2009). LocPs *fangzi-wai* and *fangzi de zuo-bian* in (55-56) (based on (19-20)) combine with *ba* as NPs introducing the ‘object’ undergoing a certain change (i.e. being made very beautiful by the children). In (57-58), based on (23-24), *bei* signals that the order of theme and agent is inverted, as befits passive voice forms. Thus, the LocPs are combined with *bei* before the agent NP *haizi-men* ‘(the) children’.

Both *ba* and *bei* ultimately form a phrase that becomes the (complex) argument of the transitive verb *nong-de* ‘make’, of type VP/NP/NP. In this case, it would be more appropriate to talk about di-transitive verbs, for *nong-de* takes an ordered pair of argument NPs as its ‘complex’ argument. For instance, in (55) we have *haizi-men ba fangzi-wai* (lit. ‘the children [the house exterior]-BA’). This corresponds to the pairing of agent NP and location, with the agent making the location beautiful (cf. Huang *et al.* 2009). What matters for our account is that LocPs can

be one of these arguments, as the derivations show. The fact that LocPs can combine also with *kanqilai* ‘seem’ without any further assumptions confirms our account of this category as a distinct unit. It confirms this fact irrespective of the presence of simple or compound classifiers in its structure (cf. (59-60), based on (26-27)).

The upshot of this analysis is that we offer a formal proof of the distributional equivalence between simple and compound localisers in their contribution to BLCs, *ba-*, *bei-* and *kanqilai*-structures. Once we assume that both localiser types are NP sub-types, their occurrence licenses the derivation of well-formed sentences in all the relevant constructions. Thus, our account offers a fully derivational argument for the analysis of both localiser types as being an integral part of Mandarin PPs. Their status as NP types rather than postpositions is a matter we discuss in the next section, once we offer an account of the ellipsis data.

We are now ready to tackle the ground NP ellipsis data. We start by spelling out our assumptions on the derivation of discourse structures. We follow Jäger’s (2001: 84-86; 2005: ch. 5) and Barker & Shan’s (2014: ch. 13) treatments of discourse in TLS. We do not employ a special type for sentences as part of discourses (e.g. Jäger 2001; 2005’s type *d*), but simply use the type VP as the output type of sentences. Since forward application is only constrained in combining constituents of matching type, it can potentially combine sentences, i.e. constituents of type VP, into larger constituents also of type VP. ‘Discourses’, then, are simply the recursive combinations of sentences into larger hierarchical structures.

From this simple assumption, we can also offer an account of anaphoric relations licensing ground NP ellipsis. Although we cannot possibly offer an overview of all ellipsis theories at our disposal, it is fair to say that at least two types of approaches are attested. In standard generative-transformational works, ellipsis is conceived as the presence of unpronounced structure. Elided constituents are not spelt out because they are ‘given’ in discourse, but they are nevertheless part of a sentence. The remaining pronounced material is moved to an argument position-related information structure (cf. Merchant 2001, 2004; Reuland 2011; Boone 2014). In HPSG, type-logical and other categorial frameworks, ellipsis is conceived as the omission of structure, possibly involving structural ‘reference’ to the type of missing constituents or fragments (Ginzburg & Sag 2000; Jäger 2005; Kobele 2012; Sag *et al.* 2012). In either account, missing or silent structure depends on pronounced structure for its identification: elided constituents are ‘copies’ of previously spelt-out items.

Our account takes a categorial view, but with some provisos. First, we assume that ellipsis corresponds to an ‘elimination’ operation (cf. Kobele 2012’s ‘delete’ operation). If FA permits us to combine basic units into

larger units (i.e. phrases and sentences) and LS to introduce new items in derivations, then ellipsis permits us to remove items. TLS includes a rich array of elimination operations, in line with its roots into formal proof systems (cf. Jäger 2005: ch. 2; Moortgat 2010, 2011; Morryll 2011: ch. 2). Here we offer a perhaps simplified view of ellipsis as the ‘inverse’ operation of LS. We thus consider ellipsis an operation that removes constituents from derivations, turning them into ‘silent’ material. In so doing, it must preserve structure: it cannot create constituents with different types. That is, elimination of a constituent from the final phonological output cannot result into a type change, e.g. from VP to VP/NP. We mark ellipsis via round brackets, e.g. ([*zhuozi*]_{NP}) is an elided ground NP.

According to this view, then, ellipsis does not simply target a vocabulary item but also its assigned type.¹⁵ Ground NP ellipsis thus removes this NP and its type NP. Since previous discourse introduces information about a ground NP, this repetition becomes unnecessary. The omission of the ground NP results into the combination of a ‘bare’ localiser with a preposition as ‘adjacent’ constituents in the derivation. If a simple localiser of type NP/NP₁ combines with a partial constituent as a result, then the ‘surviving’ structure is formed via a verb and a figure NP, of type VP/NP. The cut rule can form a constituent of type VP/NP₁. However, such a constituent would not be a fully formed sentence: the derivation therefore crashes (i.e. it does not converge to the expected type: cf. (61), from (6)). If a partial constituent (of type VP/NP) combines with a compound localiser, of type NP, then a full sentence (VP) can be derived. The derivation therefore converges (cf. (62), from (31)):

- (61) t. [[*Peng*]_{NP} *zai* [[*zhuozi*]_{NP}-*hou*]_{NP(0)}]_{VP}-[[*Peng*]_{NP} *zai* [[(*zhuozi*]_{NP}) *hou*]_{NP(0)}]_{VP} (Ellipsis)
 t + 1. [[*Peng*]_{NP} *zai* [(*zhuozi*]_{NP}) *hou*]]_{VP/NP(0)} †* (TPI: derivation crashes)
- (62) t. [[*Peng*]_{NP} *zai* ([*zhuozi*]_{NP} [*de* [*hou-mian*]]]_{NP(0)}]_{VP}-
 [[*Peng*]_{NP} *zai* ([*zhuozi*]_{NP} [*de*] [*hou-mian*]_{NP(0)}]_{VP} (Ellipsis)

In (61), the ellipsis of the ground NP causes the remnant simple localiser and the preposition to form an ill-defined constituent and type. In (62), this operation preserves structure: a compound localiser acts as an equally acceptable complement for a preposition (i.e. it is of type NP). Ellipsis is thus licensed only in referential contexts involving compound localisers because the ‘surviving’ structure is of the same type of the non-elided structure.

We can now tackle anaphoric relations. We must define how constituents across sentences can enter anaphoric relations. One possibly uncontroversial assumption that we follow is that phrases entering anaphoric relations carry the same type of grammatical information, and

(ordered) NPs is redundant, so it needs not to be part of the final discourse structure. Ellipsis of the ground NP becomes a phonological reflex of the derivational step. Ground NP ellipsis in anaphoric contexts thus becomes an operation that establishes the degree of cohesion of a discourse (Kehler 2011; Ward & Birner 2012; Boone 2014; a.o.). Since one ground NP is under discussion, only one ‘copy’ is pronounced; the others can become silent. This is possible, however, only when two NPs are identical, i.e. they carry the same formal features and types.

Note that in these cases the remnant phrase is treated as part of a larger localiser phrase, instead of the complement of a VP. Note also that ellipsis involving ground NPs as complements of simple localisers in discourse is predicted to create highly deviant structures (cf. (34), (36)). Although two ground NPs can form an anaphoric relation, ellipsis in the second sentence in the presence of a simple localiser would result in a type change, as in referential contexts. Thus, sentence structure must also be preserved in anaphoric contexts, a fact further suggesting that the use of a single derivational analysis for syntactic and discourse data is empirically appropriate.

The other discourse-bound examples discussed in section 3.2 can now find a similar account. Consider thus the proposed structures in (65-67) (based on (37), (39), (41)):

(65) $k+3$. [*Haizi-men ba fangzi...*]_{VP} [*Danshi [tamen ba (fangzi de) wai-mian]*]_{VP-NP(I)} (Ellipsis)

(66) $k+3$. [[*Fangzi li bei...*]_{VP} [*que [tamen ba (fangzi de) wai-mian...*]_{VP}]]_{VP-NP(I)} (Ellipsis)

(67) $k+3$. [*Fangzi de li-mian kangqilai...*]_{VP} [\emptyset [*(fangzi de) wai-mian kangqilai...*]_{VP}]]_{VP-NP(I)} (Ellipsis)

As (65) shows, the LocP introduced in the first sentence acts as the argument of *ba* and the antecedent of the second LocP, which undergoes ellipsis of the ground NP and *de* head. Since the spatial noun *wai-mian* ‘outside’ belongs to the same category of the phrase containing it, it establishes that the categorial identity of remnant and elided constituent. The same reasoning holds for (66), since *bei*-structures involve a different lexical item as a head, but a structurally equivalent condition. When a lexical verb such as *kangqilai* ‘seem’ is involved, the minimal change is the feature content of this verb (i.e. a VP is projected), as (67) shows. Overall, discourse structures do not hinge on this particular aspect to develop different licensing conditions. Thus, they involve the same type of ellipsis as in the cases discussed so far.

Let us summarise the results. Via the use of TLS, the proposed type assignment and the theory’s derivational apparatus, we have offered a full-fledged account of the data. We have shown that localisers dis-

tribute as either complex NPs of type NP (e.g. compound localisers: *qian-mian*), or clitic-like affixes of type NP₁/NP₁ (e.g. simple localisers: *qian*). Irrespective of the type, they can form LocPs by combining with the ground NP, via the mediating role of *de* with compound localisers. We also have shown how spatial prepositions (e.g. *zai*) and non-spatial prepositions (e.g. *ba*, *bei*) can take these different types of LocPs as their arguments. We then have offered an analysis of anaphoric relations and ground NP ellipsis that stems from the contribution of localisers' features and basic principles of syntactic derivation, extended to discourse contexts. The resulting account thus offers a unified view of several phenomena and categories that has escaped previous accounts. It also invites again questions of grammar architecture, left aside at the end of section 4.1. We can now address them.

5. Discussion

We believe that three broad points sum up the key results of our account.

The first key result is that our novel account sheds light on the relation between localisers and prepositions. It can capture a wide set of syntactic contexts validating the role of localisers: BLCs, *ba*- and *bei*-structures, and structures including the *kangqilai* verb. It therefore offers a novel contribution on the nature of localisers. This is the case because we treat localisers as adnominal elements. Simple localisers act as phrasal affixes, compound localisers as arguments of *de*-Ps. We then show that this distribution of localisers stems from general principles. Simple localisers *qua* full-fledged affixes must attach to the ground NP to form a LocP. Compound localisers *qua* bare nouns/NPs are affixed via one of the key suffixes (e.g. *-mian*), and become arguments of *de*-Ps, in turn treated as a sub-type of LocP. Irrespective of the construction, they carry information about the specific location that the figure occupies, with respect to the ground. Prepositions mediate this relation, and can do so directly when they distribute as co-verbs, i.e. their valence is increased by one 'slot'.

Our TLS account of these categories and their flexible valence thus captures the data in a unified manner. It reaches this result by offering two key innovations. The first is an explicit but flexible analysis of categories via type assignment rules, a result obtained via the residual rule. The second is a top-down, incremental derivational system that captures how these categories can combine to form complex categories (i.e. compound localisers), phrases (e.g. PPs, LocPs), sentences and discourses. Crucially, the account can also be used to analyse whether previous proposals can

reach equivalent results, hence outlining their pros and cons in their analysis. To see why this is the case, we repeat (10-14) as (68a-72a) and offer their compressed derivations in (68b-72c). We use types to represent each category, so that the analyses become easily comparable:

- (68) a. $[_{PP} [_P \text{zai} [_{PostP} [_{NP} \text{zhuozi}] \text{qian}_{Post}]]]]$
 b. k. $[\text{zai} [_{zhuozi}]]_{VP} \text{ } [_{\text{qian}}]_{NP(i)/VP} \text{ } [_{\text{zai}}]_{[zhuozi]_{VP} \text{ } NP} \text{ } [_{\text{qian}}]_{VP/NP(i)} \text{ (FA: associativity)}$
 k + 1. $[\text{zai} [_{zhuozi}]]_{VP} \text{ } NP \text{ } [_{\text{qian}}]_{VP/NP(i)} \text{ } [_{\text{zai}}]_{[[zhuozi]_{NP} \text{ } \text{qian}]]_{NP} \text{ } VP \text{ (FA)}$
- (69) a. $[_{PP} [_P \text{zai} [_{NP} \text{zhuozi}]]] [_{PostP} \text{qian}]]$
 b. k. $[\text{zai} [_{zhuozi}]]_{VP} \text{ } NP(i) \text{ } [_{\text{qian}}]_{NP(i)} \text{ } [_{\text{zai}}]_{[zhuozi]_{VP} \text{ } \text{qian}}]_{NP} \text{ } NP \text{ (FA)}$
 k + n. $[\text{Zhangsan zai zhuozi}]_{VP} \text{ } [_{\text{qian}}]_{NP(i)} \text{ } ^*$ (FA: derivation crashes)
- (70) a. $[_{PP} \text{zai} [_{LocP} [_{NP} \text{zhuozi}] \text{-qian}_{LocP}]]$
 b. k. $[\text{zai}]_{VP} \text{ } NP(i) \text{ } [_{\text{zuo zhi-qian}}]_{NP(i)} \text{ } [_{\text{zai}}]_{[\text{zuo zhi-qian}]_{NP(i)}}]_{VP} \text{ (FA)}$
- (71) a. $[_{PathP} \text{zai} [_{PlaceP} [_{NP} \text{che-zhi}] \text{qian}]]$
 b. k + 1. $[\text{zai} [_{\text{che zhi}}]]_{VP} \text{ } NP \text{ } [_{\text{qian}}]_{VP} \text{ } NP(i) \text{ } [_{\text{zai}}]_{[\text{che zhi}]_{NP} \text{ } \text{qian}}]_{NP} \text{ } VP \text{ (FA)}$
- (72) a. $[_{PlaceP} \text{zai} [_{AxpPartP} [_{DP} \text{che-zhi}] [_{\text{qian}}]_{DP} \text{ ti}]]]]$
 b. k. $[\text{zai} [_{\text{che-zhi}}]_{NP(i)} \text{ } \text{qian}]_{VP} \text{ } VP \text{ (FA)}$
 c. k. $[\text{zai} [_{\text{che-zhi}}]_{NP(i)} \text{ } \text{qian}]_{NP} \text{ } VP \text{ (FA)}$

In (68a), we have an adpositional analysis in which a localiser is a postposition taking a ground NP as its complement (cf. Tai 1973). In (68b), we model the postpositional nature of localisers by assuming that their output type is VP, the same of prepositions. That is, if localisers and prepositions belong to the same (abstract) nominal category, they must form phrases of the same type. As (68b) shows, at a given step in a derivation a ground NP forms a partial constituent with the preposition *zai*. The combination of the localiser with this complement to form a LocP would then require re-interpretation of the structure, via associativity of forward application. The ground NP must first become ‘visible’ to the localiser, and then combine with it. The resulting VP (i.e. a postposition) must become the complement of the preposition *zai* (cf. step *k + 1*). Thus, this analysis can receive a derivational account, but only via a set of supplementary steps.

In (69a), we have the Troike & Pan’s (1994) style of analysis: localisers are specifiers of PPs. As (69b) shows, if one takes a preposition to be a 2-place, transitive-like element, then a PP is formed straightforwardly via the combination of a ground NP and a localiser. However, this would lead to BLCs involving prepositions/co-verbs to become 3-place heads: they must also take the figure NP as their argument. A preposition would only act as a co-verb if assigned the type VP/NP/NP/

NP of ternary verbs. Thus, this analysis would require problematic general assumptions, to receive a fully derivational treatment.

In (70a), we have a clitic (i.e. phrasal affix) analysis of localisers (e.g. Liu 1998; Zhang 2017). As (70b) shows, this analysis presupposes that ground NP and localiser form a single syntactic unit (i.e. a LocP) that can combine with the ground directly, thereby forming a VP. Our account builds on this assumption, so the discussion in section 4 offers ample evidence that this analysis easily lends itself to further extensions. In (71a), we have the postpositional type of account advocated in Djamouri *et al.* (2013). In (71b), we show that the derivation bringing about this structure (and supplementary steps) as the one in (68b).

In (72a), then, we have the cartographic proposal advocated in Wu (2015), in which (simple) localisers realise the category *Axpart*. This proposal requires a nuanced discussion, as our distinct possible derivations show. Within cartographic approaches, *Axpart* is a category having a perhaps liminal status (cf. Svenonius 2010). It is taken to originate in the nominal domain but having been grammaticalised to the prepositional domain. Given this apparent categorial ambiguity, two possible analyses arise, in our TLS account.

The first analysis, in (72b), is based on assuming that *Axpart*'s output type is VP, like prepositions. This analysis would face the same challenges of other adpositional analyses, but would be otherwise acceptable. The second analysis, in (72c), is based on assuming that *Axpart*'s output type is NP_i. This category retains an adnominal status and invites an adnominal analysis, even though it merges within the 'P field'. Thus, the second analysis dovetails with adnominal analyses in involving derivations with fewer steps.¹⁶ To an extent, the cartographic analysis sits in the liminal space between adnominal and adpositional analyses of localisers, at least when observed through the lens of TLS. Please note here that we have simplified our presentation of this account by omitting an analysis of how the ground NP is moved into the specifier position of *Axpart*. We return to this point once we present our second key result.

Overall, this TLS-based discussion of existing proposals on Mandarin adpositions and localisers suggests that adnominal analyses can better capture the data. Two limitations nevertheless arise in each proposal. The first limitation is that these proposals need to be extended to cover compound localisers in sentential and discourse structures. Crucially, our proposal shows how our valence-flexible variant of the clitic-based account can be instead straightforwardly extended to these data. The second limitation is that these proposals also cannot directly capture ground NP ellipsis and the anaphoric relations that license this form of ellipsis. Our proposal is also designed to capture these data, for it takes the view

that ‘syntax’ can be extended to compute the structures that form the domain of ‘discourse’. Previous proposals, generative (e.g. Djamouri *et al.* 2013; Wu 2015) and non-generative (e.g. Huang *et al.* 2017) alike, do not attempt such extensions. An open question would thus be if these proposals could receive an extension to a discourse level. To address if and how this can be the case, we present the second and third key results.

The second key result is that our account derives sentential and discourse structures and computes anaphoric relations via one derivational ‘engine’. This engine does not require the postulation of traces/copies of constituents to account the data. The need for a movement analysis disappears, because we take a top-down, ‘left-to-right’ approach to derivations. As a result, units are in a sense combined ‘in situ’, provided that their types match. It is however worth discussing the possibility of following a bottom-up derivational account to highlight how our account can avoid the postulation of different syntactic and discourse engines. We first address Wu’s (2015) movement-based proposal, and then broad derivational issues.

If one follows a bottom-up derivational approach within TLS, then moved constituents arise as a logical possibility (Jäger 2005; Moortgat 2010, 2011; cf. also Stabler 1997’s Minimalist Grammar). Simplifying matters for the sake of discussion, a moved constituent can be treated as an item that is inserted again in the derivation, and co-indexed with the previous item, like copies in minimalist accounts. Thus, the ground NP receives type NP₁ and the copy NP₁NP₁, this type assignment represents the fact that the ground is an NP belonging to the *l* sub-type, and the copy is an element ‘repeating’ this information. The (partial) structures are in (73):

- (73) a. k. [*zai* [[*che-zi*]_{NP(1)} [_{VP} *qian* [_t_{NP(1)} ’NP(1)]]]_{VP} (FA)
 b. k. [*zai* [[*che-zi*]_{NP(1)} [_{NP} *qian* [_t_{NP(1)} ’NP(1)]]]_{VP} (FA)

In (73a), we have a structure involving an adpositional localiser; in (73b), an adnominal localiser. Ground NP and trace are co-indexed because the trace is represented as phrase repeating the corresponding unit that carries the same type. A parallel arises between the analysis of copies and anaphoric elements that is worth exploring in some detail.

In Jäger (2001, 2005), anaphoric relations involve pro-forms acting as categories that are treated as proxies for previously introduced phrases of a given type. Pronouns are represented as categories of type NP|NP_i, ‘|’ representing a substitution connector/rule reading as follows. A pronoun is a constituent of a ‘type’ that is related to a previously indexed NP (i.e. NP_i), e.g. an NP carrying the same morpho-syntactic features. It thus receives the type NP|NP_i, which requires a (previous)

phrase of type NP_1 to license an anaphoric relation. In our notation, we simplify matters by using ordered pairs of types (i.e. $NP_1:NP_1$) to mark anaphoric relations as ‘pairings’ of constituents matching in features. In both systems, pronouns and traces share the property of being related to other NPs carrying their types, whence the formation of anaphoric relations and the ellipsis of ‘duplicated’ constituents.

Exploring further this parallel between movement/copy theories would take us too far afield. However, we are now in a position to explore how our account could be formulated in a bottom-up, ‘right-to-left’ manner, thus comparing the two derivational views. For this purpose, we offer a partial bottom-up derivation of a *de*-phrase in (74):

- (74) t. [-mian]_{NP(i)/NP(i)} (LS)
 t + 1. [qian]_{NP(i)} (LS)
 t + 2. [qian]_{NP(i)} [-mian]_{NP(i)/NP(i)} ⊢ [[qian]_{NP(i)} -mian]_{NP(i)} (FA)
 t + 3. [de]_{NP(i)/NP(i)/NP} (LS)
 t + 4. [de]_{NP(i)/NP(i)/NP} [[qian]-mian]_{NP(i)} ⊢ [de [[qian]-mian]_{NP(i)}]_{NP(NP)} (LS)
 t + 5. [zhuozi]_{np} (LS)
 t + 6. [zhuozi]_{NP'} [de [[qian]-mian]_{NP(i)}]_{NP(i)/NP'} ⊢ [[zhuozi] [de [[qian]-mian]]]_{NP(i)}
 ...
 t + 10. [[Zhangsan] [zai [[zhuozi] [de [qian]-mian]]]]_{VP} (FA)

As (74) shows, a bottom-up derivation could proceed in a straightforward manner. At least for *de*-phrases, the combining order of constituents does not appear crucial, for this schema does not depend on order, but rather on type matching of the combined items. Thus one can wonder whether a top-down approach is indeed necessary, to account our data. However, we have at least two reasons for nevertheless pursuing this approach.

First, production models of language offer evidence that speakers plan and produce sentences in a top-down manner (Levelt 1989; Jarema & Libben 2007; Phillips 2006; Pfau 2009; Morryll 2011; Poesio *et al.* 2016). Thus, if one attempts to offer a ‘dynamic’ account of sentence derivation with psychological plausibility, one must perforce choose this perspective. Discourse production then involves the direct extension of this model to multiple senses. Bottom-up views are generally limited to the analysis of single sentences, so they do not address these issues. However, their direct extension would involve the apparent paradox of sentences being combined ‘backwards’, if one starts from the ‘bottom of the discourse’. Alternatively, sentences can be derived bottom-up and then merged together top-down, in a non-monotonic manner. A top-down model allows us to avoid these problems effortlessly, because it is designed to model the ‘flow of discourse’, and therefore the ‘flow of sentences’, via a single derivational apparatus.

Second, bottom-up approaches are rooted in classic views on constituency (e.g. Chomsky 1965's treatment of partitive/genitive phrases). Most works in the generative (transformational) tradition take this view for granted. However, Dikken (2018) builds on Chesi's (2007, 2012, 2015) results and shows that this view incurs in several structural paradoxes. Cases include filler-gap structures and other configurations in which the presence of elided or displaced material follows the phonologically realised material. Therefore, anaphoric relations and ground NP ellipsis seem to offer yet one more reason for pursuing our top-down, derivational approach. After all, one would expect that an antecedent be introduced in a derivation before an anaphor, since the anaphor depends on the antecedent for its interpretation. Thus, our top-down TLS account can also derive ground NP ellipsis patterns, naturally lending itself to a treatment of anaphoric relations in discourse.

The third key result is a consequence of the first and second results. Our contribution also offers insights on 'discourse syntax', since it shows that the account can be extended to a discourse level. This extension is possible as far as we assume that sentences can be combined by also following binary branching principles. This is far from an uncontroversial assumption, as the debate in the literature shows (e.g. Ginzburg & Sag 2000; Hardt 2013). However, following this assumption provides us with the stepping-stone for an integrated analysis of anaphoric relations and Mandarin PPs. A question arises, then, on what kind of architecture of grammar is consistent with our approach.

To the best of our understanding, proposals falling within the minimalist programme are consistent with many of our assumptions. For instance, Distributed Morphology includes three key assumptions that are consistent with our approach (e.g. Halle & Marantz 1993; Harbour 2007; Harley 2010; McGinnis 2016; a.o.). First, morphology and syntax form a single computational system; second, morphemes act as clusters/sets of features. Third, semantic interpretation and phonological (vocabulary) insertion occur after morphological derivations have generated structures (e.g. Embick & Noyer 2006; Harley 2010). Lexical Syntax takes similar views on these matters. However, it also assumes that heads may have flexible valence, and may combine with (merge, in generative parlance) none, one or two phrases as their arguments (Hale & Keyser 2002; Mateu 2002). Similar assumptions are also found in Minimalist Grammar, which acts as a rigorous formalisations of the core derivational principles of minimalism (Stabler 1997; Collins & Stabler 2016).

Interestingly, Head-Driven Phrase Structure Grammar (HPSG: Ginzburg & Sag 2000; Tseng 2000) and the Sign-based Construction Grammar introduced in Sag, Boas & Kay (2012) also display some consist-

ence with our account. Both models include a treatment of valence flexibility and change, type-based views of constituents and constructions, and formally defined, highly elaborated feature systems. They also offer treatments of anaphoric relations and ellipsis patterns that closely resemble ours, although with some noticeable differences (e.g. ‘slash’ features in HPSG). However, Sag *et al.* (2012) places a (far) greater emphasis on the study of ‘constructions’ as building blocks of language. It thus forsakes the derivational schemas employed in HSPG, its indirect predecessor (cf. Sag, Wasow & Bender 2003). In general, these approaches place a great emphasis on studying the constraints that may define the well-formedness of sentences/constructions, thus backgrounding derivational matters.

We therefore conjecture that a minimalist model blurring the borders between syntax and discourse and employing systematic valence flexibility may act as an architecture underpinning our TLS account. However, full-fledged proposals are still outstanding. The key point of divergence, once more, would be the ‘direction’ of derivations. Crucially, HPSG and Sign-Based Construction Grammar also address discourse data, and certainly offer detailed accounts of ellipsis and anaphoric relations. We believe that their insights could be incorporated in the aforementioned minimalist architecture. One could perhaps even obtain a general synthesis model, going beyond the apparent differences between these frameworks (cf. Müller 2016; for discussion). We do not pursue further conjectures, however, since we have now fully reached our second and third goals: a theoretical account of our data, and a discussion of its results. We can thus move to the conclusions.

6. Conclusions

In this article, we have offered a unified account of spatial adpositions and localisers in Mandarin that covers intra- and inter-sentential data. We have suggested that prepositions, simple and complex localisers, and *de*-phrases all contribute to form Mandarin spatial PPs. We have offered novel empirical findings on PPs’ distribution in a variety of sentential contexts (e.g. BLC constructions, ground NP ellipsis) as evidence motivating the need of such an account. We have then shown that this account can capture the distribution of these categories in a variety of syntactic structures (BLCs, *ba*- and *bei*-structures, *kangqilai* structures). The account can be extended to inter-sentential data and their corresponding anaphoric patterns, which have not been addressed in the literature. Therefore, our account can cover a variety of understudied

and unexplored data via a unified perspective, hence progressing beyond previous analyses of Mandarin spatial categories.

We believe that this account can be also extended to cover similar data across different languages, as it presents a novel perspective on spatial categories. One avenue of research could involve the connection of this framework with the emerging study of ‘chorophorics’ (Hagège 2010; Ursini 2020), spatial pro-forms that have still not received extensive attention. It also sheds light on the relation between spatial nouns and adpositions, an area of research that has emerged in recent works (Rybka 2015; Ursini & Tse 2021), but that remains understudied. Extensions that include a semantic treatment of this account are certainly possible, as discussed in Jäger (2005) (cf. also Asher & Lascarides 2003; Kamp *et al.* 2011; for DRT-based approaches). For this and similar other avenues of research, however, we must defer the readers to future works.

Abbreviations

BA = direct object marker (*ba*); BEI = passive marker (*bei*); BLC = Basic Locative Construction; DE = transitive marker function for *de*; FA = Forward Application; HPSG = Head-driven Phrase Structure Grammar; LR = Location Relation head; LS = Lexical Selection; PF = perfective marker; PL = plural marker; POSS = possessive marker function for *de*; PV = Place Value head; TLS = Type-Logical Syntax.

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Notes

¹ We use the label ‘NP’ because the label ‘DP’ (Determiner Phrase) would presuppose a fine-grained structure for the nominal domain. This assumption is not necessary for our purposes (but see Cheng & Sybesma 2012 for discussion). Furthermore, we use Leipzig Glossing rules for our examples (Croft 2003: i-xiv).

² Another pair of terms to describe these notions is ‘locatum’ and ‘location’ for ‘figure’ and ‘ground’, respectively (cf. Lewandowski 2016).

³ Peyraube (2003); Chappell & Peyraube (2008); Huang *et al.* (2017); observe that the closely related spatial nouns also include sub-types describing objects (e.g. *ping-mian* ‘entrance’, lit. ‘flat-side’) and toponyms (e.g. *Bei-jing*, lit. ‘North capital’). We do not address this issue, as it would lead us too far afield.

⁴ Certain generative analyses treat Path and Place heads as segments of one vocabulary item (Emonds 1985; 2000; van Riemsdijk & Huybregts 2007). As these proposals do not discuss Mandarin data, we can leave them aside.

⁵ Note that Zhang (2002) treats ground NPs as carrying (abstract) specificity and definiteness features, thereby triggering obligatory movement. For the purposes of our discussion, our partially simplified rendition of this analysis suffices to illustrate its main points.

⁶ Note that *de* acts as a possessive ('part of') marker when occurring in PPs, but as a transitive marker when attaching to verbs (e.g. *dong* 'make'). Our use of glosses reflects these nuanced semantic differences. We defer the reader to Zhang (2012) and references therein for a recent overview on the vast multi-functionality of this marker.

⁷ In European languages (e.g. English, Dutch, French and Spanish), the distribution of 'locative nouns' with prepositions highlights this pattern (e.g. *at home*, *at school*: Aguilar-Guevera & Zwarts 2010). We do not fully discuss this matter here, as it would lead us too far afield.

⁸ Let us note that the *-bu* examples require their interpretation against a formal, written type of context. Since our examples all involved written sentences, this condition was easily met.

⁹ Interestingly, Zhang (2017) offers a similar observation in passing. The work suggests that ellipsis may become possible when reference to a discourse-given 'place' is introduced. Although the point is not touched further, we believe that our discussion builds on this observation.

¹⁰ The forward application rule is normally defined as $(a/b)-b-a$ (Moortgat 2010: §2.1). The proof $a-(b/a)-b$ is based on proving that the relation between types involves the right division connective with those involving the left division connective (e.g. a/b being equivalent to $b\backslash a$). We can thus use a system only involving the right division connective. We do not offer the proof, for it is elementary but long (Morryll 2011: ch. 2; Ursini 2015; Ursini & Giannella 2016).

¹¹ Readers may have noticed that we are using feature 'sub-types', not 'values'. This is the case because values do not allow establishing relations between features, thus preventing us from offering an account of the ellipsis data. Our syntactic theory must thus meet certain 'interface conditions', to be adequate (Carpenter 1992: ch. 3).

¹² For instance, if *de* receives the type assigned in the main text, then *dong* as an intransitive verb can receive the type VP/NP. Via the cut rule and simplifying types to a good extent, we have VP/NP·NP/NP/NP+VP/NP/NP. That is, *de* allows this and possibly other verbs to 'gain' one further argument slot related to an argument that becomes part of their structure.

¹³ Our formal account does not directly show why *zuo* and *zai* do not form a single verbal complex, as in serial verb constructions. The type VP·VP assigned to the sentence only represents that *zuo* and *zai* 'normally' introduce their own verb phrases, but here form a complex phrase. We do not dwell on this topic further for it would lead us too far afield.

¹⁴ A parallel exists between this analysis of Mandarin prepositions as 1-place heads and prepositions as elements introducing arguments in English (e.g. Kayne 2004). Again, we do not explore this topic further.

¹⁵ This approach is not necessarily consistent with other approaches to ellipsis, especially within minimalist settings (e.g. Merchant 2001, 2004; den Dikken 2018). More in general, the exact 'size' of elided constituents, and the possible projections and arguments that elision sites can include, are topics of intense debate. We point the readers to Kobele (2012); Boone (2014); Kubota & Levin (2020: ch. 5); for recent overviews and discussions.

¹⁶ Approaches such as Svenonius (2010) seem to treat *Axpart* as a 1-place head, but Wu (2015) indirectly suggests that it is a 2-place head, as standardly assumed for functional heads in Cartography (cf. Cinque & Rizzi 2010). Our discussion simplifies these matters because the analysis proposed in the text strikes us as the most empirically sound, within the range of possible Cartographic analyses.

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