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A Dynamic Analysis of Minimizers in Chinese *lian…dou* Construction

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Abstract
Minimizers are widely acknowledged cross-linguistically to denote a minimal quantity, extent or degree. With respect to minimizers in Mandarin Chinese, Shyu (Linguistics 54:1355–1395, 2016) claims that their so-called negative polarity is purely syntactically determined and is facilitated by the *lian…dou* ('including…all') EVEN construction. Within the framework of Dynamic Syntax (Kempson et al., Dynamic syntax: the flow of language understanding, Blackwell, 2001; Cann et al., The dynamics of language, Elsevier, 2005) which allows for interaction between syntactic, semantic and pragmatic information, we demonstrate that the total negation is actually derived from the interaction between syntax, semantics and pragmatics, rather than being determined by purely syntactic means.

Keywords Negative polarity · Minimizer · Scalar implicature · Topicalized focus · Dynamic syntax

1 Introduction

Polarity phenomena, positive polarity items (PPIs) and negative polarity items (NPIs), have been cross-linguistically observed. It has been noted (e.g. Haspelmath, 1997) that NPIs are commonplace in human languages, such as English *any* and Greek *tipota* 'anything':

(1)	a.	English *any*		
		Mary didn't want any presents for her birthday		
	b.	Greek *tipota* 'anything'		
		dhen idhe tipota	*o*	*Janis*
		NEG saw anything	the	John

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'John didn't see anything.' (Giannakidou, 2011: 1661)

As far as the study of NPIs is concerned, there are two major issues under discussion, viz. the licensing problem and the sensitivity problem (see Klima, 1964; Laka, 1990; Horn & Kato, 2000 *inter alia*). According to Israel (2011) and Giannakidou (2011), NPIs are largely determined in lexis. There are mainly two lexical semantic sources: scalarity and referential deficiency. Referential deficiency means that NPIs are dependent indefinites, being unable to refer to an object in the usual way existential quantifiers do (Giannakidou, 1998). According to Giannakidou (1998: 70), referential deficiency refers to obligatorily narrow scope phenomena as in *An dhis kanenan, na tu pis na me perimeni* 'If you see anybody, tell him to wait for me.' In this example, the *kanenas* 'anybody' type of NPI must be construed as being referentially deficient, thus an obligatorily narrow scope indefinite. Scalarity, which concerns the scale established by NPIs relative to the context, means that polarity items can serve as scalar particles pointing to semantic or pragmatic end-points, as in 'John did not understand anything of what I said'.

As far as minimizer-type NPIs are concerned, these are usually phrases expressing a minimal quantity or quality. In the literature, minimizers are regarded as as "an emphatic way of expressing zero" (Bolinger, 1972: 120). And it has also been noted that minimizers are used to reinforce negation (Horn, 2001). In addition, the notion of EVEN is implied in sentences with minimizers, or is implicitly encoded in the minimizers (see Heim, 1984 for detailed discussion). It has been cross-linguistically observed that a weak predicate (one) plus a particle meaning EVEN are usually employed to encode minimizer NPIs, such as Hindi '*ek-bhii* (one-even)' (Lahiri, 1998), and Japanese '*hito-ri-mo* (one. person-also/all)'(Nkanishi 2006).

Unlike the morphological form of one+EVEN presented above, Shyu (2016) tackles the sensitivity problem, proposing that minimizer-type NPIs in Chinese are syntactically determined, as is evidenced by the *lian…dou* ('including… all') EVEN construction. (2) is illustrative of this point (which is taken from Shyu, 2016: 1357)[1]:

(2)	*Ta*	*lian*	*yiju*	*hua*	*dou*	*mei*	*shuo*
	He	LIAN	one.CL	word	DOU	not	say
	'He didn't say a word.'						

According to Shyu (2016), the pre-verbal minimal quantity indefinite object should co-occur with *lian*, a focus marker, and *dou*, a 'domain' morpheme (Lü, 1980; Wang, 1954; Zhu, 1982). The indefinite and *dou* precede the predicate negation, resulting in the interpretation of total negation. Shyu further argues that the intended negative polarity involving minimizers is achieved due to the presence of the *lian…dou* construction. She then concludes that "Chinese witnesses a purely syntactic meaning of expressing total negation" (Shyu, 2016: 1358).

[1] Abbreviations used in this paper are: CL: classifier; DOU: Chinese domain morpheme *dou*; GUO: experience aspect marker; LE: perfective aspect marker; LIAN: Chinese focus marker *lian*.

Based on naturalistic data from two influential Modern Chinese corpora, BCC and CCL,[2] this paper attempts to address the sensitivity of minimizer-type NPIs in Mandarin Chinese within the framework of Dynamic Syntax (Cann et al., 2005; Kempson et al., 2001). Contrary to Shyu (2016)'s analysis, we demonstrate that total negation involving minimizers is actually not determined via purely syntactic means; rather, it is derived from the interaction between syntax, semantics and pragmatics.

The paper is organized as follows. Section 2 presents a critical review of Shyu (2016)'s analysis. Section 3 introduces the framework of Dynamic Syntax. Section 4 first provides a preliminary analysis and then a dynamic account. A conclusion is drawn in Sect. 5.

2 Shyu (2016)'s Analysis

Shyu (1995, 2004) states that the morpheme *lian* invokes contextually quantified individuals, whereas the morpheme *dou* distributes the main predicate's properties over the individuals. An *even* reading can be obtained from *lian…dou* construction (see also Wang & Su, 2012). As has been mentioned in the introductory section, two major issues concerning minimizers are central to the study of NPIs, viz. the licensing problem and the sensitivity problem. Following the analysis in Shyu (1995, 2004), Shyu (2016) mainly addresses the second one concerning minimizer-type NPIs in Chinese, claiming that the NPI reading in Chinese is not lexically determined but is facilitated by the *lian…dou* construction. Specifically, *lian* as a focus particle functions as a scalar operator which invokes a set of order ranked alternatives determined relative to context, whereas *dou* is a maximizing/universal operator quantifying over the contextual alternatives plus the focused minimizer.

According to Shyu (2016), the total negation reading in (2) (repeated here as (3)) is actually the result of the existing *lian…dou* construction, which allows a covert *lian* when it appears before a minimizer:

(3)	*Ta lian*	*yiju*	*hua*	*dou*	*mei*	*shuo*	
	He	LIAN	one.CL	word	DOU	not	say
	'He didn't say a word.'(Shyu, 2016: 1357)						

In addition to the occurrence in the *lian…dou* construction, Chinese minimizers appearing in canonical (SVO) negative sentences may result in ambiguous readings:

(4)	a.	*Ta mei*	*shuo yiju*	*hua*
	he not	say	one + CL	word
	(i)	'He didn't say a word, (but he said more than one word).'		

[2] BCC, a corpus founded by Beijing Language and Culture University, includes nearly 15 billion Chinese characters, which ranges from newspapers, literatures to technologies. The corpus of CCL, (Center for Chinese Linguistics) is founded by Peking University.

(ii) 'He didn't say any word'

(iii) '…, (rather he said a lot).' Shyu, 2016: 1360)

In order to avoid ambiguity, the *lian…dou* construction is thus employed to emphasize the total nature of the negation, which implicates that total negation is syntactically derived in this construction (Shyu, 2016). Shyu (2016) also notes that *dou* is obligatory in negative sentences, as in (5):

(5)

Ta	*(lian) yi-ju*	*hua*	**(dou) mei shuo*	
he	LIAN one + CL	word	DOU not	say

'He didn't say even a word."

As for *lian*, Shyu (2016) proposes that it serves two major functions. In the first place, *lian* functions as a focus particle evoking a set of propositional alternatives (Rooth, 1985, 1996) that are salient in contexts. Additionally, it is a scalar operator that "places the asserted proposition containing the focus at an (near) endpoint of a scale of likelihood/expectedness in the set" (Shyu, 2016: 1380). Thus, the *lian…dou* construction syntactically manifests both the quantificational and scalar properties.

Shyu (2016)'s analysis gives rise to at least one question: is the total negation with minimizers purely determined via syntactic means? In this section, we will first test Shyu (2016)'s hypothesis based on the naturalistic data from the BCC corpus (http://bcc.blcu.edu.cn) and CCL corpus (http://ccl.pku.edu.cn).

First, our corpus data clearly shows that the *lian…dou* construction in Mandarin Chinese is not obligatory, as shown below:

(6) a.

Lu Zhao-peng	*yi-ju*	*hua*	*mei*	*shuo jiu*	*jin*	*chengli qu le*		
Lu Zhao-peng	one + CL	word	not	say	then	enter	city	go LE

'Lu Zhaopeng didn't say a word before entering into the city.' (CCL/*White Deer Plain*)

b.

Yang Hongjie	*mei*	*shuo*	*yi-ju*		*hua,*	*bian bang-zhu*	*Baojun-hua zuo*
Yang Hongjie	not say		one + CL	word,	then	help	Baojun-hua do
rengong	*huxi*						
artificial	respira-tion						

'Yang Honejie didn't say a word, and just did the artificial respiration to Bao Junjua' (CCL)

c.

Ta	*yi-dian*	*fan*	*mei*	*chi*	*jiu*	*likai*	*fanting*
she	one + CL	food	not	eat	then leave dining room		

'She left the dining room without eating anything.' (CCL)

The three examples in (6) strongly suggest that the total negation readings are not derived exclusively from the *lian…dou* construction. More importantly, if *lian…dou* were inserted in these examples, their interpretation would be different.

Consider (6a), which is just a description of *Lu Zhaopeng* entering into the city without saying a word. If *lian…dou* were used in this sentence *Lu Zhaopeng lian yijuhua dou meishuo jiu jin le cheng* '…, it would mean that *Lu Zhaopeng* entered into the city without saying a word at all (he is supposed to say something or do something for some reason).' The *lian…dou* construction implies that there exists a situation where *Lu Zhaopeng* should say something or do something, but he did not say a word and instead went back to the city. On account of this, we can say that the *lian…dou* construction is employed to invoke a set of alternatives relative to the context (for a detailed discussion, see also Sect. 3) and to strengthen the emphatic effect.

Having demonstrated that the total negation interpretation is not purely syntactically derived by *lian…dou*, we will proceed in the next section to present a preliminary analysis in Sect. 3 and then introduce the framework of Dynamic Syntax (Cann et al. 2005; Kempson et al. 2001) in Sect. 4.1.

3 A preliminary Analysis

As has been discussed previously, minimizers express minimal amounts or refer to an endpoint of a scale and are frequently used in emphatic contexts (Horn, 1989), such as *lift a finger* in English and *dhino dhekara* 'give a damn' in Greek. According to Israel (2001), the 'one'-phrase expressions can be termed as prototypical minimizers, which tend to appear in a low position in the thematic hierarchy (patient, theme) to measure the degree of how a predicate is instantiated. Moreover, they normally appear in negative contexts to achieve emphatic effects.

In Mandarin Chinese, one-phrases can function as minimizer NPIs to induce scalar inference for emphasis in negation, as shown below:

(7)	*na*	*yi*	*xiawu,*	*wo mei*	*shuo yi-ju*	*hua*
	That	one afternoon	I	not	say one CL word	
	'That whole afternoon, I didn't say a word.' (BCC)					

Yi 'one' in Chinese mainly express the minimal quantity, which means that it is the crucial element used to place the event or the object at the endpoint of a scale.

In this paper, we argue that the scalar inference or the rank is set up and invoked by the lexis in relation to the context, which is contrary to Shyu (2016)'s proposal that *lian* invokes a rank. In other words, *lian* in Chinese only invokes a set of alternatives and the rank that is constructed is built in accordance with the context. One-phrases may cause two different scalar differences depending on context:

(8)	*Wo*	*mei*	*chi*	*yi-gen*	*xiangjiao*
	I	not	eat	one + CL	banana
	(i)	'I didn't eat any banana.'			
	(ii)	'I didn't eat any banana, let alone other foods.'			

Note that the scalar inferences from (8) have two possibilities: one is based on the numeral + classifier + NP (one-phrase), while the other is based on the NP (*xiangjiao* 'banana') in relation to the context. The first scale is the quantifiable value presupposed by one + CL. In the case of (8), *yi-gen* 'one + CL' invokes a scale based on the number, such as two, three, four and more bananas. The scalar inferences are all relevant to the quantity of bananas. *Yi-gen* 'one' profiles a scale endpoint. There is another scale which is structured by the NP based on the context. In the case of (8), *xiangjiao* 'banana', as one category of fruit, can be contrasted with other kinds of fruits, or with other kinds of food. Suppose that someone usually has bananas as part of her/his breakfast, and s/he does not have time for breakfast for some reason. We then can use (8) to imply that s/he does not eat a banana at all, let alone other kinds of fruits or foods. This can apply to the *lian…dou* construction as well:

(9)	*cike*	*wo shi*	*lian*	*yi-ping*	*shui*	*dou*	*mei*	*dai*
	this moment	I SHI	LIAN	one + CL	water	DOU	not	take
	(i)	'At this moment, I even didn't take a bottle of water.'						
	(ii)	'At this moment, I even didn't take a bottle of water, let alone many other important things.'						

In the case of (9), the scale can also have two possibilities based on the one-phrase and the NP. *Yi-ping* 'one bottle' may invoke the alternative sets of possibilities 'two, three, four and more bottles of water'. Another scale is built on the NP relative to the context. Suppose that someone takes a trip. S/he may take with her/him many things, such as water, cellphones and other relevant things. In this context, water might be the least important, which would occupy the endpoint. And this can also explain why we can only put the NP after *lian* instead of the whole one-phrase in the *lian…dou* construction.[3] The one + CL appears in a lower position in the thematic hierarchy (patient, theme) to measure the degree of how a predicate is instantiated (Israel, 2001). Generally, in Chinese, we can employ different scales to achieve the emphatic effect conveyed by the one-phrases or the NPs, as can be shown in (10):

(10)	a.	*san*	*tian*	*san*	*ye*	*mei chi*	*yi-dun*	*re fan*
		three	day	three	night	not eat	one + CL	hot food
		'I have not eaten any hot food for three days.' (BCC)						
	b.	*wo jintian yi*	*tian dou meide*	*chi,*	*lian*	*shui*	*dou*	*mei*
		I	today one day DOU not	eat	LIAN	water	DOU	not
		he	*yi-kou*					
		drink	one + CL					
		'Today, I didn't eat anything. I didn't even drink any water.' (BCC)						

[3] One-phrases can also be separated by a modifier, such as *yidun re fan* 'one hot meal', *yikou re shui* 'one hot water', *yiju kaopude hua* 'one serious word' and so on.

The scale in (10a) is set up on the one-phrase to emphasize that I did not eat even any hot food at all. The scale in (10b) is based on the NP relative to the previous context. In (10b), drinking water and eating food can be construed as one event. Compared with eating food, drinking may be considered less important. The speaker uses the *lian…dou* to achieve the emphatic effect relating to how miserable s/he is. Then we can conclude that the scalar inference is not sensitive to *lian*, but is determined instead by minimizers themselves depending on the context. It should be noted that different scales established in contexts represent different effects. The quantity scale expresses the minimal quantity, while the NP scale relative to the context expresses the minimal quality or degree.

To sum up, minimizers may have two possible scalar inferences based on the one-phrase and the NP respectively, suggesting that the scalar inference is determined lexically and pragmatically, rather than purely syntactically as was proposed in Shyu (2016). The *lian…dou* construction is used to reinforce the illocutionary act. As a reviewer points out, *lian…dou* not only reinforces the illocutionary act that the semantics of the minimizer triggers but also constitutes the licensing condition for the non-specificity and minimizer reading, as can be seen in below:

(11) **Yige* *pingguo ta* *mei chi*
One + CL apple he not eat
a. 'He (even) did not eat any apple.' (intended meaning)
b. 'He did not eat a particular apple.'

(12) *Lian* *yi-ge* *pingguo ta dou* *mei* *chi*
LIAN one + CL apple he DOU not eat
'He even did not eat any apple.'

As is well known (Chao 1968), 'one + CL + NP' in Chinese cannot function as a topic if it does not have a specificity reading as in (11). However, 'one + CL + NP' is acceptable with *lian…dou* as shown in (12). In this paper, we argue that *lian* in Chinese is a topicalized focus marker (for detailed discussion, see Sect. 4.2). A topicalized focus can give rise to a hybrid reading, namely, its topicality and focality is likely to be on equal footing in context, as in (13):

(13) *Lian* *yi-gen* *xiangjiao wo* *dou* *mei chi*
LIAN one + CL banana I DOU not eat
a. I even did not eat any banana
b. I even did not eat a banana, let alone bread and milk

In (13), *lian* + *yi-gen xiangjiao* 'even one banana' may induce two relevant sets: The first is simply concerned with the number of bananas, and the second is concerned with the event relating to eating breakfast. A breakfast may include several foods, such as bread, milk and bananas. The first possible set consists of a number of bananas. The condition for inducing this set is that both speaker and hearer know there exists a number of bananas. Thus, *Yi-gen xiangjiao* 'one banana' represents a single entity of this set, which in some sense has referentiality. The second

possible set also implicates that *yi-gen xiangjiao* 'one banana' has referentiality. For example, eating breakfast can be sub-divided into drinking milk, eating bread, eating banana and so on. Eating a banana is then a subset to the event 'eating breakfast'. We then can conclude that this hybrid status licenses the usage of 'one + CL + NP' in Chinese.

In the next section, a parsing analysis will show how *lian…dou* can model the required lexical, structural and pragmatic interaction within DS.

4 A Dynamic Analysis

In this section, we present a dynamic analysis of minimizers in the *lian…dou* construction. Before doing this, we will introduce the framework to be employed, i.e. Dynamic Syntax.

4.1 The Framework: Dynamic Syntax

Standard grammar formalisms are defined without attempting to reflect the incremental, serial and context-dependent nature of language processing, which leads to a poor framework to model utterance or dialogue in real context. Language would lose its import without context, since there are rich speaker-hearer interactions and an extremely high proportion of context-dependent utterances.

Dynamic Syntax (DS) is a parsing-directed grammar formalism which seeks to represent the semantic interpretation for a natural language string, which is built up following the left–right sequence of the words in context (Cann et al. 2005; Kempson et al. 2001). The process is goal-driven, and begins with the initial and universal requirement to establish the propositional content of an utterance in context. "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: 337). Thus 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, all of which can intermingle. 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 process in which partial information is manipulated and in which incomplete specifications extend 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 yield the complete propositional content conveyed by the utterance in context. Importantly, such trees do not constitute a model of syntactic structure in the classical sense of structured strings inhabited by words, but rather a semantic one, representing the predicate-argument structure projected by the utterance under examination.

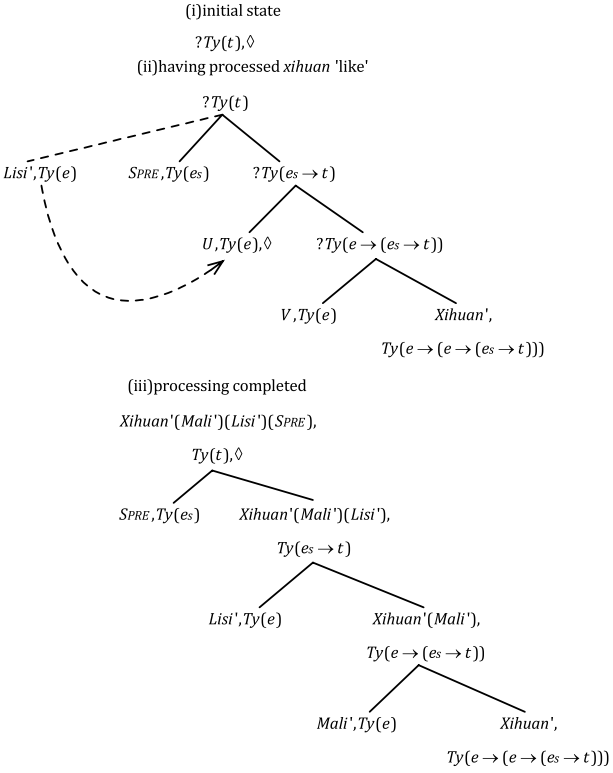

Fig. 1 Parsing *Lisi xihuan Mali* 'Lisi likes Mali'

4.1.1 Tree Structures and Tree Growth

We illustrate the tree-structural processes that will be applied to Chinese, first with the simplest assumptions about how structure for a Chinese sequence is projected as in Fig. 1 below for the utterance *Lisi xihuan Mali*, 'Lisi likes Mali'.

The general parsing process involves building a node ?*Ty*(*a*) for any type, where ? indicates the requirement, *Ty* the type. ? means that the requirement must be satisfied. For example, 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) of Fig. 1. In order to satisfy the requirement, we rely on the following sources. First, computational rules govern general tree-constructional processes, such as moving the pointer, introducing and updating nodes, with all trees invariably binary-branching. The argument will always appear on the left branch, and the functor on the right node, where the diamond is the 'pointer' which identifies the node under development, and the formula decorations are concept labels corresponding to the word in question. 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).

In the unfolding of trees, there are two basic actions, which serve as opening options: building a (locally) unfixed node (called *Adjunction), and building a pair of so-called LINKed trees. The former is the license to build an underspecified tree relation inducing an "unfixed" node, which has a more stringent variant requiring update within a single predicate-argument structure. An initial tree decorated with a condition of requiring propositional development can be expanded by the computational action (Local *Adjunction) to induce an initially unfixed node with a requirement $?\exists x \cdot Tn(x)$. The restriction imposed by this local variant of *Adjunction induces a locally unfixed node as one of a set of argument nodes within some local predicate-argument structure, a restriction 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 some locally identified propositional structure. In this framework, actions encoded in lexical items may further update the partial tree, whenever their own set of actions matches the input required. In the projection of structure, that is interpretation of *Lisi xihuan Mali* 'Lisi likes Mali', the first word *Lisi* will be parsed in line with the incrementality in communication. More precisely, the lexical entry for the word *Lisi* consists of a set of actions which are initiated by a trigger and a termination statement of aborting the parsing process if the conditional actions fails, as listed below[4]:

(14)

Lexical entry for *Lisi*:	
IF	$?Ty(e)$
THEN	put($Ty(e)$, $Fo(\mathrm{i}, x, Lisi'(x))$
ELSE	abort

The following word is the verb, and, as in other DS analyses, this projects a fully propositional structure, with specification of the adicity of the verb reflected in the number of attendant arguments the verb requires, as indicated in (ii) of Fig. 1. As (ii) also shows, the unfixed node initially introduced can then unify with the subject node, an action here we adopt by assumption, this being a very widespread routinized update in Chinese, hence a default action of Chinese processing. Finally, according to the linear order, the object *Mali* is parsed to satisfy the requirement in the internal argument position as in Fig. 1 (ii) below. Completion of the DS tree involves modalized functional application of functors over arguments, which is driven by modus ponens over types. This process would finally yield the expressions that could satisfy the open requirements, as in Fig. 1 (iii).

4.1.2 Substitution and LINK

This process of building such a simple structure is however only one among several options. It is well-known that Chinese is a typical topic-prominent and pro-drop

[4] In DS, proper names such as *Lisi* are treated as projecting an iota term (for detailed discussion, see Cann et al. 2005).

language. In Chinese, there are two types of topic constructions: the dangling topic or Chinese-topic construction (*Yuyanxue, wo xihuan yuyixue* 'As for linguistics, I like semantics') and the English-topic construction (*Yuyanxue, wo xihuan* 'Linguistics, I like'). Accordingly, verbs in Chinese are licensed to project a full propositional template with arguments identified anaphorically from the context, enabling the preceding NPs to be projected as decorating the output of one of the three types of computational actions; and our initial example could have equivalently been processed by the introduction of a LINKed structure introduced from the top root node, and then decorated through the actions of processing *Lisi*, this expression thereby projected as topic, that structure then providing the context relative to which the role of *Lisi* as subject is achieved through identifying that subject argument with the LINKed node initially constructed.[5] The English-topic construction will, on the other hand, involve adopting the second strategy of building an unfixed node and resolving it through unification with the appropriate argument node projected by the verb. Note that there may be two NPs preceding a verb in the Chinese topic construction (*Zhangsan ya, shui mei he yikou jiu zoule* 'As for Zhangsan, he just went away without drinking any water'), in which case, in order to ensure that the two decorations can be distinguished and therefore recovered from two such adjacent NPs, we adopt both the option of building a LINKed node from the root, taking the initial NP to decorate that LINKed node, and subsequently building an unfixed node. In the Chinese *lian…dou* construction, there are alsot two NPs preceding a verb (*wo lian yigen xiangjiao dou meichi* 'I even didn't eat a banana'; and the same parsing method will be adopted in that case (as will be discussed in Sect. 4.2).

What we have seen so far is the projection of structure via the use of underspecified structural relations. But also central to the DS framework is the second type of underspecification, viz. content underspecification.

Interpretively, anaphoric expressions are underspecified in content, which has to be updated by a specific semantic value from the context. In DS, a pronoun is defined to project a meta-variable (***U*** and ***V***) with a constraint, which is accompanied by the requirement $?\exists x \cdot Fo(x)$. Thus the lexical entry of 'he' can be described as below:

(15)

IF	$?Ty(e)$
THEN	put($Ty(e)$, $Fo(Umale')$,$?\exists x \cdot Fo(x)$
ELSE	abort

The requirement must be satisfied by a concrete semantic value in context which should also meet the constraint *Umale*. In DS, this can be achieved in two ways: either by use of a rule called 'SUBSTITUTION', indicated diagrammatically as (⇑) that

[5] In Kempson et al. (2001: 110), LINK relations are defined "A Linked Basic Tree structure *LBTRT* is a finite set of partial trees $\mathcal{T}_1 \ldots, \mathcal{T}_n$" with disjoint Tree Domains and a *Link* relation $\prec L \subseteq \mathrm{U}_{1 \leq i \leq n} TrDom_i \times \mathrm{U}_{1 \leq i \leq n} TrDom_i$ such that, if $n \prec_L n'$ holds between $n \in TrDom_i, n' \in TrDom_j$, then $i \neq j$.".

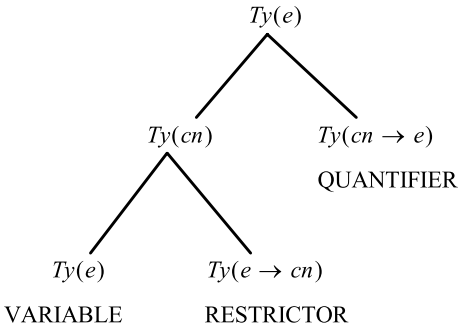

Fig. 2 Structure of quantifier phrases

is used to resolve the content underspecification, or by the re-running of actions recorded in context to induce a parallel but not necessarily identical result (Kempson et al. 2015). In the former case, this is illustrated by the following dialogue:

(16)	a:	John likes Mary
	b:	She also likes him

(16a) provides the context for (16b). In (16b), *she* and *him* project two meta-variables, each with a constraint. Thus, we can use *Mary* and *John* to substitute them respectively. The latter case is used to achieve parallel but not identical results, to which we return below.

Finally, within DS all quantifier phrases are analyzed as of simple type e, rather than a higher type, following the epsilon calculus pattern (Hilbert & Bernays, 1939), in which all quantifying terms are analyzed in the manner of natural deduction proof systems of predicate logic as epsilon terms, these are semantically a witness to the overall proposition in which they are contained. Indeed such terms are defined to satisfy the following equivalence: $\exists x.F(x) \equiv F(\epsilon, x.F(x))$ (Fig. 2).

This can also be applied to type e_s for event/situation (see Gregoromichelaki, 2006).

4.2 A Dynamic Account of Minimizers in the *lian…dou* Construction

In this section, we will present a parsing-based analysis of minimizers in the schema of *lian…dou*, demonstrating how context plays a crucial role in determining the well-formedness of natural language strings.

As has been mentioned in Sect. 1, *lian* serves as a focus marker in Mandarin Chinese, which evokes a set of propositional alternatives (Rooth, 1985, 1996). With respect to Mandarin Chinese, Liu and Xu (1998) reasonably classify 'focus' into three types in terms of properties [±prominent] and [±contrastive], namely, natural focus, contrastive focus and topicalized focus: Natural focus has the property of [+prominent] and [-contrastive], taking as background other constituents within the same clause; contrastive focus is characterized as [+prominent] and [+contrastive], taking as background the rest of the same clause and also one element of the other clause or other clauses; topicalized focus only takes as background one element of

other clauses with the property of [-prominent] and [+contrastive]. They further point out that the element following *lian* in the *lian…dou* construction is a topicalized focus, whose focality usually outweighs its topicality (Wu, 2017). A topicalized focus has a hybrid reading, namely, its topicality and focality is likely to be on an equal footing in context. In general, a topic has a presupposed nature, while a topicalized focus has a non-presupposed nature (cf. Kiss, 2002). But, as has been pointed out in Kiss (2002), the topicalized focus emerges dynamically, albeit syntactically associated with a marked position. This means that the elements following *lian* may be mentioned previously or may be set up semantically or pragmatically by the previous event, as can be seen in (17):

(17)	*Xiao*	*zhen yiyuan*	*de*	*yisheng bujin*	*mei jian*	*guo*	*zhe*
	Small town hospital		DE doctor	not only	not see	GUO	this
	qite	*de*	*bingli, lian*	*ting dou*	*mei*	*ting guo*	
	strange DE	case	LIAN	hear DOU	Not	hear GUO	

'The doctors in the small town didn't experience such a strange case. And they even didn't hear about it.' (BCC)

In (17), curing the strange case is an event (E), which may include several subevents (e_1, e_2, e_3…): experiencing the case (e_1), hearing about the case (e_2) and so on. *Lian* + object in the second clause is not mentioned previously, but it is contained in the event invoked by e_1. Based on the context, e_1 and e_2 in E may form a scale. As for curing a disease, hearing may be lower than seeing on the scale. As a topicalized focus, *lian* + object (minimizer) first functions as a topic to some degree. Although it is not previously mentioned, it is previously contained. Second, it functions as a focus, which is permitted in the second clause under the condition that the scale formed in the context. Based on the above analysis, let us see how example (18) should be parsed:

(18)	*Wo*	*lian*	*yi-gen*	*xiangjiao*	*dou*	*mei*	*chi*
	I	LIAN	one + CL	banana	DOU	not	eat
		(i)	'I even didn't eat a banana'				
		(ii)	'I even didn't eat banana, let alone many other foods for breakfast.' (BCC)				

As has been discussed above, (18) may yield ambiguous interpretations. There are two scalar implicatures based on *xiangjiao* 'banana' and *yi-gen* 'one + CL' respectively. Its parse is to illustrate: (i) how total negation is achieved; (ii) how *lian…dou* can reinforce the illocutionary act denoted by the relevant construction. *Wo* 'I' as a first-person pronoun refers to the speaker, so we use *Speaker′* to represent *wo* 'I'. As has been pointed out previously, *lian* may induce a relative scalar implicature. Then *dou* in (18), a domain morpheme, will be parsed. In the *lian…dou* construction, it indicates all the contextually relevant alternatives invoked by *lian* + objects are held to be true so the alternatives implicit in the set indicated as containing the one focused element would also be true (see also Hole 2004). Figure 3 shows how the two NPs preceding the verb *chi* 'eat' induce both a LINKed topic node and the

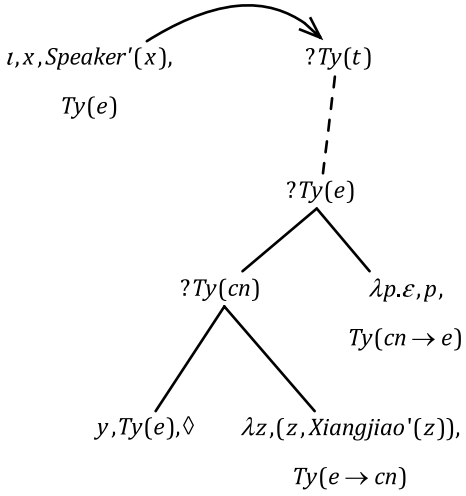

Fig. 3 Parsing *wo lian yi-gen xiangjiao*…in (15)

building of an unfixed node to host the effect of processing *yi-gen xiangjiao,* with the subject *wo* serving to decorate the LINKed node and *lian yi-gen xiangjiao* serving to decorate the unfixed node:

As pointed out in Sect. 4.1.1, Chinese is a typical topic prominent and pro-drop language, so the propositional structure for the primary structure is standardly induced by the processing of the verb at which point the inhabitant of the LINKed structure can be identified not merely as the topic, but as the subject through unifying with the appropriate verbal argument. Before reaching that point however, we assume that *dou* as a domain morpheme will project a propositional tree in the event node to capture the effect of the focus preceding *dou* to be taken as true, so the alternatives implied in the set indicated by that focused element (here by the use of the numeral *yi-ge* 'one') would also be true (see also Yang & Wu, 2019). This can be shown in the event node, anticipating the structure subject to its being completed following the processing of the verb. On this node, three metavariables (***U***, ***V***, ***W***) occupy the subject, the object and the verb positions, respectively, in anticipation of the immediately following verb. This tellingly shows that the alternatives are fully dependent on the linguistic context, with the main propositional tree still to be completed constituting the minimal context for completing the structure. That is to say, the three metavariables will all characteristically be enriched by three terms in the main propositional tree, as shown below (Fig. 4).

Subsequent to the parse of *dou*, the polarity item *mei* 'not' will be parsed in turn. Usually, *mei* 'not' serves to negate a proposition, as in *wo mei chi yi-gen xiangjiao* 'I do not eat any banana'. It can then be assumed that *mei* 'not' will introduce a $Ty(t \rightarrow t)$ node decorated with the formula *mei'* (Fig. 5).

The rest of the sentence will then be parsed, as shown in Fig. 6.

In DS, the lexical information can also serve as a tool to determine the semantic value of the subject and where the unfixed nodes should be fixed. *Chi* 'eat', as a verb, usually takes an animate agent to be its subject. Hence, *wo* 'I' can be identified as the grammatical subject, the highly routinized default choice. In Fig. 6,

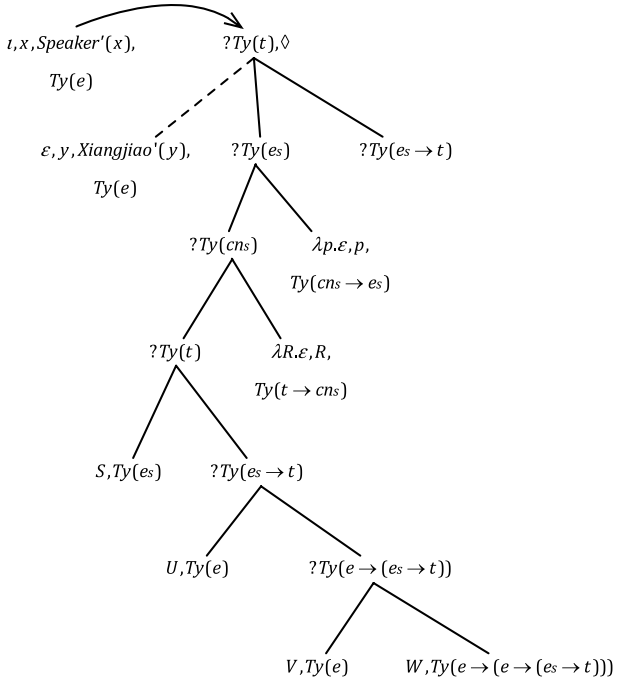

Fig. 4 Parsing *dou*

the metavariable **U** is substituted by the semantic value *ι,x,Speaker′(x)*, reflecting that routinised pragmatic heuristic, that is, the subject node is identified anaphorically from the decoration on the LINKed node.

Note that *lian* as a focus marker usually takes a grammatical object. Figure 6 shows that *lian* + noun would be taken as a logical object. It is also worth noting that '*lian* + NP' cannot be identified as the logical object unless the NP is identified as the grammatical subject first. Otherwise, both the NP and '*lian* + NP' would remain ambiguous:

(19)	*Zhege*	*xuesheng*	*lian laoshi*	*dou*	*bu renshi*
	This-CL student		LIAN teacher	DOU	not know
	(i)	'This student even does not know the teacher.'			
	(ii)	'This student even the teacher does not know.'			

After the subject is identified, the unfixed node will be unified with the fixed node through the computational rule of UNIFY. As has been pointed out previously, a noun phrase following *lian* in this sentence would be construed as a logical object. It is worth noting that the template projected by *lian…dou* can only be identified once the tree is complete. The event in the template is thus fully dependent on the main proposition. That is, the template projected by *lian…dou* based on the linear order only indicates that there will be an event relying on

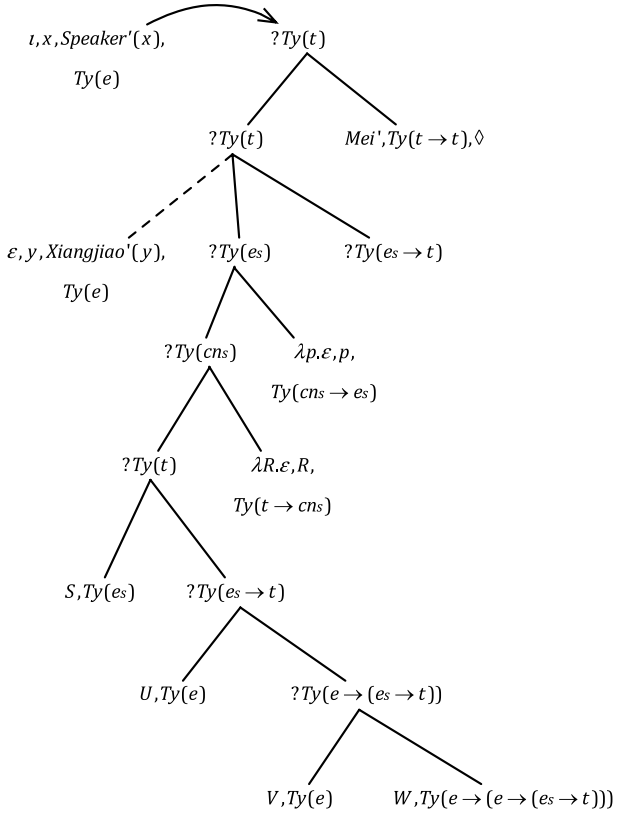

Fig. 5 Parsing *mei* 'not'

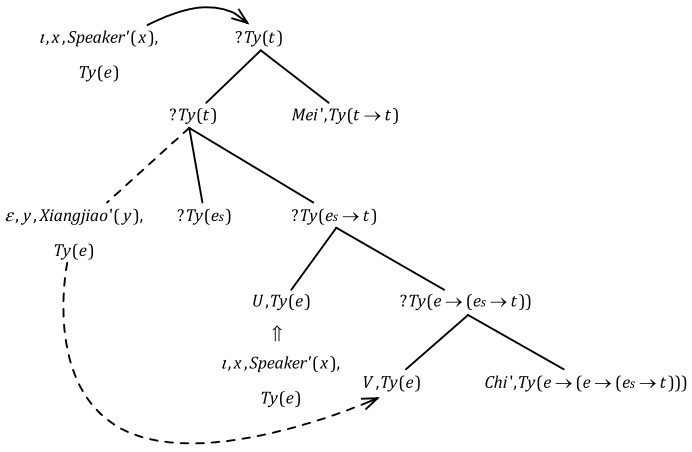

Fig. 6 Parsing *chi* 'eat'

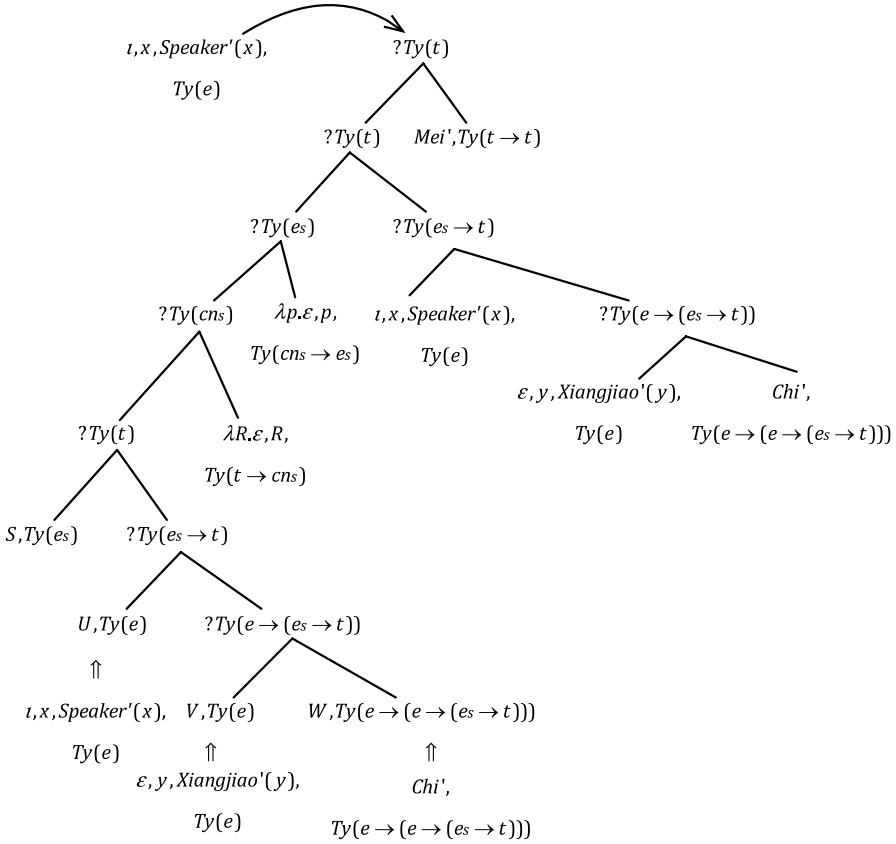

Fig. 7 Parsing *wo lian yi-gen xiangjiao dou mei chi* 'I even didn't eat any banana.'

the completion of the main proposition. The metavariables could then become enriched by terms from the main propositional tree:

Figure 7 is a representation of how the event node's value relies on the main propositional tree. Subsequently, a complete tree can be achieved. In this example, total negation is achieved by the main tree, which yields a propositional formula: $Mei'\left(Chi'\left(\varepsilon, y, Xiangjiao'(y)\right)(\iota, x, Speaker(x))\right)$. The function of the domain morpheme *dou* and the propositional tree projected by it, by virtue of the very repetition, is to reinforce the illocutionary act expressed by the same semantic formula as that of emphasis.

Here, it should be stressed that the ambiguous interpretations both reflect the context. In the second interpretation of (18), an appropriate context might be as follows. For instance, Mali's mother often prepares many foods for breakfast, such as banana, apple, bread, bacon and so on. One day, Mali gets up late and has no time to eat breakfast. When Mali returns from school, her father asks her: *ni chi zaocan le ma?* 'Did you eat breakfast?' Mali may utter "*wo lian yi-gen xiangjiao dou mei chi*" to mean that she did not eat anything for breakfast. Note that her father's utterance

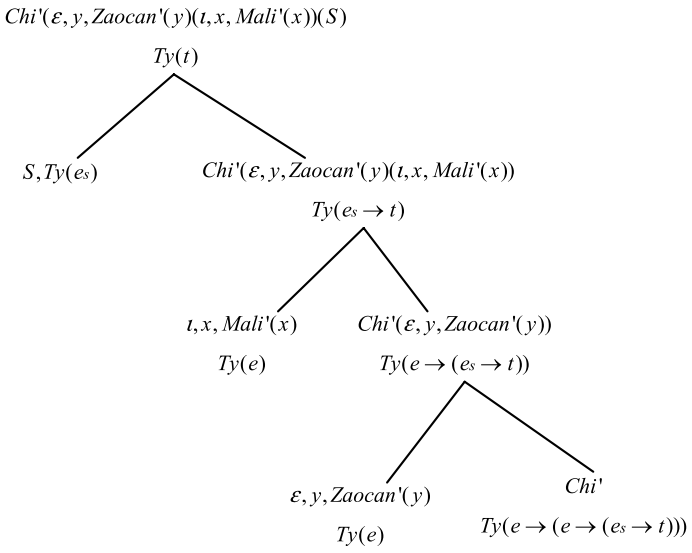

Fig. 8 *Mali chi zaofan* 'Mali eats breakfast'

ni chi zaocan le ma? 'Did you eat your breakfast?' creates a context. Based on this context, (18) can be parsed to yield the second interpretation. First, the parse of *ni chi zaocan le ma*? 'Did you eat your breakfast' will yield a context tree, as in Fig. 8.

Zaocan 'breakfast' provides a list of contents, such as banana, apple, bread, bacon and so on, which will allow speakers and hearers to establish a contextual scale based on them. That is to say, a list of context trees can be set up based on the proposition expressed by *Mali chi zaocan* 'Mali eats breakfast', such as *Mali chi xiangjiao* 'Mali eats banana', *Mali chi mianbao* 'Mali eats bread', *Mali he niunai* 'Mali drinks milk' and so on. After hearing this question, Mali may use (18) as a response to stress that she does not eat anything for breakfast. Under this context, the scale is based on the event concerning eating breakfast instead of the number. Eating breakfast can be seen as a whole event including several sub-events, such as eating banana, bread, bacon and so on. In Mali's mind, eating banana may occupy a lower point compared with other sub-events. During the parse of this example, *dou* also projects a propositional tree in the event node whose internal object node will be occupied by a metavariable. This shows that the metavariable will be enriched by a term from the context, such as apple, bread, bacon and so on. The total negation is then achieved by using *mei* 'not' to negate the main proposition expressed by *wo chi yi-gen xiangjiao* 'I eat one banana' and the alternatives projected by *dou,* as in Fig. 9.

On this view, the account reflects the assumption that *Zaocan'* can simply be understood as a group-denoting term so its contribution to the proposition by implication holds of all its members, in this case suggesting that the event term parallels that provided by the immediately preceding question. To spell this out in detail, we tentatively suggest that the same effect could be achieved by interpreting the variable **W** in the propositional structure initially constructed in the processing of *dou*

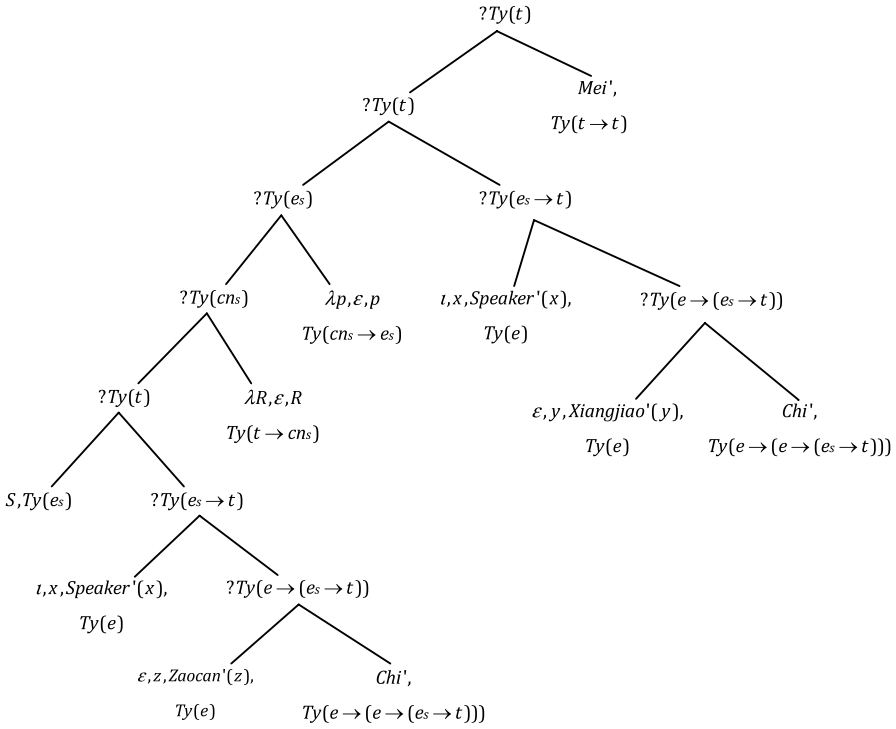

Fig. 9 Parsing *wo lian yi-gen xiangjiao dou mei chi* 'I even didn't eat any banana.'

as itself inducing not a copy of the predicate *Chi'* but repetition of the actions determined by the verb *Chi* with its arguments to be resolved in context (following the pattern of ellipsis in Kempson et al 2015). If this were the means by which these variables are saturated, this could yield iterative processes of construction in which the individual constituents of a breakfast, if relevantly salient, might be interpreted as the role of the internal argument of the reconstructed predicate *Chi'*, equally falling within the scope of the main negative operator, hence also not being eaten. The pragmatic effect of such a use of *lian…dou* could thereby be modelled either as a contingent inference to be drawn externally to the interpretation of the utterance from the group-based content associated with *Zaocan*, or as a direct consequence of the actions licensed to be invoked.[6]

[6] We are grateful to one of the reviewers for pointing out this possibility to us.

5 Conclusion

Based on the naturalistic data from two influential corpora (CCL and BCC), we have shown in this paper that the total negation induced by minimizers in Chinese is determined by the interaction between syntax, semantics and pragmatics, rather than by purely syntactic means as has been claimed by Shyu (2016). In accordance with contexts, there are at least two possible different (event) sets induced by Chinese minimizers. We have then proposed a parsing-based analysis to further show how *lian…dou* can reinforce the illocutionary act denoted by the relevant construction. In addition, we have argued that the focus marker *Lian* in Chinese induces a set of alternatives, whereas the domain morpheme *dou,* by setting up the appropriate structure within the event term of the main structure, indicates that the rest of alternatives would be true relative to the context. Albeit some aspects of the formulation of this proposal may remain tentative, the account nevertheless unambiguously provides evidence confirming that interaction of syntactic, processing and pragmatic influences jointly determine the communicative result.

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