Multiple Occurrences of the Chinese Reflexive in a Clause: At the Syntax-Pragmatics Interface

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Abstract—**Multiple occurrences of *ziji* in Mandarin Chinese pose a theoretical challenge which has not been met satisfactorily by previous analyses (see Huang & Liu, 2001; Huang et al., 2009). In this paper, we employ a parsing analysis of the co-reference relationship between *ziji*s and their potential antecedents within the framework of Dynamic Syntax (Kempson et al., 2001; Cann et al., 2005). Since the perspective center for multiple *ziji*s is determined only by looking at the context in line with the principle of relevance, *ziji* can be treated as a place-holder which can violate the locality condition. That is to say, the metavariable projected by *ziji* can only be provided via the pragmatic enrichment process: substitution. The perspective shifting for multiple *ziji*s will cause semantic confusion in communication. We then conclude that multiple *ziji*s can only take one and the same antecedent in communication context (see also Yang & Wu, 2015).**

Index Terms—**reflexive, relevance, place-holder, incrementality, substitution**

I. INTRODUCTION

The occurrence of a single *ziji* in a clause or a sentence has been much studied in syntax and pragmatics (Tang, 1989; Cole et al., 1990; Reinhar & Reuland, 1993; Cole & Sung, 1994; Baker, 1995; Pollard & Sag, 1994; Xue et al., 1994; Pollard & Xue, 1998; Pan, 2001). *Ziji*, as a reflexive in Chinese, can become a long-distance anaphor which violates the Standard Binding Principle A (Chomsky, 1981), as can be exemplified in (1):

(1) *Wangwu$_i$ renwei Lisi$_j$ lao piping ziji$_{i/j}$.*
Wangwu think Lisi often criticize self
'Wangwu$_i$ thinks that Lisi$_j$ often criticizes him$_i$/himself$_j$. (Yang & Wu, 2015, p. 142)

In (1), *ziji* can be bound in a local position by a local subject *Lisi* or refer to the matrix subject *Wangwu*. More interestingly, multiple *ziji*s can appear in one sentence in Chinese:

(2) *Tamen shuo ziji$_1$ gen haizi de guanxi hen duo shihou nenggou*
They say self with children DE relation very many time can
zheshe chu ziji2 gen ziji3 de fumu de guanxi.
reflect-CHU self with self DE parents DE relation.
'they said that their relation with their children can mostly reflect the relation between them and their parents.' (Phoenix Satellite Television/A Date With Luyu/2011-11-23) (Yang & Wu, 2015, p. 147)

There are three *ziji*s and three potential antecedents (*tamen* 'they', *haizi* 'children'and *fumu* 'parents') co-existing in one sentence. This example clearly shows that multiple occurrences of *ziji* can only refer to the same antecedent. However, Pan (1997), Huang and Liu (2001) and Huang et al. (2009) claim that multiple *ziji*s can refer to distinct antecedents. In this paper, we use the framework of Dynamic Syntax (Kempson et al., 2001; Cann et al., 2005) to demonstrate that multiple occurrences of *ziji* can only refer to one and the same antecedent in contexts with respect to the perspective center, no matter how many times it appears in a single clause. "When expressing a sentence, a speaker can and must select only one Perspective-Center (in analogy to the deictic center) which referentially denotes the psychological perspective of speaker from which the sentence is situated" (Yang & Wu, 2015, p. 142).

This paper is organized as follows. Section 2 presents previous analyses of multiple *ziji*s. In section 3, we provide a preliminary analysis of multiple *ziji*s. The theoretical framework of Dynamic Syntax is briefly introduced in section 4. We then present a dynamic account of multiple *ziji*s in section 5. Section 6 makes a conclusion.

II. PREVIOUS ANALYSES OF MULTIPLE *ZIJI*S IN A CLAUSE

Recently, one of the most interesting claims concerning the study of the Chinese reflexive is that multiple occurrences of *ziji* in a clause can refer to separate antecedents (see also Pan, 1997; Huang & Liu, 2001; Huang et al., 2009), as shown in below:

(3) *Zhangsan renwei Lisi zhidao Wangwu ba ziji$_1$ de shu*
Zhangsan think Lisi know Wangwu BA self DE book
song-gei-le ziji2 de pengyou.
give-to-LE self DE friend
'Zhangsan thinks that Lisi knows that Wangwu gave self's books to self's friends.'

(a) *ziji*$_1$= *ziji*$_2$=Wangwu;   (b) *ziji*$_1$= *ziji*$_2$=Lisi; (c) *ziji*$_1$= *ziji*$_2$=Zhangsan;
(d) *ziji*$_1$=Wangwu, *ziji*$_2$=Lisi;   (e) *ziji*$_1$=Wangwu, *ziji*$_2$=Zhangsan;
(f) *ziji*$_1$=Zhangsan, *ziji*$_2$=Wangwu;   (g) *ziji*$_1$=Lisi, *ziji*$_2$=Wangwu;
(h*) *ziji*$_1$=Zhangsan, *ziji*$_2$=Lisi;   (i*) *ziji*$_1$=Lisi, *ziji*$_2$=Zhangsan; (Huang et al., 2009, p. 340)

There are two zijis and three potential antecedents in (3). Huang et al. (2009) list eight potential coreference possibilities for zijis. First, the two zijis can refer to the same antecedent respectively, Wangwu, Lisi or Zhangsan, as in (a, b, c). Second, they may refer to separate antecedents, as long as one of zijis is locally bound by Wangwu as in cases (d, e, f, g). But cases (h) and (i) are not permitted because the third-person NP induces blocking. "The range of possibilities indicates that a third-person NP does not induce blocking when it is itself a non-binder or local binder of ziji, but does so when it is itself an LD binder of ziji. In the illicit cases (h, i), the intermediate subject Lisi is the LD binder of one occurrence of ziji, and it prevents the other ziji from being bound by the matrix subject Zhangsan" (Huang et al., 2009, p. 341). However, they do not tell us what is the semantic or conceptual mechanism underlying speakers and hearers' mind to allow zijis take distinct antecedents. Furthermore, it is rather confused with the situation how speaker encodes the sentence consisting of multiple zijis and how hearer decodes this chaotic coreference.

Huang and Liu (2001) note that "all of these complications are unexpected under the formal accounts discussed here" (p.147). And they further provide a logophorical analysis. A logophor refers to an entity "whose speech, thoughts, feeling, or general state of consciousness are reported" (Clements, 1975, p.141). Huang (2000) defines logophoricity as "the phenomenon whereby the 'perspective' of an internal protagonist of a sentence or discourse, as opposed to that of the current, external speaker, is being reported by some morphological and/or syntactic means" (p. 166). Simply, the long-distance binding can be seen as a logophor referring to the matrix subject as the speaker of an embedded clause:

(4) a. Mary said she knew Thomas.
     b. Mary said: "I knew Thomas."

In (4b), the first person 'I' is directly converted from the third-person 'she' in (4a), showing that 'she' refers to the matrix subject or the speaker of the complement clause. According to Huang and Liu (2001), only long-distance *ziji* is the logophor originating as first-person pronouns in a direct discourse. And the local *ziji* is the anaphor, which is subject to the first binding condition.[1] When there are two long-distance binders appearing in a sentence, the direct discourse representation will involve direct quote within another. As a result, the direct discourse representation for (3h-i) has the following form:

(5) *Zhangsan renwei, "Lisi zhidao, 'Wangwu ba   wo-de shu   song gei   le*
     Zhangsan think   Lisi know   Wangwu BA   my   book   give to   LE
     wo-de pengyou."
     my   friend
     Zhangsan thinks, " Lisi knows, 'Wangwu gave my book to my friend.'"

"with two occurrences of *wo*, one of which is bound by *Lisi*, the inner 'speaker' and the other bound by *Zhangsan* , the outer speaker " (Huang & Liu, 2001, p. 164), which is similar with the following case:

(6) a. *Lisi juede wo zai piping   ziji.*
        Lisi think I PRE criticize self
        'Lisi thinks that I am criticizing self.'
     b. Lisi juede, "wo zai piping   wo."
        Lisi think   I at criticize me
        Lisi thinks, "I am criticizing me."

The long-distance binding is not permitted in (6a). From the logophorical perspective, if long-distance ziji is permitted, then (6a) would have the representation (6b). In (6b), the two wos appear in one clause. The intended reading is that the first wo 'I' refers to the speaker of the entire sentence with the second one referring to Lisi. Huang and Liu (2001) point out that there is a perspective conflict in this clause, which causes unacceptability of the cases (3) and (4).

Sells (1987) classifies logophoric phenomena under three parameters: source, self and pivot. Source means the one who is the intentional agent of the communication. Self refers to whose mental state or attitude the proposition describes. Pivot is about the time or space location on the reported content. The source can always be the antecedent (Sells, 1987). As pointed out by Pan (2001), Lisi is the source which cannot refer with ziji, as shown below:

(7) *Zhangsan*$_i$ *cong Lisi*$_j$ *nar   tingshuo naben shu haile   ziji*$_{i/*j}$.
     Zhangsan   from Lisi   there hear   that-CL book hurt-LE   self
     'Zhangsan$_i$ heard from Lisi$_j$ that that book hurt him$_i$/himself$_{*j}$.'

Pan (2001) also claims that a logophor should not induce the blocking effect. In Chinese, *ziji* does induce the blocking effect, as can be seen in example (8):

(8) *Wangwu*$_i$ *renwei ni*$_j$ *lao   piping   ziji*$_{*i/j}$.
     Wangwu   think   you   often criticize self
     Wangwu$_i$ thinks that you$_j$ often criticize him$_{*i}$/yourself $_j$.'

Then Pan (2001) concludes that the long-distance reflexive *ziji* is not a logophor, which also falsifies the analysis of Huang and Liu (2001).

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[1] Chomsky (1981) claim that an anaphor is bound in its governing category.

Shuai et al. (2013) conduct two sentences reading experiments to investigate how two occurrences of ziji in a single sentence are interpreted and whether or not there are mixed readings. Shuai et al. (2013) find that the cases of multiple occurrences of ziji taking distinct antecedents are illicit in Chinese. The general interpretation pattern shows that in sentences containing two zijis, the referentially dependent reflexive is largely bound by the local subject when contextual information is not explicitly provided.

From the above analysis we can see that we are still lack of a unified analysis to multiple zijis. In this paper, we will use the framework of Dynamic Syntax to depict the parsing process of sentences containing multiple zijis. During the parsing process, we will further unveil a dynamic analysis of multiple zijis.

III. A PRELIMINARY ANALYSIS

This section will present a preliminary analysis to state that no matter how many times *ziji* appears in a single clause, it can only take one and the same antecedent in communicative contexts (see also Yang & Wu, 2015), as illustrated in (9):

(9) *Wo zhineng ziji₁ dandu gei ziji₂ bao jige jiaozi.*
     I can only self alone   for self make   several dumplings
     'I can only make several dumplings alone for myself.' (weibo/ BLCU Chinese Corpus)

Multiple perspective centers for *ziji*s will lead to the unacceptability of the sentence in communicative contexts, as (10) shows:

(10) *Huwenyu zhang hong le lian, ta diyici kanjian yixiang shuncong*
     Huwenyu turn red LE face   he   first-time see   always obedience
     ziji1 de Xufeng zheyang   dadan de   he   ziji2   zuodui, erqie yuyan
     self DE Xufeng this   bold DE against self   oppose and words
     jianli, hen nan fanbo, zhenshi you qi   you ji.
     sharp very hard refute truly YOU angry YOU   anxious

'Huwenyu turns red in his face, for the first time he sees Xufeng who is always obedient to him opposing to him boldly. And Xufeng's word is sharp and hard to refute, which truly makes Huwenyu angry and anxious' (Xue Ke/*The Fighting Youth*)

In (10), two *ziji*s occurs with two potential antecedents, namely, *Huwenyu and Xufeng*. The third pronoun *ta* 'he' in the second clause refers to *Huwenyu* in the first clause. *Yuyan jianli* 'words are sharp' in the third clause means that *Xufeng*'s words are harsh. If there are two perspective centers, say, the first *ziji* refers to *Huwenyu* and the second one refers to *Xufeng*, the utterance will be illicit since there will be a semantic conflict. *Xufeng* could not possibly fight against himself with harsh words and fight against his own words at the same time, which can also be illustrated by (11):

(11) *Tulong wufa jieshou ziji₁ yang da de tudi   beipan ziji₂.*
     Tulong not accept self raise up DE apprentice betray self
     'Tulong cannot accept that the apprentice he raised up betrays him.' (literature of Hongkong and Taiwan/ BLCU Chinese Corpus)

(11) also includes two *ziji*s with two potential antecedents: *Tulong* and *tudi* 'apprentice'. In this context, the two *ziji*s can only refer to the matrix subject *Tulong*. If there are two perspective centers for *ziji*s, the sentence will be unacceptable in meaning. It is rather absurd to say that "Tulong cannot accept that his apprentice he raised up betrays himself."

Now, the question arises as to what determines the perspective center for multiple *ziji*s. In this paper, we propose that it is relevance in communication setting the perspective center. The most relevant element in communication will be the perspective center. Relevance is "a property of inputs to cognitive process" and "an input is relevant when it connects with available contextual assumptions to yield positive cognitive effects" (Wilson & Sperber, 2012, p. 6). In context, the signal manifests that the speaker has an intention to communicate. In virtue of this intention, the hearer is justified in spending cognitive effort on processing the message. Hence "the choice as to which interpretation to construct from a signal is dictated by the very general cognitive considerations encapsulated in a constraint such as the principle of relevance" (Cann et al., 2005, p.23). The principle of relevance generally constrains the interpretation process in communication. The speaker marks the most relevant element via the first *ziji*'s position to achieve the optimal relevance, which reveals that the NP or the personal pronoun is the perspective center for multiple *ziji*s. Then the hearer can recognize the perspective center with least effort. Example (11b) obviously shows that the matrix subject *Panlong* is the perspective center for the two *ziji*s since the speaker puts the first *ziji* right behind *Panlong*. The following example tells us the fact that the most relevant element is the local subject:

(12) *Wo juede tamen yi ziji₁ de   chuangzuo chenguo   xianshi le*
     I think they use self DE   creation achievements show   LE
     ziji2 de jianshi caihua, tebieshi yongqi.
     self DE insight talent   especially courage

'I think they use their creation achievements to show their insight and talent, especially their courage.' (*Readings*/vol-051) (Yang & Wu, 2015)

In (12), the first *ziji*'s position shows that the local subject is the most relevant element in interpretation.

In this section, we offer a pragmatic analysis that multiple *ziji*s in a sentence must refer to one perspective center, that is, the most relevant element. Then we argue that the parsing process of *ziji*(s) lies in the substitution of the perspective center, which will be discussed in detail in section 5. The central thesis of this paper is that the Chinese reflexive *ziji* is semantically underspeicified. From a parsing perspective, the Chinese reflexive *ziji* may be enriched by the perspective center with respect to the principle of relevance. The theoretical framework to be employed is Dynamic Syntax (henceforth DS, Kempson et al., 2001; Cann et al., 2005), which is a grammar formalism that allows the interaction between syntactic, semantic and pragmatic information. Before presenting a DS account of multiple occurrences of *ziji*, we briefly introduce the theoretical framework.

IV. THE FRAMEWORK: DYNAMIC SYNTAX

Standard grammar formalisms are defined without reflection of the incremental, serial and context-dependent nature of language processing (Purver et al., 2006), which leads to a poor frame to modeling utterance or dialogue in real context. Language will lose its import without context, since there are rich speaker-hearer interactions and high proportion of context-dependent utterances. Previous analysis of multiple occurrences of *ziji* ignores the behavior in context, for *ziji* in Chinese is not a purely syntactic and non-syntactic factors such as discoursal, semantic and pragmatic factors also play an important role (see also Pollard & Sag, 1994; Xue et al., 1994; Pollard & Xue, 1998).

Dynamic Syntax (DS) is a parsing-directed grammar formalism to represent the semantic interpretation for a natural language string, which is built up following the left-right sequence of the words in context (Kempson et al., 2001; Cann et al., 2005). The process is goal-driven, which begins with the initial and universal requirement to establish the propositional content of utterances in context (Yang & Wu, 2021). "The concept of process is central, with syntax construed as the process by which semantically transparent structure is incrementally built up" (Cann et al., 2007, p.337). Thus Yang and Wu (2021) point out that syntax is the procedure defining how parts of representations of content can be incrementally introduced and updated. The propositional content is represented in terms of binary trees which establish the argument structure via the operation of general computational rules (general structure-building principles), lexical actions (specific actions induced by parsing particular lexical items) and pragmatic processes of enrichment.[2] The DS framework reflects the following characteristics of natural language. First, it reflects the fact that language comprehension is highly dependent on the context. Second, parsing is a manipulation process of partial information, which extends incomplete specifications from semantics and pragmatics to syntax. The interaction between the three types of action will further develop and update the underspecifications both in content and structure to the complete propositional content conveyed by the utterance in context (Yang & Wu, 2021).

A. Tree Structures and Tree Growth

The general parsing process involves the universal goal of building a root node to reflect the propositional content of utterances, namely, to establish some propositional formula $?Ty(t)$, where $?$ indicates the requirement, Ty the type and t the type of proportion. $?$ means that the requirement must be satisfied. According to Yang and Wu (2021), in parsing the string of *Lisi xihuan Mali* 'Lisi likes Mali', we first need to build a root node to represent the whole proposition of this sentence, that is, $?Ty(t)$, as can be shown in (i). In order to satisfy the requirement, we mainly rely on the following sources (see also Yang & Wu, 2021). In accordance with Yang and Wu (2021), First, computational rules govern general tree-constructional processes, such as moving the pointer, introducing and updating nodes. As has been pointed out, the DS trees are invariably binary. The argument will always appear on the left branch, and the functor on the right node, [3]where the diamond is the 'pointer' which identifies the node under development. Note that the figure includes an event or situation argument S of $Ty(e_s)$. DS uses this node for propositional representations standing for the situation of evaluation (Gregoromichelaki, 2006; Cann, 2011). First the tree is implemented by the computational action (Local *Adjunction) inducing initially unfixed nodes with a requirement $?\exists x.Tn(x)$. For example, *John xihuan Mali* 'John likes Mali' first induces a locally unfixed node as one of a set of argument nodes within some local predicate-argument structure., which is expressed as $?\langle\uparrow_0\rangle\langle\uparrow_*^1\rangle Tn(a)$. This indicates that the annotated node must be eventually fixed as a fixed argument node in tree-growth. Second, actions encoded in lexical items will further update the incomplete partial tree. In sentence *Lisi xihuan Mali* 'Lisi likes Mali', the first word *Lisi* will be parsed in line with the incrementality in communication. The lexical actions for the word *Lisi* consists of a set of actions which are initiated by a trigger and a failure statement to abort the parsing process if the conditional actions fails (Yang & Wu, 2021), as listed below:[4]

(13) Lexical entry for *Lisi*:

IF $?Ty(e)$ trigger

THEN $\text{put}(Ty(e), Fo(\iota, x, Zhangsan'(x)))$ actions

ELSE   abort   failure

This parsing process will satisfy the requirement of the node $?Ty(e)$, which allows the pointer moving on to the predicate node. More complex lexical actions are associated with transtive verbs, like *xihuan* 'like' in Chinese:

(14) Lexical entry for *Xihuan*:

IF $Tn(a)?Ty(t)$

THEN IF $\langle\downarrow^1_*\rangle\langle\downarrow_0\rangle Ty(e)$

          THEN $go(\langle\downarrow^1_*\rangle\langle\downarrow_0\rangle); put(?\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(0))$

                $go(\langle\uparrow_0\rangle\langle\uparrow^1_*\rangle Tn(a))$

                $make(\langle\downarrow_0\rangle); go(\langle\downarrow_0\rangle); put(Ty(e_s), Fo(U_{PRE}), ?\exists x Fo(x)); go(\langle\uparrow_0\rangle)$

                $make(\langle\downarrow_1\rangle); go(\langle\downarrow_1\rangle); put(?Ty(e_s \to t));$

                $make(\langle\downarrow_0\rangle); go(\langle\downarrow_0\rangle); put(?Ty(e)); go(\langle\uparrow_0\rangle);$

                $make(\langle\downarrow_1\rangle); go(\langle\downarrow_1\rangle); put(?Ty(e \to (e_s \to t)));$

                $make(\langle\downarrow_1\rangle); go(\langle\downarrow_1\rangle)$

                $put(Fo(Xihuan'), ?Ty(e \to (e \to (e_s \to t)))); go(\langle\uparrow_1\rangle);$

                $make(\langle\downarrow_0\rangle); go(\langle\downarrow_0\rangle); put(?Ty(e))$

          ELSE Abort

     ELSE Abort

$\langle\uparrow\rangle$ $\langle\downarrow\rangle$ are modal operators indicating mother and daughter relations. [5] $\langle\downarrow_0\rangle$ $\langle\downarrow_1\rangle$ are concrete marks to distinguish daughters decorated with argument and functor. The lexical actions can further manipulate the movement of the pointer. The pointer first moves up to the root node to annotate the present tense information to the whole proposition. Then it returns to the predicate node. Next, it moves a new predicate node to annotate the two-place verb content $Xihuan'$. After this process, the pointer moves to the new argument node $?Ty(e)$ to indicate that this node is under development. Finally, according to the linear order, the object *Wangwu* is parsed to satisfy the requirement in the internal argument position. Completion of the DS tree involves functional application of functors over arguments, which is driven by modus pones over types. This process will finally yield the expression satisfying the open requirements, as in Fig. (iii):

(i) initial state

$?Ty(t), à$

(ii) having processed *xihuan* 'like'

$?Ty(t)$

$S_{PRE}, Ty(e_s)$ $?Ty(e_s \to t)$

$Lisi', Ty(e)$ $?Ty(e \to (e_s \to t))$

$U, à$ $Xihuan',$

$Ty(e)$ $Ty(e \to (e \to (e_s \to t)))$

(iii) processing completed

$Xihuan'(Mali')(Lisi')(S_{PRE}), à$

$Ty(t)$

$S_{PRE}, Ty(e_s)$ $Xihuan'(Mali')(Lisi'),$

$Ty(e_s \to t)$

$Lisi', Ty(e)$ $Xihuan'(Mali'),$

$Ty(e \to (e_s \to t))$

$Mali',$ $Xihuan',$
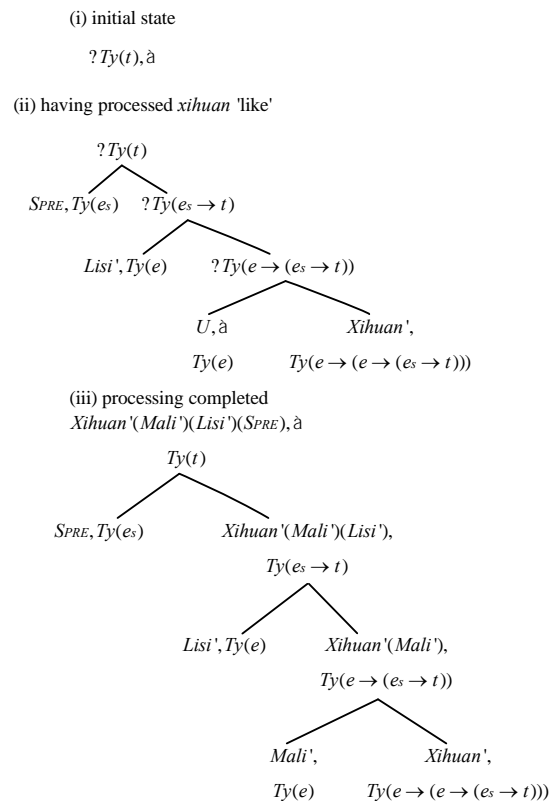
$Ty(e)$ $Ty(e \to (e \to (e_s \to t)))$

Figure 1 Parsing *Zhangsan xihuan Wangwu* 'Zhangsan likes Wangwu'.

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[5] $\langle\uparrow\rangle$ $\langle\downarrow\rangle$ are modal operators from the The Logic of Finite Trees (LOFT) (Blackburn and Myer-Viol, 1994), which is central to DS framework.

B. Substitution and LINK

As mentioned above, the interaction between three types of action is central to DS tree's updating and developing. In parsing, there are two kinds of underspecification, that is, content underspecification and structural underspecification.

In parsing process, anaphoric expressions encode the underspecification of content, which has to be updated by a specified semantic value from the context (Yang & Wu, 2021). In DS, pronoun is defined to project a meta-variable (U and V) with constraint which is accompanied by the requirement $?\exists x.Fo(x)$. Thus the lexical entry of 'he' can be listed below (Yang and Wu, 2021):

IF $?Ty(e)$

(15) THEN $\mathrm{put}(Ty(e), Fo(U_{male}'), ?\exists x.Fo(x))$

ELSE abort

According to Yang and Wu (2021), the requirement must be satisfied by the concrete semantic values in context which also meets the constraint U_{male}. In DS, we use the term 'Substitution' ($\Uparrow$) to satisfy this underspcification, as can be shown in the following dialogue:

(16)   a: John likes Mary.

b: She also likes him. (Yang & Wu, 2021)

(16a) provides the context for b. In (16b), *she* and *him* project two meta-variables with constraints. Thus, we can use Mary and John to substitute them respectively.

DS also employs another technical tool 'LINK' to pair two trees sharing the same cotent, such as non-restrictive relative clauses 'John, who Sue hates, smokes'. In DS, we take the process of 'LINK' as linking a second propositional structure with a requirement $?Ty(t)$ with one completed node of type e in a partial tree. When we parse 'John, who Sue hates, smokes' in accordance with the principle of linearity, the first term $Fo(\iota, x, John'(x))$ holds the subject node. Then we link that term to the non-restrictive relative clause whose propositional structure is constructed via a parse of the relative clause. At last we achieve the final propositional structure via parsing the verb 'smokes': $Smoke'(\iota, x, John'(x)) \wedge Hate'(\iota, x, John'(x))(\iota, y, Sue'(y))$.

V. A DYNAMIC ANALYSIS

In Section 3, it is pointed out that the Chinese reflexive is underspecified in content. That is, its interpretation is crucially dependent on the content provided by the perspective center, precisely the most relevant element in context.

In English, reflexive should be bounded in the local domain. Cann et al. (2005) point out that "Substitution is not involved here but the lexical actions associated with a reflexive identify a local formula and use that as a substitute as part of the parsing process directly" (p. 73). They further depict the lexical entry of the English reflexive 'herself':

IF $?Ty(e)$

THEN IF $\langle\uparrow_0\rangle ?Ty(t)$

THEN abort

ELSE IF $\langle\uparrow_0\rangle \langle\uparrow*_1\rangle \langle\downarrow_0\rangle Fo(\alpha)$

THEN $\mathrm{put}(Ty(e), Fo(\alpha), [\downarrow]\perp)$

ELSE abort

ELSE abort

This lexical entry denotes that the English reflexive cannot appear in the subject position, which will cause the failure of the parsing process. As noted above, the Chinese reflexive behaves differently from its English counterpart. First, it can violate the locality constraint and become a long-distance reflexive. Second, the English reflexive, such as herself, also projects a constraint to person pronouns. While ziji in Chinese does not project such a constraint. Third, ziji in Chinese can appear in the subject position, such as ziji de haizi mei dejiang rang Lisi hen shangxin 'the fact that Lisi's child does not get the reward makes Lisi very sad'. Further, ziji can also refer to an inanimate object:

(17) *Xuexiao   you   ziji   de   shitang.*

school   have   self   DE   dinninghall

'School has its own dinninghall.'

As discussed in previous section, the Chinese reflexive *ziji* can thus be uniformly analyzed as a placeholder requiring enrichment for interpretation to occur. The enrichment should be provided directly through the selected perspective center. Therefore, it is plausible to propose that *ziji* projects a metavariable *U*, with an associated requirement to identify some semantic content.

IF $?Ty(e)$

(18) THEN $\mathrm{put}(Ty(e), Fo(U), ?\exists x Fo(x))$

ELSE Abort

This lexical entry indicates that the behavior of *ziji* is parallel to a pronoun. In the case of a pronoun, the metavariable

is provided by a process of substitution, usually by a term in the previous discourse. As to the Chinese reflexive, the hearer however has to recognize the perspective center and then to substitute the metavavriable U from the context. The value of the metavariable U is therefore subsequently updated, through recognizing the perspective center. Before capturing this update process, we first redefine the process of substitution. Cann et al. (2007) define the process of substitution as following:[6]

$$
(19) \quad \text{SUBSTITUTION} \begin{vmatrix} \text{IF} & ?Ty(X), ?\exists xFo(x), \\ & N \in C, N = \{Ty(X), Fo(Y)\} \\ \text{THEN} & put(Fo(Y)) \\ \text{ELSE} & \text{Abort} \end{vmatrix}
$$

(19) is a general process of substitution. With regard to the Chinese reflexive, we revise the process:

$$
(20) \quad \text{SUBSTITUTION} \begin{vmatrix} \text{IF} & ?Ty(X), Fo(U), ?\exists xFo(x) \\ & PC \in C, PC = \{Ty(X), Fo(Y)\} \\ \text{THEN} & put(Fo(Y)) \\ \text{ELSE} & \text{Abort} \end{vmatrix}
$$

(20) emphasizes that the recognition of the perspective center is the crux to the interpretation of the Chinese reflexive.

With a dynamic analysis of *ziji* as projecting a metavariable without any constrain and a technical tool for identifying the content value from the context, we should be able to characterize sentences including multiple *ziji*s in a straightforward way.

A. Multiple Zijis Referring to the Matrix Subject

To see how the parse of multiple *ziji*s referring to the same antecedent, let us fist consider example (13a), repeated here as (21):

(21) *Panlong jian ziji de shuxia   jie beipan ziji.*
      Panlong see   self DE subordinates all betray self
      'Panlong sees that his subordinates all betray him.'

The first word *Panlong* is parsed to decorate the subject node with $Fo(\iota, x, Panlong'(x))$. The second word *jian* 'see' first makes a new node $Ty(t \rightarrow (e \rightarrow t))$ to put the content $Jian'$. And then it makes a new argument node with a requirement for type t, as shown in Figure 2:
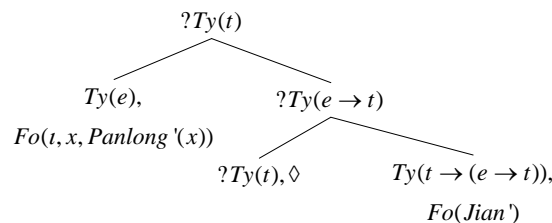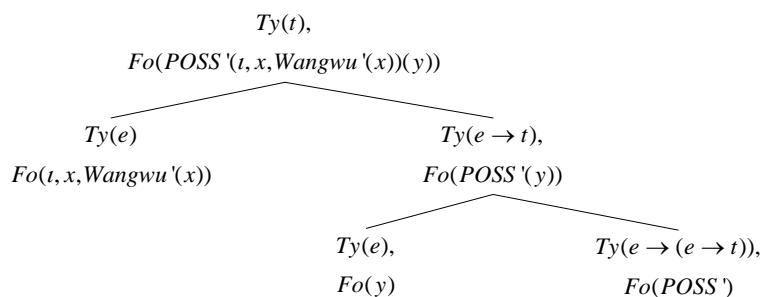

Figure 2. Paring *Panlong Jian*

Then the local subject, *Ziji de shuxia* 'his subordinates', will be parsed. Note that it is a typical genitive construction in Chinese. A question naturally arises that how to parse the genitive construction in Chinese. Lü(1976) notes that there are mainly three types of *de* construction in Chinese: genitive construction, descriptive construction and appositive construction (see also Zhang, 1994). According to Lü(1976), the genitive construction in Standard Chinese is parallel to *you* character sentence. For example, *Wangwu de lanqiu* 'Wangwu's basketball' can be interpreted as *Wangwu you lanqiu* 'Wangwu has a basketball'. Therefore, the interpretation of *de* construction expressing the possessive meaning is equal to *you* character sentence. Thus, we assume that *de* in genitive construction projects a proposition $Ty(t)$ including a subject node and a predicate node. The predicate node can be further expanded into a node occupied by the semantic content of the verb *you* and its internal argument node:[7]

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[6] "Given a current node with a particular type $Ty(X)$ and an unfulfilled requirement $?\exists xFo(x)$, we can use a suitably typed and formula-specified node N in the context C to provide a Fo value" (Cann et al., 2007, p. 342).

[7] Kempson et al. (2001) propose that the actions projected by ''s' in genitive construction, such as John's friend, are first to embed the possessor in a tree typed as t and subsequently link the root node to a head node in which the possessee is embedded. The embedded tree contains a binary POSSESS relation. Hence, we here use $POSS'$ to replace You'.

$$Ty(t),$$
$$Fo(POSS\,'(\iota, x, Wangwu\,'(x))(y))$$

$$Ty(e)$$
$$Fo(\iota, x, Wangwu\,'(x))$$

$$Ty(e \rightarrow t),$$
$$Fo(POSS\,'(y))$$

$$Ty(e),$$
$$Fo(y)$$

$$Ty(e \rightarrow (e \rightarrow t)),$$
$$Fo(POSS\,')$$

Figure 3. Parsing *Wangwu de*

At this point, the propositional tree cannot be completed because the internal argument still lacks a semantic content. The parsing of *lanqiu* 'basketball' provides the semantic content for it. We then use the technique tool 'LINK' to pair the two nodes. The parsing of this genitive phrase is finished with a complete propositional structure: $Fo(\varepsilon, y, (POSS\,'(\iota, x, Wangwu\,'(x))(Lanqiu\,'(y)))$.
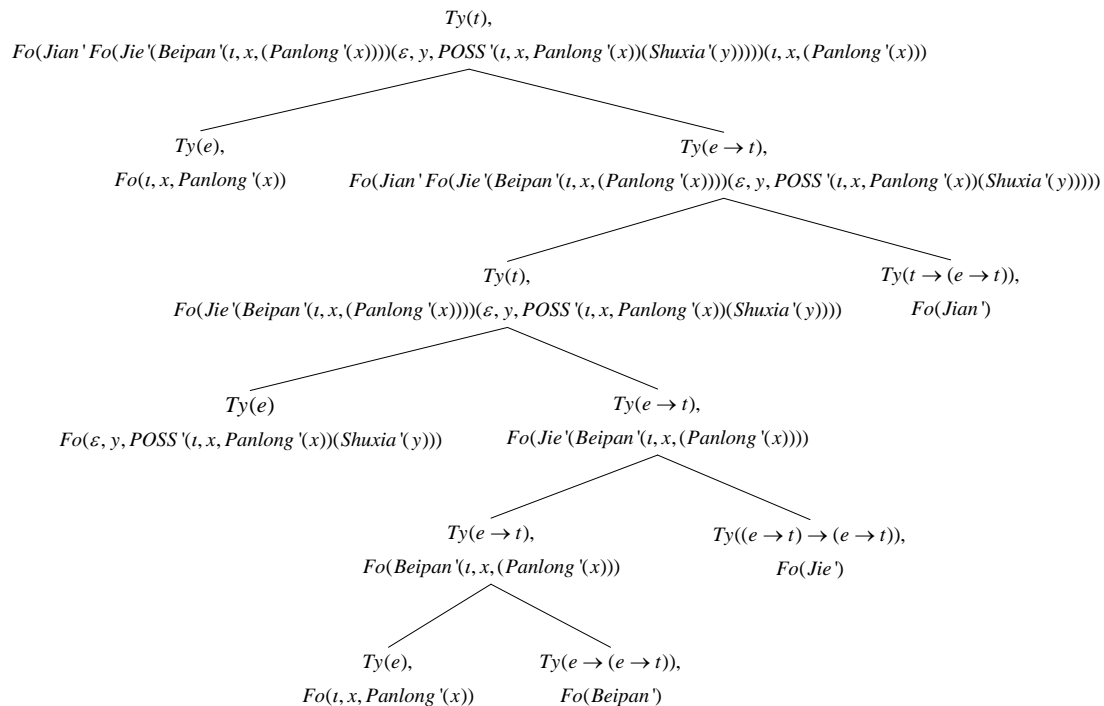
Now, let us parse the local subject *Ziji de shuxia* 'his subordinates'. *Ziji de* first projects a propositional structure with an outstanding formula requirement $Fo(U)$. We must provide a substituent for it. In line with the principle of linearity, there is only one antecedent in the context, that is, the matrix subject *Panlong*. Then the parsing process will continue with the substitution of the semantic content $\iota, x, Panlong\,'(x)$ for the metavirable projected by the first *ziji*, as shown in Figure 4. Notice that the process of substitution is inferentially derived in accordance with the principle of relevance in contexts, because only the matrix subject *Panlong*, which is already appear in the given context, qualifies as the substituent. This also tellingly point to the fact that *Panlong* is the most relevant element for *ziji*s' coreference.

$$Ty(t),$$
$$Fo(POSS\,'(\iota, x, Panlong\,'(x))(y))$$

$$Ty(e), Fo(U),$$
$$?\exists x Fo(x)$$
$$\Uparrow$$
$$Ty(e),$$
$$Fo(\iota, x, Panlong\,'(x))$$

$$Ty(e \rightarrow t),$$
$$Fo(POSS\,'(y))$$

$$Ty(e),$$
$$Fo(y)$$

$$Ty(e \rightarrow (e \rightarrow t)),$$
$$Fo(POSS\,')$$
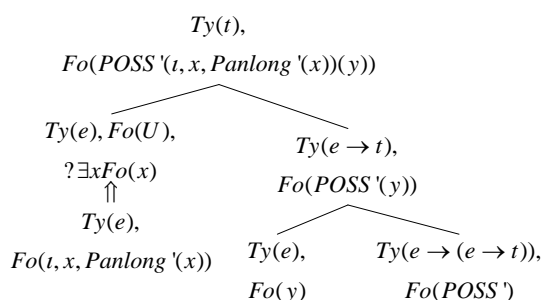
Figure 4. Parsing *ziji de*

Afterwards, the completion of the parsing of ziji de shuxia 'his subordinates' gives rise to a well-formed semantic formula $\varepsilon, y, POSS\,'(\iota, x, Panlong\,'(x))(Shuxia\,'(y)$, which will decorate the subject node of the subordinate clause following the matrix verb jian 'see'.

Next, let us consider the parse of the verb phrase beipan ziji 'betray oneself'. Gao et al. (2005) conduct a cross-modal priming experiment. And Liu (2009) conducts a lexical decision experiment. Their experimental results all support that local binding has a preference over long distance binding. Ziji de shuxia 'his suboriantes' and the second ziji are in the same local domain. In keeping with Gao et al. (2005) and Liu (2009), the second ziji should refer to shuxia 'subordinates', which also corresponds to the hypothesis insisted by Huang et al. (2009). As discussed in section 3, this interpretation is unacceptable since multiple zijis must refer to the same antecedent. Hence the metavariable projected by the second ziji also will be substituted by the matrix subject:

$$Ty(t),$$
$$Fo(Jian'\,Fo(Jie'(Beipan'(\iota, x, (Panlong'(x))))(\varepsilon, y, POSS'(\iota, x, Panlong'(x))(Shuxia'(y)))))(\iota, x, (Panlong'(x)))$$

$$Ty(e),$$
$$Fo(\iota, x, Panlong'(x))$$

$$Ty(e \rightarrow t),$$
$$Fo(Jian'\,Fo(Jie'(Beipan'(\iota, x, (Panlong'(x))))(\varepsilon, y, POSS'(\iota, x, Panlong'(x))(Shuxia'(y)))))$$

$$Ty(t),$$
$$Fo(Jie'(Beipan'(\iota, x, (Panlong'(x))))(\varepsilon, y, POSS'(\iota, x, Panlong'(x))(Shuxia'(y))))$$

$$Ty(t \rightarrow (e \rightarrow t)),$$
$$Fo(Jian')$$

$$Ty(e)$$
$$Fo(\varepsilon, y, POSS'(\iota, x, Panlong'(x))(Shuxia'(y)))$$

$$Ty(e \rightarrow t),$$
$$Fo(Jie'(Beipan'(\iota, x, (Panlong'(x)))))$$

$$Ty(e \rightarrow t),$$
$$Fo(Beipan'(\iota, x, (Panlong'(x))))$$

$$Ty((e \rightarrow t) \rightarrow (e \rightarrow t)),$$
$$Fo(Jie')$$

$$Ty(e),$$
$$Fo(\iota, x, Panlong'(x))$$

$$Ty(e \rightarrow (e \rightarrow t)),$$
$$Fo(Beipan')$$

Figure 5. Parsing *Panlong jian ziji de shuxia jie beipan ziji*.

B. Multiple Zijis Referring to the Local Subject

We now turn to the case that multiple *ziji*s refer to the local subject. Yang and Wu (2015) observe that "*ziji*s can only take reference to the local subject under the condition that the first *ziji* follows the local subject but precedes the rest of noun phrases or pronouns" (p. 154). This statement confirms to the fact that if speaker intends to select the local subject as the most relevant element or the perspective center, s/he must put the first *ziji* right behind it, as can be shown in (25):

(22) *Wo juede   tamen   yi   ziji$_1$ de   chuangzuo chenguo   xianshi   le*
I   think   they   use   self   DE   creation   achievements   show   LE
ziji2   de   jianshi   caihua,   tebieshi   yongqi.
self   DE   insight   talent   especially   courage
'I think they use their creation achievements to show their insight and talent, especially their courage.' (Readings/vol-051) (Yang & Wu, 2015)

The two zijis cannot refer to distinct antecedents since it is unacceptable in semantics. (25) only have one interpretation , that is, the two zijis can only take the local subject as their antecedents because the linear position of the first ziji clearly manifests that the local subject is the perspective center. Therefore, the metavariables projected by the two zijis can be substituted by the same semantic content Tamen 'they', which will also need a semantic content to be the substituent in the previous context, say, wo de pengyou "my friends".

VI. Conclusion

In this paper, we employ a parsing account of multiple occurrences of ziji in a sentence. Ziji, as a reflexive in Chinese, is analyzed as a place holder with a projected metavariable. In sentences containing multiple zijis, the metavariable can only be provided via a pragmatic enrichment relative to the perspective center in line with the principle of relevance in communication contexts. Multiple zijis must refer to one and the same antecedent corresponding to the observation made in Yang and Wu (2015). They claim that "When constructing a sentence containing multiple zijis, a speaker can and must select only one Perspective-Center. Our naturalistic data unequivocally demonstrate that the Chinese reflexive, no matter how many times it appears in a single clause, must be bound by one and the same antecedent" (Yang & Wu, 2015, p. 150).

This paper only concentrates on multiple zijis. We then can make a fine-tuned prediction that the interpretation of a single occurrence of ziji is similar to the its multiple occurrences. The metavariable projected by ziji must be enriched pragmatically relative to the perspective center in contexts. The only difference lies in how to determine the perspective center for a single ziji. As listed above, discoursal, syntactic, semantic and pragmatic factors all play an important role in determining the perspective center for ziji.

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