

The procedural syntax of fake modification constructions in Chinese

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For my mother

Abstract

The clitic morpheme *de* in Mandarin Chinese has various uses. Typically, it is cliticized to a phrase whether the phrase is nominal or adjectival; it can also occur between two noun phrases when there is no relation of semantic modification. The constructions that involve the latter use of *de*, known as fake modification constructions, have been theoretically characterized many a time. In the existing characterizations, the morpheme is treated either as a mysteriously inserted lexical item, a modification marker, or a genitive morpheme. The existing accounts suffer from a variety of theoretical and empirical problems. Evidence is presented that in some other constructions and in fake modification constructions, *de*, while having no lexical semantic content of its own, occupies a position that is otherwise occupied by a two-place predicate. Based on this observation, a partially unitary theoretical account of fake modification constructions is formulated from a parsing perspective in the framework of Dynamic Syntax. In this account, four *de*-morphemes in fake modification constructions are recognized with different syntactic distributions; however, they all contribute a semantically underspecified predicate that is updated by syntactically constrained or context-based inference.

Keywords: fake modification construction, semantic underspecification, context-dependency, Dynamic Syntax

Résumé

Le morphème clitique *de* en Chinois Mandarin a diverses utilisations. Typiquement, il est cliticisé en une phrase, qu'elle soit nominale ou adjectivale; il peut également se produire

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entre deux phrases nominales entre lesquelles il n'y a pas de relation de modification sémantique. Les constructions qui impliquent cette dernière utilisation de *de*, connues sous le nom de fausses constructions de modification, ont été théoriquement caractérisées à plusieurs reprises. Dans les caractérisations existantes, le morphème est traité soit comme un item lexical mystérieusement inséré, soit comme un marqueur de modification, soit comme un morphème génitif. Les comptes rendus existants souffrent de divers problèmes théoriques et empiriques. Il est prouvé que dans certaines autres constructions ainsi que dans les fausses constructions de modification, *de*, bien que n'ayant pas de contenu sémantique lexical propre, occupe la position qui est autrement occupée par un prédicat à deux places. Sur la base de cette observation, un compte rendu théorique partiellement unitaire des fausses constructions de modification est formulé à partir d'une perspective d'analyse dans le cadre de la Syntaxe Dynamique. Dans ce récit, quatre *de*-morphèmes dans les fausses constructions de modification sont reconnus parce qu'ils ont des distributions syntaxiques différentes; cependant, ils contribuent tous à un prédicat sémantiquement sous-spécifié, qui est mis à jour par une inférence syntaxiquement contrainte ou basée sur le contexte.

Mots-clés: fausse construction de modification, sous-spécification sémantique, dépendance au contexte, Syntaxe Dynamique

1. INTRODUCTION

In natural languages, there are morphemes that are semantically underspecified; typical examples are those which are traditionally called pronouns, such as personal pronouns, *I, you, they, it, she, and he* in the English language and their exact or quasi-counterparts in other languages. These pronouns obtain semantic content from the context either inside or outside the utterance in which they appear. There are also some morphemes that only obtain semantic content from within the utterance in which they appear. A typical example is the expletive *it* in English. See the following examples (Cann et al. 2005, 194).¹

- (1) a. That we are wrong is possible (but not likely).
 b. It's possible that we are wrong (but it's not likely).

The expletive pronoun *it* in (1b) obtains its content from a later string *that we are wrong*. In this sense, *it* in (1b) is just a placeholder.

Morphemes that function as placeholders are not restricted to pronouns; for example, the copular verb *be* in English has been analyzed as a placeholder in Cann et al. (2005), which successfully accounts for the various uses of *be*. In the following sentences, *be* (in its various inflectional forms), contributes a placeholder the content of which is provided by some expressions that come up later. The semantic placeholder of *be* in (2a)-(2c) is filled in respectively with the semantic content of *happy, on the train, and a teacher*.

¹In this paper, the following glossing abbreviations are employed. ASP = aspectual marker; CL = classifier; PRT = particle; 1ST.SG = first person singular; 2ND.SG = second person singular; 3RD.SG = third person singular; DE = the morpheme *de* at issue; GEN = genitive marker.

- (2) a. John is happy.
 b. Robert was on a train.
 c. Mary is a teacher.

It follows that copular verbs in any languages are all placeholders. For example, the copular verb *shi* in Mandarin Chinese has been analyzed as contributing a placeholder (Wu 2011; Li 2016). This paper, by looking into the clitic morpheme *de* in the so-called fake modification constructions in Mandarin Chinese, continues the enterprise of investigating lexical semantic underspecification. (See the work mentioned above.) The grammatical property of this morpheme has been a controversial topic in Chinese linguistics but its semantic contribution has been little considered. The existing analyses, which are all implemented in the framework of Generative Grammar, suffer from the problem of theoretical incoherence. In this paper, a theoretical account of fake modification constructions is formulated in the framework of Dynamic Syntax (Kempson et al. 2001; Cann et al. 2005). I argue that different fake modification constructions involve different *de*-morphemes. The different *de* morphemes, while having different syntactic distributions, all contribute a predicate that does not have its own meaning but obtains semantic content from context. This analysis of *de* provides a partially unitary characterization of the four fake modification constructions. The rest of the paper unfolds as follows. In section 2, basic data of the so-called canonical use of *de* and the puzzling use of *de* are described. In section 3, four existing accounts of fake modification constructions are reviewed. In section 4, it is argued that *de* can function as a two-place predicate although in a rather restricted way and that its presence is restricted by what precedes it and imposes requirements on what follows it. In section 5, a formal characterization of fake modification constructions is formulated in the framework of Dynamic Syntax. section 6 is the conclusion of the paper.

2. BASIC DATA

In this section, fake modification constructions involving *de* between two noun phrases are described. These constructions are puzzling in that the use of *de* in them is quirky compared with its use in typical modification constructions. In order to make clear why the use of *de* in fake modification constructions is puzzling, the typical use of *de* in modification constructions is briefly described first.

2.1 The use of *de* in modification constructions

In Mandarin Chinese, the monosyllabic morpheme *de* (zero tone) occurs in a modifier phrase, as shown in (3).

- (3) a. Měilì de fēngjǐng xīyǐn dàliàng yóurén.
 beautiful DE scenery attract a.large.number.of tourist
 ‘The beautiful scenery attracts a large number of tourists.’
 b. Wǒ de fùqīn shì gōngchéngshī.
 1ST.SG DE father be engineer
 ‘My father is an engineer.’

- c. Zhèi-běn shū shì wǒ de.
 this-CL book be 1ST.SG DE
 ‘This book is mine.’
- d. Zhèi-běn shù shì wǒ de shū.
 this-CL book be 1ST.SG DE book
 ‘This book is my book.’

In (3a), *de* is cliticized to the word *měilì* ‘beautiful’ and the phrase *měilì de* ‘beautiful DE’ modifies *fēngjǐng* ‘scenery’. In (3b), the possessive modifier, *wǒ de*, which consists of the first person singular pronoun *wǒ* ‘1ST.SG’ and *de*, is semantically identical to the possessive pronoun ‘my’ in English. In (3c), *wǒ* and *de* jointly work as *mine* in English does. But it can be argued that in (3c), *wǒ de* is the same as that in (3b); the evidence is that a noun can be added after *wǒ de* in (3c), shown in (3d).

Since the *de*-phrase modifies a nominal head, *de* is usually treated as a nominal modification marker. A noun phrase in which *de* functions as a modification marker, undoubtedly, can be anaphorically referred to by a pronoun, as shown in (4). In (4a), *tā* ‘3RD.SG’ refers to *měilì de fēngjǐng* ‘beautiful DE scenery’ [the beautiful scenery]; in (4b), *tā* ‘3RD.SG’ refers to *wǒ de fùqīn* ‘1ST.SG DE father’ [my father].

- (4) a. Měilì de fēngjǐng xīyǐn dàliàng yóurén, dāngdì rén
 beautiful DE scenery attract a.large.number.of tourist, local people
 quán kào tā móushēng.
 all rely.on 3RD.SG make.a.living
 ‘The beautiful scenery attracts a large number of tourists and the local people all rely on it to make a living.’
- b. Wǒ de fùqīn shì gōngchéngshī, dànshì tā bù dǒngdé
 1ST.SG DE father be engineer, but 3RD.SG NEG know
 zěnmē jiàoyù háizǐ.
 how educate child
 ‘My father is an engineer, but he does not know how to educate a child.’

However, there is evidence that even though *de* in (3a)/(4a) and (3b)/(4b) has long been taken to be a modification marker, the syntactic relationship between *de* and an expression to which it is cliticized varies from case to case. Compare the following two sentences first to see the variation.

- (5) a. Měilì de fēngjǐng xīyǐn rén; *(měilì de) rén gèng xīyǐn
 beautiful DE scenery attract people; beautiful DE people more attract
 rén.
 people
 ‘Beautiful scenery attracts people; (beautiful) people more attract people.’
- b. Tā de fùqīn shì gōngchéngshī, (tā de) mǔqīn shì dàxué
 3RD.SG DE father be engineer, 3RD.SG DE mother be college
 jiàoshī.
 teacher
 ‘His father is an engineer and his mother, a college teacher.’

In (5a), *měilì de* ‘beautiful DE’ in the second clause cannot be omitted unless the meaning of the modifier is lost; in contrast, in (5b), *tā de* ‘1ST.SG DE’ can be omitted without losing the meaning of the modifier.

Semantically, while *de* in the case of adjectival modification seems to contribute little meaning,² in the case of a genitive modification such as (3b)/(4b)/(5b), *de* contributes the meaning of possession. As can be seen in (6), where the absence of *de* results in the loss of the meaning of possession.

- (6) a. Yīfū túshūguǎn
 Yīfū library
 ‘The Yifu Library’
 b. Yīfū de túshūguǎn
 Yīfū DE library
 ‘Yifu’s library’

In (6a), *de* does not appear and the phrase does not have the meaning of possession; the modifier is interpreted as a personal name after which a building is named. In (6b), *de* appears and the noun preceding *de* is interpreted as the possessor of a building. Another example that shows the semantic contribution of *de* between two nouns in a possessive relationship is given below.

- (7) Zhèi zhǒng píngguǒ zhī’er shì jiǎde, lǐmiàn bù hán píngguǒ de zhī’er
 this kind apple juice be fake, inside NEG contain apple DE juice.
 ‘This kind of apple juice is fake, for it does not contain any juice of apples.’

In (7) *píngguǒ zhī’er* ‘apple juice’ is semantically distinguished from *píngguǒ de zhī’er* ‘juice of apples’; in the former, *píngguǒ* ‘apple’ does not necessarily mean the fruit from which some juice is extracted; it may simply refer to some taste similar to that of an apple, while *píngguǒ de zhī’er* unambiguously expresses the natural possessive relationship between the fruit and its juice. Treating *de* as semantically void is at most a technical simplification because the presence and absence of *de*, as shown in (6), makes a difference in meaning. Even if *de* does not contribute a conceptual meaning on its own, it must have the function of triggering some inference that leads to the semantic effect observed in cases like (6).

To sum up, occurring in different types of modification constructions, *de* makes different contributions. In this sense, *de* is either a polysemous morpheme or different morphemes. In the following section, I show that *de* can occur between two expressions that do not have the relationship of modification, which, as is shown in section 3, has been treated as a genitive morpheme in some existing accounts.³

²Liu (2016) argues that the presence of *de* following a predicative adjectival modifier gives rise to a restrictive meaning, while the absence of *de* gives rise to a non-restrictive meaning.

³*De* can also appear in the emphatic construction, shown below, which is irrelevant to the current discussion.

- (i) Zhāngsān (shì) zuótiān lái de.
 Zhangsan be yesterday come DE
 ‘It was yesterday that Zhangsan came.’

2.2 The use of *de* in four fake modification constructions

Of those non-modification uses of *de*, one is superficially related to the possessive/genitive *de*. In this use, *de* occurs between two nominal phrases between which, however, there is no relation of possession, as illustrated by the underlined parts in the sentences in (8).

- (8) a. Zhāngsān de lánqiú dǎ dé hǎo.
 Zhāngsān DE basketball play PRT good
 ‘Zhangsan plays basketball well.’
- b. Zhāngsān pǎo-le sān fēnzhōng de bù.
 Zhāngsān run-ASP three minute DE step
 ‘Zhangsan ran for three minutes.’
- c. Zhāngsān dǎ Zhāngsān de lánqiú (Lǐsì pǎo Lǐsì de bù).
 Zhāngsān play Zhāngsān DE basketball Lisi run Lisi DE step.
 ‘Zhangsan plays basketball; (Lisi runs) [Note: the two-clause sentence has the implicature that the two persons do/did not interfere with each other].’
- d. Zhèi dùn fàn, Zhāngsān de dōngjiā.
 this CL meal Zhāngsān DE host
 ‘As for the meal, Zhangsan is the host.’

The fact that *de* appears between two nominal expressions results in the impression that it is a modification marker, like that in (3a), (3b), (3d), (4a), (4b), (5a), (5b), and (6b). However, as was indicated above, there is no possessive relation between the two nouns in all the four sentences in (8).

In (8a), *Zhāngsān* is not understood as the owner of *lánqiú* ‘basketball’, which in the sentence does not express an entity or a kind of entity but rather a kind of game. If *Zhāngsān de lánqiú* is interpreted as a composite concept that involves a possessive relationship, the sentence as a whole is nonsensical.⁴ In (8b), *sān fēnzhōng de bù* ‘three minute DE step’ can hardly be interpreted without an appropriate context; therefore, there cannot be a relation of modification between *sān fēnzhōng* and *bù*. In (8c), like in (8a), *Zhāngsān de lánqiú* ‘Zhangsan DE basketball’ does not express a possessive relationship between *Zhāngsān* and *lánqiú*. The whole sentence, including the part in the brackets, expresses a distinction and separation of what *Zhāngsān* does/did and what *Lǐsì* does/did, having a conventional implicature that *Zhāngsān* and *Lǐsì* do not interfere with each other. In (8d), *Zhāngsān de dōngjiā* ‘Zhangsan DE host’ does not involve a genitive relationship; instead, it expresses a subject-predicate relationship, in which *Zhāngsān* is assigned the status of a host.

Among the four constructions, (8b) looks slightly different from the other three. In (8b), what occurs before *de* is the temporal expression *sān fēnzhōng* ‘three minute’. In the other three, what occurs before *de* is a personal noun. However, there is

⁴An anonymous reviewer asks whether the sentence can mean ‘Zhangsan’s playing basketball is good’ if *Zhāngsān de lánqiú* expresses a possessive relationship. There is no evidence that the sentence in this case has the suggested meaning. Although in English, *Zhāngsān’s playing basketball* is a well-formed phrase, *Zhāngsān de dǎ lánqiú* ‘Zhangsan DE play basketball’ in Chinese is outright unacceptable.

evidence that the personal noun *Zhāngsān*, which occupies the initial position in (8b), can occur immediately before *de*, as is shown in (9), which is semantically equivalent to (8b). It should be noted that (9) looks exactly the same as (8a) regarding the linear order of the NPs flanking *de*.

- (9) Zhāngsān de bù pǎo-le sān fēnzhōng.
 Zhāngsān DE step run-ASP three minute
 ‘Zhangsan ran for three minutes.’

The constructions illustrated by the sentences in (8) are dubbed as fake modification constructions (e.g., Zhu 1982, and works to be reviewed below), because in these sentences, *de* and the noun phrase that precedes it together have the appearance of constituting a modifier of the noun phrase that follows *de*, even though there is no recognizable relation of modification between the two expressions that respectively precede and follow *de*.

3. EXISTING ANALYSES OF FAKE MODIFICATION CONSTRUCTIONS

Theoretical linguists have long been interested in fake modification constructions. Many accounts have been proposed to characterize the syntactic and semantic properties of *de*. Below is a review of four existing accounts, which take three different approaches in the framework of Generative Grammar. Other analyses that can be found in the literature (Tang 2010; Guo 2017; Pan and Lu 2011) are also carried out in the same framework and adopt similar assumptions. This review mainly aims to demonstrate the problems that existing analyses of *de* in these constructions suffer from. Generally, there are three approaches to the appearance of *de* in fake modification constructions. One is to assume that *de* is inserted for a syntactic purpose. The second is to assume that *de* is a genitive morpheme, functioning like ‘s’ in English. The third is to assume that *de* is inserted to satisfy some phonological-syntactic interface mapping rule. The three approaches are reviewed one by one.

3.1 The syntactic insertion approach

Mei (1978) first proposes a generative account of the generation of a fake modification construction, with (10a) as an example and (10b) as a reference for facilitating discussion.

- (10) a. Tā de lǎoshī dāng dé hǎo.
 3RD.SG DE teacher do PRT good
 ‘He served well as a teacher.’
 b. Tā dāng lǎoshī dāng dé hǎo.
 3RD.SG do teacher do PRT good
 ‘He served well as a teacher.’

Based on the fact that (10a) and (10b) are the same semantically, Mei proposes the following operations of generating (10a). It is assumed that (10a) has the deep structure given in (11a), which looks identical to (10b). Then, the first token of the verb

dāng ‘act.as’ is deleted, shown in (11b). Next, *de* is inserted where *dāng* ‘act.as’ has been deleted, shown in (11c).

- (11) a. Tā dāng lǎoshī dǎng dé hǎo. (deep structure)
 3RD.SG act.as teacher act.as PRT good
- b. Tā dǎng lǎoshī dāng dé hǎo. (deleting the first verb ‘dāng’)
 3RD.SG act.as teacher act.as PRT good
- c. Tā de lǎoshī dāng dé hǎo. (inserting ‘de’).
 3RD.SG DE teacher act.as PRT good

This account suffers from three defects. First, it is not clear what motivates the deletion of *dāng* in (11a). Second, it is not clear whether this deletion is merely a phonetic deletion in the surface structure or a lexical deletion in the deep structure. Third, whatever the essence of the deletion of *dāng* is, an account of the syntactic and semantic properties of *de* is wanting; that is, there should be an explanation of why *de* can be inserted into a position where a verb has been deleted.

Briefly, the account seems to be nothing but an ad hoc manipulation to yield the syntactic form of (10a) because the deletion and insertion operations are not well motivated in theory and nothing is said about the syntactic and semantic properties of *de* that endow the morpheme with the qualification for being inserted in a position where a verb can occur. In spite of these defects, this account is enlightening in that the suggestion that *de* can be ‘inserted’ in a position where a verb can occur implies that it is very likely that *de* in this case is close in function to a verb. A novel account proposed below capitalizes on this implication.

Huang (1982, 1998) proposes a different and rather sophisticated account of the same fake modification construction, where it is also assumed that *de* is inserted for some syntactic purpose. The operations assumed in this account are sequentially displayed in (12).

- (12) a. Tā dāng lǎoshī dé hǎo (deep structure)
 3RD.SG act.as teacher PRT good
- b. Tā lǎoshī dāng dé hǎo (‘lǎoshī’ is fronted)
 3RD.SG teacher act.as PRT good
- c. Tā de lǎoshī dāng dé hǎo (‘de’ is inserted)
 3RD.SG DE teacher act.as PRT good

As shown in (12a), a deep structure is assumed, where the morpheme at issue *de* does not appear, and then *lǎoshī* ‘teacher’ is fronted to a position next to *tā* ‘3RD.SG’, as shown in (12b). To account for *de*’s insertion, Huang (1982, 1998) assumes that the linear adjacency of *tā* and *lǎoshī* leads to a structural reanalysis or restructuring, giving rise to a *NP* which licenses the insertion of *de*. The computation of reanalysis is schematically represented as (13).

- (13) $NP_1 NP_2 \rightarrow [_{NP} NP_1 NP_2] \rightarrow [_{NP} NP_1 de NP_2]$

This account is problematic in the following aspects: First, the second step, shown in (12b), is poorly motivated. It is not known why *lǎoshī* is fronted to a preceding position instead of remaining in situ. Second, it is not clear in which sense

reanalysis is applied as a mechanism in generating the structure at issue. If structural reanalysis is adopted in the sense of Manzini (1983) and others of the same line of thought, it is mysterious why *de* is inserted between two nominal phrases which otherwise have a loose structure relationship and get structurally closer to each other through reanalysis. As was illustrated by (6) and (7), the presence and absence of *de* between two nominal phrases produce different semantic effects. Thus, simply assuming that *de* is inserted between two *NPs* that have a closer structural relationship because of undergoing reanalysis is not enough in face of the semantic facts. Third, even if the structural relationship between the two adjacent *NPs* is reanalyzed as an *NP*, the structural position for *de* to be inserted into is still unavailable because [_{NP} *NP*₁ *NP*₂] is a structure that has already been formed through applying some phrase structure rule(s). Therefore, the insertion of *de* is poorly motivated. Fourth, if *NP*₁ and *de* constitute an *NP*, called *NP*₃, then the phrase structure on the rightmost of (13) should be [_{NP} [_{NP} *NP*₁ *de*] *NP*₂] rather than [_{NP} *NP*₁ *de* *NP*₂].

3.2 The genitive approach

Huang (2008) proposes another account, which is intended to solve the problem of overgeneration that the previous account (Huang 1982, 1998) suffers from and avoid using reanalysis as a theoretical apparatus because of its being poorly motivated. The theory of lexical decomposition and the theory of head movement are adopted to explain the generation of fake modification constructions. Regardless of the problem of overgeneration, the new account, theoretically, does not fare better than the one reviewed above, for it suffers from the problem of theoretical incoherence, which can be seen in his account of the generation of the following two sentences. The first one is (14), which is another instance of the construction instantiated by (8c).

- (14) Nǐ jiāo nī de yīngwén.
 2ND.SG teach you DE English
 ‘You teach English [as your own business].’

The generation of the surface structure of (14) is shown as Figure 1. In the deep structure, where DO stands for a light verb, *nǐ de* ‘2ND.SG DE’ as a phrase occupies the Specifier (Spec) of a Gerund Phrase (GP) headed by a gerund (G), on which there is an empty category. Put in plain English, *nǐ de jiāo yīngwén* ‘2ND.SG DE teacher English’ is treated as a gerund phrase in which *nǐ de* ‘2ND.SG DE’ is a genitive modifier of *jiāo yīng* ‘teach English’. The verb *jiāo*, which initially occurs in a low position, moves upward via G(erund) to a higher position occupied by the light verb DO. This account faces an obvious empirical challenge: *nǐ de jiāo yīngwén* is in no way a well-formed phrase. Although undeniably, in Chinese a phrase like *tā de dào lái* ‘3RD.SG DE arrive’ [his arriving/arrival] is intuitively acceptable, a phrase like *tā de dào Běijīng* ‘3RD.SG DE arrive Beijing’ is absolutely bad. Even if there is such a thing as a gerund, there is no telling evidence that a transitive verb and its object complement can appear in a gerund phrase.

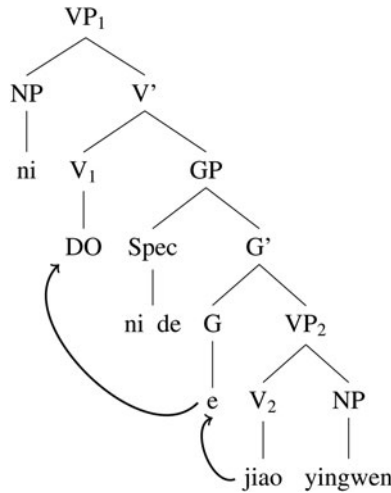


Figure 1: Generation of the surface structure of example (14)

The second one is (10a), repeated as (15), which is structurally the same as (8a). According to Huang (2008), the sentence is generated through the syntactic computations shown in (16).

- (15) Tā de lǎoshī dāng dé hǎo.
3RD.SG DE teacher act.as PRT good
 ‘He teaches well.’ [Literally: He acts as a teacher well.]
- (16) a. Step 1: tā DO tā de dāng lǎoshī (dé hǎo). (deep structure)
- b. Step 2: tā dāng_i tā de t_i lǎoshī (dé hǎo) (the movement of the core verb dāng)
- c. Step 3: [e] dāng_i tā de t_i lǎoshī (dé hǎo). (the deletion of the subject tā)
- d. Step 4: [tā de t lǎoshī]_j dāng t_j (dé hǎo). (the fronting of the object tā de lǎoshī to become an accusative subject)
- e. tā de lǎoshī dāng (dé hǎo) (Step 5: the surface structure)

As shown in (16a), the deep structure consisting of a light verb DO, its subject and object complements are generated. The verb *dāng* in the gerund phrase moves (via the assumed empty category on the head of the gerund phrase) to where DO is located, shown in (16b). Then the subject of the deleted DO is deleted. Subsequently, *tā de t_i dāng lǎoshī* moves to where *tā* has been deleted, resulting in (16e).

This account suffers from the following problems:

First, Huang (2008) is silent on the structural relationship between *de hǎo* and *tā de dāng lǎoshī* in (15). It is not clear whether *de hǎo* is part of the gerund phrase that includes *tā de dāng lǎoshī*. If it is, why can’t *de hǎo* move together with *tā de dāng lǎoshī* to the subject position, resulting in *tā de lǎoshī de hǎo dāng*, which is

unacceptable? What is worse is that without *dé háo*, (15) remains unacceptable. Although *dé hǎo* is so important for the well-formedness of (15), the generative account simply leaves it aside as something trivial. Apparently, this account fails to achieve descriptive adequacy (Chomsky 2014).

Second, although the movement of the gerund phrase to the subject position is motivated by the need for an explicit subject, the reason the original subject is deleted is not clearly stated. It seems that the deletion of the NP and the movement of a gerund phrase to the position of the NP is nothing but an ad hoc stipulation aimed to construct the surface structure.

Third, in (16d), *tā de t lǎoshī* occurs in the subject position as a result of movement; this leads to the fact that the trace that the movement of *dāng* leaves behind in Step 2 is higher than the position of *dāng*. The consequence of this operation is that the trace of *dāng* is neither antecedent-governed nor theta-governed by *dāng* ‘act.as’, which violates ECP, a principle that cannot be violated in the framework in which Huang’s formulates his account.

Fourth, the gerund phrase assumption is short of empirical corroboration; *tā de dāng lǎoshī*, just like *tā de jiāo yīngwén*, is in no way a well-formed phrase in Chinese. Other generative accounts (Tang 2010; Guo 2017; Pan and Lu 2011), which will not be reviewed in detail, either assume that *de* is the marker of a genitive modifier subsumed in a gerund phrase as Huang (2008) does or assume that *de* is inserted between two adjacent NPs which undergo reanalysis, constituting a larger NP as Huang (1982, 1998) assumes. For these reasons, they suffer from the same problem of making assumptions that go against empirical facts.

3.3 The phonological-syntactic interface approach

Zhuang (2017) proposes an account of fake modification constructions instantiated by (10a), where the insertion of *de* is phonologically motivated. As Zhuang (2017) argues, *tā* and *lǎoshī* belong to the same prosodic domain if the sentence is pronounced at a fast speed although they belong to different syntactic components and do not semantically combine. This results in a mismatch between the prosodic structure and the syntactic structure of the sentence, violating the phonological-syntactic Mapping Rule (Tokizaki 1999, 2005, 2007). By the insertion of a pause, or *ya* or *ba* or *de* between *tā* and *lǎoshī*, the mismatch can be solved because morphemes such as *ya*, *ba* and *de* are clitics that are attached to the preceding content phrase.

This analysis is faced with empirical challenges. Consider the examples in (17). Intuitively, when *ya* or *ba* is inserted between *tā* and *lǎnqiú*, a pause can still be inserted, immediately following *ya* or *ba*, for example in (17a). In contrast, when *de* is inserted between *tā* and *lǎnqiú*, further inserting a pause results in awkwardness, such as (17b). If *de* is inserted merely to construct the correspondence between the prosodic and syntactic structures, it is surprising that a pause cannot follow it. To my knowledge, a pause cannot occur between a verb and its object in natural Chinese speech; this fact makes *de* at issue look rather similar to a verb. This similarity is further elaborated in section 4.

- (17) a. Zhāngsān ya/ba [] lánqiú dǎ dé hǎo.
 Zhangsan YA/BA PAUSE basketball play PRT well
 ‘As for Zhangsan, he plays basketball well.’
- b. *Zhāngsān de [] lánqiú dǎ dé hǎo.
 Zhangsan DE PAUSE basketball play PRT well
 ‘As for Zhangsan, he plays basketball well.’

Another fact that suggests that Zhuang’s (2017) account is problematic is given below.

- (18) a. Lánqiú ya/ba/[] Zhāngsān dǎ dé hǎo.
 basketball YA/BA/PAUSE Zhangsan play PRT well
 ‘As for basketball, he plays it well.’
- b. *Lánqiú de Zhāngsān dǎ dé hǎo.
 basketball DE Zhangsan play PRT well
 ‘As for basketball, he plays it well.’

In (18a), *lánqiú* ‘basketball’ appears in sentence-initial position, as a topic; the sentence is fully acceptable no matter whether *ya*, *ba*, or a pause follows the topic or not. Syntactically, the topic, *lánqiú* and the subject *Zhāngsān* do not belong to the same syntactic components and do not semantically combine, inserting *ya*, *ba*, or a pause after the topic is not surprising according to Zhuang (2017). However, as shown in (18b), inserting *de* after the topic is disallowed. This fact supports my argument that Zhuang’s (2017) account is not on the right track. Besides, although (18b) is unacceptable for the given translation therein, the sentence is acceptable when it has the pragmatically odd meaning ‘The basketball plays Zhangsan well’. This fact strongly suggests that the presence of *de* in this fake modification construction is not motivated at the phonological-syntactical interface but rather at the semantic-syntactic interface.

4. NEW OBSERVATION OF *DE*

The difficulties that the existing accounts are faced with justify further investigation and an alternative analysis of *de*. By drawing upon the literature and new observation, I argue that *de* contributes a semantically underspecified predicate, the meaning of which is specified via context-based inference.

4.1 *De* as a semantically underspecified predicate

It has been observed that *de* in some uses occupies a position that is otherwise occupied by a two-place predicate, as illustrated by (19a) and (19b), with (19c) as a reference for the discussion.

- (19) a. Wǒ de yí gè péngyǒu, zhǎng dé hěn shuài.
 1ST.SG DE one CL friend, look PRT very handsome
 ‘I have a friend, looking very handsome.’

- b. Wǒ yǒu yí gè péngyǒu, zhǎng dé hěn shuài.
 1ST.SG have one CL friend, look PRT very handsome.
 'I have a friend, looking very handsome.'
- c. *Wǒ yǒu de yí gè péngyǒu, zhǎng dé hěn shuài.
 1ST.SG have DE one CL friend, look PRT very handsome.
 'I have a friend, looking very handsome.' [intended]

In (19a), *wǒ de* is conventionally regarded as a syntactic combination of the first person pronoun *wǒ* with a clitic *de*, which functions like the possessive pronoun *my* in English, as mentioned before. According to this conventional view, *wǒ de yí gè péngyǒu* is the grammatical subject of sentence (19a) and *zhǎng dé hěn shuài* is the predicate. Nevertheless, it should be noted that the sentence can be paraphrased as (19b), in which the possessive relationship is expressed by the verb *yǒu* 'have'. The structural analysis of (19b) is a thorny issue. One possible analysis is that *wǒ yǒu yí gè péngyǒu* is a clause and *zhǎng dé hěn shuài* is another clause, the semantic subject of which is 'a friend of mine' or literally 'a friend that I have'. In other words, the first clause in (19b) very likely is a noun phrase consisting of the head *yí gè péngyǒu* 'a CL friend' and a relative clause *wǒ yǒu* '1ST.SG have', which does not carry the modification marker *de*. It is not uncommon that in some cases a relative clause does not carry the modification marker *de* although in many cases *de* is present. Compare (20a), where the modification marker *de* occurs and (20b) where the marker does not occur.

- (20) a. Wǒ mǎi de nà běn shū hěn piányi.
 1ST.SG buy DE that CL book very cheap
 'That book which I bought is very cheap.'
- b. Wǒ mǎi nà běn shū hěn piányi.
 1ST.SG buy that CL book very cheap
 'That book which I bought is very cheap.'

Assuming that (19b) involves an ellipsis of *de*, it is expected that *de* could be recovered in it; but the co-occurrence of *yǒu* and *de* results in ungrammaticality, as shown in (19c). An explanation of the ungrammaticality is that in such a case, *de* has obtained some property of a predicate and competes with *yǒu* for the same syntactic function, although *de* itself is semantically underspecified.

The second piece of evidence for this hypothesis comes from the use of *de* in oral calculation. On some occasions, *de* occurs where the word *chéng* occurs. The word *chéng* expresses multiplication calculation involving two numbers, for example (21a).

- (21) a. Èrshí wǔ de èrshí wǔ, liù bǎi èrshí wǔ.
 twenty five DE twenty five, six hundred twenty five
 'Twenty five multiplied by/times twenty five is six hundred and twenty five.'
- b. Èrshí wǔ chéng èrshí wǔ, liù bǎi èrshí wǔ.
 twenty five multiplied.by/times twenty five, six hundred twenty five
 'Twenty five multiplied by/times twenty five is six hundred and twenty five.'

Sentence (21a) can be straightforwardly paraphrased by sentence (21b).⁵ Where *de* occurs in (21a) is exactly where *chéng* ‘multiplied by/times’ occurs in (21b).

Interestingly, on other occasions, speakers use *de* to express addition calculation, illustrated by (22a), with (22b) as a paraphrase.

- (22) a. Èrshí wǔ de èrshí wǔ, wǔshí.
 twenty five DE twenty five, fifty
 ‘Twenty five plus twenty five is fifty.’
 b. Èrshí wǔ jiā èrshí wǔ, wǔshí.
 twenty five plus twenty five, fifty
 ‘Twenty five twenty five is fifty.’

(21) and (22) illustrate a case where the semantically underspecified *de* obtains its semantic content via context-based semantic enrichment.⁶ Since *de* is either interpreted as multiplication or addition when it occurs between two numeral phrases, its interpretation heavily depends on the context in which it appears. Such facts are similar to (8a) and (8d), repeated below as (23a) and (24a), where *de* can be paraphrased by a two-place verb, as is illustrated by (23b) and (24b).

- (23) a. Zhāngsān de lánqiú dǎ dé hǎo. [= (8a)]
 Zhangsan DE basketball play PRT good
 ‘Zhangsan plays basketball well.’
 b. Zhāngsān dǎ lánqiú dǎ dé hǎo.
 Zhangsan play basketball play PRT good
 ‘Zhangsan plays basketball well.’
 (24) a. Zhèi dùn fàn, Zhāngsān de dōngjiā. [= (8d)]
 this CL meal Zhangsan DE host
 ‘As for this meal, Zhangsan acts as the host.’
 b. Zhèi dùn fàn, Zhāngsān dāng dōngjiā.
 this CL meal Zhangsan act.as host
 ‘As for this meal, Zhangsan acts as the host.’

In another sentence, which has the same structure as (24a)[=(8d)], *de* is paraphrased by *yǎn* ‘play as’, as shown in (25a) and (25b).

- (25) a. Zhèi chǎng xì Méi Lánfāng de Yúji.
 this CL opera Mei Lanfang DE Yuji
 ‘In this opera, Lanfang Mei played as Princess Yuji.’
 b. Zhèi chǎng xì, Méi Lánfāng yǎn Yúji.
 this CL opera, Mei Lanfang act.as Yuji
 ‘In this opera, Lanfang Mei played as Princess Yuji.’

⁵An informant indicates that the larger numbers are, the more natural *de* sounds in this position.

⁶Not all informants agree upon this use of *de*: some accept it, even though they themselves may have never used it; others do not accept it. This variation is related to the informants’ dialectal background.

It should be noted that *de* in (8b) cannot be straightforwardly interpreted as a predicate. But (8b) has a variant, given above as (9) and repeated below as (26a). The morpheme *de* in (26a) can be paraphrased by a full verb, as shown in (26b).

- (26) a. Zhāngsān de bù pǎo-le sān fēnzōng [= (9)].
 Zhangsan DE step run-ASP three minute
 ‘Zhangsan ran for three minutes.’
- b. Zhāngsān pǎo bù pǎo-le sān fēnzōng.
 Zhangsan run step run-ASP three minute
 ‘Zhangsan ran for three minutes.’

This indirectly shows that *de* in (8b) can be paraphrased by a full verb. Unlike (8a), (8b), and (8d), in which *de* can be somehow paraphrased by a full verb, (8c), repeated as (27a), does not have a corresponding paraphrasing sentence. But it still can be assumed that *de* therein is a semantically underspecified predicate. If *de* is replaced by a full verb, although the resulting sentence as a whole is weird, neither of the parts indicated by the separating ‘||’ in (27b) is unacceptable.

- (27) a. Zhāngsān dǎ Zhāngsān de lánqiú, (Lǐsì pǎo Lǐsì de bù.) [= (8c)]
 Zhangsan play Zhangsan DE basketball, Lisi run Lisi DE step
 ‘Zhangsan plays basketball and Lisi runs [they do not interfere with each other].’
- b. *Zhāngsān dǎ || Zhāngsān dǎ lánqiú, (Lǐsì pǎo || Lǐsì pǎo bù.)
 Zhangsan play || Zhangsan play basketball, (Lisi run || Lisi run step)
 ‘Zhangsan plays basketball and Lisi run.’

Although it seems that simply repeating a full verb is dispreferred, assuming *de* as a semantically underspecified predicate that expresses what a full verb expresses does not go against any empirical fact.

Additionally, it is likely that this use of *de* occurs as a result of degrammaticalization (Norde 2009), wherein *de* changes from a pure functional clitic to a semantically underspecified two-place predicate either by reanalysis, in which *de* absorbs some property of some adjacent predicate that no longer appears, or by analogy because *de* happens to appear in a position where a two-place predicate can appear. In fact, the thought that *de* is a semantically underspecified two-place predicate has been suggested before. As mentioned in the literature review, Mei (1978) proposes that *de* is inserted in a position where a verb is deleted but, unfortunately, he does not clarify the syntactic and semantic properties of *de* in this case.⁷

To sum up, the above observation reveals that *de* has the status that a verb typically has, but it is semantically underspecified in the sense that its specific semantic content is contextually enriched.

⁷Wu Y. (p.c.) suggests an alternative analysis of the sentence in (24a), where he assumes that between *Zhāngsān* and *de* there is an unpronounced verb *dāng*. I think it is a case of the emphatic construction where *de* is a melange of emphatic marker and tense marker rather than the morpheme *de* at issue. For more discussion on the use of *de* in the emphatic ‘*shì...de*’ construction, see Cheng (2008), Paul and Whitman (2008), among many others.

4.2 The syntactic restrictions concerning *de*

The semantic underspecification of *de* determines that the morpheme is context-dependent semantically, either obtaining its semantic content from a preceding context, for example (8b) and (8c), or from a later context, e.g., (8a) or from the speaker's world knowledge such as (8d), (22a), and (22b). Apart from being semantically context-dependent, the morpheme is also syntactically dependent. In (8a), *de* requires the occurrence of its grammatical subject and object, and it also requires the presence of the verb and a postverbal adverbial. In (8b) and (8c), where the linear position of *de* is different from that in (8a), the word has other requirements on what can or cannot appear before or after it. The examples in (28) illustrate the syntactic restrictions concerning *de*.⁸

- (28) a. *(Zhāngsān) de *(lánqiú) *(dǎ) *(dé hǎo).
 Zhāngsān DE basketball play PRT good
- b. Zhāngsān de lánqiú (*Zhāngsān) dǎ dé hǎo.
 Zhāngsān DE basket Zhāngsān play PRT good
- c. Zhāngsān dǎ sān tiān (*Zhāngsān) de lánqiú.
 Zhāngsān play three day Zhāngsān DE basketball
- d. Zhāngsān dǎ (*sān tiān) Zhāngsān de lánqiú.
 Zhāngsān play three day Zhāngsān DE basketball

Sentence (28a) shows that *de* requires the presence of its grammatical subject, grammatical object, the verb, and some following adverbial expressions, such as *dé hǎo*. The absence of any one of these expressions results in ungrammaticality. Sentence (28b) shows that the presence of *de* does not allow *dǎ dé hǎo* to be immediately preceded by a local subject. Sentences (28c) and (28d) jointly show that the postverbal adverbial and the local subject cannot co-occur. In the generative accounts reviewed above, the significance of the presence of *dé hǎo* for the well-formedness of (28a) and (28b) is simply ignored, since the theoretical tools in those accounts cannot accommodate the requirement of the presence of a postverbal adverbial that *de* imposes. Briefly, a number of facts regarding *de* and fake modification constructions in which it appears can hardly be explained by any general rules in Generative Grammar. Instead, it seems that *de* turns out to be different morphemes in different fake modification constructions, because its presence in these various constructions is syntactically constrained in different ways and imposes constraints on other expressions in different ways, although in each fake modification construction, *de* always contributes a semantically underspecified predicate. In the following section, a formal characterization of fake modification constructions is proposed, where the

⁸Parentheses are a notational convention. The expression between a pair of parentheses is optional. For example, A(B)C indicates that both AC and ABC are acceptable strings. If an asterisk '*' immediately precedes the expression inside the parentheses, as in A(*B)C, then AC is acceptable but ABC is not. If instead the asterisk immediately precedes the left parenthesis, as in A*(B)C, then ABC is acceptable but AC is not (Huang et al. 2009).

common contribution to semantic interpretation and the syntactic peculiarities of different *de*-morphemes are captured in parallel as part of parsing processes.

5. A PARSING ACCOUNT OF FAKE MODIFICATION CONSTRUCTIONS

The semantic underspecification and update and syntactic restrictions concerning *de* exhibit themselves in dynamic processes of expressing propositional meanings by uttering strings of words. A string of words that is used for communication is a grammatical sentence only if it is parsable. Hence, the grammaticality of a sentence can be defined as its parsability and seen from the parsing perspective, the grammar of a language is the procedural actions that are directly employed in parsing. This is the very linguistic philosophy of Dynamic Syntax (Kempson et al. 2001; Cann et al. 2005). This section is devoted to proving such a parsing account of the constructions at issue in the framework of Dynamic Syntax. The framework is briefly introduced first in 5.1. For more details, see Kempson et al. (2001), Cann et al. (2005), Gregoromichelaki and Kempson (2013), Kempson et al. (2015), Kempson et al. (2016), Gregoromichelaki and Kempson (2017), among many other Dynamic Syntax studies. The parsing account of the fake modification constructions is given in 5.2.

5.1 Essentials of Dynamic Syntax

In Dynamic Syntax, well-formed sentences are parsable strings of words. The parse of a string of words is aimed to construct a propositional formula. It is hypothesized that a parsing process involves the application of some general computational rules that induce the construction of semantic structures, lexical information of words parsed one by one, contextual information relevant to an ongoing parsing process, and pragmatic inference triggered either verbally or non-verbally. A parsing process is an informationally incremental process, where what has been used can be reused, and it is also a process where semantic underspecification and update keep happening, which means that initially, some semantic content does not have fixed status or some expressions do not have specific semantic content and semantic underspecification is updated in later parsing stages.

Technically, Dynamic Syntax employs the Logic of Finite Trees (Blackburn and Meyer-Viol 1994), a modal logic which describes binary branching tree structures, reflecting the mode of semantic combination in the form of functional application. The monotonic growth of a partial semantic tree is employed to represent stepwise accumulation of semantic content obtained from linearly parsed words and relevant context. Next, (29) is used as an example to demonstrate how the parsing process unfolds and how computational rules and lexical information are employed in the parsing process, and to introduce some basic assumptions that are adopted in the following account of fake modification constructions.

- (29) Zhāngsān dǎ lánqiú.
 Zhangsan play basketball
 ‘Zhangsan plays basketball.’

The parsing process starts with setting up the initial goal of constructing a proposition on the root node of a partial semantic tree. The initial goal is represented by $?t$, where ‘?’ stands for the requirement of a formula and ‘t’ stands for the truthvalue type of a formula, i.e., a proposition. New tree nodes are created as a result of applying general computational rules or lexical actions. Tree nodes accommodate semantic content obtained from scanned words or context. A tree node under construction is indicated by \diamond , called the pointer. The pointer moves from one tree node to another as the parsing process unfolds and more and more tree nodes are created and constructed one by one. When a tree node initially has a requirement to be met, the requirement must be satisfied somehow; otherwise, the parsing process cannot be successfully accomplished. As the requirements on all terminal tree nodes are satisfied, the semantic formulae on sister nodes combine through functional application to satisfy the requirements on the immediately dominating tree nodes until there is no outstanding requirement on any tree node, a state in which the utmost goal is achieved.

The parsing process starts with setting the initial goal $?t$ of a partial semantic tree, the address of the root node being $Tn(n)$, which is either $Tn(0)$, i.e., a node dominated by no other node, or some node properly dominated by $Tn(0)$ (see Figure 2).

$$Tn(n), ?t, \diamond$$

Figure 2: Setting the initial goal

After the initial goal is set, the LOCAL *ADJUNCTION rule is applied, which has the effect of creating an e-type unfixed node,⁹ which is an argument daughter node of a predicate node somewhere below $Tn(n)$. The LOCAL *ADJUNCTION rule is motivated by the fact that in Mandarin Chinese, an expression that contributes an argument-type formula does not initially get fixed a semantic status in the propositional formula to be constructed, as shown in Figure 3.

$$\begin{array}{c} Tn(n), ?t, \\ \vdots \\ \langle \uparrow_0 \rangle \langle \uparrow_*^1 \rangle Tn(n), ?e, \diamond \end{array}$$

Figure 3: After applying LOCAL *ADJUNCTION

Presently, the pointer is on an e-type node. The goal e can be achieved by scanning the lexical item *Zhāngsān*, the semantic content of which is simply represented as ‘zhangsan’. By convention, contentful formulas are all represented in this way (See Figure 4).

⁹The formal definitions of the general computational rules applied in this paper are given in the Appendices.

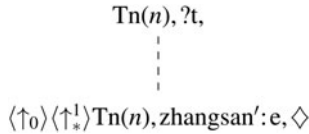


Figure 4: After scanning *Zhangsan*

As the requirement on the argument node is satisfied, the pointer moves upward through applying the rule of COMPLETION (See Figure 5) (Cann et al. 2005, 50).¹⁰

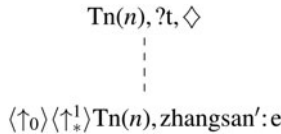
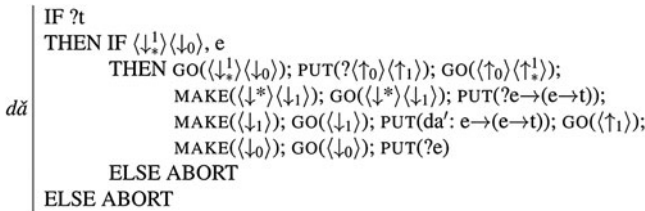


Figure 5: Applying COMPLETION

At this stage, the lexical item *dǎ* ‘play’ is scanned, which provides lexical information. In Dynamic Syntax, lexical information consists of triggering conditions and lexical actions. The ‘IF’ clause expresses triggering conditions; the ‘THEN’ clause delivers lexical actions to be taken if triggering conditions are met and the ‘ELSE’ clause provides lexical actions when triggering conditions are not met.

(30) The lexical information of *dǎ*¹¹



There are two conditions in the lexical information of *dǎ*. The first condition is the pointer is on a node with a type *t* requirement. The second condition is there is an *e*-type unfixed node. The lexical actions that *dǎ* contributes include ‘MAKE()’, ‘PUT()’, ‘GO() and ‘ABORT’. The function of ‘MAKE()’ is to create a node; the tree modal relationship between the current node and the node to be created is

¹⁰In fact, after the parse of *Zhāngsān*, which leads to the annotation of the argument node at issue with a semantic formula of type *e*, the requirement on the node is removed through applying the rule of THINNING; this rule will not be mentioned in the following demonstration, since it is always the case that a requirement is not longer valid once it is satisfied.

¹¹This is just the information related to the current use of *dǎ*. This lexical item can be used in various contexts and therefore its lexical information cannot be restricted to what is presented here.

given as the argument of ‘MAKE()’. The tree modal operators ‘⟨↓⟩’ and ‘⟨↑⟩’ respectively point to the mother node or the daughter node of a node at issue and the subscripts ‘0’ and ‘1’ indicate the logical type of node pointed to. ‘0’ means that the node pointed to is an argument node and ‘1’ means that the node pointed to is a functor node. The Kleene star ‘*’ is used to express some underspecified tree node relation. For example ⟨↑*⟩Tn(n) expresses a node that is somewhere below the root node Tn(n). The tree modal operators can be used successively to indicate the tree modal relationship between any two nodes on the same semantic tree. The function of ‘GO()’ is to move the pointer from the current node to another node and the tree modal relationship between the current node and the node to which the pointer moves to is given as the argument of ‘GO()’. ‘PUT()’ annotates a node with some lexically provided semantic content or requirements. The action ‘ABORT’ is responsible for terminating a parsing process. All linguistic expressions, including lexical items and clitics, contain lexical actions.¹² To continue, as the word *dǎ* is parsed, the lexical actions that the word contributes update the partial semantic tree. When the triggering conditions are satisfied, the word constructs an unfixed node that dominates two nodes, annotates the functor type daughter node with a semantic formula, and drives the pointer to the e-type node created as a result of applying lexical actions. The assumption that the lexical actions of *dǎ* create an unfixed node is motivated (see Figure 6) by the fact that content verbs in Chinese can be used either finitely or non-finitely, and when they occur, their semantic status in a propositional formula under construction is not fixed initially.

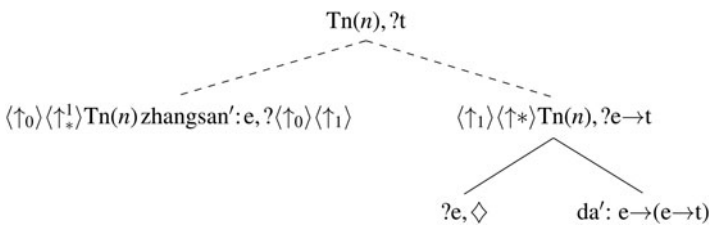


Figure 6: After parsing *Zhangsan da*

Following *dǎ*, *Lǐsì* is parsed, which updates the partial tree, as shown in Figure 7.

Next, at this stage, two rules are applied consecutively. The COMPLETION rule moves the pointer up from a daughter to a mother and annotates the mother node with the information that it indeed has a daughter with certain properties. The ELIMINATION rule takes the formulae on two daughter nodes, performs functional application over these and annotates the mother node with the resulting formula and type, thus satisfying an outstanding type requirement on the non-terminal mother

¹²The lexical information of the proper name *Zhāngsān* is as follows.

<i>Zhāngsān</i>	IF ?e
	THEN PUT(zhangsan': e)
	ELSE ABORT

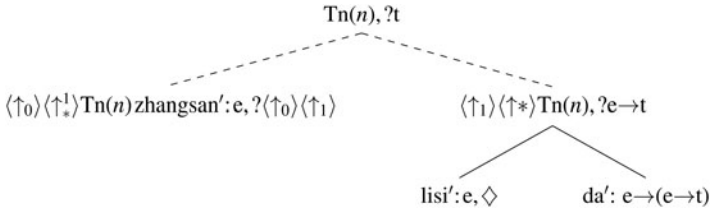


Figure 7: After parsing *Zhangsan da Lisi*

node. Then, the INTRODUCTION and PREDICTION rules are applied successively, which construct a tree structure to accommodate semantic components of a propositional formula. By applying the ANTICIPATION rule, the pointer moves to the type $(e \rightarrow t) \rightarrow (e \rightarrow (e_s \rightarrow t))$ node, which is assumed to be there to accommodate the semantic content from an adverb that semantically modifies the verb, if available, or to accommodate an identity functor if no such adverb is available (see Figure 8). An identity functor, similar to a metavariable, does not have conceptual content, but unlike a metavariable, which obtains conceptual content from context, it takes a concept obtained through parsing as its argument to yield the same concept as the result of semantic combination. In the current case, the identity functors represent the lack of an adverb that modifies a predicate. The appearance of the identity functor in a partial tree is achieved through applying the IDENTITY FUNCTOR INSERTION rule (given in the Appendices).

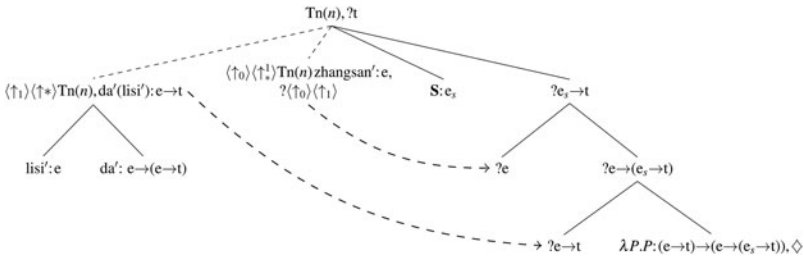


Figure 8: After applying INTRODUCTION and PREDICTION repeatedly

With the propositional template constructed, a few fixed nodes with logical type requirements are available. At this parsing stage, the previously constructed unfixed nodes unify with some of the newly created fixed nodes on the condition that they have the same logical types. The process of an unfixed node and a fixed node unifying is achieved via the action of UNIFICATION, which is indicated by the dashed curves in Figure 8. This operation has the effect of satisfying some, if not all, requirements on both the unfixed node and the fixed node at issue.

Next, since the requirements on the node under construction are satisfied, the COMPLETION and ELIMINATION rules are applied routinely. The pointer

moves upward and the semantic formulae on the sister nodes combine, providing composite semantic values for mother nodes (Cann et al. 2005, 52). The metavariable on the type e_s node (event argument node) is replaced by a free variable s , which happens as a result of pragmatic inference and has the result of specifying an event that is predicated by the proposition to be accomplished (see Gregoromichelaki 2006, 2011, for more details about the significance of the event argument). Finally, all the requirements on the tree are satisfied and a propositional formula is obtained on the root node, as shown in Figure 9.

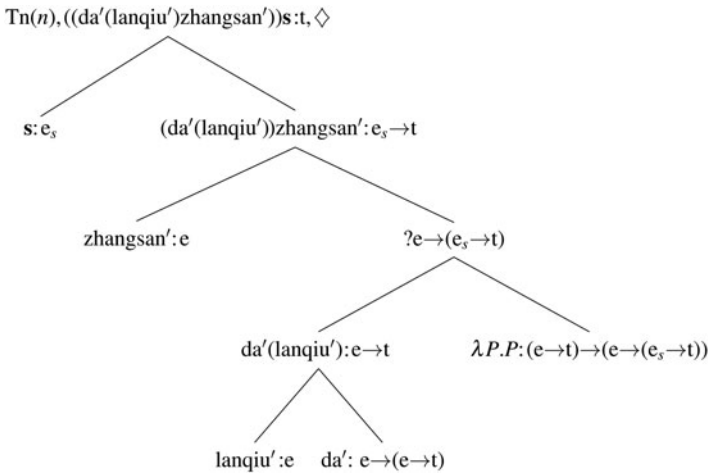


Figure 9: After applying the COMPLETION and ELIMINATION rules repeatedly

The above parsing process illustrates how general computational rules work and what happens when a word is parsed while parsing Chinese sentences. These theoretical tools are employed in characterizing the parsing of the fake modification constructions, along with three LINK-related rules, which are introduced where they are employed. (See Gregoromichelaki and Kempson 2013, 2015; Kempson et al. 2016; Gregoromichelaki and Kempson 2017; Gregoromichelaki 2018, for more on the latest technical and theoretical notions in Dynamic Syntax).

5.2 The dynamics of *de* in fake modification constructions

The four sentences (8a)-(8d), repeated below in each subsection to facilitate readers’ following the formal characterization, are used as examples to illustrate what contribution *de* makes to semantic interpretation in parsing the fake modification constructions. I show that the syntactic constraints on the occurrence of *de* in the fake modification constructions are different from each other and for this reason, different *de*-morphemes are recognized, even though they make rather similar semantic contribution.

5.2.1 Zhangsan de lanqiu da de hao ‘Zhangsan plays basketball well’

- (30) Zhāngsān de lánqiú dǎ dé hǎo. [= (8a)]
 Zhangsan DE basketball play DE good
 ‘Zhangsan plays basketball well.’

The DS characterization of how (30) is parsed goes as follows. First, the initial goal ?t is set on $Tn(n)$. The words to be parsed make two propositions, each of which, semantically, is not embedded in but related to the other. This situation is similar to the case of a relative clause and a matrix clause, or to the case of two conjoined clauses; the mechanism of connecting two partial trees, LINK, is employed (Kempson et al. 2001; Cann et al. 2005). The LINK relationship is represented by a pair of modal operators, $\langle L \rangle$ and $\langle L^{-1} \rangle$; the former ‘points’ to a tree linked to the current node on the matrix tree and the latter ‘points backwards’ to that node. If a node of the first tree has the address $Tn(n)$, the root node of the LINKed tree that LINK points to has the address $\langle L^{-1} \rangle Tn(n)$. Finally, the semantic content on the two partial trees are integrated through applying the rule of LINK EVALUATION. Since *de* cannot function as the predicate of a contextually independent sentence/clause, the information that the string *Zhāngsān de lánqiú* is accommodated on the LINKed tree, similar to that of a relative clause, the interpretation of which is dependent on another clause, even though it has a full clausal structure.

The parsing process starts with setting the root node of a main tree and then LINK ADJUNCTION is applied under the condition of ?t on the root node of the main tree, giving rise to the LINK relationship between the root nodes of two partial trees, one being the main tree and the other, the LINKed tree. The pointer is moved to the root node of the LINKed tree. At this stage, LOCAL *ADJUNCTION is applied, creating an e-type unfixed node, and then *Zhāngsān* is processed. After these operations, the partial tree grows into the state shown in Figure 10.

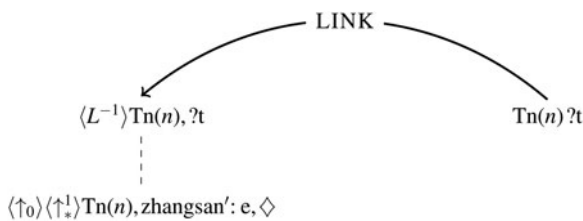


Figure 10: After parsing *Zhangsan*

Now, the lexical item *de* is processed. The above description shows that *de* appears in different positions in the different fake modification constructions. To capture this fact, I assume that *de* can be parsed under different conditions. In the current case, the conditions under which *de* (referred to as *de_i*) contributes lexical actions are that the pointer is located on the root node of a tree LINKed to the root node of a main tree, which does not have any daughter nodes yet and under the current node of the LINKed tree, there is an unfixed node that accommodates an e-type formula and there are no other daughter nodes. Once the triggering conditions

in de_i are satisfied, the lexical actions in de_i are triggered. The lexical actions include those that construct a propositional template, which are given in (32) and are referred to as ‘...’ henceforth, and those which impose some requirements on the growing tree(s).

(32) Lexical actions that the de -morphemes at issue commonly contribute

```

Referred to as ‘...’
MAKE( $\langle \downarrow_0 \rangle$ ); GO( $\langle \downarrow_0 \rangle$ ); PUT( $?e_s$ ); GO( $\langle \uparrow_0 \rangle$ );
MAKE( $\langle \downarrow_1 \rangle$ ); GO( $\langle \downarrow_1 \rangle$ ); PUT( $?e_s \rightarrow t$ );
MAKE( $\langle \downarrow_0 \rangle$ ); GO( $\langle \downarrow_0 \rangle$ ); PUT( $?e$ ); GO( $\langle \uparrow_0 \rangle$ );
MAKE( $\langle \downarrow_1 \rangle$ ); GO( $\langle \downarrow_1 \rangle$ ); PUT( $e \rightarrow (e_s \rightarrow t)$ );
MAKE( $\langle \downarrow_1 \rangle$ ); GO( $\langle \downarrow_1 \rangle$ ); PUT( $\lambda P.P:(e \rightarrow t) \rightarrow (e \rightarrow (e_s \rightarrow t))$ ); GO( $\langle \uparrow_1 \rangle$ );
MAKE( $\langle \downarrow_0 \rangle$ ); GO( $\langle \downarrow_0 \rangle$ ); PUT( $?e \rightarrow t$ );
MAKE( $\langle \downarrow_1 \rangle$ ); GO( $\langle \downarrow_1 \rangle$ ); PUT( $\mathbf{R}, ?\exists z.z: e \rightarrow (e \rightarrow t)$ ); GO( $\langle \uparrow_1 \rangle$ );
MAKE( $\langle \downarrow_0 \rangle$ ); GO( $\langle \downarrow_0 \rangle$ ); PUT( $?e$ )
    
```

(33) The lexical information of de_i

```

IF  $\langle L^{-1} \rangle Tn(n), ?t$ 
THEN IF  $\langle L^{-1} \rangle Tn(n) \downarrow \vee Tn(n) \downarrow$ 
    THEN ABORT
    ELSE IF  $\langle \downarrow_1 \rangle \langle \downarrow_0 \rangle e$ 
        THEN GO( $\langle L^{-1} \rangle$ );
        PUT( $? \langle \downarrow_0 \rangle, \mathbf{S}: e_s, ? \langle \downarrow^* \rangle \langle \downarrow_1 \rangle, \mathbf{R}, ?\exists z.z: e \rightarrow (e \rightarrow t),$ 
             $? \langle \downarrow^* \rangle (e \rightarrow t) \rightarrow (e \rightarrow (e_s \rightarrow t))$ );
        GO( $\langle L \rangle$ ); ....
    ELSE ABORT
ELSE ABORT
    
```

The effect of parsing de_i and that of applying UNIFICATION are shown in Figure 11.

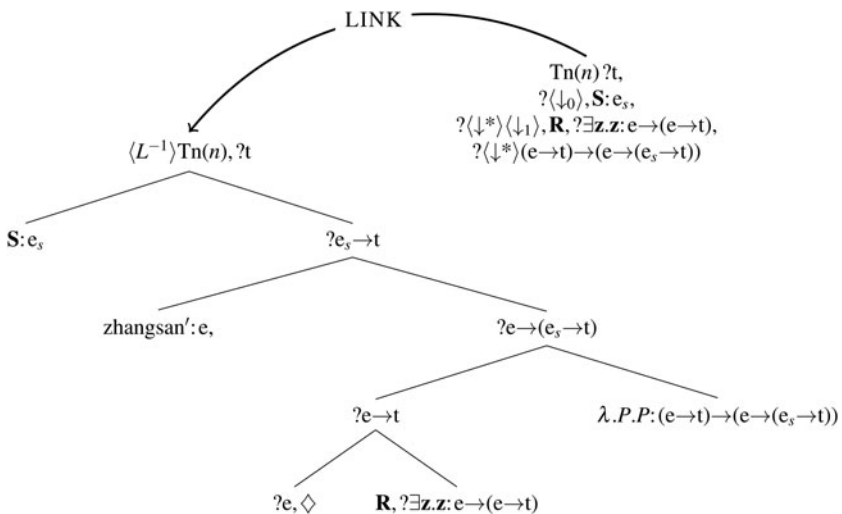


Figure 11: After parsing *Zhangsan de*

As a result of parsing *de*, the pointer is now located on the internal argument node on the LINKed tree. This allows *lǎnqiú* ‘basketball’ to be parsed, which annotates the current node with an e-type formula. Then the LINK ANTICIPATION rule is applied, pushing the pointer to the root node of the main tree, as shown in Figure 12.

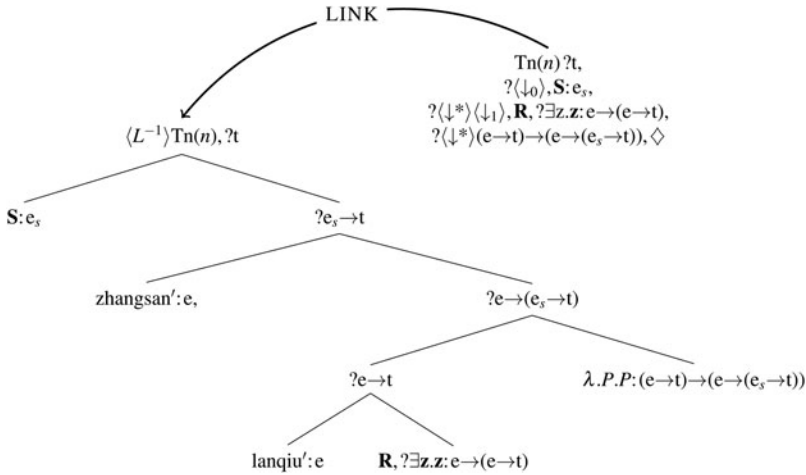
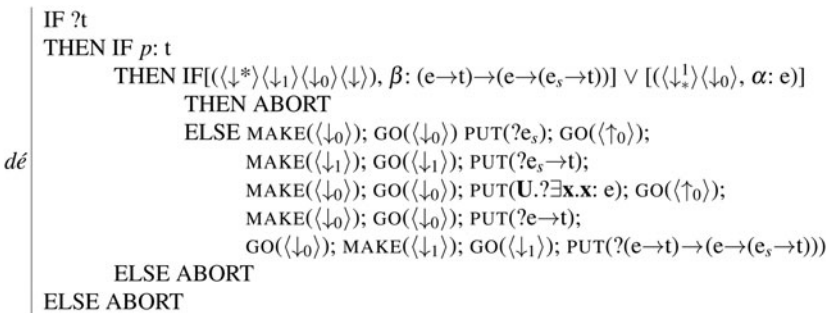


Figure 12: After parsing *Zhangsan de lanqiu*

Then *dǎ* ‘play’ is scanned, projecting an unfixed node that dominates two daughter nodes, including an e-type one that is annotated with a metavariable. The pointer goes back to the root node of the main tree as a result of applying ANTICIPATION, as shown in Figure 13.

Next, the postverbal *dé* is parsed, which requires that a clause has already been parsed; however, the clause already parsed cannot have a postverbal object and also requires that after the objectless clause is a verb without an explicit subject. The lexical information of *dé* is defined as follows.

- (34) The lexical information of the postverbal particle *dé*



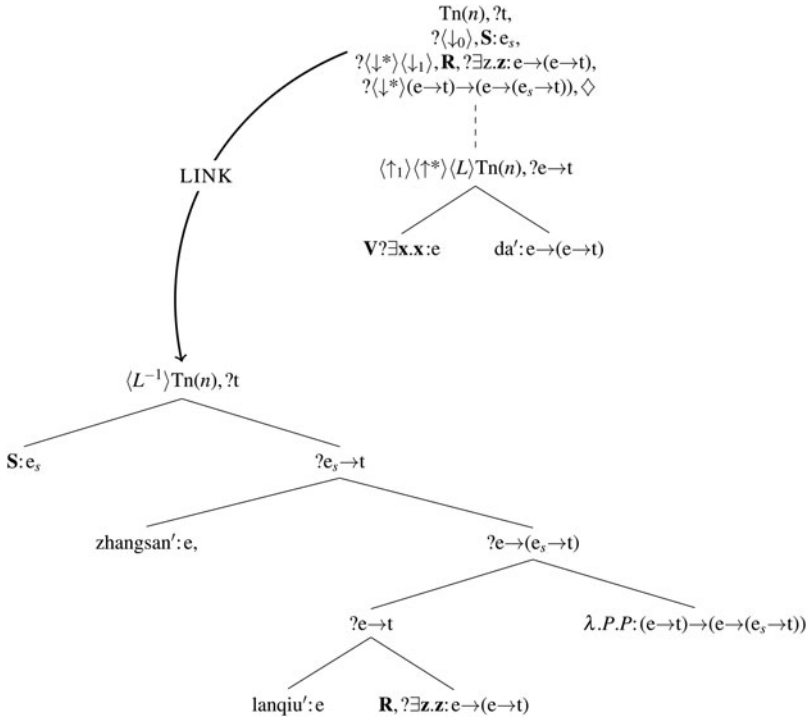


Figure 13: After parsing *Zhangsan de lanqiu da*

The two conditions, ‘*p*:*t*’ and “[$\langle\langle\downarrow^*\rangle\langle\downarrow_1\rangle\langle\downarrow_0\rangle\langle\downarrow\rangle\rangle\beta : (e \rightarrow t)(e \rightarrow (e_s \rightarrow t)) \vee [\langle\langle\downarrow^*\rangle\langle\downarrow_0\rangle\rangle\alpha : e]$]’ together with the ABORT in the same scope of IF, have the function of ensuring that *dé* immediately follows a proposition that has already been constructed and ensuring that it is not immediately preceded by a noun phrase, excluding the ungrammatical string such as *Zhāngsān dǎ lánqiú dé hǎo* ‘Zhangsan play basketball PRT good’ or *Zhāngsān dǎ Zhāngsān dé hǎo* ‘Zhangsan play Zhangsan PRT good’. The condition simply states that if there is a locally constructed argument formula that has daughter nodes, the parse is terminated. In the current case, the internal argument node, where ‘lanqiu’ occurs, does not have daughter nodes because the formula ‘lanqiu’ is not locally constructed through parsing a word, but rather comes from the context (see Figure 14).

After the postverbal *dé* is scanned, the current partial tree is updated, as shown in Figure 14, where the requirement $\langle\langle\downarrow^*\rangle\langle\downarrow_0\rangle\rangle\alpha : e$ is satisfied by the construction of such a node through applying the lexical actions of *hǎo*. At the same time, the unfixed node on the current tree unifies with the lower *e*→*t* type node. The requirements of constructing some nodes below the root node of the current tree are all satisfied (see Figure 15).

The COMPLETION and ELIMINATION rules are applied; a metavariable is inserted in the open *e*-type node and the semantic content of the metavariable

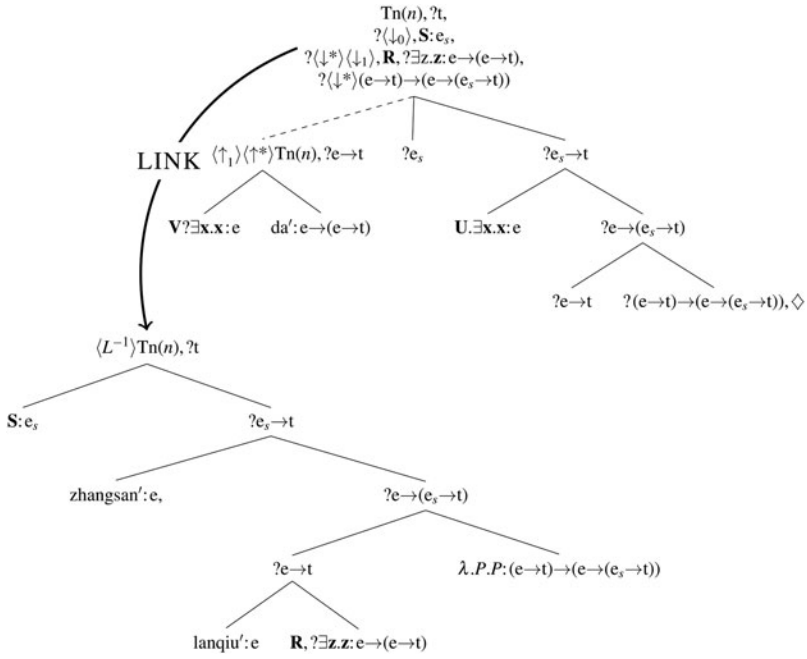


Figure 14: After parsing *Zhangsan de lanqiu da de*

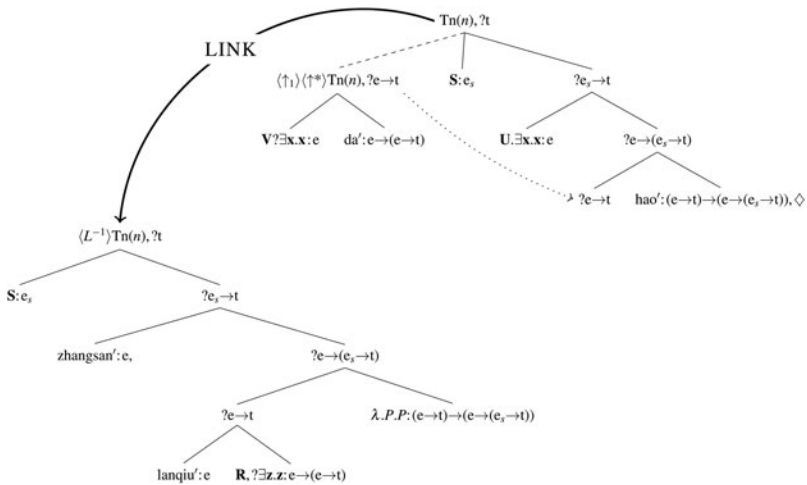


Figure 15: After parsing *Zhangsan de lanqiu da de hao*

comes from the latest context. The metavariable **S** on the current node is replaced by the free variable **s**. The metavariables **U** and **V** are replaced by contentful formulae from the latest context. The pointer goes back the LINKed tree, where there are still requirements to be satisfied. The pointer goes down to the bottommost node first. The metavariable **R** is replaced by the semantic content of *dā*; then the pointer moves upward as the COMPLETION rule is applied several times (see Figure 16).

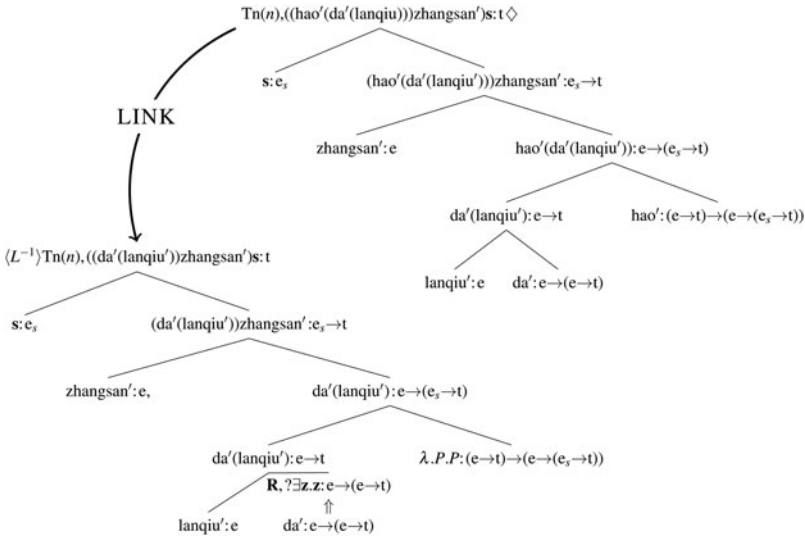


Figure 16: After parsing *Zhangsan de lanqiu da de hao*

As the root nodes of two LINKed semantic trees obtain formulae, the rule of LINK EVALUATION (Cann et al. 2005, 92) is applied. The propositional formulae on the root nodes of the two trees combine into a compound propositional formula, given as (35).

$$(35) \quad (((da'(lanqiu'))zhangsan')s) \wedge (((hao'(da'(lanqiu'))))zhangsan')s)$$

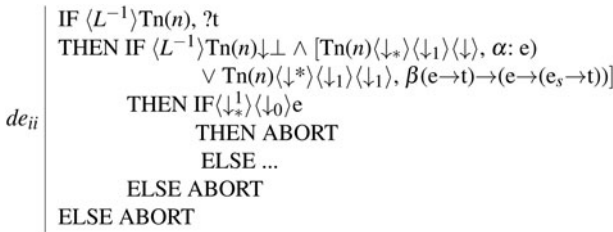
As shown above, in the parsing process, *de_i* contributes a semantically underspecified predicate, the semantic content of which is specified through inference (see Cann et al. 2005 for a similar treatment of *be* in English). Besides, the definition of *de_i* at issue also captures the fact that its presence imposes requirements and constraints on words parsed later. To save space, the following demonstrations only include the state of partial trees before metavariable substitution, COMPLETION, and ELIMINATION rules are applied. Details before and following the presented state are omitted because they are similar to those given above, .

5.2.2 Zhangsan pao-le san fenzhong de bu ‘Zhangsan ran for three minutes’

- (36) Zhāngsān pǎo-le sān fēnzhōng de bù. [= (8b)]
 Zhangsan run-ASP three minute DE step
 ‘Zhangsan ran for three minutes.’

The process of parsing (36) is demonstrated below. The string *Zhāngsān pǎo le sān fēnzhōng* is parsed just like an ordinary simple clause. After this, a LINK relation is constructed between the root node of the current tree and the root node of a LINKed tree. Then, *de* (here referred to as de_{ii}) and *bù* are parsed one by one. The triggering conditions and the lexical actions in de_{ii} are different from those in de_i . In the current case, the triggering conditions consist of three parts: (i) the pointer is located at root node of the LINKed tree; (ii) there exists a propositional formula on the root node of the main tree, which consists of an argument subject, a predicate, and an adverbial; (iii) there is no e-type unfixed node under the root node of the LINKed tree. The lexical actions of de_{ii} includes constructing a propositional template but does not include imposing some requirements on the growing trees.

- (37) The lexical information of de_{ii}



Via parsing de_{ii} and *bù* ‘step’, the partial trees are updated, as shown in Figure 17.

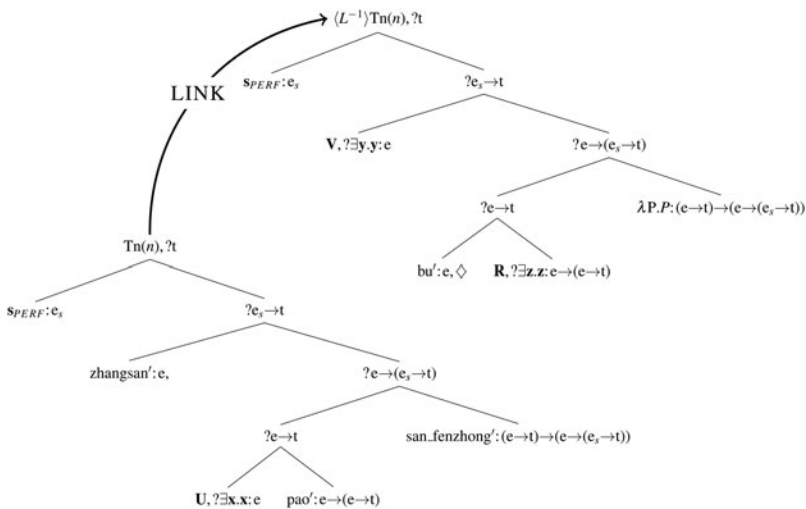


Figure 17: After parsing *Zhangsan pao le san fenzhong de bu*

By applying the COMPLETION and ELIMINATION rules, the propositional formula (38) is obtained.

(38) ((san fenzhong'(pao'(bu'))zhangsan')s

As is seen in the above demonstration of the parsing process, *sān fēnzhōng de bù* ‘three minute DE step’ is not a nominal expression as is assumed in the literature; instead, *de* is a predicate, taking *bù* as its object complement. To reiterate, there is no relation of modification between *sān fēnzhōng* and *bù*.

5.2.3 Zhangsan da Zhangsan de lanqiu ‘Zhangsan played basketball’

(39) Zhāngsān dǎ Zhāngsān de lánqiú. [= (8c)]
 Zhangsan play Zhangsan DE basketball
 ‘Zhangsan played basketball.’

In the beginning, the parse of *Zhāngsān dǎ* leads to the construction of a partial tree, which includes an internal argument node with an outstanding e-type requirement, which is provisionally satisfied by inserting an e-type metavariable. The pointer goes back to the root node of the current tree; then a LINK relationship is constructed between the root node of the current tree and that of a LINKed tree. Then, LOCAL *ADJUNCTION is applied, constructing an unfixed node with an e-type requirement. The e-type requirement is then satisfied through parsing *Zhāngsān*. Then *de* (here referred to as *de_{iii}*) is parsed. Apparently, the triggering conditions of the lexical actions in *de_{iii}* are different from those in the case of *de_i* and *de_{ii}*, specifically including there being no fixed node under the current node, and the root node of the main tree dominating an external argument node with an e-type formula, an internal argument node with an e-type formula and an adverbial functor node with an identity functor.

(40) The lexical information of *de_{iii}*

<i>de_{iii}</i>	IF $\langle L^{-1} \rangle Tn(n), ?t$ THEN IF $\langle L^{-1} \rangle Tn(n) \downarrow \perp \wedge Tn(n) \langle \downarrow^* \rangle \langle \downarrow_1 \rangle \langle \downarrow_1 \rangle, \beta(e \rightarrow t) \rightarrow (e \rightarrow (e_s \rightarrow t))$ $\wedge Tn(n) \langle \downarrow_1 \rangle \langle \downarrow_0 \rangle, \alpha: e \wedge Tn(n) \langle \downarrow_1 \rangle \langle \downarrow_1 \rangle \langle \downarrow_0 \rangle \langle \downarrow_0 \rangle, U: e$ $\wedge Tn(n) \langle \downarrow_1 \rangle \langle \downarrow_1 \rangle \langle \downarrow_1 \rangle, \lambda P.P: (e \rightarrow t) \rightarrow (e \rightarrow (e_s \rightarrow t))$ THEN IF $\langle \downarrow_+ \rangle \langle \downarrow_0 \rangle e$ THEN ... ELSE ABORT ELSE ABORT ELSE ABORT
-------------------------	--

After parsing *de_{iii}*, UNIFICATION is applied. The effects of the two parsing steps are given in Figure 18.

After COMPLETION, LINK COMPLETION, and ELIMINATION are applied repeatedly to the partial trees, the propositional formula (41a) is yielded on the root node of the main tree. The two conjuncts of (41a) are identical and therefore the final semantic representation obtained by this process is (41b).

(41) a. (((da'(lanqiu'))zhangsan')s)∧(((da'(lanqiu'))zhangsan')s)
 b. (((da'(lanqiu'))zhangsan')s)

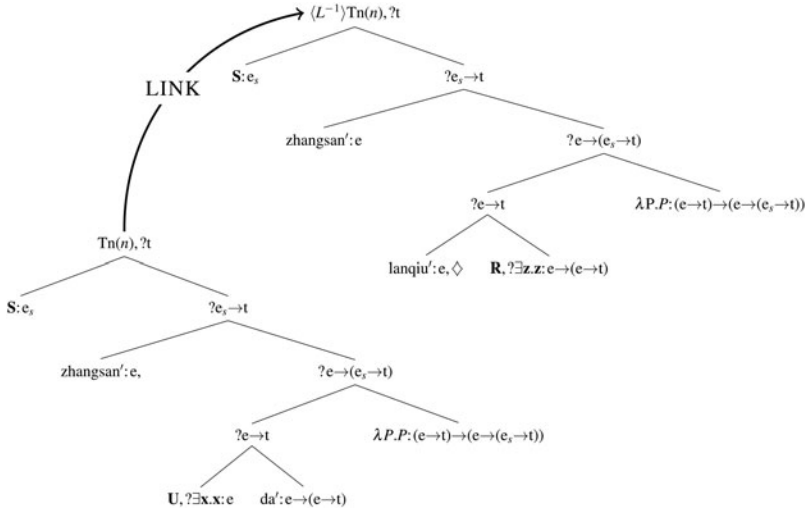


Figure 18: After parsing *Zhangsan da Zhangsan de lanqiu*

The process of constructing one and the same simple proposition twice does not make semantic contribution, but it produces the effect of emphasizing the proposition at issue.

5.2.4 *Zhei dun fan, Zhangsan de dongjia* ‘as for this meal, Zhangsan is the host’

Finally, the fake modification construction that involves a dangling topic is analyzed. The example is repeated below for ease of observation.

- (42) Zhèi dùn fàn, Zhāngsān de dōngjiā. [= (8d)]
 this CL meal, Zhangsan DE host
 ‘As for this meal, Zhangsan is the host.’

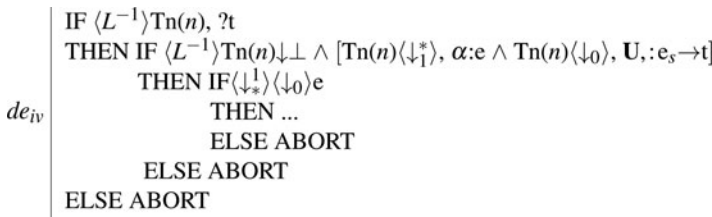
In parsing (42), *zhèi dùn fàn* provides semantic content for an e-type node somewhere below the root node of a partial tree. It should be noted that the assumption that the dangling topic *zhèi dùn fàn* provides semantic content for a partial tree LINKed to the partial tree for which the comment provides semantic content is motivated by the observation that the dangling topic may have its own predicate in some cases. See the following example.

- (43) Zhèi dùn fàn hěn zhòngyào, Zhāngsān de dōngjiā.
 this CL meal very important, Zhangsan DE host.
 ‘This meal is important, (for) Zhangsan will act/acted as the host.’

In this example, the dangling topic appears as the subject of the first clause, followed by the second clause, which appears as the comment in (43). This assumption also has a theoretical bonus: the semantic content of the dangling topic appears on a main tree, providing a LINK context for the parse of *de*, which is similar to the parse of the other two fake modification constructions where *de* appears in the second clause.

Next, LINK ADJUNCTION is applied, imposing the requirement of locating a copy of the content of *zhèi dùn fàn* somewhere on the LINKed tree. After this, *zhāngsān de dōngjiā* is parsed. The semantic content of *zhāngsān* appears initially on an e-type unfixed node that is created through applying LOCAL *ADJUNCTION. Then, *de* (here referred to as *de_{iv}*) is parsed, which contributes a propositional template, just as *de_i*, *de_{ii}*, and *de_{iii}* do. The triggering conditions are that the pointer is located at the root node of a LINKed tree, which does not have any fixed daughter nodes, that the root node of the main tree has an e-type daughter node which has already been annotated with a formula and a functor daughter node, which is provisionally annotated with a metavariable, and that there is an e-type unfixed node annotated with a formula under the root node of the current node.

(44) The lexical information of *de_{iv}*



After *de_{iv}* is parsed, the e-type unfixed node, where the semantic content of *zhāngsān* is located, and the external e-type argument node on the propositional template collapse into each other as UNIFICATION is applied. Through pragmatic inference, the metavariable projected by *de* is replaced by a semantically contentful formula. The partial trees are updated as follows, where, on the LINKed tree, λy . CIR(y) is pragmatically introduced into the scene as a functor that expresses the circumstance status assigned to $\iota, x.fan'(x)$ and the metavariable **R** projected by *de* is replaced by a contentful formula through pragmatic inference, which is semantically equivalent to 'dang''(act.as'). The overall effect of the above parsing stages is demonstrated in Figure 19.

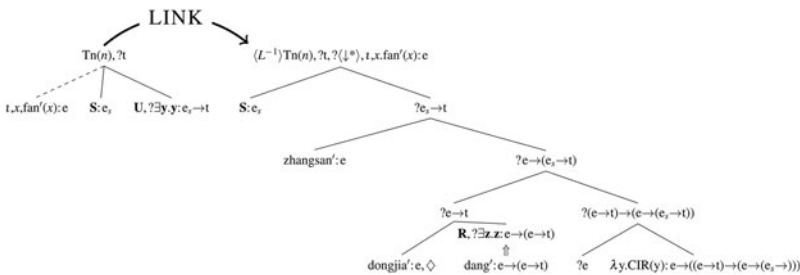


Figure 19: After parsing *Zhei dun fan, Zhangsan de dongjia*

Next is the application of the COMPLETION and ELIMINATION rules and metavariable substitution. Then the pointer goes back to the main tree. I assume

that the structure of the LINKed tree is reused (Gargett et al. 2008) to complete the main tree, which provides a fixed node with which the unfixed node where $\iota, x.fan'(x)$ is located unifies. After the LINK EVALUATION rule is applied, the following propositional formula is obtained (45).

(45) (((CIR(ι , $x.fan'(x)$))(dang'(dongjia'))))zhangsan's)

This parsing process involves two types of semantic underspecification. First, the semantic relation between *zhèi dùn fàn* 'this CL meal' and the rest of the sentence is not marked linguistically but rather is established by pragmatic inference.¹³ Second, the semantically underspecified predicate cannot obtain its semantic content without the context in which the string uttered is parsed. Without the context, *zhèi dùn fàn* 'thisCL meal', *Zhāngsān de dōngjiā* can barely be interpreted as 'Zhangsan acted as the host'. The context, *zhèi dùn fàn* 'thisCL meal' helps exclude the possibility that *Zhāngsān de dōngjiā* is interpreted as a nominal phrase involving a possessive relation between the modifier and the head; if the string of three words is parsed this way, the string *zhèi dùn fàn*, *Zhāngsān de dōngjiā* is meaningless.

In this way, the generation of all the four fake modification constructions at issue has been characterized as parsing processes. In this account, no deletion, movement, or empirically problematic assumption of a gerund phrase is involved. Instead, words are processed one by one, contributing actions and formulae, to construct propositional formulae. However, it should be noted that in the current account of the fake modification constructions, four different *de*-morphemes are recognized, which were referred to as *de_i*, *de_{ii}*, *de_{iii}*, and *de_{iv}*. Distinguishing the four *de*-morphemes is empirically justified because the lexical actions that the four morphemes contribute are merely similar rather than identical.

6. CONCLUSION

Fake modification constructions have long puzzled linguists of Chinese, who, on the one hand, acknowledge that there is no evidence that *de* and the two expressions which respectively precede and follow *de* constitute a phrase but, on the other hand, cannot break the mindset that *de* is an modification marker. The previous accounts, formulated in the framework of Generative Grammar, suffer from various theoretical problems and empirical challenges such as mysterious empty categories, poorly motivated deletion and movement, and mysterious insertion of morphemes; they even simply leave unaccounted for the obligatory appearance of some

¹³In the literature on the topic-comment constructions in Chinese (Chao 1968; Li and Thompson 1981; Shi 2000; Xu and Langendoen 1985; Pan and Hu 2002; Wu 2016), it is assumed either that the dangling topic corresponds to some syntactic slot in the comment or that there is a semantic slot to be filled with the meaning of the dangling topic. Viewed from the parsing perspective, the recovery of anything omitted cannot occur without inference based on lexical information of pronounced words, prosodic information, and contextual information (Hendriks 2004).

constituents in these constructions. This paper solves the puzzle posed by fake modification constructions, showing that the fake modification in these construction is really fake, there being no relation of modification between the two noun phrases that precede and follow *de*, and proposes a new account of the generation of fake modification constructions from a parsing perspective, revealing that fake modification constructions involve different *de*-morphemes with different syntactic properties, though all contribute a semantically underspecified predicate. This paper exposes a new case of semantic underspecification, enlarging the scope of the investigation of semantic underspecification in natural languages. Besides, the current account of *de*-morphemes, with the theoretical tools in Dynamic Syntax, can properly capture the syntactic idiosyncrasies, which, as far as I can see, can hardly be accurately captured in the accounts developed in the generative framework. The restricted ability of the generative accounts in integrating the characterization of idiosyncratic syntactic properties of individual words in a so-called ‘principled’ account arises due to the gap between the peculiar properties and the categorial properties of words. Compared with generative accounts, the current account in Dynamic Syntax entertains general computational rules and lexically encoded syntactic properties of words in parallel, which makes it possible to characterize the peculiar syntactic properties of fake modification constructions.

APPENDICES

The definitions of the rules listed below but IDENTITY FUNCTOR INSERTION are from Kempson et al. (2001) and Cann et al. (2005).

$$\frac{\{...\{\text{Tn}(n), ?X, \diamond\}...\}}{\{...\{\text{Tn}(n), ?X, ?\langle\downarrow_0\rangle Y, ?\langle\downarrow_1\rangle Y \rightarrow X, \diamond\}...\}}$$

Table 1: INTRODUCTION

$$\frac{\{...\{\text{Tn}(n), ?X\}...\}}{\{...\{\text{Tn}(n), ?X, ?\langle\downarrow_0\rangle Y, ?\langle\downarrow_1\rangle Y \rightarrow X, \diamond\}, \{\langle\uparrow_0\rangle \text{Tn}(n), ?X\}, \{\langle\uparrow_1\rangle \text{Tn}(n), ?Y \rightarrow X\}...\}}$$

Table 2: PREDICTION

$$\frac{\{...\{\text{Tn}(n), ?X, \langle\downarrow_0\rangle, \alpha: Y, \langle\downarrow_1\rangle, \beta: Y \rightarrow X, \diamond\}...\}}{\{...\{\text{Tn}(n), \beta(\alpha): X, \langle\downarrow_0\rangle, \alpha: Y, \langle\downarrow_1\rangle, \beta: Y \rightarrow X, \diamond\}...\}}$$

Table 3: ELIMINATION

$$\frac{\{...\{\text{Tn}(n), \dots\}, \{\langle \uparrow_i \rangle \text{Tn}(n), \dots \phi, \dots, \diamond\} \dots\}}{\{...\{\text{Tn}(n), \dots, \langle \downarrow_i \rangle, \phi, \dots, \diamond\}, \{\langle \uparrow_i \rangle, \text{Tn}(n), \phi, \dots\} \dots\}}$$

Table 4: COMPLETION

$$\frac{\{\text{Tn}(n), \dots, \langle \text{MOD} \rangle, \phi : X, \dots, \diamond\}}{\{...\{\text{Tn}(n), \dots, \langle \text{MOD} \rangle, \phi : X \dots\}, \{\langle L \rangle \text{Tn}(a), \dots, ?\phi, \dots, ?\langle \downarrow^* \rangle, \phi : X, \dots, \diamond\} \dots\}}$$

Table 5: LINK ADJUNCTION

$$\frac{\{...\{\text{Tn}(n), \dots, \diamond\}, \{\langle \text{MOD} \rangle \langle L \rangle \langle \text{MOD} \rangle \text{Tn}(n), ?X, \dots\} \dots\}}{\{...\{\text{Tn}(n), \dots\}, \{\langle \text{MOD} \rangle \langle L \rangle \langle \text{MOD} \rangle \text{Tn}(n), ?X, \dots, \diamond\} \dots\}}$$

Table 6: LINK ANTICIPATION

$$\frac{\{...\{\text{Tn}(n), \dots\}, \{\langle L^{-1} \rangle \text{Tn}(n), \dots \phi, \dots, \diamond\} \dots\}}{\{...\{\text{Tn}(n), \dots, \langle L \rangle, \phi, \dots, \diamond\}, \{\langle L^{-1} \rangle \text{Tn}(n), \dots \phi \dots\} \dots\}}$$

Table 7: LINK COMPLETION

$$\frac{\{...\{\text{Tn}(n), \dots, \phi : t, \diamond\}, \{\langle L^{-1} \rangle \text{Tn}(n), \psi : t \dots\}}{\{...\{\text{Tn}(n), \dots, \phi \wedge \psi : t, \{\langle L^{-1} \rangle \text{Tn}(n), \psi : t \dots\}}$$

Table 8: LINK EVALUATION

$$\frac{\{...\{\text{Tn}(n), \dots, ?t, \diamond\} \dots\}}{\{...\{\text{Tn}(n), \dots, ?t \dots\}, \{\langle \uparrow^* \rangle \langle \uparrow_0 \rangle \text{Tn}(n), ?\exists x. \text{Tn}(x), \dots, ?e, \diamond\} \dots\}}$$

Table 9: LOCAL *ADJUNCTION

$$\frac{\{...\{\text{Tn}(n), \dots, ?t, \diamond\}...\}}{\{...\{\text{Tn}(n), \dots, ?t\}, \{(\uparrow^*)\text{Tn}(n), ?\exists x.\text{Tn}(x), \dots, ?e, \diamond\}...\}}$$

Table 10: *ADJUNCTION

$$\frac{\{...\{\text{Tn}(n), \dots, ?t, \dots, \langle \downarrow^* \rangle ?(e \rightarrow t) \rightarrow (e \rightarrow (e_s \rightarrow t)), \diamond\}...\}}{\{...\{\text{Tn}(n), ?t\}, \{(\uparrow^*)\text{Tn}(n), \lambda P.P: (e \rightarrow t) \rightarrow (e \rightarrow (e_s \rightarrow t)), \diamond\}$$

Table 11: IDENTITY FUNCTOR INSERTION**REFERENCES**

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