VARIETIES OF ALTERNATIVES

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ABSTRACT OF THE DISSERTATION

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This dissertation concerns two focus particles (*jiu*, *dou*) and *wh*-expressions (*shenme* 'what', *na geren* 'which person') in Mandarin Chinese. These items are systematically 'ambiguous' and have played important roles in various aspects of Mandarin grammar. An idea based on alternatives and varieties of alternatives in particular – following Chierchia's 2013 analysis of the polarity system – is pursued to account for the systematic ambiguities. Unambiguous semantics of *jiu*, *dou* and *wh*-expressions is maintained and 'ambiguity' explained through varieties of alternatives interacting with other independently motivated aspects of the structure they occur in. A better understanding of a large array of phenomena that involve these items – exhaustivity, distributivity, questions and conditionals – is achieved.

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Acknowledgments

I would like to start with a paragraph from Chierchia 1984: iv that best describes the current form of the dissertation:

> Various circumstances in my life prevent me from being a student any longer. For this reason, it was necessary to finish the present dissertation. But this should not be taken to imply that I regard it in any way as a complete piece of work.

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Chapter 1

Introduction

1.1 The cast of characters

This dissertation mainly investigates two focus particles (*jiu*, *dou*) and *wh*-expressions (*shenme* 'what', *na geren* 'which person'[1], . . .) in Mandarin Chinese. These items are interesting for at least the following reasons.

First, both *jiu*/*dou* and *wh*-expressions appear to be massively ambiguous:

- *jiu* seems to be an exclusive particle similar to English *only*, a non-exclusive scalar particle expressing small quantities (Biq 1984, Lai 1999), a default conditional marker and so on (Chao 1968, Li & Thompson 1981, Hole 2004) (1) ;
- *dou* is a distributive operator similar to English *each* (Lin 1998) (or a universal of some sort, as in Lee 1986, Cheng 1995), a scalar particle expressing unlikelihood as English *even* (Shyu 1995, Chen 2008), an unconditional marker (Lin 1996) and so on (2);
- *wh*-expressions in Mandarin Chinese function as question words, negative polarity items (NPIs), free choice items (FCIs) and so on (Li 1992, Cheng 1997, Lin 1996, Dong 2009, Liao 2011) (3).

(1) 'Ambiguity' of *jiu*

a. Jiu Yuehan hui shuo fayu.
jiu John can speak French
'Only John can speak French.' *'only'*

[1] The *ge* in *geren* is a classifier, *ren* being 'person'. I take numeral+ cl+noun to have the structure of [numeral [cl noun]]. Nothing crucial hinges on this.

b. Yuehan jiu hui shuo fayu.
John JIU can speak French
'John, who is easy to get hold of, can speak French.' — Scalar particle

c. A shi hong qiu, B jiu shi lan qiu.
A be red ball, B JIU be blue ball
'If ball-A is red, then ball-B is blue.' — Conditional marker

(2) 'Ambiguity' of *dou*

a. Tamen Dou mai le yi liang chezi.
they DOU buy ASP one CL car
'They each bought a car.' — Distributive operator

b. Yuehan dou mai le yi liang chezi.
John DOU buy ASP one CL car
'Even John bought a car.' — *'even'*

c. ta lai bu lai, wo dou bu qu.
he come NEG come, I DOU NOT go
'Whether he comes or not, I will not go.' — Unconditional marker

(3) 'Ambiguity' of *wh*

a. Zhangsan qing le shei?
Zhangsan invite ASP who
'Who did Zhangsan invite?' — Question word

b. Zhangsan mei qing shei.
Zhangsan not invite who
'Zhangsan didn't invite anyone.' — NPI

c. Ni shei dou neng qing.
you who DOU can invite
'You can invite anyone.' — FCI

How could a single item have so many uses? The thesis tries to answer this interesting question.

Second, the two focus particles and *wh*-expressions have played an important role in various aspects of Mandarin grammar. To illustrate, consider the following claims from the literature[2]:

- to express a distributive reading in the case of plural predication, *dou* is needed (Lin 1998: 201);
- to express universal quantification, *dou* is needed (Lin 1998: 219);
- to express a conditional meaning, *jiu* is usually needed in the consequent of the conditional (Chao 1968, Hole 2004);
- and needless to say, Mandarin *wh*-expressions are needed in constituent questions and work as indefinites in certain restricted environments.

(4) DISTRIBUTIVE READINGS NEED *dou*

a. NO *dou* → COLLECTIVITY [Lin 1998: (1a)]

Tamen mai-le yi-bu chezi.
they buy-ASP one-CL car
'They bought a car.'

b. *dou* → DISTRIBUTIVIY

Tamen <u>dou</u> mai-le yi-bu chezi.
they DOU buy-ASP one-CL car
'They <u>each</u> bought a car.'

(5) UNIVERSAL QUANTIFICATION NEEDS *dou* [Lin 1998: (31a)]

Meige ren *(dou) mai-le shu.
every man *(DOU) buy-ASP book
'Everyone bought a book.'

(6) DEFAULT CONDITIONALS USUALLY NEED *jiu*

a. NO *jiu* → CONJUNCTION

A shi hong qiu, B shi lan qiu.
A be red ball, B be blue ball
'Ball-A is red, and ball-B is blue.'

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[2]These claims are not to be taken as written in stone. In fact I will later take issues with these claims. I list them here to illustrate that the items I am interested in play an important role in Mandarin grammar. For discussion of the *dou*'s distributive effects, see §3.2.2 and §3.4.2. For *dou* combining with *every*, see §3.4.2.

b. *jiu* → CONDITIONAL

A shi hong qiu, B jiu shi lan qiu.
A be red ball, B JIU be blue ball
'If ball-A is red, then ball-B is blue.'

Thus, understanding these items helps us understand how plural predication, quantification, conditionals and questions work, both in Mandarin Chinese and more broadly across languages. The thesis aims at gaining a slightly better understanding of these important issues.

There is a third reason why this particular group of items takes center stage in the dissertation: it will turn out that analyses of these items all rely on alternatives and in particular the idea of there being varieties of alternatives. I will say more about the use of alternatives and their role in the grammar in Chapter 2, especially in §2.1.3 and §2.1.5.

1.2 Main themes

Below I will highlight some of the main themes and ideas to be pursued and defended in the thesis.

1.2.1 No functional homonyms

Questions with regard to whether a functional item is ambiguous or not abounds in the semantics literature. Here are some of the well known examples in English:

- Is *and* ambiguous between a boolean *and* and a sum-formation *and*?
- Are modal expressions such as *must* and *might* ambiguous between epistemic, deontic, bouletic... readings?
- Is *any* ambiguous between its NPI use and its FCI use?
- Is *if* ambiguous between if_Q and if_C, the former used in questions and the latter in conditionals?

It seems that a no-answer to the above questions always brings out a more elegant analysis and helps us deepen our understanding of the grammar.

I take it to be my working hypothesis that there exists no homonyms within the functional vocabulary of a natural language. 'Ambiguity' of a function word should be reduced and unified to a single semantic core. Two of the most famous illustrations of this idea are Kratzer's analysis of modal expressions (Kratzer 1981a, 2012) and Chierchia's analysis of polarity items (Chierchia 2006, 2013), the latter of which will be discussed in detail in §2.1.3.

Applying No Functional Homonyms to the items discussed in this thesis, we expect both Mandarin focus particles and *wh*-words should receive a unified analysis. The basic strategy (due to Kratzer and more directly to Chierchia) is to reduce 'ambiguity' to the different environments the relevant item can appear in.

In the case of focus particles, I propose that different uses of a focus particle are achieved by varying its associated alternative set (Rooth 1985). Specifically, by positing sum-based alternative sets and atom-based ones, an unambiguous semantics for *jiu* as $\textsc{only}_{weak}$ and *dou* as EVEN can be maintained, and 'ambiguity' explained through *varieties of alternatives* interacting with other independently motivated aspects of the structure they occur in.

To give a concrete example, consider the $\textsc{only}_{weak}$ in (7), which (combined with an extra scalar presupposition to be discussed in §3.2.4 and §4.2.4) explains both *jiu*'s exclusive use as in (1a) and its non-exclusive use (1b)[3].

(7) $[\![\textsc{only}_{weak}(\pi)]\!]$ is true iff $\forall q \in [\![\pi]\!]_{Alt}[q \subset [\![\pi]\!] \rightarrow \neg q]$

Alternatives asymmetrically entailing the prejacent are false.

(8) $[\![\textsc{only}_{strong}(\pi)]\!]$ is true iff $\forall q \in [\![\pi]\!]_{Alt}[[\![\pi]\!] \not\subseteq q \rightarrow \neg q]$

[3] A few words on the notation used here. $[\![.]\!]$ is the ordinary interpretation function that maps a linguistic expression to its meaning, while $[\![.]\!]_{Alt}$ maps an expression containing an alternative trigger such as focus to a set of alternative meanings (Rooth 1985). Since ONLY is alternative sensitive, its semantics involves reference to the alternative semantic value of its prejacent $[\![\pi]\!]_{Alt}$. By *prejacent*, I mean the ONLY-less part of the sentence containing an ONLY (Horn 1996). For example, the prejacent of *only* in *John only invited Bill* is *John invited Bill*. See §2.1.2 for a brief introduction of classical Roothian alternative semantics.

Alternatives not entailed by the prejacent are false.

Different from the standard semantics of English *only* in (8), ONLY_{weak} only negates alternative propositions strictly stronger than the prejacent and is sensitive to the sum/atom distinction of its alternative set (9)-(10).

(9) $[\![\pi]\!]_{Alt,sum}$={that j can spk French, that j⊕b can spk French...} Exclusive

(10) $[\![\pi]\!]_{Alt,atom}$={that j can spk French, that b can spk French...} Non-exclusive

Let the prejacent be *John can speak French*. Since the sum-based alternative set in (9) contains stronger propositions such as that j ⊕ b can speak French, exclusivity obtains with ONLY_{weak}. Instead, the atom-based alternative set in (10) does not contain (strictly) stronger propositions, leading to non-exclusivity. Furthermore, we will show that exactly the same varieties of alternatives capture *dou*. In this way, varieties of alternatives explains *systematic* 'ambiguities' of Mandarin focus particles.

In the case of Mandarin *wh*-words, which can be used outside questions as polarity sensitive items, a unified analysis within Chierchia's (2013) system is given in Liao 2011 and Chierchia & Liao 2014, where all *wh*s are analyzed as existentials. I extend their proposal to one of the most recalcitrant puzzles regarding *wh*-existentials, the consequent-*wh* of a Mandarin *wh*-conditional.

(11) Zhangsan qing <u>shei</u>, Lisi jiu qing <u>shei</u>.
Zhangsan invite who, Lisi JIU invite who
'If Zhangsan invites <u>X</u>, Lisi invites <u>X</u>.' [Cheng & Huang 1996]

The consequent-*wh* in (11) is a puzzle for Chierchia-polarity-existential because it is licensed in the consequent of a conditional (an obvious upward-entailing context) without triggering any epistemic effect.

The key to understanding the puzzle is to abandon the idea that *wh*-conditionals are donkey sentences (Cheng & Huang 1996, Chierchia 2000). Instead, I propose they are interrogative conditionals[4], which involve embedding two questions within a conditional; transition from a Hamblin/Karttunen question to a conditional semantics is achieved by answerhood operators. Besides providing a simple and intuitive meaning: answers to the antecedent question already contains information to answer the consequent question, the proposal explains the puzzle of the consequent-*wh*s: they are not Chierchia-polarity-existentials, but are simple Karttunen-question-existentials. A unified *wh* semantics is still maintained.

1.2.2 Varieteis of alternatives

Besides giving rise to varieties of implicatures and deepening our understanding of the polarity system (Chierchia 2013, see §2.1.3 for discussions), varieties of alternatives also offers us a window into the relation between questions and their answers: by having an answerhood operator (Dayal 1996) that is sensitive to the entailment profiles of its question argument (a set of propositional alternatives), questions' uniqueness presuppositions and negative islands are accounted for.

In the thesis, the idea of varieties of alternatives offers an appealing explanation to the systematic 'ambiguities' puzzle within the Mandarin focus particle system, as was briefly touched upon above. It furthermore helps us understand some (dis)harmony phenomena (Chen 2005, 2008), illustrated by the following contrast.

(12) Exclusive (Dis)-Harmony

a. jiu/zhi(you) budao shi ge ren lai.
   only/only less-than 10 CL people come
   Only less than 10 people came to the party.

b. *jiu/*zhi(you) chaoguo shi ge ren lai.
   only/only more-than 10 CL people come
   Intended: '*Only more than 10_F people came to the party.'

Why are exclusives such as Mandarin *zhi*/*jiu* (and to a lesser extent English *only* discussed

[4]This is one of the two accounts I propose for *wh*-conditional (see Chapter 6). The other account to be discussed in Chapter 7 also solves this puzzle, since the *wh*-clauses there are still treated as questions and the *wh*-items interrogative pronouns, just as in the first account.

in Alxatib 2013) not able to be associated with *more than n* but are fine with *less than n*? §4.2 offers an explanation where the two cases involve different types of alternatives. In particular, due to a scalar presupposition of *zhi/jiu*, the exclusives are associated with all-entailed alternative sets in the case of *less than n* but with all-entailing ones in the case of *more than n*. It is the two varieties of alternatives that explain the contrast above.

In general, the thesis pleads for a recognition of varieties of alternatives in semantic theorizing, especially in the case of focus association and focus particle semantics.

1.2.3 Combinability

The phenomena the thesis discusses require collaboration from different semantic modules, which also provides a nice testing ground for checking whether different semantic modules are combinable into a unified semantic theory.

For example, to analyze Mandarin focus particles, I have combined Link-Landman's theory of plurality (Link 1983 with Landman's (1989) *group*s) with Rooth theory of alternative semantics. The combination is non-trivial: it not only explains systematic 'ambiguities' of Mandarin focus particles, but also uncovers correlation between 'readings' of focus particles and the distributive-collective distinction discussed in the plurality literature. To give some such correlations: exclusivity of *jiu* usually correlates with distributive readings while non-exclusivity collective ones; *even*-*dou* usually correlates with collective readings while *even*-less-*dou* obligatorily selects for distributivity.

Another case of combining proposals from different semantic modules is my analysis of Mandarin *wh*-conditionals as interrogative conditionals (§6), where a Hamblin/Karttunen semantics of questions is combined with a Dayal-style answerhood operator (Dayal 1996), the resulting proposition further embedded under a situation semantics of conditionals/counterfactuals (Fine 2012). The analysis is further supported by a series of interrogative properties exhibited by *wh*-conditionals.

During the combination, compatibility between proposals from different modules of grammar can be tested. For instance, a case is given from focus association that favors Landman's groups over Schwarzschild's (1996) *covers*.

1.2.4 What we see is not necessarily what we get

When we see *dou* forces distributive readings in cases of plural predication, we are tempted to say *dou* is a distributive operator (or a universal quantifier of some sort). Similarly, when we see *jiu* turns a conjunction into a conditional, we might take *jiu* to be a conditional operator (that takes two propositions and returns a conditional proposition). But sometimes what we see is not what we get.

Specifically, I will argue in the thesis that *dou* is not a distributive operator and is never quantificational, its distributive effect arises simply because of the incompatibility between a collective reading and *dou*'s occasional desire to be *even*-less. Similarly, I have argued elsewhere (Liu forthcoming) that *jiu* is not a conditional operator; it forces a conditional meaning simply because its weak exclusive semantics is not compatible with a conjunctive interpretation.

1.3 Overview of things to come

Here is the plan.

- Chapter 2 provides the background needed to understand the rest of the thesis.
- Chapter 3 introduces the main varieties of alternatives used in the thesis and show how it makes possible a unified analysis of *jiu* and *dou*, thus explaining systematic 'ambiguities' within the Mandarin focus particle system.
- Chapter 4 is built on the proposal presented in Chapter 3; it discusses two additional phenomena – exclusive-(dis)harmonies and the too-many-ONLYS construction – concerning exclusives *jiu*, *zhi* and English *only*.
- Chapter 5 shifts the focus a little bit, and investigates Mandarin *wh*-expressions. A problematic case for Chierchia's unified system of Mandarin *wh*-items is identified — *wh*-conditionals, that is. Basic facts of *wh*-conditionals are presented and a wide range of its semantic properties uncovered and discussed, which speak against all

the existing analyses of the construction. Two novel accounts are thus proposed in the next two chapters.

- Chapter 6 introduces the first proposal. *Wh*-conditionals are analyzed as interrogative conditionals where both the antecedent and the consequent embed questions. Transition from questions to a conditional semantics is achieved by answerhood operators.

- Chapter 7 discusses the second proposal of *wh*-conditionals as an alternative to the first. The *wh*-clauses in a *wh*-conditional are still treated as questions while the entire construction encodes a particular dependency relation between the questions. A variant of the functional/categorial approach to questions is adopted to implement this idea.

- Finally, in Chapter 8 I conclude and list some remaining issues.

Chapter 2

Background

This chapter lays out the basic semantic framework I will be working with. It also introduces standard treatments of focus, polarity, pluralities and questions in natural languages, and discusses some syntactic facts about Mandarin focus particles, *jiu* and *dou* in particular. It needs to be emphasized that we will only discuss the basics, and we will be brief. Refinements and relevant details will be introduced as we move on. Finally, emphasis will be put on the role of alternatives (especially varieties of alternatives) in the grammar.

2.1 Semantic assumptions

2.1.1 The semantic framework

Truth-conditions and semantic values

We take the truth-conditional approach to natural language semantics standardly used by generative linguists inherited from Richard Montague and David Lewis (e.g., Montague 1973, Lewis 1970). The specific implementation used in the thesis comes from Heim & Kratzer 1998 and its intensional extension von Fintel & Heim 2011 (cf. Chierchia & McConnell-Ginet 2000). In this framework, the meaning of a sentence (largely) amounts to its truth-condition – the condition under which the sentence is true. Characterization of truth-conditions is achieved by compositionally assigning linguistic expressions – lexical items, phrases and sentences – semantic values (or *denotations* as they are usually called) by the interpretation function $[\![.]\!]$. In a way that matches our intuition, proper names are assigned the individuals they refer to as their values, while sentences are assigned truth values – True (1) or False (0) as their denotations. Furthermore, to capture quantification and intensionality, $[\![.]\!]$ is relativized to an assignment function g (a partial function from the set of natural numbers into the set of individuals, which takes care of pronouns, traces, variables, etc) and a possible world w (Lewis 1986)[1]. The following entries illustrate how proper names and unembedded sentences receive their semantic values. Examples are given in Mandarin with glosses.

(1) For any possible w and any assignment function g:

a. $[\![\text{Lisi}]\!]^{w,g}$ = Lisi

b. *Lisi likai.le* 'Lisi leave.ASP'

$[\![\text{Lisi likai.le}]\!]^{w,g} = 1$ iff Lisi left in w.

c. *ta likai.le* 'He leave.ASP'

$[\![\text{ta}_6 \text{ lekai.le}]\!]^{w,g} = 1$ iff $g(6)$ left in w

It is helpful to distinguish between expressions whose denotations are dependent on the evaluation parameters (the world and the assignment function under which the denotation is evaluated) and parameter-independent expressions. As illustrated in (1a), proper names are treated as both world and assignment function independent — in other words, they pick up the same individual in any possible world, as *rigid designators* (Kripke 1980). Sentences that do not contain free pronouns are world-dependent, as in (1b), while sentences with

[1]Here is a well-cited quote from Lewis 1986: 1f. that might help us understand what a possible world is:

> The world we live in is a very inclusive thing. Every stick and every stone you have ever seen is part of it. And so are you and I. And so are the planet Earth, the solar system, the entire Milky Way, the remote galaxies we see through telescopes, and (if there are such things) all the bits of empty space between the stars and galaxies. There is nothing so far away from us as not to be part of our world. Anything at any distance at all is to be included. Likewise the world is inclusive in time. No long-gone ancient Romans, no long-gone pterodactyls, no long-gone primordial clouds of plasma are too far in the past, nor are the dead dark stars too far in the future, to be part of the same world. . . .
> The way things are, at its most inclusive, means the way the entire world is. But things might have been different, in ever so many ways. This book of mine might have been finished on schedule. Or, had I not been such a commonsensical chap, I might be defending not only a plurality of possible worlds, but also a plurality of impossible worlds, whereof you speak truly by contradicting yourself. Or I might not have existed at all — neither myself, nor any counterparts of me. Or there might never have been any people. Or the physical constants might have had somewhat different values, incompatible with the emergence of life. Or there might have been altogether different laws of nature; and instead of electrons and quarks, there might have been alien particles, without charge or mass or spin but with alien physical properties that nothing in this world shares. There are ever so many ways that a world might be: and one of these many ways is the way that this world is.

free pronouns are both world and assignment function dependent, as in (1c). Finally, unembedded sentences are usually evaluated in the actual world, notated as $w_\star$.

Besides the two types of denotations – individuals and truth-values – discussed above, we have denotations of functional types. For example, the denotation of an intransitive verb as in (2a) is a (characteristic) function from individuals to truth-values, capturing the intuitive idea that the denotation of a predicate in a world w is the the set of individuals that bear it in w (let's not fuss over the difference between a characteristic function and the set it characterizes).

(2) a. *likai.le* 'leave.ASP'

$[\![\text{likai.le}]\!]^{w,g}$ = the function f from individuals to truth-values such that for all individual x, $f(x) = 1$ iff x left in w.

b. *xihuan* 'like'

$[\![\text{xihuan}]\!]^{w,g}$ = the function f from individuals to functions from individuals to truth-values such that for all individual x, y, $f(x)(y) = 1$ iff y likes x in w.

The function in (2b) starts to get unintelligible, which calls for some easy-to-read notation. λ can be used to define functions. $\lambda\alpha : \phi.\ \gamma$ represents the (smallest) function which maps every α such that ϕ to γ, and we call α the *argument*, ϕ the *domain condition* and γ the *value description*. To give an example, $\lambda x : x \in \mathbb{N}.\ x + 1$ is the successor function for natural numbers.

The functions in (2) can be represented using λ, as in (3).

(3) SOME LEXICAL ENTRIES — 1st simplification

a. $[\![\text{likai.le}]\!]^{w,g}$ = $\lambda x : x$ is an individual. 1 iff x left in w.

b. $[\![\text{xihuan}]\!]^{w,g}$ = $\lambda x : x$ is an individual. [$\lambda y : y$ is an individual. 1 iff y likes x in w]

Following Heim & Kratzer 1998: 37, we further simplify the use of λ with the following convention. The result is illustrated in (5), where both entries are written according to (4b).

(4) Read "$[\lambda\alpha : \phi\ .\gamma]$" as either (a) or (b), whichever makes sense.

a. "the function which maps every α such that ϕ to γ"

b. "the function which maps every α such that ϕ to 1 iff γ"

(5) Some lexical entries — 2nd simplification

a. $[\![\text{likai.le}]\!]^{w,g} = \lambda x : x$ is an individual. x left in w.

b. $[\![\text{xihuan}]\!]^{w,g} = \lambda x : x$ is an individual. $[\lambda y : y$ is an individual. y likes x in $w]$

The introduction of denotations of various functional types greatly increases our inventory of denotations. It is thus convenient to have a labeling system that groups denotations into different types. Following Montague's type theory (e.g., Montague 1973), we employ e for the type of individuals, t for the type of truth-values. Next there are functional types built from the two basic types such as $\langle e, t\rangle$ (functions from individuals to truth values), $\langle e, \langle e, t\rangle\rangle$ (functions from individuals to functions from individuals to truth values), and in general $\langle \sigma, \tau\rangle$ (functions whose arguments are of type σ and whose values are of type τ). Finally, since we also have possible worlds (the set of all possible worlds being W), we have functions from possible worlds to other kinds of denotations, represented by $\langle s, \sigma\rangle$. (6) is a recursive definition of our semantic types[2].

(6) Semantic Types

a. e and t are semantic types.

b. If σ and τ are semantic types, then $\langle \sigma, \tau\rangle$ is a semantic type.

c. if σ is a semantic type, then $\langle s, \sigma\rangle$ is a semantic type.

d. Nothing else is a semantic type.

(6) types all possible denotations (of natural language expressions) into different domains.

(7) Semantic Denotation Domains — [Heim & Kratzer 1998: 303]

Let W be the set of all possible worlds, and D the set of all possible individuals.

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[2]Notice that there is no type s. This follows Montague's original set-up.

a. $D_e = D$, the set of all possible individuals

b. $D_t = \{0, 1\}$, the set of truth-values

c. If σ and τ are semantic types, then $D_{\langle\sigma,\tau\rangle}$ is the set of all functions from D_σ to D_τ.

d. If σ is a type, then $D_{\langle s,\sigma\rangle}$ is the set of all functions from W to D_σ.

Typing our semantic denotations simplifies further our lexical entries. Adopting the usual convention that x, y, z are of type e, P, P', Q, Q' of type $\langle e, t\rangle$, and p, p', q, q' of type $\langle s, t\rangle$, the entries in (5) are simplified as follows.

(8) Some lexical entries — 3rd simplification

a. $[\![\text{likai.le}]\!]^{w,g} = \lambda x.x$ left in w.

b. $[\![\text{xihuan}]\!]^{w,g} = \lambda x \lambda y.y$ likes x in w

I would like to use a final simplification. Instead of using English to describe truth-conditions, sometimes I will use a formal language similar to Ty2 (a type language with two sorts of individual types e and s; Gallin 1975) as my representation language. In (9), $\mathsf{left}_w(x)$ is read as "x left in w"[3].

(9) Some lexical entries — final simplification

a. $[\![\text{likai.le}]\!]^{w,g} = \lambda x.\mathsf{left}_w(x)$

b. $[\![\text{xihuan}]\!]^{w,g} = \lambda x \lambda y.\mathsf{likes}_w(y, x)$

Typing also makes it easier to write denotations for quantificational determiners. *Every* takes two sets and returns 1 iff the first set is a subset of the second set, as in (10a); *a/some* takes two sets and returns 1 iff the intersection of the two sets is non-empty, as in (10b)[4].

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[3]This is an abuse of notation. The interpretation function $[\![.]\!]$ returns entities/functions/truth-values, not logical expressions. Technically I shall write $[\![\text{likai.le}]\!]^{w,g} = ||\lambda x.\mathsf{left}_w(x)||^g$, assuming $||.||^g$ is the interpretation function for the logic. I will however stick to the notation in (9), hoping that no confusion will arise. In general, I will allow myself the freedom to choose either logical representation (9) or plain English enriched with some logical symbols (8) to write denotations.

[4]I use English as examples since it is controversial whether Mandarin Chinese has real universal quantifiers. This issue will be picked up when I discuss *dou* in §3.4.2.

(10) Lexical entries: determiners

a. $[\![\text{every}]\!]^{w,g} = \lambda P \lambda Q \forall x[P(x) \rightarrow Q(x)]$

b. $[\![\text{a/some}]\!]^{w,g} = \lambda P \lambda Q \exists x[P(x) \wedge Q(x)]$

Compositionality and LFs

The semantic framework we are adopting is also compositional, in the sense that the semantic values of syntactically complex expressions are systematically derived from the denotations of their constituents, via a limited set of compositional rules that respect the syntax of the complex expressions. The most frequently used rule is functional application (FA), which simply applies a function to its argument(s) (Heim & Kratzer 1998: 44). An illustration of FA is in (12).

(11) Functional Application

If α is a branching node and $\{\beta, \gamma\}$ the set of its daughters, then, for any world w and assignment g: if $[\![\beta]\!]^{w,g} \in D_{\langle\sigma,\tau\rangle}$ and $[\![\gamma]\!]^{w,g} \in D_{\sigma}$, then $[\![\alpha]\!]^{w,g} = [\![\beta]\!]^{w,g}([\![\gamma]\!]^{w,g})$.

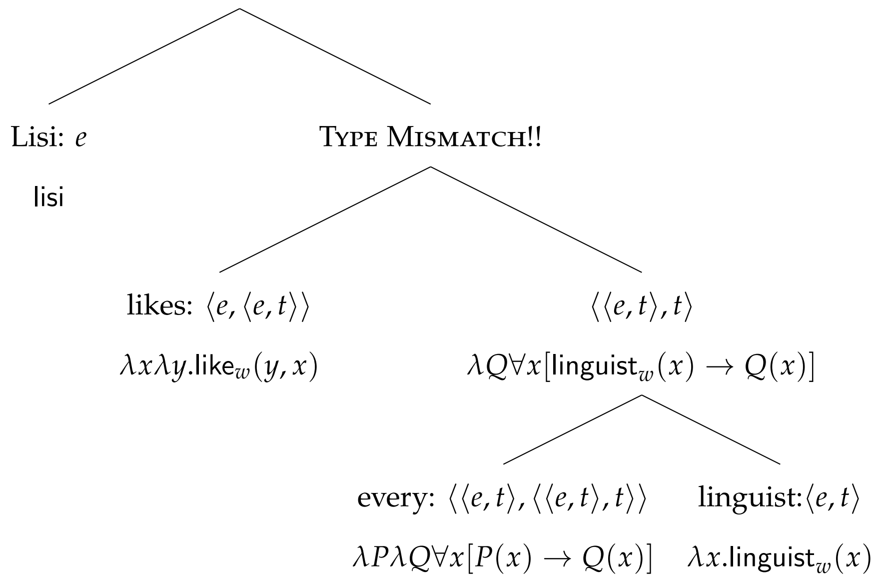
(12) FA: $\text{left}_w(\text{lisi})$

Lisi: e — likai.le: $\langle e, t\rangle$

lisi — $\lambda x.\text{left}_w(x)$

FA alone is not enough. For example, it cannot handle quantifiers in object positions. In (13), the object quantifier is of type $\langle\langle e,t\rangle,\langle\langle e,t\rangle,t\rangle\rangle$ while the instrasitive verb is of type $\langle e,\langle e,t\rangle\rangle$, FA cannot apply due to a type mismatch.

(13)



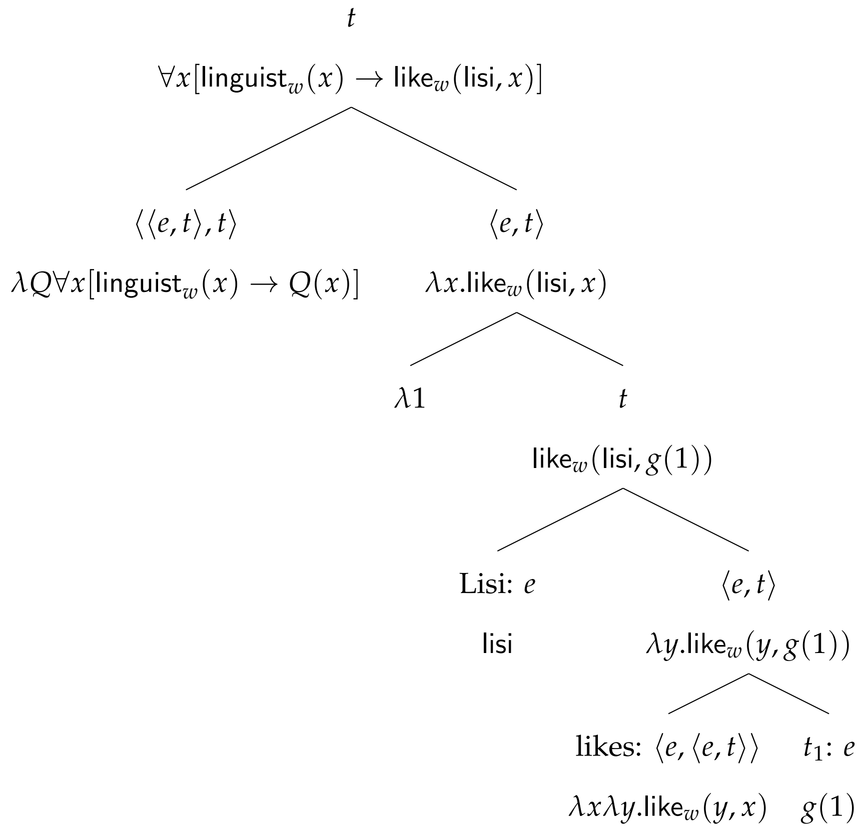
The standard treatment of (13) in a LogicalForm(LF)-based framework such as Heim & Kratzer 1998 and von Fintel & Heim 2011 is to covertly move the object quantifier acorss the subject – while leaving a trace t_i – at LF, which also creates a binder index coindexed with the trace λi immediately below the landing site, and to have a corresponding rule Prediate Abstraction to interprete the reuslting tree. An illustration is in (15).

(14) Predicate Abstraction

If α is a branching node and $\{\lambda i, \beta\}$ the set of its daughters, then, for any world w and assignment g: $[\![\alpha]\!]^{w,g} = \lambda x.[\![s]\!]^{w,g[x/i]}$,

where $g[x/i]$ is a modified assignment function different from g at most in that $g[x/i](i) = x$.

(15)



In general, we take LFs – syntactic tree representations enriched with covert movement, binding indices and covert operators – to be the input of semantic interpretation.

Propositions and entailment

The denotations discussed above are extensional; in other words, they are all semantic objects relative to a particular given world. The semantic framework we adopt also provides us with a second type of semantic values – the *intension* of an expression. For any expression α, $[\![\alpha]\!]^{w,g}$ is the extension of α in w, while $\lambda w.[\![\alpha]\!]^{w,g}$ is its intension — the function that assigns to any world w the extension of α in that world. Following Dowty et al. 1981: 147, we use the abbreviation in (16) to represent intensions.

(16) $[\![\alpha]\!]^{g}_{\text{¢}} := \lambda w.[\![\alpha]\!]^{w,g}$

One kind of intension of particular interest to us is the intension of a sentence, which in our framework employing possible worlds is a (characteristic) function that can be applied to any world and returns the truth-value of the sentence in that world (or equivalently, the set of possible worlds where the sentence is true). Sentence intensions can be taken as *propositions* — the meaning of declarative sentences.

Sentences and their corresponding propositions have relations between them, the most important one being *entailment*. Intuitively, a sentence ϕ *entails* a sentence ψ iff: the information that ψ conveys is contained in the information that ϕ conveys; or equivalently, whenever ϕ is true, ψ is true too.

Treating propositions as sets of possible worlds provides an appealing formal construal of entailment. Entailment corresponds to subset relation between propositions/sets of possible worlds.

(17) Entailment

A sentence ϕ entails a sentence ψ iff $[\![\phi]\!]^g_¢ \subseteq [\![\psi]\!]^g_¢$

Intensional contexts

Having propositions around, we can handle modal expressions, such as English *may*, *must* and Mandarin *keneng* 'may', *yiding* 'must'. Syntactically, I will assume that a modal combines with a sentence (its *prejacent*) to form another sentence. Semantically, modals take propositions as their argument and return truth-values. In other words, they are (generalized) quantifiers over possible worlds: possibility modals such as *may* and *keneng* are existentials while necessity modals *must* and *yiding* are universals. Below in (18), R is the *accessibility relation* and it encodes the domain of quantification for the modal.

(18) Modal Expressions

a. $[\![\text{may/keneng}]\!]^{w,g} = \lambda p \exists w'[R(w', w) \wedge p(w')]$

b. $[\![\text{must/yiding}]\!]^{w,g} = \lambda p \forall w'[R(w', w) \rightarrow p(w')]$

We cannot interpret sentences containing modals yet. A sentence like *John may leave* cannot be interpreted by applying functional application to $[\![\text{may}]\!]^{w,g}$ and $[\![\text{John leave}]\!]^{w,g}$ — the former is of type $\langle\langle s, t\rangle, t\rangle$ while the latter t. A new rule – Intensional functional application

– is needed.

(19) Intensional Functional Application

If α is a branching node and $\{\beta, \gamma\}$ the set of its daughters, then, for any world w and assignment g: if $[\![\beta]\!]^{w,g} \in D_{\sigma}$ and $[\![\gamma]\!]^{w,g} \in D_{\langle\langle s,\sigma\rangle,\tau\rangle\rangle}$, then $[\![\alpha]\!]^{w,g} = [\![\gamma]\!]^{w,g}([\![\beta]\!]^{g}_{¢})$.

Intentional functional application allows us to combine $[\![\text{may}]\!]^{w,g}$ with the intension of its prejacent $[\![\text{John leaves}]\!]^{g}_{¢}$, an illustration of which is given in (20).

(20) IFA: $\exists w'[R(w', w) \wedge \mathsf{leave}'_{w}(\mathsf{john})]$

may: $\langle\langle s, t\rangle, t\rangle$ — John leave: t

$\lambda p \exists w'[R(w', w) \wedge p(w')]$ — $\mathsf{leave}_{w}(\mathsf{john})$

Before we end this section, I would like to use some notational convenience. Following Heim & Kratzer 1998: 304, when the choice of assignment does not matter (for example, when a sentence does not contain a free pronoun), we will drop reference to the assignement function:

(21) Dropping the assignment function

$[\![\alpha]\!]^{w} := [\![\alpha]\!]^{w,\emptyset}$

Finally, I will also drop the reference to w (and the subscript $_{¢}$) when convenient. The context will disambiguate, I hope, whether I am talking about intesions, extensions (relativized at $w_{\star}$), or something else.

This concludes our brief introduction of the basic semantic framework to be adopted in the thesis. Next we are going to discuss particular natural language phenomena that require various addition/modification to the current system.

2.1.2 Focus association and alternatives

Focus particles such as English *only*, *even* and Mandarin *jiu*, *dou* "contribute to the meaning of a sentence in ways that depend on the position of the focal accent in the setence" (Krifka 2006: 105). This is the phenomenon of *focus association* (Rooth 1985). Consider English *only*.

(22) FOCUS ASSOCIATION: *only*

a. John $[_{\text{VP}_1}$ only $[_{\text{VP}_2}$ introduced Bill to SUE$_F$]].

b. John $[_{\text{VP}'_1}$ only $[_{\text{VP}'_2}$ introduced BILL$_F$ to Sue]].

The only difference between (22a) and (22b) is their prosody but the two have different meanings. In (22a), SUE bears prosodic prominence, and the sentence means that John introduced Bill to Sue but didn't introduce Bill to any other people, while in (22b), BILL bears prosodic prominence and the sentence means that John introduced Bill to Sue but didn't introduce any other people to Sue. The two are different in truth-conditions: in a context where John introduced Bill and Mary to Sue but did no other introduction, (22a) is true while (22b) false.

Mandarin *jiu*/*zhi* 'only', *dou* 'even' exhibit focus association as well. Here is an illustration using *jiu*/*zhi* 'only'. The above description of (22) also applies here.

(23) FOCUS ASSOCIATION: *jiu*/*zhi*

a. Lisi $[_{\text{VP}_1}$ jiu/zhi $[_{\text{VP}_2}$ jieshao.le Bier gei SU$_F$]].
Lisi JIU/only introduce.ASP Bill to Sue
'John only introduced Bill to SUE.'

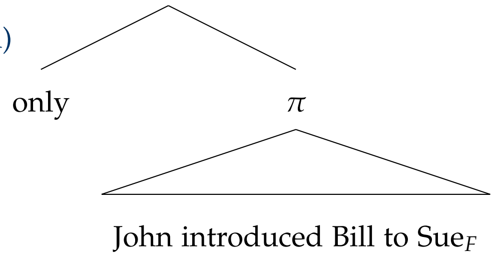
b. Lisi $[_{\text{VP}'_1}$ jiu/zhi $[_{\text{VP}'_2}$ jieshao.le BIER$_F$ gei Su]].
Lisi JIU/only introduce.ASP Bill to Sue
'John only introduced BILL to Sue.'

The semantic framework sketched in the previous section cannot handle focus association. In (22) (similarly in (23)), the two outer VPs (VP_1 and $\text{VP}_{1'}$) need to have different meanings since the two sentences of which they are daughters differ in truth-conditions. Furthermore, both outer VPs have *only* and the inner VP (VP_2 and $\text{VP}_{2'}$ respectively) as their constituents. Since we want to keep the meaning of *only* constant in the two cases, VP_2 and $VP_{2'}$ need to have different meanings, which however is impossible in the current framework we are adopting: VP_2 and $VP_{2'}$ have the same intention, that is, they denote the same $\langle s, \langle e, t \rangle \rangle$-function that returns the set of people that introduced Bill to Sue in w when applied to w.

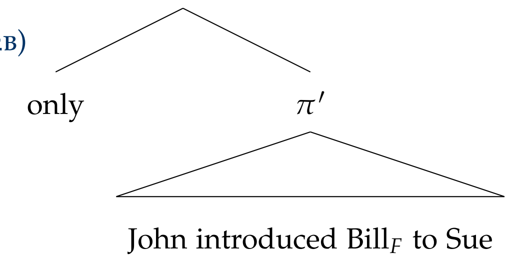
We need to enrich the notion of meaning. The standard way to go following Rooth 1985 is to use *alternatives*. Roughly, focus triggers alternatives, and alternatives play a role in the meaning conveyed by natural language expressions. Thus two expressions, though they might agree on their truth-conditions, still differ in meanings if they have different alternatives. Here is a quote from Krifka 2007: 18 that summarizes this idea: "Focus indicates the presence of alternatives that are relevant for the interpretation of linguistic expressions."

Before we implement this basic idea, I would like to propose a simplification regarding focus particles *only*, *even*, *jiu* and *dou*. For the purposes of this thesis, I will treat these focus particles as sentential/propositional operators. In other words, at least one of their argument is a proposition, namely, the proposition denoted by the *only*-less sentence called the prejacent (cf. the prejacent of a modal). An advantage of doing so is that we can keep a unified semantics for these particles while abstracting away the complexity of using lexical entry schema (Rooth 1985, Coppock & Beaver 2014, also see discussion in §4.3.4). This allows us to concentrate more on alternatives than on compositionality. The move is also justified by the facts we are interested in: Mandarin focus particles are always adverbs (see below for more discussion of this point); they adjoins to VP, TP but never to DP, PP. Since both TP and VP can be taken as propositional (that is, they denote propositions at some syntactic level, with the VP-internal subject hypothesis), it makes sense to say that Mandarin focus particles are always propositional operators. We thus propose the following LFs as the input to semantic interpretation. These LFs can be obtained by covertly moving *only* to have scope over its prejacent, similar to *even*-movement (Karttunen & Peters 1979, Lahiri 1998, Crnič 2014).

(24) LF of (22a)



(25) LF of (22b)



Now Rooth's idea can be implemented as follows. First, focused constituents are F-marked by an $_F$ feature in the narrow syntax (the part of syntax before spell-out, cf. Jackendoff 1972). $_F$ is interpreted both at PF (Phonological Form) and at LF (we are only interested in the LF part; for the relationship between $_F$ and prosody in English, Selkirk 1996 and Schwarzschild 1999 are two classical references). At LF, the contribution of $_F$ is formalized by assigning linguistic expressions (besides their ordinary semantic values[5]) a second semantic value — the *alternative semantic value* by $[\![.]\!]_{Alt}$. Specifically, the alternative semantic value of a non-focused terminal is the singleton set consisting of its ordinary semantic value, while the alternative value of a focused node is the set of semantic values that share with its ordinary value the same type. Next, focus values of non-terminals can be computed compositionally, via *pointwise functional application*. Finally, note that ordinary semantic values and their composition are not affected by $_F$.

(26) Roothian Alternatives Semantics

a. Focus values for non-F-marked terminals: $[\![\alpha]\!]_{Alt} = \{[\![\alpha]\!]\}$

b. Focus values for F-marked terminals:

$[\![\alpha_F]\!]_{Alt} = D_\sigma$, where σ is the type of $[\![\alpha]\!]$.

c. Pointwise functional application:

$[\![\alpha\ \beta]\!]_{Alt} = \{f(x) | f \in [\![\alpha]\!]_{Alt}\ \&\ x \in [\![\beta]\!]_{Alt}\}$

---

[5] Ordinary values can be extensions or intensions.

Interpretation of focus particles such as *only* make reference to the alternative semantic value of its prejacent. Since $_F$ affects alternative semantic value, placement of $_F$ affects the interpretation of an *only*-sentence.

The alternative semantic values of the prejacents in (22a) and (22b) are sets of propositions (type $\langle st,t\rangle$), as in (27) and (28)[6]. These sets can be compositionally derived from the rules in (26)[7].

(27) $$[\![\pi_{(22a)}]\!]_{Alt} = \left\{ \begin{array}{l} \boxed{\lambda w.\text{ John introduced Bill to Sue in } w}, \\ \lambda w.\text{ John introduced Bill to Ann in } w, \\ \lambda w.\text{ John introduced Bill to Sam in } w, \\ \ldots \end{array} \right\}$$

(28) $$[\![\pi_{(22b)}]\!]_{Alt} = \left\{ \begin{array}{l} \boxed{\lambda w.\text{ John introduced Bill to Sue in } w}, \\ \lambda w.\text{ John introduced Ann to Sue in } w, \\ \lambda w.\text{ John introduced Sam to Sue in } w, \\ \ldots \end{array} \right\}$$

Only basically says that the prejacet π is true in the evaluation world and propositions within $[\![\pi]\!]_{Alt}$ that are not entailed by the prejacent proposition are all false in the evaluation world[8].

(29) $[\![\text{only } \pi]\!]^w = 1$

iff $[\![\pi]\!](w) \wedge \forall q \in [\![\pi]\!]_{Alt}\ [q(w) \rightarrow [\![\pi]\!] \subseteq q]$ [Schwarzschild 1994]

---

[6]I use $\boxed{\text{boxes}}$ to single out the prejacent proposition.

[7]Technically, it is not easy to compositionally get sets of propositions in the framework we adopt from Heim & Kratzer 1998. In this framework, most semantic composition is done extensionally, and (possible world) intensions are defined as λ-abstraction over the world parameter. However, as is discussed in Shan 2004, Novel & Romero 2010, Charlow 2014, Ciardelli & Roelofsen 2015, $\lambda-$abstraction is problematic in alternative semantics. There are various ways to resolve this conflict. The easiest one is to modify the types of predicates. Instead of being $\langle e,t\rangle$, a verb like *leave* has a denotation of type $\langle e,st\rangle$ — a function from individual to propositions. Now we only need pointwise functional application to combine $[\![\text{John}_F]\!]_{Alt}$ with $[\![\text{leave}]\!]_{Alt}$ into a set of propositions. I will however not dwell too much on this compositional issue in the thesis, since the use of propositional alternative set as in (27)-(28) is fairly uncontroversial and it is intuitively clear what the alternatives are.

[8]This entry will be discussed in detail Chapter 3. I am also ignoring the presuppositionality of *only*'s prejacent proposition.

Applied to (27), (29) negates propositions such as that John introduced Bill too Ann and that John introduced Bill to Sam (since they are not entailed by the prejacent). We get the intuitively correct truth-condition: (22a) is true iff John introduced Bill to Sue but not to other people. Similarly, (22b) is true iff John introduced Bill but not other people (Ann and Sam) to Sue. Focus association is accounted for.

Alternatives come in different varieties. Varieties of alternatives help us understand a set of phenomena that seems to bear no connection to focus: that is, the polarity system, to which we now turn.

2.1.3 Polarity

I follow Chierchia's (2013) *alternatives-&-exhaustification* approach to the polarity system (built on insights from Kadmon & Landman 1993, Krifka 1995, Lahiri 1998, Kratzer & Shimoyama 2002, Chierchia 2006, Fox 2007a, Chierchia et al. 2012), where implicatures and polarity items constitute a unified phenomenon and receive the same explanation. The polarity system is relevant to the discussion because (i), it illustrates how alternatives, especially varieties of alternatives, can provide a principled explanation to a seemingly highly heterogeneous system consisting of implicatures, negative polarity items and free choice items; (ii), Mandarin *wh*-items are a kind of polarity items (Cheng 1997, Lin 1996) and Chapter 5-7 of this thesis concern a puzzling use of *wh*-items in Mandarin Chinese.

Implicatures

There are fruit, cake and ice cream on the table. My son (suppose I have one) asks me what to have for desert, and I say:

(30) You can have fruit or cake.

My son is smart, and he quickly draws a variety of inferences.

(31) Implicatures of (30)

a. $\rightsquigarrow$ He cannot have both fruit and cake. Scalar

b. ⇝ He can have fruit and he can have cake. FREE CHOICE

c. ⇝ He cannot have ice cream. EXHAUSTIVE

These inferences are all plausible but they cannot be hardwired into the semantics of (30), for all of them are optional. I can explicitly cancel any one of them using the corresponding continuation in (32).

(32) IMPLICATURES CANCELLATION

a. And you can have both. NOT SCALAR

b. But I'm not going to tell you which. NOT FREE CHOICE

c. And you can have ice cream! NOT EXHAUSTIVE

We call the defeasible inferences in (30) *implicatues*, following Grice 1975. Specifically, (31a) is a *scalar implicature* (Horn 1972), (31b) a *free choice impplicature* (Kamp 1973), and (31c) an *exhaustive implicature* (Schulz & Van Rooij 2006).

Implicatures can be seen as derived from alternatives, and varieties of implicatures from varieties of alternatives. Specifically, the implicatures in (31) arguably involve the following alternatives in (33).

(33) VARIETIES OF ALTERNATIVES: SCALAR IMPLICATURES

a. $\mathcal{A}lt_{\text{SCALAR}}$ = {you can have fruit and cake}

b. $\mathcal{A}lt_{\text{FREE.CHOICE}}$ = {you can have fruit but not cake,
you can have cake but not fruit}

c. $\mathcal{A}lt_{\text{EXHAUSTIVE}}$ = {you can have ice cream}

Once alternatives are introduced into the semantic computation, they have to be utilized (alternatives being idle is not a good thing). The process of using up the alternatives is called *exhaustification* in Chierchia's (2013) framework, and it is done by covert counterparts of *only* and *even* exhaustifying the alternatives and factoring their contribution into the overall meaning.

The implicatures in (31) are obtained by $\mathcal{E}xh_o$, the covert counterpart of *only*, as in (29).

(34) $[\![\mathcal{E}xh_{o,\mathcal{A}lt}\ \pi]\!]^w = 1$

iff $[\![\pi]\!](w) \wedge \forall q \in \mathcal{A}lt\ [q(w) \rightarrow [\![\pi]\!] \subseteq q]$ [Chierchia 2013: 34]

Similar to *only*, $\mathcal{E}xh_o$ asserts its prejacent and negates all alternative propositions that are not entailed by the prejacent. Applying $\mathcal{E}xh_o$ to the alternatives in (33), we get meanings that come close to the implicatures in (31).

(35) Implicatures as Exhaustification

a. Exhaustifying $\mathcal{A}lt_{\text{SCALAR}}$: You cannot have both fruit and cake.

b. Exhaustifying $\mathcal{A}lt_{\text{FREE.CHOICE}}$:

You can have cake $\leftrightarrow$ you can have fruit[9]

c. Exhaustifying $\mathcal{A}lt_{\text{EXHAUSTIVE}}$: You cannot have ice cream.

(35a) and (35c) directly correspond the implicatures we intuitively feel, as in (31a) and (31c). Combining (35b) with the prejacent – $\Diamond$(you have fruit or cake)[10] –, we also get (31b). Implicatures are accounted for.

Finally, recall from (32) that implicatures can be cancelled. This could be explained by resorting to optionally activating alternatives of a particular kind (Chierchia 2006, 2013). Suppose I say "you can have fruit or cake, and you can have ice cream". The first clause is still able to give rise to the scalar and the free choice implicatures, but exhaustive implicatures such as (31c) cannot be generated (or there will be a contradiction). This is accounted for by activating the alternatives in (33a) and (33b) but not in (33c).

Before we leave implicatures, I would like to mention two things. First, implicatures (and varieties of implicatures) also appear in Mandarin Chinese. The following sentence

---

[9]It might not be obvious why applying $\mathcal{E}xh_o$ to (33b) amounts to Cake $\leftrightarrow$ Fruit (let Cake/Fruit be 'you can have cake/fruit'). Here are some details: the two alternatives in (33b) are not entailed by the prejacent so they are negated, and we have $\neg$(Cake $\wedge$ $\neg$Fruit) and $\neg$(Fruit $\wedge$ $\neg$Cake); applying De Morgan's laws we get Fruit $\rightarrow$ Cake and Cake $\rightarrow$ Fruit; conjoining them we get (35b).

[10]$\Diamond$ is the possiblility modal *can*; I use symbols instead of plain English to avoid possible confusion: the prejacent in English *you can have fruit or cake* already leads us to expect the free choice implicature.

(uttered in the same context as its English counterpart (30)) has the implicatures in (36), which can be cancelled by the continuations in (37). The explanation is exactly as before.

(36) Ni keyi chi shuiguo huozhe dangao
You can eat fruit or cake
'You can eat fruit or cake'.

a. ⇝ Ni bu keyi liangge dou chi 'You cannot have both'

b. ⇝ Ni keyi chi shuiguo 'You can have fruit'

⇝ Ni keyi chi dangao 'You can have cake'

c. ⇝ Ni bu keyi chi bingqilin 'You cannot have ice cream'

(37) IMPLICATURES CANCELLATION

a. ni ye keyi liang.ge dou chi
you also can two.CL DOU eat
'and you can also have both.' NOT SCALAR

b. dan wo bu xiang gaosu ni juti nage
but I NEG want tell you specific which
'but I don't want to tell you which.' NOT FREE CHOICE

c. ni ye keyi chi bingqilin
you also can eat ice.cream
'and you can also have ice cream.' NOT EXHAUSTIVE

Second, the use of alternatives and varieties of alternatives is actually theory-neutral. What we just showed is the *Grammatical* view of implicatures, according to which implicatuers (at least the ones considered here) are derived from semantic computation. There is a conceptually different view – the Gricean view, which takes implicatures to be an entirely pragmatic phenomenon, arising from Gricean reasoning. Alternatives also play an important role in a Gricean theory. See for example Geurts 2010 for a recent Gricean account of various implicatures using alternative *belief states*.

Polarity items

Across languages, there are expressions that are restricted to "negative" and/or "modal" environments. They are called polarity items. Typical examples include English *any, ever*, German *irgendein* and Mandarin *wh*-items (Cheng 1997, Lin 1996, Liao 2011, Chierchia & Liao 2014).

Alternatives and varieties of alternatives can also be used to explain behaviors of polarity items and variation between different polarity items. This is the *alternatives-&-exhaustificaiton* approach to polarity items (Chierchia 2013).

In Chierchia's system, polarity items are analyzed in the same way as implicatures. They trigger alternatives (an idea going back to Fauconnier 1975) and thus need exhaustification. Different from implicatures, the alternatives they trigger are lexically specified and obligatory. Exhaustifying these alternatives in certain contexts gives rise to contradiction, and thus the polarity item is ungrammatical in these contexts.

I will illustrate Chierchia's framework using English *ever* and German *irgendein*[11]. *Ever* is a typical negative polarity item (NPI). It appears only in "negative" environments such as the ones shown in (38) (the list is not exhaustive).

(38) English Ever

a. Negation
   (i) I do not ever vote republican.
   (ii) ∗ I ever vote republican.

b. Negative Quantifier
   (i) No one has ever failed this class.
   (ii) ∗ Many people have ever failed this class.

c. First argument of *every*
   (i) Everyone who ever read a book got a prize.
   (ii) ∗ Everyone who read a book ever got a prize.

An important generalization of these environments is that they are all Downward-entailing (DE) contexts (Ladusaw 1979). A DE context is a context that reverses the direction of entailment and licenses set-to-subset inferences. Consider *every*. From (39a), we see

[11] *Irgendein* is chosen as an illustration because the facts are relatively clear and "*irgendein* seems to constitute the simplest element of the Polarity System" (Chierchia 2013: 255).

that *every* is DE in its first argument position – from the fact that everyone who read a book got a prize we can infer that everyone who read a good book got a prize, with $\lambda x.[x$ read a book$]$ being a superset of $\lambda x.[x$ read a good book$]$. In parallel, from (39b) we see that *every* is upward-entailing (UE) in its second argument position. Formally, DE is defined in (40).

(39) DE: EVERY

a. first argument of *every*: set-to-subset
Everyone [who read a book] [got a prize]
$\subseteq$
Everyone [who read a good book] [got a prize]

b. second argument of *every*: subset-to-set
Everyone [who has read a book] [got a prize]
$\supseteq$
Everyone [who has read a book] [got a big prize]

(40) DE [von Fintel 1999: 100]
A funtion f of type $\langle\sigma,\tau\rangle$ is DE iff for a, b of type σ such that $a \subseteq b$: $f(b) \subseteq f(a)$.

The reader can check that all the environments that license *ever* are DE. We thus have a generalization that a NPI is only grammatical if it is in the scope of an α such that $[\![\alpha]\!]$ is DE (von Fintel 1999: 100).

Within Chierchia's framework one finds a very neat explanation for the DE-generalization of NPIs. The basic idea is that NPIs such as *ever* are existentials that obligatorily trigger alternatives, which can only be exhaustified successfully in DE-contexts.

Specifically, *ever* is an exisential quantifier over times (of type $\langle\langle\tau, t\rangle, t\rangle$[12]), just like *sometimes* (Chierchia 2013: 29). Being a quantifier, *ever* comes with a covert domain restriction variable (von Fintel 1994) ranging over properties of times and is represented as T in (41).

[12] τ is the type of times, and our semantic domains need to be enlarged with a set of time points/intervals. Sentences now receive truth-values relative to an assignement, a world and a time.

(41) $[\![ever_T]\!] = \lambda P_{\langle\tau,t\rangle} \exists t \in T[P(t)]$

Different from *sometimes*, *ever* obligatorily triggers alternatives; in particular, it triggers *sub-domain* alternatives — alternative exisential quantifiers with domain T' being subset of the original T, as in (42).

(42) $[\![ever_T]\!]_{D\text{-}Alt} = \{\lambda P_{\langle\tau,t\rangle} \exists t \in T'[P(t)] : T' \subseteq T\}$

Alternatives, once activated, must be exhaustified. In the case of *ever*, it is the $\mathcal{E}xh_o$ in (34) that does the exhaustification. Now consider the pair in (38a): with (covert) $\mathcal{E}xh_o$ and domain variables, they have the following LFs.

(43) Alternatives-&-Exhaustification: *ever*

a. $\mathcal{E}xh_o$ [I do not ever$_T$ vote republican]

Prejacent: I do not vote republican at some t in T.

Application of $\mathcal{E}xh_o$ is trivial.

b. $\mathcal{E}xh_o$ [I ever$_T$ vote republican] Contradiction!

Prejacent: I vote republican at some t in T.

Applying $\mathcal{E}xh_o$:

$\forall T' \subseteq T$, I do not vote republican at some t in T'.

It turns out that a computation of the meaning of (43b) returns a contradiction. This is because *that I vote republican at some t in T* (the prejacent of $\mathcal{E}xh_o$) entails *that there is a $T' \subset T$ such that I vote republican at some t in T'*. The latter contradicts the result of exhaustification using $\mathcal{E}xh_o$, according to which *I do not vote republican at some t in any (strict) sub-domains of* T. This contradiction explains why *ever* cannot be used in a positive context (see Gajewski 2002 for ungrammaticality caused by contradictions).

On the other hand, in (43a), the exhaustificaiton of $\mathcal{E}xh_o$ does not cause a problem, because the prejacent (*that I do not vote republican at some t in T*) now entails all the other alternatives (*that I do not vote republican at some time in T'*, where $T' \subseteq T$). Applying $\mathcal{E}xh_o$ simply returns the prejacent and no contradiction results. This explains why *ever* can be used under negation.

In general, the above discussion establishes that NPIs like *ever* can only be used in DE contexts (where exhaustification does not return a contradiction for lack of stronger alternatives). The DE generalization of NPIs is thus explained in Chierchia's system.

We just saw that domain alternatives play an important role in the explanation of weak NPIs such as *ever*. Besides *ever*, there are polarity items across languages with very different behaviors. Varieties of alternatives help us understand this variation in Chierchia's framework. Consider German *irgendein*. As shown below, *irgendein* can be used in negative contexts, behaving like a simple negative polarity item such as English *ever* and *any* (on its NPI use), as in (44a). It can also appear below a modal, triggering a free choice effect – *any professor is an option* – in (44b). Finally, when it appears in episodic contexts, it triggers an epistemic effect – in (44c) the speaker conveys that s/he "doesn't know or care about who called, or thinks the identity of the speaker is irrelevant" (Kratzer & Shimoyama 2002: 9). If the context forces the absence of this epistemic effect, ungrammaticality ensues as in (44d) (Chierchia 2013: 257).

(44) German Irgeindein

a. Negative contexts

Niemand hat irgeindein Buch mitgebracht
No.one had irgeindein book brought.along
'No one brought along any book.'

b. Modal contexts

Du darfst mit irgendeinem Professor sprechen
you can with irgeindein professor speak
'You can speak with any professor'

c. Positive contexts with modal flavor

Irgendein Student hat angerufen
irgeindein student has called
'Some student called. For all the speaker knows, it might be any student.'

d. ∗Positive contexts without modal flavor

John hat geschummelt. ∗Deshalb ist irgendein Student aus deiner Klasse
John has cheated. Therefore is irgendein student in your class

ein Betrueger.
a cheater
'John has cheated. ∗Therefore irgendein student in your class is a cheater.'

To explain the dual status of *irgeindein* both as a NPI and a free choice item (FCI), Chierchia (following insights in Kratzer & Shimoyama 2002, Fox 2007a) proposes to use *pre-exhaustified sub-domain alternatives*. Let me first briefly introduce the notion of pre-exhaustified sub-domain alternatives.

Recall how free choice implicatures are derived in the alternatives-&-exhaustification approach. The sentence *you can have fruit or cake* carries a free choice implicature that both fruit and cake are possible options, and the implicature is derived (discussed in the previous section) by exhaustifying alternatives such as *you can have fruit but not cake* and *you can have cake but not fruit*. These alternatives are pre-exhaustified sub-domain alternatives — they amount to domain alternatives already exhaustified by $\mathcal{E}xh_o$ (≈ *only*): *you can only have fruit* and *you can only have cake*[13].

With this in mind, let's see how *irgendein* is treated in Chierchia 2013. Chierchia takes *irgendein* to be an existential determiner (similar to *some/a*) that obligatorily activates two kinds of alternatives: scalar alternatives[14] and domain ones (let's side aside pre-exhaustified alternatives for the moment).

(45) a. $[\![\text{irgendein}_D]\!] = \lambda P \lambda Q \exists x \in D[\mathsf{one}(x) \wedge P(x) \wedge Q(x)]$

b. $[\![\text{irgendein}_D]\!]_{\sigma\text{-}Alt} =$

$\{\lambda P \lambda Q \exists x \in D[\mathrm{n}(x) \wedge P(x) \wedge Q(x)] : n \in \mathbb{N}^+\}$

c. $[\![\text{irgendein}_D]\!]_{D\text{-}Alt} =$

$\{\lambda P \lambda Q \exists x \in D'[\mathsf{one}(x) \wedge P(x) \wedge Q(x)] : D' \subseteq D\}$

Consider how the entry works with (44b). Plugging in (45), we get (46a) as the prejacent of

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[13]Think of them as alternative assertions; that is, when uttering *you can have fruit or cake*, we are also considering alternative assertions such as A = *you can have fruit*. A, as an assertion, is itself pragmatically enriched, which in the alternatives-&-exhaustification framework amounts to pre-exhaustified.

[14]Scalar alternatives vary the numeral part of an existential. For example, the scalar alternatives of *one/a* are *two*, *three*, and so on.

the exhaustive operator, (46b) as the scalar alternatives and (46c) the domain alternatives.

(46) ALTERNATIVES: (44b)

a. PREJACENT: $\Diamond\exists x \in D[\mathsf{one}(x) \wedge \mathsf{professor} \wedge \mathsf{speak.to}(\mathsf{you}, x)]$

b. SCALAR ALTERNATIVES:

$\{\Diamond\exists x \in D[n(x) \wedge \mathsf{professor} \wedge \mathsf{speak.to}(\mathsf{you}, x)] : n \in \mathbb{N}^{+}\}$

c. DOMAIN ALTERNATIVES:

$\{\Diamond\exists x \in D'[\mathsf{one}(x) \wedge \mathsf{professor} \wedge \mathsf{speak.to}(\mathsf{you}, x)] : D' \subseteq D\}$

Suppose there are three professors a, b, c, and we can represent the content of (46) equivalently as (47)[15], where a/b/c abbreviate *you speak with a/b/c*. Note here that due to the equivalence between disjunction and existential quantification, $\Diamond(\mathsf{a} \vee \mathsf{b})$ is equivalent to $\Diamond\exists x \in \{a, b\}[\mathsf{speak.to}(\mathsf{you}, x)]$.

(47) ALTERNATIVES: (44b)

	$\Diamond(\mathsf{a} \vee \mathsf{b} \vee \mathsf{c})$		PREJACENT
$\Diamond(\mathsf{a} \vee \mathsf{b})$	$\Diamond(\mathsf{b} \vee \mathsf{c})$	$\Diamond(\mathsf{a} \vee \mathsf{c})$	D-ALTERNATIVES
$\Diamond\mathsf{a}$	$\Diamond\mathsf{b}$	$\Diamond\mathsf{c}$	
	$\Diamond(\mathsf{a} \wedge \mathsf{b} \wedge \mathsf{c})$		σ-ALTERNATIVES

Chierchia also assumes that the two types of alternatives can be exhaustified separately by two exhaustificaiton operators $\mathcal{E}xh_{\mathrm{DA}}$ and $\mathcal{E}xh_{\sigma\mathrm{A}}$[16], both of which have the same semantics as the exhaustification operator introduced in (34).

It turns out that while exhaustificaiton over the scalar-alternatives gives rise to a sensible meaning — $\neg\Diamond(\mathsf{a} \wedge \mathsf{b} \wedge \mathsf{c})$, exhaustification over the domain-alternatives delivers $\neg\Diamond\mathsf{a} \wedge \neg\Diamond\mathsf{b} \wedge \neg\Diamond\mathsf{c}$, which however contradicts the prejacent. So far this is exactly parallel to our discussion of *ever* in positive contexts (43b).

It's time for pre-exhausitified domain-alternatives to come into play. Pre-exhaustifying

[15] In (47), I omit, following Chierchia (2013: 253), intermediate scalar alternatives $\Diamond(\mathsf{a} \wedge \mathsf{b}), \Diamond(\mathsf{b} \wedge \mathsf{c}), \Diamond(\mathsf{a} \wedge \mathsf{c})$, since the derivation of the free choice inference below is not affected by this simplification.

[16] See Chierchia (2013: 176-190, 277-280) for the difference between exhaustifying the entire set and exhaustifying separately.

the domain alternatives in (47) gives rise to the alternatives in (48).

(48) Pre-exhaustified Alternatives: (44b)

	$\Diamond(\mathsf{a} \vee \mathsf{b} \vee \mathsf{c})$		Prejacent
$\mathcal{E}xh_o\Diamond(\mathsf{a} \vee \mathsf{b})$	$\mathcal{E}xh_o\Diamond(\mathsf{b} \vee \mathsf{c})$	$\mathcal{E}xh_o\Diamond(\mathsf{a} \vee \mathsf{c})$	Exh-D-alternatives
$\mathcal{E}xh_o\Diamond\mathsf{a}$	$\mathcal{E}xh_o\Diamond\mathsf{b}$	$\mathcal{E}xh_o\Diamond\mathsf{c}$	
	$\Diamond(\mathsf{a} \wedge \mathsf{b} \wedge \mathsf{c})$		σ-alternatives

We unpack the pre-exhaustified domain alternatives, as follows.

(49) Unpacking Pre-exhaustification

a. $\mathcal{E}xh_o\Diamond(\mathsf{a} \vee \mathsf{b}) = \Diamond(\mathsf{a} \vee \mathsf{b}) \wedge \neg\Diamond\mathsf{c}$

b. $\mathcal{E}xh_o\Diamond(\mathsf{b} \vee \mathsf{c}) = \Diamond(\mathsf{b} \vee \mathsf{c}) \wedge \neg\Diamond\mathsf{a}$

c. $\mathcal{E}xh_o\Diamond(\mathsf{a} \vee \mathsf{c}) = \Diamond(\mathsf{a} \vee \mathsf{c}) \wedge \neg\Diamond\mathsf{b}$

d. $\mathcal{E}xh_o\Diamond\mathsf{a} = \Diamond\mathsf{a} \wedge \neg\Diamond\mathsf{b} \wedge \neg\Diamond\mathsf{c}$

e. $\mathcal{E}xh_o\Diamond\mathsf{b} = \Diamond\mathsf{b} \wedge \neg\Diamond\mathsf{a} \wedge \neg\Diamond\mathsf{c}$

f. $\mathcal{E}xh_o\Diamond\mathsf{c} = \Diamond\mathsf{c} \wedge \neg\Diamond\mathsf{a} \wedge \neg\Diamond\mathsf{b}$

None of the pre-exhaustified domain-alternatives in (49) are entailed by the prejacent, so they are all negated by the outer $\mathcal{E}xh_o$, as in (50).

(50) Exhaustifying Pre-exhaustification

a. $\neg(\Diamond(\mathsf{a} \vee \mathsf{b}) \wedge \neg\Diamond\mathsf{c})$

b. $\neg(\Diamond(\mathsf{b} \vee \mathsf{c}) \wedge \neg\Diamond\mathsf{a})$

c. $\neg(\Diamond(\mathsf{a} \vee \mathsf{c}) \wedge \neg\Diamond\mathsf{b})$

d. $\neg(\Diamond\mathsf{a} \wedge \neg\Diamond\mathsf{b} \wedge \neg\Diamond\mathsf{c})$

e. $\neg(\Diamond\mathsf{b} \wedge \neg\Diamond\mathsf{a} \wedge \neg\Diamond\mathsf{c})$

f. $\neg(\Diamond\mathsf{c} \wedge \neg\Diamond\mathsf{a} \wedge \neg\Diamond\mathsf{b})$

(50) is further logically equivalent to (51).

(51) Exhaustifying Pre-exhaustification : simplification

a. $\Diamond(\mathsf{a} \vee \mathsf{b}) \rightarrow \Diamond\mathsf{c}$

b. $\Diamond(\mathsf{b} \vee \mathsf{c}) \rightarrow \Diamond\mathsf{a}$

c. $\Diamond(\mathsf{a} \vee \mathsf{c}) \rightarrow \Diamond\mathsf{b}$

d. $\Diamond\mathsf{a} \rightarrow (\Diamond\mathsf{b} \vee \Diamond\mathsf{c})$

e. $\Diamond\mathsf{b} \rightarrow (\Diamond\mathsf{a} \vee \Diamond\mathsf{c})$

f. $\Diamond\mathsf{c} \rightarrow (\Diamond\mathsf{a} \vee \Diamond\mathsf{b})$

The conjunction of (51) amounts to $\Diamond\mathsf{a} \leftrightarrow \Diamond\mathsf{b} \leftrightarrow \Diamond\mathsf{c}$[17], which not only is compatible with the prejacent $\Diamond(\mathsf{a} \vee \mathsf{b} \vee \mathsf{c})$, but also produces the free choice effect in conjunction with the prejacent — $\Diamond\mathsf{a} \wedge \Diamond\mathsf{b} \wedge \Diamond\mathsf{c}$, *every professor is an option*. Again, this is exactly in parallel with the explanation of free choice implicatures given in (31). Thus Chierchia provides a unified account of both free choice implicatures and FCI, the only difference being that the former is optional while the latter obligatory.

Now we have seen how Chierchia accounts for the fact that *irgendein* is possible under a modal, triggering a free choice effect (44b). Can it also appear without a modal? It turns out Chierchia predicts it cannot. Consider the alternatives *irgendein* triggers in a modal-less environment.

(52) Pre-exhaustified Alternatives: modal-less

	$\mathsf{a} \vee \mathsf{b} \vee \mathsf{c}$		Prejacent
$\mathcal{E}xh_o(\mathsf{a} \vee \mathsf{b})$	$\mathcal{E}xh_o(\mathsf{b} \vee \mathsf{c})$	$\mathcal{E}xh_o(\mathsf{a} \vee \mathsf{c})$	Exh-D-alternatives
$\mathcal{E}xh_o\mathsf{a}$	$\mathcal{E}xh_o\mathsf{b}$	$\mathcal{E}xh_o\mathsf{c}$	
	$\mathsf{a} \wedge \mathsf{b} \wedge \mathsf{c}$		σ-alternatives

Exhaustifying the above alternatives produces a contradiction: conjoining $\mathsf{a} \vee \mathsf{b} \vee \mathsf{c}$ (the prejacent) with the result of exhaustification over the pre-exhaustified domain-alternatives $\mathsf{a} \leftrightarrow \mathsf{b} \leftrightarrow \mathsf{c}$ we get $\mathsf{a} \wedge \mathsf{b} \wedge \mathsf{c}$, which is in plain contradiction with the result of exhaustifying the scalar alternatives — $\neg(\mathsf{a} \wedge \mathsf{b} \wedge \mathsf{c})$.

[17]A proof: suppose $\Diamond\mathsf{a}$ is true. Then (a) and (c) in (51) are true and their consequents $\Diamond\mathsf{c}$ and $\Diamond\mathsf{b}$ must also be true. Similarly for all other alternatives.

So modals are crucial: different from the modal-less case, $\Diamond a \wedge \Diamond b \wedge \Diamond c$ (the free choice effect) and $\neg\Diamond(a \wedge b \wedge c)$ (the scalar effect) is not a contradiction[18]. The affinity to modality of *irgendein* is thus accounted for — *irgendein* needs modals to avoid exhaustification failure. This further has consequences for *irgendein* in episodic sentences such as (44c). In these cases, a covert modal is inserted, which both save *irgendein* from exhaustification failure and produces a modal flavor (Chierchia 2013: 256-257). When modal qualifications are impossible as in (44d), *irgendein* is deviant.

Finally, *irgendein* also appears below negation, acting like a canonical NPI without the free choice effect, as in (44a), repeated below.

(53) Irgeindein: NPI

a. Niemand hat irgeindein Buch mitgebracht
   No.one had IRGEINDEIN book brought.along
   'No one brought along any book.'

b.

	$\neg(a \vee b \vee c)$		Prejacent
$\mathcal{E}xh_o\neg(a \vee b)$	$\mathcal{E}xh_o\neg(b \vee c)$	$\mathcal{E}xh_o\neg(a \vee c)$	Exh-D-alternatives
$\mathcal{E}xh_o\neg a$	$\mathcal{E}xh_o\neg b$	$\mathcal{E}xh_o\neg c$	
	$\neg(a \wedge b \wedge c)$		σ-alternatives

where $\mathcal{E}xh_o\neg(a \vee b) = \neg(a \vee b) \wedge c$, etc.

It turns pre-exhaustification has no effect: the scalar alternative is entailed by the prejacent so it is not negated; all the pre-exhaustified domain-alternatives are *incompatible* with the prejacent (for example $\neg(a \vee b) \wedge c$ is incompatible with $\neg(a \vee b \vee c)$), so the result of negating them (and conjoining them with the prejacent) will just return the prejacent. Exhaustification has no effect and no contradiction arises, and it is correctly predicted that *irgendein* is happy in negative contexts without triggering a free choice effect.

It's time to summarize our brief discussion of German *irgendein* analyzed in Chierchia

[18]Here is a model for it (let's assume there are exactly three worlds in the model):
w_1 $a \wedge \neg b \wedge \neg c$
w_2 $b \wedge \neg a \wedge \neg c$
w_3 $c \wedge \neg a \wedge \neg b$
Also notice that with modals we can actually have real split exhaustificaiton — we can exhaustify the scalar alternatives below the modal while keep the exhaustificaiton of the pre-exhaustified domain-alternatives above it. This will deliver a reading without the scalar implicature. See Chierchia 2013: 254 for details.

2013. We saw from the above that the use of two types of alternatives – pre-exhaustified domain-alternatives and scalar alternatives – (and their exhaustification) provides a unified analysis for a wide range of properties of *irgendein*, including: its dual status of being both a NPI and a FCI, its free choice effect and its affinity to modals. . . . Varieties of alternatives indeed play an important role in the explanation of polarity items.

Furthermore, varieties of alternatives help us understand variations within the polarity systems. Consider *ever* and *irgendein* together. While *irgendein* is both a NPI and a FCI, *ever* is a pure NPI that remains ungrammatical in modal contexts. Varieties of alternatives provide a simple explanation: they activate different types of alternatives. Specifically, *irgendein* can trigger pre-exhaustified alternatives while *ever*'s domain alternatives cannot be pre-exhaustified; since pre-exhaustified alternatives are crucial in producing the free choice effect in modal contexts, *irgendein* but not *ever* can be a FCI in modal contexts.

I will end the discussion of the polarity system by exhibiting the following beautiful chart from Chierchia 2013: 367 which provides a very plausible typology of polarity items across natural languages. Without going into the details, it's obvious that varieties of alternatives provide one of the two parameters based on which polarity items can vary. The other parameter involves modes of exhaustification, including choices of exhaustificaiton operators, constrains on the exhaustificaiton process etc.

	Modes of exhaustification			
Types of alternatives	WEAK Only truth conditions count for exhaustification		STRONG i. Truth conditions+ impl+ presupp. count for exhaustification (O^S) ii. Proper strengthening (O_{PS})	
Degree alternatives (emphatic NPIs)	E *koii bhii, ek bhii, give a damn*		E^S *sleep a wink*	
Simple D-alternatives +σ-alternatives (pure NPIs)	O *ever, mai, alcun*		O^S *in weeks*, *N*-words	
Exhaustified D-alternatives + Rich Scale (Total variation ∃-FC)	O *irgendein, un qualsiasi NP* (Total ∃−FCI/NPI)		O^S ?	O^{PS} *un NP qualsiasi, un oarecare, un quelconque* (Total pure ∃−FCI)
Exhaustified singleton D-alternatives + Rich Scale (Partial variation ∃-FC)	O *irgendein* (Partial ∃−FCI/NPI without anti-total variation)	O_{ATV} *vreun* (Partial ∃−FCI/NPI with anti-total variation)	O^{PS} *un qualche* (Partial pure ∃-FCI without anti-total variation)	O^{PS}_{ATV} ? (Partial pure ∃−FCI with anti-total variation)
Exhaustified D-alternatives + Reduced Scale (∀-FCI)	O *any* (∀−FCI/NPI without)		O^S ?	O^{PS} *qualsiasi* (Pure ∀-FCI)

This ends our discussion of polarity. Next, we will consider varieties of alternative from a different perspective. Specifically, we are going to discuss plural alternatives and singular alternatives and operators that are sensitive to this distinction. To do this, we need to consider pluralities and questions first.

2.1.4 Pluralities

Besides singular individuals, natural languages also have expressions which intuitively refer to collections of individuals, such as *John and Mary* and *the students*. To model denotations of such expressions, plural individuals are to be introduced into the entity domain D_e. Following Link 1983, we take the domain of individuals D_e to consist of singular individuals (atoms), and plural ones (sums), both being *e*-type entities. Furthermore, sums are formed out of atoms under the operation of sum-formation $\oplus$, which is associative, commutative and idempotent.

(54) Summation

a. $(\alpha \oplus \beta) \oplus \gamma = \alpha \oplus (\beta \oplus \gamma)$ — Associative

b. $\alpha \oplus \beta = \beta \oplus \alpha$ — Commutative

c. $\alpha \oplus \alpha = \alpha$ — Idempotent

We take D_e to be closed under summation (that is, for any α and β in D_e, the sum $\alpha \oplus \beta$ is also in D_e). With $\oplus$, we can further define a partial order $\leq$ (reads "part of") on the set of individuals D_e:

(55) Part of

$\alpha \leq \beta$ iff $\alpha \oplus \beta = \beta$

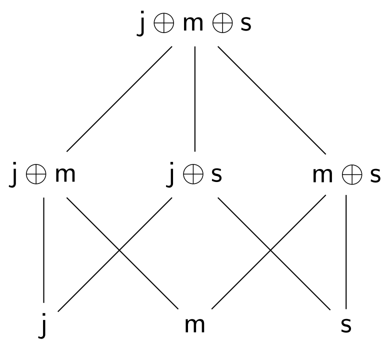
We can also define atomic individuals as individuals that have no proper parts.

(56) Atoms

$Atom(\alpha)$ (reads "α is an atom") iff $\forall \beta \leq \alpha [\alpha = \beta]$

Together, $\langle D_e, \oplus \rangle$ forms a complete atomic join semi-lattice (see Landman 1991 for details). A domain containing three (atomic) individuals John, Mary and Sue has the following structure.

(57) Complete Atomic Join Semi-lattice



Assuming that only John and Mary are students, we would like to have the following intuitively plausible (extensional) denotations.

(58) Denotations

a. ⟦John and Sue⟧ = $\mathsf{j} \oplus \mathsf{s}$

b. ⟦the students⟧ = $\mathsf{j} \oplus \mathsf{m}$

c. ⟦student⟧ = $\{\mathsf{j}, \mathsf{m}\}$

d. ⟦students⟧ = $\{\mathsf{j}, \mathsf{m}, \mathsf{j} \oplus \mathsf{m}\}$

To compositionally derive the above denotations, I following Link 1983 take *and* to correspond to $\oplus$ [19], and I take English singular nouns to refer to sets of atoms while plural nouns sets that include both sums and atoms (Zweig 2008). Specifically, we can derive the denotation of the latter from the former by assuming the plural morphology *-s* to be the sum-closure operator $*$ (Link 1983).

[19] This merelogical sum *and* is different from the logical boolean *and* that connects sentences. The current thesis is not in a position to offer a unified analysis of *and*. For analyses that take the boolean *and* to be the basic, see Winter 2001, Champollion 2015b. For analyses that take the sum *and* to be the basic, see Krifka 1990, Heycock & Zamparelli 2005, and recently Fine 2015, from which I quote "'and' is essentially mereological rather than logical in character; 'and', whether it is used to connect nominal or sentential expressions, will signify fusion".

(59) $*P$ is the smallest set such that:

$P \subseteq *P$ and

$\forall x, y \in *P : x \oplus y \in *P$

(60) $[\![\text{students}]\!] = *[\![\text{student}]\!]$

Finally, following Sharvy 1980, Link 1983 I take *the* to be a presuppostional generalized $\bigoplus$[20]. As in (61), *the P* is defined only if $\bigoplus P \in P$, and if it is defined, *the P* denotes $\bigoplus P$. Consider the model we described above: *the student* is not defined since $\bigoplus \mathsf{student} = \mathsf{j} \oplus \mathsf{m}$, which is not a member of student. On the other hand, *the students* is defined and denotes $\mathsf{j} \oplus \mathsf{m}$, since $\bigoplus \mathsf{students} = \mathsf{j} \oplus \mathsf{m}$, which is also a member of students. Uniqueness is captured.

(61) $[\![\text{the}]\!] = \lambda P : \bigoplus P \in P. \bigoplus P$

This completes the background on pluralities.

2.1.5 Questions

The truth-conditional semantic framework we use cannot make sense of interrogative sentences yet, since interrogative sentences do not seem to have truth-conditions.

Questions as sets of propositions

We adopt a Hamblin/Karttunen semantics of questions (Hamblin 1973, Karttunen 1977), where a question denotes a set of propositions — the set of its possible answers. To illustrate, suppose that there are exactly three people besides Zhangsan in the domain, Bill, Mary and Sue, and that inviting is irreflexive; then the question in (1) denotes the set of propositions in (2).

(62) Who did Zhangsan invite?

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[20] $\bigoplus P :=$ the α such that $\alpha = \alpha_1 \oplus \alpha_2 \oplus \alpha_3 \oplus \ldots$ for all members α_i in P. I also use a colon and a period to enclose materials that is presupposed, following Heim & Kratzer 1998.

(63) $$[\![(1)]\!] = \left\{ \begin{array}{l} \lambda w.\text{z invited b in } w, \\ \lambda w.\text{z invited m in } w, \\ \lambda w.\text{z invited s } w, \\ \lambda w.\text{z invited b}\oplus\text{m in } w, \\ \lambda w.\text{z invited m}\oplus\text{s in } w, \\ \lambda w.\text{z invited b}\oplus\text{s in } w, \\ \lambda w.\text{z invited b}\oplus\text{m}\oplus\text{s in } w, \end{array} \right\}$$

Question-answer congruence

Treating questions as sets of propositions leads us to a neat characterization of the condition on question-answer congruence (Rooth 1992).

(64) Question-Answer Congruence

a. Q_1: Who did John invite?

A_1: John invited Mary_F.

$A_1{}'$: #John_F invited Mary.

b. Q_2: Who invited Mary?

A_2: #John invited Mary_F.

$A_2{}'$: John_F invited Mary.

As is shown in (64), a congruent answer to a *wh*-question must have $_F$-marking (indicated by prosodic prominence) on the constituent corresponding to the *wh*-phrase.

Taking questions to be sets of propositions and $_F$ to trigger alternatives (§2.1.2) provides us with the condition in (65)

(65) Q-A Congruence [Rooth 1992]

$[\![Q]\!] \subseteq [\![A]\!]_{Alt}$

In words: the denotation of the question has to be a subset of the alternative semantic value of its answer.

Since $[\![Q_1]\!] \subseteq [\![A_1]\!]_{Alt}$ but $[\![Q_1]\!] \not\subseteq [\![A'_1]\!]_{Alt}$, A_1 but not A'_1 is a felicitous answer to Q_1. The same explanation applies to Q_2 and A_2/A'_2.

Answerhood operator and varieties of alternatives

There are not only matrix questions but also embedded questions.

(66) John knows [$_Q$ who Zhangsan invited].

What does the question in (66) denote? Taking it to be a set of propositions (of type $\langle st, t\rangle$) seems problematic, since it predicts that *know* takes a set of propositions as its first argument — *know* will be of type $\langle\langle st, t\rangle, \langle e, t\rangle\rangle$. But *know* also takes propositions, it should be of type $\langle st, \langle e, t\rangle\rangle$ according to (67).

(67) John knows that Zhangsan invited Mary and Sue.

The standard solution is to assume the existence of answerhood operators (Heim 1994, Dayal 1996, Beck & Rullmann 1999). Answerhood operators mediate between *know* and its embedded question, reduces the latter to a propositional type, and thus allow for a unified analysis of *know* as of type $\langle e, \langle st, t\rangle\rangle$. (68) is Dayal's (1996) answerhood operator.

(68) $\textsc{Ans}_w(Q) = \iota p \in Q[p(w) = 1 \wedge \forall q \in Q[q(w) = 1 \rightarrow p \subseteq q]]$

Given an evaluation world $w*$, applying Ans to a question Q gives us the most informative proposition p in Q that is also true in $w*$, if there is such a p (if no such p exists, $\textsc{Ans}_{w*}(Q)$ is undefined).

To illustrate, let's still suppose that there are exactly three people besides Zhangsan in the domain, Bill, Mary and Sue, and that inviting is irreflexive; next, let's suppose Zhangsan invited Bill and Mary but not Sue in the actual world. Then the question in (1) (who did Zhangsan invited?) has the following shape, with true propositions underlined.

(69) $$[\![(1)]\!] = \left\{ \begin{array}{l} \underline{\lambda w.\text{z invited b in } w}, \\ \underline{\lambda w.\text{z invited m in } w}, \\ \lambda w.\text{z invited s in } w, \\ \boxed{\underline{\lambda w.\text{z invited b}\oplus\text{m in } w}}, \\ \lambda w.\text{z invited m}\oplus\text{s in } w, \\ \lambda w.\text{z invited b}\oplus\text{s in } w, \\ \lambda w.\text{z invited b}\oplus\text{m}\oplus\text{s in } w, \end{array} \right\}$$

Within the true propositions, there is the most informative one λw.z invited b⊕m in w, boxed in (69). Because of the existence of this most informative true proposition, $\textsc{Ans}_{w*}(Q_{(1)})$ is defined and it is the boxed proposition. Now *know* can take this proposition as its argument, with the semantic representation of (66) being know (j, $\textsc{Ans}_{w*}(Q_{(1)})$).

There is another nice feature about Dayal's answerhood operator. It captures questions' uniqueness presuppositions. Consider the following paradigm.

(70) a. Which person did Zhangsan invite?
b. Who did Zhangsan invite?

(71) a. Zhangsan invited Bill.
b. Zhangsan invited Bill and Mary.

(70a) can only be felicitously answered by (71a), which names a single person. On the other hand, (70b) can be answered either by (71a) or (71b). In other words, while (70a) has a uniqueness presupposition that there was exactly one person that Zhangsan invited, (70b) does not. Let's see how Dayal's answerhood operator captures this contrast.

First, assuming that singular *wh*-phrases such *which person* ranges over atomic individuals while number-neutral ones such as *who* ranges over both atoms and sums, we have the following denotations for the two questions in (70): $[\![(70a)]\!]$ corresponds to an atom-based propositional set while $[\![(70b)]\!]$ a sum-based one.

(72) $[\![(70a)]\!] = \left\{ \begin{array}{l} \lambda w.\text{z invited } \mathsf{b} \text{ in } w, \\ \lambda w.\text{z invited } \mathsf{m} \text{ in } w, \\ \lambda w.\text{z invited } \mathsf{s} \text{ in } w, \end{array} \right\}$

(73) $[\![(70b)]\!] = \left\{ \begin{array}{l} \lambda w.\text{z invited } \mathsf{b} \text{ in } w, \\ \lambda w.\text{z invited } \mathsf{m} \text{ in } w, \\ \lambda w.\text{z invited } \mathsf{s} \text{ in } w, \\ \lambda w.\text{z invited } \mathsf{b}\oplus\mathsf{m} \text{ in } w, \\ \lambda w.\text{z invited } \mathsf{m}\oplus\mathsf{s} \text{ in } w, \\ \lambda w.\text{z invited } \mathsf{b}\oplus\mathsf{s} \text{ in } w, \\ \lambda w.\text{z invited } \mathsf{b}\oplus\mathsf{m}\oplus\mathsf{s} \text{ in } w, \end{array} \right\}$

It turns out that Dayal's answerhood operator is sensitive to the atom-sum distinction of its question argument. Suppose in the actual world Zhangsan invited Bill and Mary but not Sue. $\text{ANS}_{w*}(Q_{(70b)})$) is defined but $\text{ANS}_{w*}(Q_{(70a)})$) is not. This is because in $[\![(70a)]\!]$ there are exactly two true propositions (λw.z invited b in w and λw.z invited b in w), neither one is more informative than the other; thus there is no proposition that is the most information one, and $\text{ANS}_{w*}(Q_{(70a)})$) is not defined. On the other hand, as was discussed above, there is a proposition in $\text{ANS}_{w*}(Q_{(70b)})$) - λw.z invited b$\oplus$m in w - that is the most information proposition, and thus $\text{ANS}_{w*}(Q_{(70b)})$) is defined. In general, $\text{ANS}_{w*}(Q_{(70a)})$) is defined only if there is a unique person that Zhangsan invited, while $\text{ANS}_{w*}(Q_{(70b)})$) does not have this restriction.

Finally, if we assume that a question Q always presupposes that $\text{ANS}_{w*}(Q)$) is defined, that is, its Dayal-answer exists, the uniqueness presupposition of (70a) (and the lack of it in (70b)) is captured.

In sum, we have identified more varieties of alternative, this time, atom-based ones and sum-based ones, which can be directly read off the morphological composition of a question. We also saw that there are alternative sensitive operators such as Dayal's answerhood operator that are sensitive to the atom-sum distinction. The two components together explain the uniqueness presuppositions of questions.

My analysis of the Madnarin focus particle system, as will be clear, is greatly inspired by Dayal's answerhood operator[21]. In chapter 3, varieties of alternatives – in particular, atom-based ones and sum-based ones – will be posited to be associated with alternative sensitive operators, which again are sensitive to the atom-sum distinction of their alternative sets. The combination of the two features will be shown to explain several puzzling phenomena concerning Mandarin focus particles. Systematic ambiguities within the Mandarin focus particle system will receive a principled explanation.

2.2 Syntactic assumptions

I spell out my syntactic assumptions in this section.

2.2.1 Adverbial status

I claim that *jiu* and *dou* are adverbs that adjoins to the Extended Verbal Projections (Grimshaw 1991) such as VP, TP. It differs from English *only* in that it never adjoins to arguments (such as DPs); in this respect, *jiu* is similar to German focus particles such as *nur*, *auch* and *sogar* ('only', 'also', 'even') (Büring & Hartmann 2001).

(74a), (74b) and (74c) below illustrate the above claim for *jiu*. Crucially, (74c) is bad because *jiu* cannot adjoin to a DP.

(74) a. [$_{TP}$ Jiu [$_{TP}$ YUEHAN qing le Lisi]].
JIU John invite ASP Lisi
'Only John$_F$ invited Lisi.' Adjunction to TP

b. Yuehan [$_{VP}$ jiu [$_{VP}$ qing le LISI]].
John JIU invite ASP Lisi
'John only invited Lisi$_F$.' Adjunction to VP

c. *Yuehan qing le [$_{DP}$ jiu [$_{DP}$ LISI]].
John invite ASP JIU Lisi
Intended: 'John invited only Lisi$_F$.' *Adjunction to DP

[21] I thank Roger Schwarzschild for first pointing out the significance of Dayal's answerhood operator to my project.

Addition evidence supporting *jiu*'s adverbial status comes from the fact that it never appears within simple nominal arguments. This differs from English *only* which is able to appear within DPs acting as an adjective. To get an adjectival ONLY in Mandarin Chinese, a different item *weiyi* 'only' has to be used (75c) (the *de* below is just a modification marker that occurs between a modifier and the nominal it modifies).

(75) ADJECTIVAL-ONLY

a. John is the only teacher.

b. *Lisi shi zhi/jiu de laoshi.
Lisi BE only/JIU DE teacher
Intended: 'Lisi is the only teacher.'

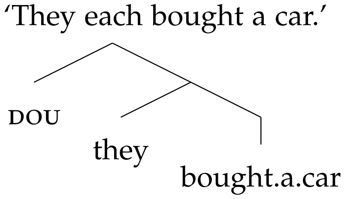
c. Lisi shi weiyi de laoshi.
Lisi BE only DE teacher
'Lisi is the only teacher.'

Dou behaves in exactly the same manner.

2.2.2 Focus association and covert movement

Both *jiu* and *dou* can be associated to its left. In these cases, I assume that they covertly move to the top of the structure and have scope over their associates, similar to *even*-movement. A LF is given in (76).

(76) Tamen dou mai.le yi.bu chezi
they DOU buy.ASP one.CL car
'They each bought a car.'



A proposal is given in §3.3.1 that explains how and why *jiu* can be associated to its left on the surface. No explanation is attempted as for why *dou* is required to be associated to its left. See Lin 1998, Yang 2001, Liao 2011 for some discussions.

This concludes my discussion of the background assumptions adopted in the thesis. In the next chapter we will see how the semantic tools and ideas presented here provide a unified account of Mandarin *jiu*, *dou*, and systematic 'ambiguities' of the Mandarin focus particle system.

Chapter 3

Varieties of alternatives: Mandarin focus particles

Mandarin focus particles systematically have heterogeneous uses. By examining details of two focus particles *jiu* 'only' and *dou* 'even', this chapter explores the hypothesis that varieties of alternatives give rise to systematic 'ambiguities'. Specifically, by positing sum-based alternative sets and atom-based ones, it maintains unambiguous semantics of *jiu* as ONLY_{weak} and *dou* as EVEN, while deriving their variability through interaction with alternatives. Independently motivated analyses of distributive/collective readings and contrastive topics, combined with varieties of alternatives, deliver a wide range of facts concerning *jiu* and *dou*. Theoretically, the chapter illustrates an integration of Link, Landman's theory of pluralites into Rooth's alternative semantics.

3.1 Introduction

Focus particles (FPs) (such as *jiu*, *dou*, *ye*,. . .) in Mandarin are adverbs syntactically; semantically, they systematically have heterogeneous uses. Take *jiu* and *dou* as examples: *jiu* can either have an exclusive semantics, similar to English *only* (1), or it can convey just a scalar reading but without the exclusive part (2); as for *dou*, it can either act like a distributive operator (3) (Lin 1998), or simply be a scalar particle similar to English *even*(4) (Shyu 1995, Chen 2008)[1][2].

---

[1]The chapter uses small capitals to indicate the associate of an FP, and underlying to highlight the relevant FP and to show its semantic contribution.

[2]*Jiu* and *dou* also have other temporal/modal uses, which are analyzable once the theory presented here is properly enriched to include *events, times* and so on. But we must leave this for another occasion. Further, notice that syntactic positions of *jiu*'s associate (post-*jiu* (1) vs. pre-*jiu* (2)) correlates with different uses of *jiu*. An explanation of this fact is provided in Section 3.3.1, where we discuss the interaction of *jiu* and contrastive topics.

(1) Jiu Yuehan hui shuo fayu.
JIU John can speak French
'Only John can speak French.' *'only'*

(2) Yuehan jiu hui shuo fayu.
John JIU can speak French
'John, who is easy to get hold of, can speak French.' *low-rank*

(3) Tamen dou mai le yi liang chezi.
they DOU buy ASP one CL car
'They each bought a car.' *distributive operator*

(4) Yuehan dou mai le yi liang chezi.
John DOU buy ASP one CL car
'Even John bought a car.' *'even'*

The feature of being ambiguous as illustrated above for *jiu* and *dou* applies to other FPs as well (see Hole 2004: §2 for a description of various uses for a variety of FPs), so it is unlikely to be an idiosyncrasy of a certain FP. Then, a natural question to ask is: why does Mandarin allow such massive ambiguities within the FP system? The current chapter is devoted to answering this question with special reference to the two FPs *jiu* and *dou*.

Specifically, it will argue that for each FP, it is possible (and even necessary sometimes) to assign it a single unambiguous semantics, while deriving different 'uses' of the FP by varying choices of the alternative set associated with it.

Let me elaborate. First, I take it to be our basic assumption that an FP operates on a set of alternatives (Rooth 1985). Then, the meaning of an expression containing an FP is a function of (a) the meaning of the FP, (b) the meaning of FP's prejacent π[3], and (c) π's alternatives.

With this background, what we propose about Mandarin FPs is that (c), instead of (a), is the locus of 'ambiguity': with varieties of alternatives, apparent distinct meanings can be derived without altering the semantics of the FP.

By making (c) the locus of generating 'ambiguities', we are not making any specific

[3]Following Horn 1996, we call the FP-less part of the sentence containing a FP the FP's prejacent. For example, the prejacent of *only* in *Only John can speak French* is *John can speak French*. In the chapter, π stands for either the prejacent sentence or its denotation (the prejacent proposition); as usual, contexts disambiguate.

claim about any particular FP; rather, we are making a claim about the entire Mandarin FP system. Since Mandarin has the option of associating different sorts of alternatives with an FP, we predict that for each FP it is in principle possible to combine it with different sorts of alternative sets. This gives rise to 'ambiguities' for each FP; thus massive 'ambiguities'.

The idea of positing different sorts of alternative sets for a single alternative sensitive operator is not novel. A notable recent example is Chierchia 2013, who associates different sorts of alternatives (subdomain alternatives, scalar alternatives, pre-exhaustified subdomain alternatives, etc.) with two alternative sensitive operators (ONLY and EVEN), deriving different types of polarity sensitive items and thus unifying the polarity system. The current project can be seen as another implementation of Chierchia's general idea, extending it to the analysis of focus sensitive items.

Of course, the plausibility of the project depends on how successfully we can assign each of the FPs a unified semantics and at the same time account for its variability through varieties of alternatives. Thus, in this chapter, we will use two case studies– *jiu* 'only' (Section 3.2.1) and *dou* 'even' (Section 3.2.2)– to demonstrate that our project is on the right track. Specifically, we will identify two types of alternative sets – sum-based ones and atom-based ones; together with a novel analysis of *jiu* as ONLY_{weak} and *dou* as EVEN, they account for the *jiu* and *dou* in (1)-(4). Next, in Section 3.3, we will explore how the proposal introduced in Section 3.2 interacts with other components of the grammar, and thus regulate the 'ambiguities' generated by varieties of alternatives. Finally, in Section 3.4 we will discuss issues that emerge when we consider the present proposal against earlier work on these topics, and in Section 3.5 we conclude.

3.2 Deriving 'ambiguities' through alternatives

3.2.1 *Jiu* as weak *only*

A weakened semantics of *only*

Let's start with (1). (1) has an exclusive inference[4] contributed by *jiu*: people other than John cannot speak French. It is evidenced by (5), where continuing (1) with *(it's possible that) Lisi/someone else also can* is impossible. This is similar to English *only*, where any form of canceling/suspending of the exclusive inference is totally out (Horn 1996, a.o.), as shown in (6).

(5) #jiu Yuehan hui shuo fayu, (keneng) Lisi ye hui.
JIU John can speak French, (possible) Lisi also can
'#Only John can speak French, (but It's possible) that Lisi also can.'

(6) #Only John speaks French, and/but Mary may too.

There is a vast literature on how to capture the exclusive inference of exclusive particles like *only* (see Coppock & Beaver 2014 for a recent discussion); (7) is an early attempt, due to Horn 1969, as cited in Rooth 1996: 277.

(7) $[\![only_{Horn}(\pi)]\!]$ is true iff $\forall q \in C[\pi \neq q \rightarrow \neg q]$

Alternatives not equivalent to the prejacent are false.

Notice that the C in (7) is the quantificational domain of *only* and it is restricted by focus: focus on an expression a triggers alternatives which share with a the same semantic type (Rooth 1985). C is required to be a subset of the set of propositions obtained by replacing the focus part of the prejacent with its alternatives. This is formally represented in (8) (cf. the Focus Interpretation Principle in Rooth 1992: §3).

(8) $C \subseteq \{q \mid \exists x.(x \in ([\![Focus]\!]_{Alt}) \wedge q = ([\![Background]\!](x)))\}$

---

[4] *Jiu* also conveys a scalar meaning *that the people that can speak French are few*, similar to English *only*. The scalar aspect of *jiu* will be discussed in §3.2.4.

where *Background* is the predicate which when combining with the focus, forms the prejacent.

The lexical entry in (7) was later shown to be inadequate, one of its problems involving plural focused DPs (Rooth 1992: 77, Krifka 1993: 272). Consider *only John and Bill speak French*. The sentence is a problem for (7): q= *that Bill speaks French* is an alternative not equivalent to the prejacent; yet q cannot be false (as is required by (7)), or the sentence will be a contradiction.

The solution to the plural DP problem leads to a weakening of (7), into (9): since q is entailed by the prejacent, it is not negated by ONLY$_{strong}$. ONLY$_{strong}$ has later become the standard analysis of English *only*'s assertive component[5].

(9) $[\![\text{ONLY}_{strong}(\pi)]\!]$ is true iff $\forall q \in C[\pi \nsubseteq q \rightarrow \neg q]$ [Schwarzschild 1994]
Alternatives not entailed by the prejacent are false.

In fact, once pluralities are brought into the picture, (9) can be weakened even further into (10). (10) is what we propose to be the assertive component of *jiu* (note that we do not deny the existence of ONLY$_{strong}$, which we take to be the correct semantics for English *only* and Mandarin *zhi* 'only', see Section 3.3.2).

(10) $[\![\text{ONLY}_{weak}(\pi)]\!]$ is true iff $\forall q \in C[q \subset \pi \rightarrow \neg q]$
Alternatives asymmetrically entailing the prejacent are false.

Compare (10) with (9): (9) negates all alternative propositions in C that are not entailed by the prejacent, while (10) only negates propositions in C that asymmetrically entail the prejacent. Since the set of propositions asymmetrically entailing the prejacent is a subset of the set of propositions that are not entailed by the prejacent, (10) is weaker.

The weak (10) can still produce an exclusive reading when pluralities are in the

[5](9) is also essentially what Coppock & Beaver (2014: 394) posit for the assertive component of *only*. Their lexical entry can be represented by: $[\![\text{ONLY}_{C\&B}(\pi)]\!]$ is true iff $\forall q \in CQ_S[q \rightarrow \pi \geq_S q]$. Taking their CQ_S to be our C and their $\geq_S$ to be entailment (as they suggest later in the chapter), their assertive component of *only* is equivalent to (9).

alternative set. We show this in the next subsection.

Sum*-based alternatives and exclusive *jiu

We sketch our assumptions on pluralities first. Following Link 1983, we take the domain of individuals D_e to consist of singular individuals (atoms), and plural ones (sums), both being *e*-type entities. Furthermore, sums are formed out of atoms under the operation of sum-formation $\oplus$. Together, $\langle D_e, \oplus \rangle$ forms a complete atomic join semi-lattice (see Landman 1991 for details).

With sums available, consider *jiu* JOHN *can speak French* in (1). We propose that *jiu* is ONLY$_{weak}$. Taking the alternative set of JOHN to consist of sums like $j \oplus b$, $j \oplus m \ldots$, we derive the exclusive inference as illustrated in (11).

(11) Jiu JOHN can speak French. (# Bill also can.)

$[\![John]\!]_{Alt,sum}$= {j, b, m, j ⊕ b, j ⊕ m, b ⊕ m, *j* ⊕ b ⊕ m}

π = John can speak French.

Assertion of *jiu* applied to C_{sum}= {~~j, b and m can spk.F~~ ⊂ ~~j and b can spk.F~~, ~~j and m can spk.F~~ ⊂ j can spk.F...}

Exclusive Inference b can't spk.F and m can't spk.F.

j can spk.F & ¬ (j and b can spk.F) ⇒ b can't spk.F

j can spk.F & ¬ (j and m can spk.F) ⇒m can't spk.F

In (11), *jiu*'s quantificational domain C_{sum} contains propositions asymmetrically entailing the prejacent, for example, *John and Bill can speak French* — these are the alternative propositions formed by replacing *j* in the prejacent by one of its sum alternatives that has *j* as a subpart. The strictly stronger propositions are negated according to the assertive component of *jiu* as in (10) (crossing-out indicates direct negation by ONLY$_{weak}$); next, we get the inference that Bill cannot speak French and that Mary cannot speak French, because:*John can speak French*[6] & *it's not the case that (both) John and Bill speak French* ⊆ *Bill*

[6]This is the prejacent. In the chapter, we remain neutral on whether the prejacent is presupposed or asserted. See Horn 2009 for a recent overview of the complexity of the issue (for *only*). For expository

cannot speak French; by parallel reasoning, Mary cannot speak French. We correctly get our exclusive reading that other people (Bill and Mary) cannot speak French.

It needs to be mentioned that Rooth (1992: 83) uses the same mechanism to derive the implicature that Paul didn't pass, from the sentence *Well, I_F passed*. In Rooth 1992, the operation that generates scalar implicature encapsulates our ONLY$_{weak}$. This is not surprising in view of ONLY$_{weak}$'s identity to Krifka's (1995: 224) SCAL.ASSERT, which is also responsible for scalar implicature generation. But as far as I am aware, ONLY$_{weak}$ has not been proposed as the semantics of any overt exclusive particle in natural languages and its interaction with non-cumulative sets (see the next subsection) has not been explored[7]. On the other hand, the relation between focus particles and scalar implicatures is in fact very tight– witness the Grammatical view of scalar implicatures (Chierchia et al. 2012), where scalar implicatures are generated by application of a covert *only*. Notice the *only* in Chierchia et al. 2012 is ONLY$_{strong}$. It remains to be seen whether there is any empirical difference between ONLY$_{strong}$ and ONLY$_{weak}$ in the case of scalar implicatures.

It's perhaps also unsurprising that ONLY$_{weak}$ can trigger exclusive inference as ONLY$_{strong}$ is supposed to. After all, the two are equivalent if the quantificational domain C is closed under conjunction (van Rooij & Schulz 2007: 197), which is the case for (1)/(11): *can speak French* is a distributive predicate, ensuring *John and Bill can speak French* entails *John can speak French* and *Bill can speak French* (collective predicates will be discussed in Section 3.4.1), and we take the alternative set of JOHN to include all sums that are available in the context, that is, the focus alternative set is cumulative (closed under $\oplus$).

On the other hand, ONLY$_{weak}$ differs from ONLY$_{strong}$ if C is not closed under conjunction. This happens when all the alternatives are *atoms*. In such cases, the alternative propositions do not entail each other, ONLY$_{weak}$ does not trigger exclusivity and a non-exclusive *jiu*

purposes, we treat the prejacent as an assertion.

[7] A qualification. The analysis of *jiu* and the significance of ONLY$_{weak}$ were presented at a CLS-talk in early 2014. After I finished this chapter (and an *L&P* submission based on it) in 2015, I had the chance to read Uegaki's (2015) dissertation. Uegaki's exhaustive operator X (built on Klinedinst & Rothschild 2011) for analyzing exhaustivity of question-embedding sentences has the same semantics as ONLY$_{weak}$ (Uegaki 2015: 87). Importantly, the fact that X is sensitive to the entailment profile of its associated alternative set is explored to explain the distribution of weak exhaustivity (of *surprise*) and intermediate exhaustivity (of *tell*). Uegaki's analysis adds independent support for the existence of ONLY$_{weak}$ in natural languages.

obtains.

Atoms-based alternatives and non-exclusive *jiu*

Our second example (2) involves a non-exclusive *jiu*, as it can be felicitously followed by *Bill also can*, as in (12).

(12) YUEHAN jiu hui shuo fayu, Bill ye hui.
John JIU can speak French, Bill also can
'John, who is easy to get hold of, can speak French; Bill also can.'

(12) is naturally used in a context where A asks *Who can speak French? I am looking for someone for language help*. In such a context, B can use (12) as a felicitous answer if John is familiar to both A and B, and is easy to get hold of (For example, John is A and B's roommate). In this case, we are evaluating (atomic) individuals' accessibility to the interlocutors; thus, it is reasonable to take the alternatives to *John* to be *Bill, who is the addressee's friend in the French department*, *a real Frenchman such as the president of France*. . . .

Now, with all focus alternatives being atomic individuals, the result of applying *jiu* (=ONLY$_{weak}$ (10)) does not deliver an exclusive meaning. Consider in this case *jiu*'s quantificational domain C_{atom} = {John can speak French, the addressee's friend Bill in the French department can speak French, the president of France can speak French. . . }. Since there are no propositions in C_{atom} that asymmetrically entails the prejacent, the application of *jiu*, which according to (10) only negates alternatives asymmetrically entailing the prejacent, is trivial, and non-exclusive *jiu* obtains. This is sketched in (13).

(13) JOHN jiu can speak French, (Bill also can.)

$[\![John]\!]_{Alt,atom}$= {our roommate John $<_{\text{effort}}$ the addressee's friend in the French department Bill $<_{\text{effort}}$ the President of France $<_{\text{effort}}\ldots$}

$\boldsymbol{C}_{atom}$= {John can spk.F, the addressee's friend in the French department can spk.F, the president of France can spk.F. . . }

Assertion of *jiu* applies vacuously since there are no stronger proposition in C_{atom}.

It's time to take stock: we have proposed a semantics for *jiu* (ONLY$_{weak}$) that is weaker than the standard semantics of English *only* (ONLY$_{strong}$). We have further posited two types of alternative sets: alternative sets based on *sums* and those based on *atoms*. Since ONLY$_{weak}$ is 'super-alternative-sensitive', it gives rise to an exclusive meaning when it operates on sum-based alternative sets, but becomes non-exclusive when the alternative set is atom-based. In this way, the 'ambiguity' of *jiu* is explained.

In the next subsection, we will use the same mechanism to derive facts about *dou*, which is claimed to be 'ambiguous' between *even* and a distributive operator similar to VP-*each*. Crucially, we will stay with the two types of alternative sets (sums vs. atoms) posited for the analysis of *jiu*, and show how they can be associated with a single *dou* and derive the right set of facts.

3.2.2 *Dou* as *even*

Unlike *jiu*, *dou* is well discussed in the literature (Lee 1986, Cheng 1995, Shyu 1995, Huang 1996, Lin 1998, Hole 2004, Chen 2008, Cheng 2009, Liao 2011, a.o.). Instead of reviewing/answering all the empirical and theoretical questions raised in the literature, we will first start with the most basic facts concerning *dou*, and show how a unified analysis of *dou* can be developed. Discussion of more complicated data is postponed to Section 3.3 and 3.4.

Basic facts

Our (3) and (4) (repeated here as (15) and (14)) from the very beginning of the chapter illustrate the two 'uses' of *dou*.

(14) YUEHAN <u>dou</u> mai le yi liang chezi.
John DOU buy ASP one CL car
'<u>Even</u> John bought a car.' *'even'*

(15) TAMEN <u>dou</u> mai le yi liang chezi.
they DOU buy ASP one CL car
'They <u>each</u> bought a car.' *distributive operator*

In (14), *dou* adds an *even* flavor, and the sentence conveys that John's purchasing a car is less likely/more noteworthy than other people buying a car. On the other hand, (15) is *even*-less (with stress on *dou*[8]), and the *dou* forces a distributive reading: they each bought a car. (16) is the generalization.

(16) ***dou*'s distributive effect**

Even-less *dou* forces distributive readings.

The generalization in (16) is implicitly assumed by most analyses of *dou*. Take Lin 1998 as an example; Lin discusses only distributive-*dou* without mentioning *even-dou* in his paper. The latter seems to him to be a different, homophonous item from the former (though there is no a priori reason for doing so). Thus, Lin's generalization that distributive-*dou* (or equivalently, the *dou* that is not the *even-dou*) forces distributive readings is equivalent to (16).

The rest of Section 3.2.2 is devoted to deriving (16). Before we spell out the details, it might be useful to note that our proposal involves a change of perspective: instead of focusing on how distributive readings are forced by distributive-*dou*, as usually seen in the literature, we focus on how the *even*-flavor can disappear when a distributive reading is present.

Towards an analysis

We first introduce the ingredients needed to derive (16), specifically: a semantics of *dou* equal to English *even*, a covert distributive operator generating distributive readings, and a group operator responsible for collective readings.

[8]A reviewer at *Linguistics & Philosophy* questions our alternative-based account of *dou* to be presented below based on the fact that distributive-*dou* often bears stress while the alternative triggers we posit sometimes do not. While we think getting stress patterns right is important, not receiving stress does not mean not triggering alternatives: there are *second occurance focus* (Partee 1999) that never receives the main stress but triggers alternatives, and *stressed additive particles* (Krifka 1998) that themselves receive stress but are associated with alternative-triggering items. More generally, alternative semantics has become a useful theoretical tool employed to explain a large variety of phenomena such as scalar implicatures, polarity sensitive items, *wh*-indeterminates and so on. Our account follows this tradition and we have to leave how Mandarin alternative triggers get phonetically realized to another occasion. See Liao (2011: §4.3.2) for evidence supporting the claim that distributive *dou* is alternative-sensitive.

We propose that *dou* has the semantics of English *even*, as proposed in Karttunen & Peters 1979 (cf. Liao 2011: 217): *dou* is truth conditionally vacuous but presupposes that its prejacent is the most unlikely proposition among its alternatives (17) (we set aside the additive presupposition of *even*).

(17) $[\![dou(\pi)]\!]$ is defined iff $\forall q \in C[\neg(\pi = q) \rightarrow \pi \prec_{likely} q]$
if defined, $[\![dou(\pi)]\!] = [\![\pi]\!]$

With (17), the *even-dou* in (4)/(14) is straightforwardly captured.

As is mentioned in Section 3.2.2, we follow Link's (1983) theory of plurality where the domain of individuals consists of *sums* and *atoms*. We also adopt Landman's (1989) group operator ↑ which turn sums into atoms. In (18), both z and $\uparrow(\mathsf{z} \oplus \mathsf{l})$ are atoms: they either have no proper parts (pure atoms) or have proper parts that are not linguistically accessible for predication (groups).

(18) a. $[\![\text{Zhangsan}]\!] = \mathsf{z}$ — Pure atom
b. $[\![\text{Zhangsan and Lisi}_{sum}]\!] = \mathsf{z} \oplus \mathsf{l}$ — Sum
c. $[\![\text{Zhangsan and Lisi}_{group}]\!] = \uparrow(\mathsf{z} \oplus \mathsf{l})$ — Group/impure atom

Next, distributive readings are analyzed by a covert distributive operator (19) on VP (Link 1983), while (thematic) collectivity involves predication over *groups* Landman 1996, 2000 (see also Chierchia 1998a: 64, Champollion 2010: 210).

(19) $[\![Dist]\!] = \lambda P \lambda x \forall y[(y \leq x \ \wedge \ Atom(y)) \rightarrow P(y)]$

(20) a. $\text{lift this piano}(\uparrow(\mathsf{z} \oplus \mathsf{l}))$ — Collective
b. $Dist(\text{lift this piano})(\mathsf{z} \oplus \mathsf{l})$ — Distributive

(20) illustrates how the system works. To combine the VP *lift this piano* with *Zhangsan and Lisi*, we can either apply the group operator to the DP as in (20a) or apply the distributive operator to the VP as in (20b). The former gives a collective reading, the latter a distributive one.

The existence of a covert distributive operator in Mandarin Chinese is independently justified by (21a) where *dou* is absent but a distributive reading is possible and strongly preferred for every speaker consulted. In this respect, our judgment agrees with Xiang (2008: 229), but differs from Lin (1998: 201), who claims that (definite) plurals in Mandarin do not have distributive readings, unless *dou*, according to Lin a distributive operator, is added. However, it seems that Lin did not take context into consideration. For (21a), even Lin himself (personal communication) agrees that a distributive reading is the preferred one. Below, (21b) and (21c) spell out the LF and semantics of (21a).

(21) a. (Context: I asked who among the kids drew two pictures; you replied:)

Zhangsan he Lisi hua le liang fu.
Zhangsan and Lisi draw ASP two CL
'Zhangsan and Lisi each drew two pictures.'

b. [$_{TP}$ Zhangsan and Lisi [$_{VP}$ *Dist* [$_{VP}$ drew two pictures]]]

c. $\forall y[(y \leq \mathsf{z} \oplus \mathsf{l} \wedge Atom(y)) \rightarrow \exists X[|X| = 2 \wedge \mathsf{pics}(X) \wedge \mathsf{draw}(y, X)]]$

Finally, we integrate Link-Landman's theory of pluralities into Rooth's theory of alternatives. We propose that a sum has other sums (including pure atoms) as its alternatives (22a), while a group has as its alternatives other groups, as in (22b) ($\uparrow (z) = z$, Landman (2000: 100)).

(22) a. $\mathcal{A}lt_{sum}(\mathsf{z} \oplus \mathsf{l}) = \{\mathsf{z} \oplus \mathsf{l}, \mathsf{z}, \mathsf{l}, \mathsf{z} \oplus \mathsf{w} \ldots\}$

b. $\mathcal{A}lt_{atom}(\uparrow (\mathsf{z} \oplus \mathsf{l})) = \{\uparrow (\mathsf{z} \oplus \mathsf{l}), \uparrow (\mathsf{z}), \uparrow (\mathsf{z} \oplus \mathsf{w}) \ldots\}$

Together with our assumptions on alternatives of pure atoms like *john* discussed in Section 3.2.1, repeated here as (23), they illustrate one of the main themes of the thesis – varieties of alternatives.

(23) a. $\mathcal{A}lt_{sum}(\mathsf{j}) = \{\mathsf{j}, \mathsf{z}, \mathsf{j} \oplus \mathsf{z} \ldots\}$

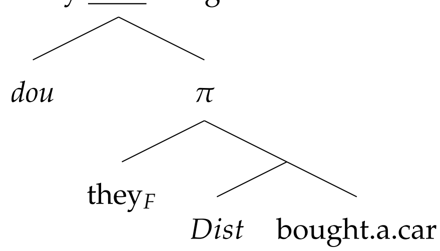
b. $\mathcal{A}lt_{atom}(\mathsf{j}) = \{\mathsf{j}, \mathsf{z}, \ldots\}$

Now we are ready to explain the distributive effect of *dou* (16).

Sum*-based alternatives and distributive-*dou

Dou's distributive effect (16) states that *even*-less *dou* forces distributive readings. An equivalent way of saying (16), as hinted at the end of Section 3.2.2, is that (a) *dou*'s *even* flavor can disappear in distributive contexts, and (b) it cannot disappear in collective contexts. In this subsection we focus on explaining (a). Following the literature we call *even*-less *dou* distributive-*dou*. Now consider a distributive-*dou* example (24a), repeated from (3)/(15).

(24) a. TAMEN dou mai le yi liang chezi.
they DOU buy ASP one CL car
'They each bought a car.'

b. 

We propose that (24a) has the analysis in (24b). Here, *dou* takes sentential scope[9], and a covert distributive operator is present, giving rise to the distributive reading.

Supposing now that Zhangsan, Lisi and Wangwu are the individuals in the context and *they* refers to the sum $\mathsf{z} \oplus \mathsf{l} \oplus \mathsf{w}$, we have (25) as *they$_F$*'s alternative set, (26) the prejacent and (27) the propositional-level alternative set C_{sum}.

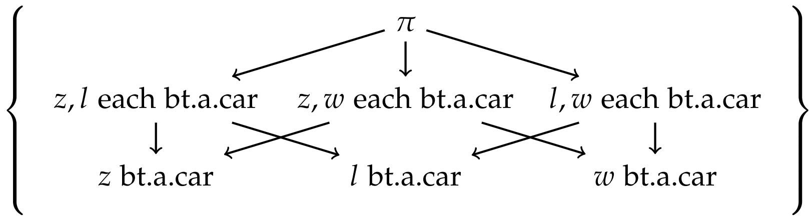
(25) $[\![they_F]\!]_{Alt,sum} = \{\mathsf{z}, \mathsf{l}, \mathsf{w}, \mathsf{z} \oplus \mathsf{l}, \mathsf{z} \oplus \mathsf{w}, \mathsf{l} \oplus \mathsf{w}, \mathsf{z} \oplus \mathsf{l} \oplus \mathsf{w}\}$

(26) $\pi = \forall y[(y \leq \mathsf{z} \oplus \mathsf{l} \oplus \mathsf{w} \ \wedge \ Atom(y)) \rightarrow \exists x[\mathsf{car}(x) \wedge \mathsf{bought}(y, x)]]$

In words: z, w, l each bought a car.

[9] This could be achieved either by movement of *dou*, similar to movement of *even* (Wilkinson 1996, Karttunen & Peters 1979, Lahiri 1998, Crnič 2014: §2.3), or by making *dou* an indicator of a covert *even* that has sentential scope (Liao 2011: 215). In the latter view, *dou* does not have its own meaning. In the chapter, we adopt the movement view, but nothing crucial hinges on this.

(27) $C_{sum} =$



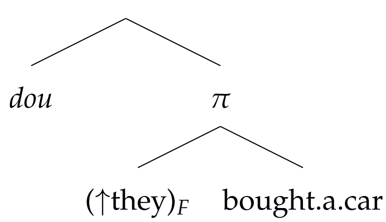
Note that the propositions in C_{sum} stand in a very interesting relation: *dou*'s prejacent π logically (asymmetrically) entails all the other alternatives.

We have proposed that *dou* is *even*, whose semantics requires that the prejacent π be less likely than all π's alternatives. But entailment is stronger than likelihood: if p entails q, p is at least as unlikely as q (Lahiri 1998, Crnič 2014). Thus, the *even*-presupposition of *dou*, which essentially is a requirement on the shape of its C_{sum}, is weaker than what we already know about the C_{sum} as in (27) and is automatically satisfied[10]. In this case, the *even*-meaning is trivial (cf. Liao 2011). In other words, when the alternatives of *dou*'s prejacent are based on sums, *dou*'s *even* presupposition can be trivialized by a distributive operator. This I claim is how *dou*'s *even* meaning could disappear in a distributive context.

Atom*-based alternatives and *even-dou

We now consider *dou* associated with atom-based alternative sets, where there is no entailment relation within the C_{atom}. For instance, under a collective construal of (24a), whose LF being (28), *dou*'s prejacent does not entail its alternatives (*that z and w together bought a car* has nothing to do with *that w and l together bought a car*); thus the *even*-presupposition of *dou* is not trivial and it surfaces. This is indeed a possible interpretation of (24a), which means that even they (as a very poor couple) together bought a car[11].

(28)



[10]We also need to assume that non-equivalent propositons within C_{sum} have different likelihood, which I take to be satisfied by normal contexts.

[11]This reading has been noted, for example, by Chen (2008: 65) and Liao (2011: 220).

The same thing happens with pure atoms as in (29), repeated from (3)/(14).

(29) Yuehan <u>dou</u> mai le yi liang chezi.
John DOU buy ASP one CL car
'<u>Even</u> John bought a car.' *'even'*

(30) summarizes our discussion of *dou*: *dou* is always *even*; distributive-*dou* is just a trivialized-*even*-*dou*. Since trivialized-*even*-*dou* happens only if *dou* is associated with a sum-based alternative set and a *Dist* is present, we have the correlation between *dou* and distributivity, i.e., *dou*'s distributive effect (16).

(30)

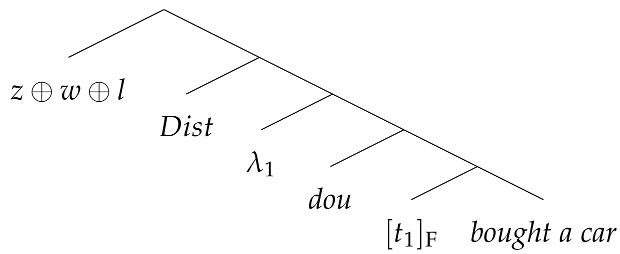
Alternatives	*dou*	Explanation
Sums	distributive-*dou*	*even* trivialized by *Dist*
Pure atoms	*even-dou*	No entailment, no trivialization
Groups	*even-dou*	No entailment, no trivialization

There are three caveats, the latter two having to do with the trivialization of *even*.

First, A reviewer at *Linguistics & Philosophy* correctly points out that *dou* is compatible with certain 'collective' predicates such as *be classmates*, without necessarily having the *even*-flavor. The reviewer takes this to be our problem: if collective predicates do not license entailment down to subgroups, how could the *even*-presupposition of *dou* be trivially satisfied? However, it turns out that *be classmates* is not a real collective predicate. It licenses what Dowty 1987 calls *distributive sub-entailments*. Regardless of how *be.classmates*-type predicates are analyzed (see Champollion 2015a for a recent analysis compatible with our proposal), the distributive sub-entailment property will make *that X, Y and Z are classmates* entail *that Y and Z are classmates*. This trivializes *dou*'s *even* flavor, if *X,Y and Z* is the maximal individual in the context, with its alternatives being *X and Y*, *X and Z* and so on. Crucially, for genuine collective predicates such as *be numerous* that do not distribute at all, *dou* necessarily adds the *even* flavor, as predicted.

Second, our proposal only states that *dou*'s *even*-presupposition *can* be trivialized by a distributive operator, but it does not have to be. Specifically, trivialization happens when *dou* scopes over *Dist* (see (24b)), but the other option (*Dist* > *dou*) is also available in our system (31).

(31)



In (31), since there is no *Dist* below *dou* to trivialize its *even* presupposition, (31) corresponds to the meaning that for each of Zhangsan, Wangwu and Lisi, it was unlikely for him to buy a car, but each of them bought one, which is a combination of distributive reading with *even* flavor[12].

Third, for *dou*'s *even* flavor to be trivialized, the sum involved in the prejacent has to be the maximal among its alternatives (if not, there would be at least one proposition in C_{sum} based on a more inclusive sum that asymmetrically entails the prejacent, and this would make *dou*'s least-likely presupposition unsatisfiable). This is the maximality effect of *dou*, to be discussed in Section 3.2.4 and especially 3.4.3, when we compare our analysis with proposals that treat *dou* as a maximality operator (Giannakidou & Cheng 2006, Xiang 2008).

3.2.3 Summary

It's time to take stock. We have identified two varieties of alternatives: sum-based ones and atom-based ones; we have also assigned single unambiguous semantics to both *jiu* and *dou*: *jiu* as ONLY_{weak} and *dou* as *even*. The two aspects of our proposal interact, generating the matrix in (32) and capturing apparent 'ambiguities' of the two FPs.

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[12]The technical details of (31) are not trivial. It involves focused bound pronouns/variables. A similar situation happens with *functional/pair-list* readings in questions with quantifiers. I believe Chierchia's (1992) functional trace (following Engdahl 1986) can be used here. Specifically, we can take the trace in (31) to consist of an identity function combining with t_1, with $_F$ on the identity function. An alternative suggested by Daniel Büring (p.c.) is to extend Rooth's semantics so as to treat variables just like other expressions of type *e*, but the difficulty lies in how to contextually restrict these alternatives. I have to leave this to another occasion.

(32)

	jiu = ONLY_{weak}	*dou* = *even*
Alternatives of Sums	exclusive *jiu*	distributive-*dou*
Alternatives of Atoms	nonexclusive *jiu*	*even*-*dou*

In (32), it is important to note that we have two cases of trivialization: when *jiu* is associated with a set of atomic alternatives, its exclusive meaning is trivialized (because there is no proposition asymmetrically entailing the prejacent within C_{atom} for ONLY_{weak} to negate); when *dou* is associated with a set of sums (with the prejacent involving the maximal sum), its *even* meaning is trivialized (because the prejacent entails all the other propositions in C_{sum}).

There are two questions about trivialization. First, is it ever possible for an FP such as *only* to have no semantic effect? If yes, then the second question is: if an environment makes an FP vacuous, why do we want to keep the FP in that environment? The next subsection will answer the questions.

3.2.4 Trivialization

Trivialization in the Alternative-Exhaustification approach

Our answer to the first question is: yes, trivialization is possible. It actually plays a very important role in the alternatives-&-exhaustification approach to (weak) NPIs as in Krifka 1995, Chierchia 2013.

The basic fact about NPIs like English *any* (setting aside free choice *any*) is that they are only grammatical in downward entailing contexts such as in the scope of negation (33).

(33) a. *John met any student.

b. John didn't meet any student.

According to the alternatives-&-exhaustification approach in Chierchia 2013, *any student* is a special existential quantifier with a domain of quantification *D* (34). The difference between *any student* (under an NPI use) and a plain indefinite *a student* is that only the former obligatorily activates alternatives, which are also existentials but with domains being subsets of D (35).

(34) $[\![\text{any student}_D]\!] = \lambda P \exists x \in D[\mathsf{student}(x) \wedge P(x)]$

(35) $[\![\text{any student}_D]\!]_{Alt\text{-}D} = \{\lambda P \exists x \in D'[\mathsf{student}(x) \wedge P(x)] : D' \subseteq D\}$

Alternatives, once activated, must be *exhaustified*. Chierchia proposes that the alternatives to *any student* are exhaustified by a covert *only*, which semantically equals to our ONLY$_{strong}$. With ONLY$_{strong}$, (33) has the following analyses.

(36) ONLY$_{strong}$ [John met any$_D$ student]

Prejacent: John met a student in D.

Applying ONLY$_{strong}$: $\forall D' \subseteq D$,John didn't meet a student in D'.

(37) ONLY$_{strong}$ [John didn't meet any$_D$ student]

Prejacent: John didn't met a student in D.

Application of ONLY$_{strong}$is trivial.

It turns out that a computation of the meaning of (36) returns a contradiction, because: John met a student in D (the prejacent) entails there is a $D' \subset D$ such that John met a student in D', which contradicts the result of applying ONLY$_{strong}$, according to which John didn't meet a student for all (strict) sub-domains of D. This contradiction explains why *any* cannot be used in a positive context (and in other upward entailing contexts).

On the other hand, in (37), the application of ONLY$_{strong}$ does not cause a problem, because the prejacent (that John didn't meet a student in D) now entails all the other alternatives (that John didn't meet a student in D', where $D' \subseteq D$). Applying ONLY$_{strong}$ simply returns the prejacent and no contradiction results. This explains why *any* can be used under negation (and in other downward entailing contexts).

Crucially, trivialization of the covert *only* (= ONLY$_{strong}$) has to be granted to make sure (37) is semantically well-formed.

We take Chierchia's analysis of weak NPIs to be correct. It shows that there is no principled constraint in the grammar that forbids trivialization of a certain semantic effect of an FP.

Now we turn to the second question raised at the end of section 3.2.3, which asks what contribution a trivialized FP brings to a sentence. Notice that for Chierchia, the function of the trivialized covert *only* is to exhaustify the alternatives triggered by an NPI, in syntactic parlance, to check the inherent focal feature of the NPI.

Instead of resorting to syntax, we propose that *jiu* and *dou*, even after trivialization, are actually not semantically vacuous. *Jiu* contributes a scalar presupposition, while *dou* gives rise to a maximality effect.

Jiu's scalar presupposition

We have mentioned the scalar low-rank reading of *jiu*. For example, our non-exclusive *jiu* example, repeated here as (38), has a scalar low-rank reading: (our roommate) John is easy to get hold of. This scalar reading can be seen as coming from a presupposition of *jiu*[13]; thus, even though the assertive component of *jiu* (the exclusive part) can be trivialized, by contributing the scalar presupposition *jiu* is still not entirely vacuous.

(38) (Women.de shiyou) YUEHAN jiu hui shuo fayu.
(our roommate) John JIU can speak French
'Our roommate John, who is easy to get hold of, can speak French.'

To formally represent the scalar reading, we assign *jiu* a presupposition that requires *jiu*'s associate to be ranked lower on a scale *R* than its any other alternatives. Formally, this is represented in (17).

(39) Scalar Presupposition of *jiu*

$$\forall x \in [\![Associate]\!]_{Alt}[x \neq [\![Associate]\!] \rightarrow [\![Associate]\!] <_R x]$$

(40) Scalar Presupposition of *even*

[13]It is a presupposition because it projects over yes-no questions, possibility modals and antecedents of conditionals. For example: *It's possible that* [JOHN JIU *can speak French*] carries the inference that John is easy to get hold of.

$$\forall q \in [\![Prejacent]\!]_{Alt}[q \neq [\![Prejacent]\!] \rightarrow [\![Prejacent]\!] <_{likely} q]$$

(17) follows a common way of capturing the scalar presuppositions of scalar FPs like *even* (Karttunen & Peters 1979) and *already/still* (Krifka 2000)[14]. To take *even* for instance, the only difference between (17) and (18) is that the former ranks individuals while the latter propositions. By ranking the prejacent of *even* as the bottom of a likelihood scale we obtain the inference that the prejacent is the least likely. Similarly, by ranking John as the bottom of an *effort* scale, we obtain the inference that John is easy to get hold of[15].

Exclusive *jiu* is also scalar[16] . For example, [*jiu* John$_F$ can speak French] (=(1)) carries the implication that the sum of people that can speak French is small in number. We can capture this inference by ranking *John* on an individual part-of scale (Link 1983) $j < j \oplus b, j \oplus m < j \oplus b \oplus m$[17].

---

[14]Krifka 2000 is interested in German *schon/noch* 'already/still', which contribute *early/late* scalar inferences. Krifka's way of capturing these scalar inferences is exactly like our (17). For example, *schon* is truth-conditionally vacuous but presupposes that its associate is ranked earlier than all the other alternatives.

[15]We are here actually using a superlative semantics to capture an evaluative intuition, which is not quite right. To witness, that John is lower than any of its alternatives on an effort scale does not mean getting hold of John is easy (perhaps all of them are difficult to get hold of), just as John is the tallest does not mean John is tall. To fix this, we posit a requirement (i) which says that the context dependent expected value s_c (Kennedy 1999) should always be included in the restricted alternative set induced by *jiu*. Intuitively, this is plausible, since the restricted alternative set tries to capture the idea of *alternatives under consideration* (Krifka 2000), and the expected value seems to always qualify as one of them.

(i) *Expected value always under consideration*
$\exists x \in \mathcal{A}lt([\![\alpha]\!])[x \neq [\![\alpha]\!] \wedge \mu_{\mathrm{R}}(x) = s_c]$

[16]For the scalarity of English *only*, see Zeevat 2008, Klinedinst 2005, Coppock & Beaver 2014. (i) below shows that exclusive *jiu* and *only* both contribute a scalar low-rank inference.

(41) (**jiu*/*only) 10 people came, which was a lot.

(i) without *jiu* is good because 10 people can either be many or few, depending on the context. (i) with *jiu* sounds contradictory because *jiu* carries a scalar meaning that the people that came were few, which contradicts the content of the following relative clause.

[17]Reducing the complete set $\{j, b, m, j \oplus b, j \oplus m, b \oplus m, j \oplus b \oplus m\}$ as in (11) to $\{j, j \oplus b, j \oplus m, j \oplus b \oplus m\}$ does not affect the exclusive inference. The reader can verify this by running the computation in (11), or by simply observing the cumulativity of the latter set.

***Dou*'s maximality effect**

After showing the non-vacuity of trivialized *jiu*, we turn to trivialized *dou* now. In our proposal, distributive-*dou* results from trivialization of its *even* flavor by a distributive operator within its scope. However, as was explained at the end of Section (27), the maximality part of *even* stays intact. This gives rise to *dou*'s maximality effect (Xiang 2008, Cheng 2009).

We can observe the maximality effect of *dou* in listing contexts (42a).

(42) a. Zhexie haizi zhong, Yuehan he Lisi (*? dou) hua le yi fu hua,
these kids among, John and Lisi DOU draw ASP one CL picture,
Zhangsan he Mali (*? dou) hua le liang fu, Wangwu he Bier (*? dou)
Zhangsan and Mary DOU draw ASP two CL, Wangwu and Bill DOU
hua le san fu.
draw ASP three CL
'Among these kids, *j* and *l* each drew one picture, *z* and *m* each drew two, and *w* and *b* each drew three pictures.'

b. Zhexie haizi dou hua le liang fu hua.
these kids DOU draw ASP two CL picture
'These kids all drew two pictures'.

Suppose that for each of the kids, you wonder how many pictures s/he drew. A listing sentence such as (42a) cannot have *dou* in each of its conjuncts. This can be seen to follow from *dou*'s maximality effect: since none of the conjuncts involves a maximal sum, none of them allows *dou*. (42a) contrasts with (42b), which involves predication over the maximal sum and thus allows *dou*.

Overall, while we think trivialization of certain semantic components of an FP is in general not ruled out by the grammar, we agree that having an entirely semantically-vacuous FP within a sentence needs motivation. However, we have shown that trivialized *jiu* and *dou* are not vacuous: *jiu* always conveys a low-rank reading, and *dou* gives rise to a maximality effect. While the low-rank meaning needs to be built into the lexical entry of *jiu* as a scalar presupposition, the maximality effect of *dou* naturally follows from our proposal of *dou* as *even*.

3.3 Regulating ambiguities

Our proposal is capable of deriving systematic 'ambiguities'. However, not every sentence containing an FP is ambiguous and not every FP has multiple 'uses'. This section is devoted to regulating ambiguities by independently motivated principles and proposals.

3.3.1 Contrastive topic and Maximize presupposition

A single *jiu*-sentence is not ambiguous. Consider (1)-(2) (repeated here as (43)-(44)), neither of the sentences is ambiguous: (43) has to be exclusive while (44) nonexclusive. Syntax seems to matter. Specifically, we have (45) as the generalization (Hole 2004: 8): exclusive *jiu* appears to the left of its associate while non-exclusive *jiu* appears to the right.

(43) Jiu YUEHAN hui shuo fayu.
JIU John can speak French
'Only John can speak French.' (# Bill also can.)

(44) YUEHAN jiu hui shuo fayu.
John JIU can speak French
'John, who is easy to get hold of, can speak French.' (Bill also can.)

(45) The *jiu* generalization

a. *jiu* > Associate → Exclusive

b. Associate > *jiu* → Non-exclusive

This is a potential problem because in our story *John* can either trigger a sum-based alternative set or an atom-based one. Without any constraint, we predict that both (43) and (44) can be exclusive or non-exclusive, depending on the choice of the alternative set. This is the *over-generation* problem of *jiu*.

To solve the over-generation problem and explain (45), we need to add some constraints into our account. Two independently motivated constraints will be discussed below.

The first constraint has to do with *constrastive topics*. We propose that post-*jiu* associates are foci, while pre-*jiu* associates are contrastive topics (CT). Since CT carries an anti-exhaustive requirement (Büring 1997, Krifka 1998, Hara 2005, Wagner 2012), it is incompatible with an exclusive construal of *jiu*.

Before we spell out the details of this proposal, it needs to be mentioned that the idea of FPs associating with (contrastive) topics is well discussed in the syntactic literature of Mandarin Chinese (Shyu 1995, Hole 2004, a.o.). We are here simply adding a semantic aspect to the idea.

We take CTs to be alternative-triggering topics with certain pragmatic effects such as anti-exhaustiveness as in (46)[18]. CTs are similar to foci in that both of them trigger (flat) alternatives, their differences mainly being syntactic (scope) and pragmatic (anti-exhaustiveness) (Tomioka 2010, Wagner 2012).

(46) $[\![\text{CT}(\pi)]\!]$ is defined only if $\exists q \in C[\pi \not\subseteq q \wedge \Diamond q]$
if defined, $[\![\text{CT}(\pi)]\!] = [\![\pi]\!]$
In words: a sentence π containing a CT presupposes that an alternative q not entailed by π is possibly true. [Wagner 2012: (46)]

Now consider (44) with the CT marking as in (47)[19].

(47) YUEHAN$_{CT}$ jiu hui shuo fayu.
John JIU can speak French
'John, who is easy to get hold of, can speak French.'(Bill also can.)

In (47), in keeping with the idea of varieties of alternatives, *John*$_{CT}$ can either trigger a sum-based alternative set or an atom-based one. However, the former, associated with *jiu* (=ONLY$_{weak}$), obligatorily activates an exclusive inference that other people cannot speak

[18]An anonymous reviewer at *Linguistics & Philosophy* suggests the anti-exhaustiveness of CT in (46) be replaced by a $\neg\forall$-presupposition proposed in Hole 2004, and it can be built into the lexical meaning of *jiu*. A $\neg\forall$-presupposition says there is an alternative proposition in C that is false. While we agree that a $\neg\forall$ inference might be real in certain [CT + *jiu*] cases, it is independent of anti-exhaustiveness, cancellable and thus can be derived as a Gricean implicature (cf. Büring 2003: 523).

[19]We assume that in (47) the CT stands on its own with no free focus below it (cf. Constant's (2014) lone CT). This is supported by the fact that in (47) nothing below *jiu* can be stressed: if, for example, *fayu* 'French' gets stress, *jiu* will obligatorily associate with it instead of associating with the CT *John* (but an explanation of this fact has to be left for another occasion). In (47), we further assume that *jiu* covertly moves across the CT to have sentential scope, similar to *even*-movement (see footnote 9); then the alternatives triggered by CT make up the quantificational domain C of both *jiu* and CT, in the style of (8).

French, which contradicts the anti-exhaustive presupposition of CT that it is possible that other people can also speak French. On the other hand, with an atom-based alternative set, no exclusive inference is triggered, and thus CT is compatible. In general, only atom-based alternative sets and the ensuing nonexclusivity are allowed when *jiu*'s associates appear before *jiu* as a CT. This, I submit, explains (45b) and the non-ambiguity of (44)/(47).

Now let us consider (43), repeated here with focus marking as (48). (48) is also unambiguous, but CT has no jurisdiction here.

(48) Jiu YUEHAN$_F$ hui shuo fayu.
JIU John can speak French
'Only John can speak French.' (# Bill also can.)

We suggest that the non-ambiguity of (48) results from a competition of (48) and its CT counterpart (47). Roughly, to generate a non-exclusive *jiu*-sentence, we prefer to choose the more specialized CT rather than focus.

Specifically, the competition between (48) and (47) is an instance of *Maximize Presupposition* (Heim 1991), which says: in certain cases, when two sentences have the same assertive information, only one of them, that is, the one with stronger presuppositions, can be felicitously used.

Consider (48). Given varieties of alternatives, *John$_F$* can either generate a sum-based alternative set or an atom-based one. The latter, when combined with *jiu*, does not give rise to an exclusive inference. In this case, the resulting assertive component (*that John can speak French*) is equivalent to that of (47). However, (47) has an extra anti-exhaustive presupposition contributed by its CT, and consequently it blocks its focus counterpart by Maximize Presupposition. On the other hand, when *John$_F$* takes up a sum-based alternative set, *jiu* will trigger an exclusive inference, which its CT counterpart cannot have because of anti-exhaustiveness. Thus, the two will not share the same assertive information and Maximize Presupposition does not have a say. This, I claim, explains (45a) and why (48) is exclusive but not ambiguous.

Summarizing our discussion so far, we have introduced two independently motivated constraints – the anti-exhaustiveness of CT and Maximize Presupposition – into our system. The former militates against exclusive *jiu* with CT, while the latter blocks non-exclusive *jiu* with focus. This is shown in (49).

(49)

	jiu = ONLY$_{weak}$	CT/Focus	Result
Sum-alternatives	exclusive	pre-*jiu* CT	Contradiction
Atom-alternatives	nonexclusive	pre-*jiu* CT	√
Sum-alternatives	exclusive	post-*jiu* Focus	√
Atom-alternatives	nonexclusive	post-*jiu* Focus	Blocking

The above ideas make several predictions. First, since topicalization is a common way of creating topics in Mandarin, topicalization of alternative-triggering items is expected to create CTs. Thus, we predict that topicalization of *jiu*'s associate makes the sentence nonexclusive. This prediction is borne out by (50)-(51).

(50) Yuehan jiu kan-guo AoManYuPianjian$_F$.
John only read-ASP Pride.and.Prejudice
John has only read Pride and Prejudice.

Impossible continuation: # he probably has also read Emma.

(51) AoManYuPianjian$_{CT,1}$ Yuehan jiu kan-guo t_1.
Pride.and.Prejudice John JIU read-ASP
As for Pride and Prejudice, John has read it.

Possible continuation: he probably has also read Emma.

The only difference between (50) and (51) is topicalization, but (50) is exclusive while (51) not. This seemingly surprising fact follows naturally from our proposal: (51) has to be nonexclusive because of the CT effect, while (50) has to be exclusive because of its CT counterpart and Maximize Presupposition.

The second prediction is a syntactic one. We mentioned earlier that pre-*jiu* associates are topics while post-*jiu* associates are foci. Combining this claim with the generally held assumption (Shyu 1995, Paul 2005, a.o.) that topic and focus have different structural positions in Mandarin, we predict the two instances of *John* in (47)-(48) occupy different syntactic positions. This is also a correct prediction, evidenced by placement of sentential adverbs (52)-(53).

(52) {**jingran**} [$_{TP}$ jiu Lisi$_F$ {***jingran**} hui shuo fayu].
surprisingly JIU Lisi surprisingly can speak French
'Surprisingly, only Lisi can speak French.'

(53) {**jingran**} [$_{TopicP}$ Lisi$_{CTi}$ {**jingran**} [$_{TP}$ jiu t_i hui shuo fayu]].
surprisingly Lisi surprisingly JIU can speak French
'Surprisingly, Lisi, who is easy to get hold of, can spk.F.'

(52) illustrates that sentential adverbs such as *jingran* 'surprisingly', *mingxian* 'obviously' and yes-no question operator *shi-bu-shi* 'be-not-be' cannot appear after post-*jiu* associates. To add a sentential adverb, the adverb has to appear before *jiu*. In contrast, sentential adverbs have no problem following the *Lisi* in (53), which is a pre-*jiu* associate. These facts are explained if we assume that post-*jiu* associates are within TP where sentential adverbs (which we take to reside at left-periphery positions) cannot occur, while pre-*jiu* associates have moved out of TP to Spec TopicP, a Topic position.

Finally, it needs to be emphasized that our proposal in this subsection not only makes sure that the *jiu* in a [Associate > *jiu*] sentence is nonexclusive; it makes a stronger prediction: the entire sentence is anti-exhaustive, because of the CT status of the associate. This is a correct prediction. Consider (54) (built on Tomioka 2010: (7)).

(54) A: Among John, Bill and Mary, who won?

B: #Yuehan$_{CTi}$ jiu ying le.
John JIU win ASP
Intended: 'John, who is very salient in the context, won.'

In (54), B's answer is infelicitous because A's question carries a presupposition that there is only one winner in a match (due to world knowledge), which contradicts the anti-exhaustive presupposition of the CT. (54) supports our strategy of using CT as an independent factor triggering anti-exhaustiveness, and thus forbidding *jiu* to be used exclusively.

3.3.2 Strong *only*

Not every FP is 'ambiguous'. There is a second ONLY in Mandarin – *zhi*, which is always exclusive. It is not 'ambiguous' because its semantics is not sensitive to the sum-atom distinction of its alternative sets.

First, *zhi* can usually be used interchangeably with exclusive *jiu* (55).

(55) Yuehan zhi/jiu kan-guo AoManYuPianjian$_F$.
John only read-ASP Pride.and.Prejudice
John has only read Pride and Prejudice.
Impossible continuation: # he probably has also read Emma.

Zhi does not allow association to its left[20]. For example, topicalization of *zhi*'s associate leads to ungrammaticality (56).

(56) *AOMANYUPIANJIAN$_{CT,1}$ Yuehan zhi kan-guo t_1.
Pride.and.Prejudice John only read-ASP

Our system contains everything we need to account for the behavior of *zhi*. First, we propose that *zhi* and *jiu* differ minimally in the semantics: *zhi* is ONLY$_{strong}$, while *jiu* is ONLY$_{weak}$. The two are repeated here as (57) and (58).

(57) $[\![\text{ONLY}_{strong}(\pi)]\!]$ is true iff $\forall q \in C[\pi \not\subseteq q \rightarrow \neg q]$
Alternatives not entailed by the prejacent are false.

(58) $[\![\text{ONLY}_{weak}(\pi)]\!]$ is true iff $\forall q \in C[q \subset \pi \rightarrow \neg q]$
Alternatives asymmetrically entailing the prejacent are false.

We also stick to varieties of alternatives. However, it turns out that although *jiu* (ONLY$_{weak}$) is sensitive to the atom/sum distinction of its alternatives, *zhi* (ONLY$_{strong}$) is not. A proposition involving an atomic individual, such as *that John read Emma*, is enough to

[20]This exemplifies Tancredi's (1990) Principle of Lexical Association (PLA): an operator like *only* must be associated with a lexical constituent in its c-command domain. Our discussion below constitutes a partial explanation of PLA. See Erlewine 2014 for a different view.

make *zhi* exclusive (for the latter proposition is not entailed by the prejacent and thus negated by (57).).

Now the topicalization fact of *zhi* (56) follows from our assumption that topicalization gives rise to an anti-exhaustive presupposition. As is illustrated in (59), this anti-exhaustive presupposition contradicts *zhi*'s assertion, and we suggest this explains why *zhi* is unable to associate with a topic.

(59) *AomanYuPianjian$_{CT,1}$ Yuehan zhi kan-guo t_1.
Pride.and.Prejudice John only read-ASP
Assertion of *zhi*: John did not read other books.

Presupposition of CT: John might have read other books.

Our explanation of (56) could be extended to English. As is shown by (60), English *only* does not allow topicalization but *even* does.

(60) a. $*$Emma$_{CT1}$, John only read t_1.

b. Emma$_{CT1}$, John even read t_1.

We suggest that English *only* is strong (which happens to be the standard analysis of *only*). Together with the assumption that topicalized foci are CTs, it explains why English *only* does not allow topicalization of its associate but *even* does. ONLY$_{strong}$ (but not *even*) triggers exclusivity (regardless of varieties of alternatives) and contradicts CT's anti-exhausitve requirement[21].

Time to summarize. In this section, we have shown how the system sketched in Section 3.2 that uses varieties of alternatives to generate 'ambiguities' can be constrained and regulated. Specifically, not every FP is 'ambiguous', because the semantics of an FP might

[21]Our analysis of (60a)-(60b) is an alternative to Erlewine 2014, where the crucial difference between *only* and *even* is that *only* affects truth-conditions while *even* does not (it only adds presuppositions). Different from Erlewine, we emphasize the exclusive-nonexclusive distinction (an idea picked up from Krifka 1998: §3.6). Interestingly, exclusive particles like *only* seem to be the only focus particles that change truth-conditions. So our prediction and Erlewine's might not be that different. Overall, we remain neutral on whether Erlewine's proposal is correct. If it turns out that he is on the right track, all we have to change is the anti-exhaustiveness-based account of the non-ambiguity of nonexclusive *jiu* (Subsection 3.3.1); the rest of the proposal including varieties of alternatives and lexical entries of *jiu* and *dou* will stay intact. However, notice that Erlewine's proposal has nothing to say about anti-exhaustiveness; this would leave the anti-exhaustiveness of sentences containing non-exclusive *jiu* (for example (54)) unexplained, if we were to adopt his proposal.

not be sensitive to the distinction that we posit for its alternative sets, for instance Mandarin *zhi* and possibly English *only*. Furthermore, even if an FP itself is 'ambiguous', a particular sentence containing the FP might not be. *Jiu* is such as a case. We have explained this type of non-ambiguity of *jiu* by independent motivated proposals and principles such as contrastive topics and maximize presupposition.

In the next section we will address four issues that emerge when we consider the present proposal against earlier work on *jiu* and *dou*: *jiu* is not ambiguous, *dou* is not quantificational, *dou* is not just a maximizer and *dou* does not work well with *covers*.

3.4 Connection to previous work

3.4.1 No lexical ambiguities for *jiu*

As far as I am aware, our unified analysis of *jiu* is the first proposal that captures both its exclusive and non-exclusive 'uses'. All the other analyses (Biq 1984, Lai 1999, Hole 2004: 18, a.o.) explicitly or implicitly adopt a lexical-ambiguity view. Everything being equal, a unified analysis is to be preferred. In this subsection, we will further show that an ambiguity analysis of *jiu* (or any analysis that separates exclusivity from *jiu*) misses important correlations, thus to be empirically dispreferred as well.

First, *jiu*'s scalarity and the availability of its exclusivity are correlated.

To see the correlation, consider the scalar inferences *jiu* can trigger. Our previous examples have identified two such scalar inferences: an easy-to-obtain inference and a small-in-number inference (see §3.2.4).

As an example of the correlation, an easy-inference never combines with exclusivity, while a small-in-number inference usually does. For example, our exclusive-*jiu* example (61a) can never have the meaning in (61b), which is a combination of the easy-inference with an exclusive inference.

(61) a. <u>Jiu</u> YUEHAN hui shuo fayu.
jiu John can speak French
'<u>Only</u> John can speak French.'

b. **Not**: John is easy to get hold of, *easy-to-obtain*

and no people other than John can speak French. *exclusive*

Similarly, the non-exclusive-*jiu* example (62a) never has the meaning in (62b), which combines a small-in-number inference with a non-exclusive *jiu*.

(62) a. YUEHAN jiu hui shuo fayu.
John JIU can speak French
'John, who is easy to get hold of, can speak French.'

b. **Not**: Few people can speak French, *small-in-number*

and/but John can speak French. *non-exclusive*

This is expected under our proposal: computations of the scalar inference and the exclusive inference (or the lack of it) are closely connected, i.e., they rely on the same alternative set: in order to get an easy-inference, an atom-based alternative set $\{j < b < m\}$ that ranks different individuals has to be employed, which is only compatible with a nonexclusive interpretation of *jiu*; similarly, to get a small-in-number scalar inference in cases like (61a) or (62a), we need a sum-based alternative set $\{j < j \oplus b, j \oplus m < j \oplus b \oplus m\}$, which automatically generates an exclusive interpretation. In general, the correlation between scalarity and exclusivity naturally follows from our proposal.

The second correlation predicted by our proposal concerns the connection between exclusivity, distributivity and collectivity. Consider (63)-(64).

(63) Shangci, jiu liang$_F$-ge ren taiqi le gangqin.
last.time, JIU two-CL people lift ASP the.piano
'Only two people lifted the piano.'

(64) Shangci, liang$_{CT}$-ge ren jiu taiqi le gangqin.
Last.time two-CL people JIU lift ASP the.piano
'Last time, a group of two people, which was a small group, together lifted the piano.'

(63) means only two people (individually) lifted the piano, a distributive reading with

an exclusive inference, while (64) has no exclusive inference but a collective reading that a group of two people together lifted the piano.

This interesting pattern follows from our proposal. A distributive construal of the prejacent in (63) delivers the C_{sum} in (65) while a collective reading of the prejacent in (64) gives rise to the C_{atom} in (66). The former contains stronger propositions, thus exclusivity and the corresponding [*jiu* > Associate] form, while the latter does not contain stronger propositions, thus non-exclusivity and the corresponding [Associate > *jiu*] form (see (49) for the generalization).

(65) C_{sum} of (63)= $\left\{ \begin{array}{l} \text{\sout{that three people each lift the piano}}, \\ \text{that two people each lift the piano } (= \pi), \\ \ldots \end{array} \right\}$

(66) C_{atom} of (64)= $\left\{ \begin{array}{l} \text{that three people together lift the piano}, \\ \text{that two people together lift the piano } (= \pi), \\ \ldots \end{array} \right\}$

Again, the correlation between distributivity/collectivity and exclusivity is a natural consequence of our proposal: distributivity and collectivity correspond to different types of alternative sets, to which *jiu* as ONLY_{weak} is sensitive.

The two correlations discussed above are not captured by ambiguity-based analyses: suppose that *jiu* is ambiguous between jiu_{scalar} and $jiu_{exclusive}$; there is no reason why the former prefers collective readings in (64) while the latter distributive ones in (63). Furthermore, any analysis of *jiu* that separates its exclusive component from its scalar component (as an ambiguity analysis would have to) cannot explain the close connection between the two.

Finally, let me mention that a reviewer at *Linguistics & Philosophy* asked whether my proposal predicts (67) to have only a distributive+exclusive reading, and s/he remarks that it can also read collective+exclusively. I share the judgment.

(67) Shangci, jiu Yuehan he Mali_F taiqi le gangqin
Last.time, JIU John and Mary lift ASP the.piano

Last time, only John and Mary lifted the piano.

Our proposal gets both readings. The distributive+exclusive reading is obtained by taking *John and Mary* to be a sum $j \oplus m$ and its alternatives other sums $\{j \oplus m, j \oplus m \oplus s \ldots\}$. The collective+exclusively reading is achieved by taking *John and Mary* to be a group $\uparrow (j \oplus m)$ and its alternatives other groups and their sums $\{\uparrow (j \oplus m), \uparrow (b \oplus s), \uparrow (j \oplus m) \oplus \uparrow (b \oplus s), \ldots\}$ (Landman 2000: §6.3). With a distributive operator that can distribute to non-pure atoms (groups), both of the resulting C's contain strictly stronger propositions, thus the exclusivity. Finally, (63) does not have the collective+exclusive option since alternatives to the prejacent such as *three people lifted the piano* does not have a meaning equal to *that a group of two people lifted the piano and another person also lifted the piano* (though it could be true in such a context). The latter meaning however is needed under a collective construal of the prejacent to trigger exclusivity of *jiu*.

3.4.2 *Dou* is not quantificational

Most analyses of *dou* treat *even*-less *dou* as a quantificational element, either a (adverbial) universal quantifier (Lee 1986, Cheng 1995, Dong 2009) or a distributive operator (Lin 1998, Yang 2001, Chen 2008). In this subsection, we will take the distributive operator analysis in Lin 1998 as representative of the quantificational analyses (but what we will say applies to the universal quantifier analyses as well). We will argue that *dou* cannot be quantificational, because it does not have fixed quantificaitonal force and it does not take scope.

There are mainly two types of facts that motivate Lin 1998 to treat *dou* as a distributive operator whose semantics equals to the covert *Dist* in (19).

First, when associated with a plural definite, *dou* forces distributive readings. This is the distributive effect of *even*-less *dou* (16) discussed in Section 3.2.2.

The second type of facts involves quantifiers. Most importantly, universal quantification in Mandarin requires the presence of *dou*, illustrated in (68a).

(68) a. Mei-ge-xuesheng *(dou) mai-le yi-ben-shu.
every-CL-student DOU buy-ASP one-CL-book
'Every student bought a book.'

b. $[\![\text{mei-CL-student}_{\text{LIN}}]\!] = \bigoplus \mathsf{student}(x)$[22]

c. $\forall x[(x \leq \bigoplus \mathsf{student} \wedge Atom(x)) \rightarrow \exists y(\mathsf{book}(y) \wedge \mathsf{bought}(x,y))]$

Lin 1998 analyzes the *every-dou* puzzle as follows: different from English *every*-NP, Mandarin *meige*-NP is referential (68b), synonymous with *the*-NP. Thus it requires *dou* in order to express a quantificational meaning, as in (68c).

Notice however assigning *meige*-NP a (plural) definite semantics does not really explain why *meige*-NP needs *dou*: there is no reason why a plural definite $\oplus\mathsf{student}$ cannot directly combine with the VP predicate $\lambda x \exists y[P(x) \wedge \mathsf{book}(y) \wedge \mathsf{bought}(x,y)]$, delivering a collective reading in Lin's framework (where collectivity does not need groups). Lin seems to be aware of this problem. He appeals to syntax: *meige*-NP carries a Q-feature, and thus it has to be distributively quantificational and needs *dou*. This weakens Lin's overall semantic account. Later, we will present our take on this *every-dou* puzzle.

From the above illustration of Lin's account we can see that the essence of a distributive operator analysis (and other quantificational analyses) of *dou* is that *dou*, being quantificational, introduces universal quantification into the truth-conditional semantics. Below, we would like to challenge this basic idea, by showing that *dou* does not seem to be quantificational and *meige*-NP in Mandarin is not referential. Our evidence concerns two very important aspects of a quantificational element – quantificational force and scope.

Consider first quantificational force. When *dou*'s associate is a definite, another quantificational element Q_{adv} can be added, with the resulting sentence carrying various quantificational force based on the Q_{adv}. This is the quantificational variability (QV) problem of *dou*.

[22] $\bigoplus \mathsf{student}(x)$ is a (presupposition-less) notational variant of $\sigma x.\mathsf{student}(x)$ (Sharvy 1980, Link 1983), which stands for the mereological sum of all entities to which student applies. we adopt this notation from Champollion (2010). Notice that Lin's own analysis uses *sets* instead of *sums* to represent pluralities, so he has $\bigcup \mathsf{student}$. We systematically use *sums*.

(69) Tamen daduo/henduo dou xihuan Lisi.
they most/many DOU like Lisi
'Most/many of them like Lisi.' Definite → $\surd$-QV

(69) seems to be a problem for analyses that treat *dou* as a quantificational element. It shows that a *dou*-sentence doesn't uniformly have ∀-quantification[23]. In other words, if *dou* were indeed quantificational, it would have to be a very vacuous one.

Further and more importantly, *meige*-NPs '*every*-NP' do not show quantificational variability (70).

(70) meige xuesheng (*daduo/*henduo) dou xihuan Lisi.
every student most/many DOU like Lisi
Intended: 'Most/many of the students like Lisi.' *every*→ *-QV

A comparison of (69)-(70) suggests that Mandarin *every*-NPs are quantificational while definite NPs are not. Thus the latter but not the former allows for another quantificational element. But this distinction (betweem definites and *meige*-NP) is hard to maintain under Lin's quantificational analysis of *dou*.

Next let us turn to scopal facts. Under a quantificational analysis of *dou*, *dou* is expected to take scope. Since Mandarin is a famous surface-scope-only language (Huang 1982), we expect everything that comes before *dou* at the surface to have semantic scope over ∀ (introduced by *dou* according to a quantificaitonal analysis), and everything after *dou* to fall within the scope of ∀. (71)-(72) seems to confirm this prediction (Yang 2001). In (71), *dou* comes before negation and the sentence has the $\forall > \neg$ reading; in (72), negation comes before *dou* and the sentence is interpreted as $\neg > \forall$.

(71) Tamen dou bu xihuan Lisi.
they DOU not like Lisi

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[23] I take the *daduo/henduo* in (69) to be adverbial (generalized) quantifiers relating two sets of atomic individuals, roughly $\lambda P \lambda X.\text{MOST/MANY}(\lambda x[x \leq X \wedge Atom(x)], P)$. They are not like English *most of the NPs* that introduces ∃-quantification over a group X whose cardinality is greater than a half of the NPs (Nakanishi & Romero 2004). The evidence for this analysis comes from the fact that adverbial *daduo/henduo* do not allow collective readings; that is, [they *daduo/henduo* lift the piano] can only be interpreted distributively, unlike *most of the NPs* but similar to *most NPs* (Nakanishi & Romero 2004: footnote 3). Under this analysis of *daduo/henduo*, it is hard to make sense of the *dou* in (69), if it is indeed a universal.

'They all don't like Lisi.' $\forall > \neg$

(72) Tamen bu-(shi) dou xihuan Lisi.
they not-(be) DOU like Lisi
'Not all of them like Lisi.' $\neg > \forall$

However, *meige*-NPs 'every-NP' are different again. In (73), both *meige* and *dou* occur before negation, and the sentence has $\forall > \neg$ reading, a result compatible with a quantificational analysis of *dou*. On the other hand, a $\neg > \forall$ reading surprisingly requires negation to appear before *meige*-NP at the surface (74); just putting negation before *dou* results in ungrammaticality (75).

(73) meige xuesheng dou bu xihuan Lisi.
every student DOU not like Lisi
'Every student is such that they don't like Lisi.' $\forall > \neg$

(74) bu-shi meige xuesheng dou xihuan Lisi.
not-be every student DOU like Lisi
'Not every student likes Lisi.' $\neg > \forall$

(75) *meige xuesheng bu-(shi) dou xihuan Lisi.
every student not-(be) DOU like Lisi
Intended: 'Not every student likes Lisi.' *every>NOT>DOU

(76) Tamen bu-(shi) dou xihuan Lisi.
they not-(be) DOU like Lisi
'Not all of them like Lisi.' they>NOT>DOU

The scopal contrast between *meige*-NPs (75) and definites (76) is again unexpected under Lin's quantificational analysis of *dou*, where *meige*-NPs and plural definites are treated on a par. Instead, the behavior of *meige*-NPs in (74)-(75) suggests that *meige*-NP should really take scope, explaining why a $\neg > \forall$ reading must have negation appear before *meige*-NP (instead of just *dou*) at the surface. But if *meige*-NPs take scope, *dou* had better not.

We seem to have a dilemma: (71)-(72) suggests *dou* takes scope, while (74)-(75) shows the opposite.

Yet the dilemma is only superficial. First, even in the definite-case, *dou* need not take scope: a overt $Q_\forall$ *quan*, if present, determines scope. The contrast between (77) and (78) shows that (exactly as in the case of *meige*-NPs (74)-(75)), in order to get a $\neg > \forall$ reading, negation has to appear before *quan*, indicating *quan*, rather than *dou*, is the scope-taking universal.

(77) Tamen bu-shi **quan** dou xihuan Lisi.
they not-be all DOU like Lisi
'Not all of them like Lisi.' $\neg > \forall$

(78) *Tamen **quan** bu-(shi) dou xihuan Lisi.
they all not-(be) DOU like Lisi
Intended: 'Not all of them like Lisi.' **quan* >NOT>DOU

In the absence of *quan*, we can rely on the covert distributive operator *Dist* (19) posited in Section 3.2.2 and require it to sit next to *dou* to capture *dou*'s 'scopal' facts. In other words, (71) and (72) actually have the following structures (79)-(80), and what takes scope in these structures is the *Dist*, not *dou*; since *dou* is next to *Dist*, other scopal elements that appear before or after *Dist* at LF also appear before or after *dou* at the surface, thus *dou*'s 'scopal' facts[24].

(79) [*they* [*dou* [*Dist* [¬ *like Lisi*]]]]

(80) [*they* [¬ [*dou* [*Dist like Lisi*]]]]

It's time to take stock. We have shown that a quantificational analysis of *dou* such as Lin's (1998) is problematic. *Dou* neither has obvious quantificational force nor determines scope. It simply does not behave like a quantificational expression. On the other hand, *meige*-NP '*every*-NP', although it generally requires *dou*'s support, is truly quantificational: it contributes stable quantificational force (universal) and takes scope.

After showing the inadequacy of a quantificaitonal analysis, we have to make sure that

[24]Some clarifications: under an account where *meige*-NP, *quan* and *Dist* are quantificational while *dou* is not, (75) and (78) are predicted to have a $\forall > \neg$ reading. Yet the two are bad; this is because, we suggest, the default position of (a narrow scope) negation is low Beghelli & Stowell 1997, and there is no motivation to move it across *dou*. Indeed, in all cases of $\forall > \neg$, negation has to appear after *dou*, if *dou* is present. See (73) for an example.

our proposal for *dou* can handle (or at least is compatible with) the facts discussed above. We know how our proposal accounts for the distributive effect of *dou* from Section 3.2.2, but we don't have an analysis of *meige*-NP and its association with *dou* yet, to which we now turn.

Based on the facts discussed above, we propose Mandarin *meige*-NP is quantificational with standard generalized quantifier semantics Barwise & Cooper 1981. We also assume with von Fintel 1994 that quantifiers have covert domain restriction variables ranging over properties of indivduals and represent it as $_D$ in (81). Further, our *dou* is still *even* (82), repeated from (17).

(81) $[\![\text{mei}_D\text{-}\textsc{cl}\text{-student}]\!] = \lambda P \forall x \in D[\mathsf{student}(x) \rightarrow P(x)]$

(82) $[\![dou(\pi)]\!]$ is defined iff $\forall q \in C[\neg(\pi = q) \rightarrow \pi \prec_{likely} q]$

if defined, $[\![dou(\pi)]\!] = [\![\pi]\!]$

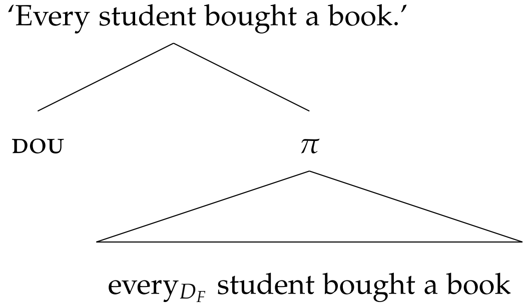
Next, *dou* associates with an alternative-triggering item, so we need to determine the alternatives to *meige*-NP, which we propose to be its subdomain alternatives (83) (Chierchia 2013).

(83) $[\![\text{mei}_D\text{-}\textsc{cl}\text{-student}]\!]_{Alt}$

$= \{\lambda P \forall x \in D'[\mathsf{student}(x) \rightarrow P(x)] : D' \subset D\}$

Finally, we assume that a sentence contaning a *meige*-NP and *dou* such as (84a) has the analysis in (84b), with *dou* having sentential scope.

(84) a. Mei-ge-xuesheng dou mai-le yi-ben-shu.
every-CL-student DOU buy-ASP one-CL-book
'Every student bought a book.'

b. 

c. $[\![\pi]\!] = \forall x \in D[\mathsf{student}(x) \rightarrow \exists y(\mathsf{book}(y) \wedge \mathsf{bought}(x,y))]$

d. $[\![\pi]\!]_{Alt} = \{\forall x \in D'[\mathsf{student}(x) \rightarrow \exists y(\mathsf{book}(y) \wedge \mathsf{bought}(x,y))] : D' \subset D\}$

With the LF in (84b), (84c) is the meaning of the prejacent π, and (84d) as π's alternatives.

Now we have a familiar situation: the prejacent entails all the other alternatives. Again, *dou*'s *even* presupposition is trivialized, and this is, I claim, why *dou* is possible with *meige*-NPs without contributing an *even* flavor.

To explain why *dou* is required, we suggest that the domain variable of *mei* 'every' is obligatorily focused; in other words, it always triggers subdomain alternatives, similar to NPIs in Chierchia 2013. Thus, it needs *dou* to exhaustify these alternatives away.

Now with *dou* being *even* and *meige*-NPs quantificational, our proposal are compatible with all the facts discussed in this subsection. Since *meige*-NPs are quantificational, they do not allow quantificational variability (70), and they determine the scope of the universal based on their surface position (74). Since definites are non-quantificational, they allow quantificational variability (69) and the 'scopal facts' of *dou* (71)-(72) are due to a covert *Dist* on VP that sits next to *dou*. Finally, since *dou* is *even* and truth-conditionally vacuous, it does not interfere with any of the above truth-conditional phenomena[25].

3.4.3 *Dou* is not just a maximizer

We have seen that *even*-less *dou* still has the maximality effect (to satisfy the universal part of *even*). This aspect of *dou* has been emphasized in Xiang 2008, Cheng 2009, who follow Giannakidou & Cheng 2006 analyzing *dou* as a maximality operator (85) (setting aside intensionality).

(85) $[\![dou_{G\&C}]\!] = \lambda P.\sigma x P(x)$

(86) (cf. Cheng 2009: 67) supports (85). In (86), the bare numeral phrase associated with *dou* is interpreted as a definite: (86) is felicitous only if there are exactly three

[25]We do need *dou* to scope over a universal to get its *even* meaning trivialized. This is easy to obtain even with negation around. To get a $\forall > \neg$ reading, *dou*$> \forall > \neg$ will do, while $\neg > \forall$ requires $\neg >$ *dou*$> \forall$, both of which can be achieved by covert movement of *dou*.

students in the context. This definiteness effect of *dou* is straightforwardly captured by directly treating *dou* as a definite determiner (and *three* as having an adjectival semantics $\lambda P \lambda X.|X| = 3 \wedge P(X)$).

(86) san-ge xuesheng dou mai.le yi.ben shu.
three-CL student DOU buy.ASP one.CL book
'The three students each bought one book.'

However, we observe that (86) also shows the distributive effect. It only has a distributive reading that the three students each bought one book; it lacks the collective reading that the three students together bought one book. This is not captured by treating *dou* as a definite determiner/maximality operator.

Our proposal captures both *dou*'s maximality/definite effect and its distributive effect. Both of them are derived from its *even* presupposition. Let's illustrate this claim again by considering how (86) is analyzed in our system.

First, we propose that *three students* is an existential quantifier and activates scalar alternatives, as in (87a)-(87b).

(87) a. $[\![\text{three students}]\!] = \lambda P \exists X[\mathsf{students}(X) \wedge |X| = 3 \wedge P(X)]$

b. $[\![\text{three students}]\!]_{Alt} = \{\lambda P \exists X[\mathsf{students}(X) \wedge |X| = n \wedge P(X)] : n \in \mathbb{N}^{+}\}$

(87) is compatible with both distributivity and collectivity. Consider distributive readings first. Combining *three students* with *Dist*(*bought a book*), we get π and its alternatives in (88).

(88) a. $[\![\pi]\!] = \exists X[\mathsf{students}(X) \wedge |X| = 3$
$\wedge \forall y\ (\ y \in X \wedge Atom(y) \rightarrow y\ \mathsf{bought.a.book})]$

b. $[\![\pi]\!]_{Alt} = \{\exists X[\mathsf{students}(X) \wedge |X| = n$
$\wedge \forall y\ (\ y \in X \wedge Atom(y) \rightarrow y\ \mathsf{bought.a.book})] : n \in \mathbb{N}^{+}\}$

Now consider contexts where there are exactly three students. In such contexts, any alternative with $n > 3$ won't be included in the actual alternative set C. This is because it does not make sense to consider a proposition like*there are four students such that each of them bought a book* if we already know there could only be three students. Thus, the C has to be the one in (89).

(89) $$C_{=3} = \left\{ \begin{array}{l} \text{there are 3 students such that each bought a book } (= \pi), \\ \text{there are 2 students such that each bought a book,} \\ \text{there are 1 students such that each bought a book,} \end{array} \right\}$$

This is again familiar: *dou*'s prejacent entails all the other alternatives. Thus the *even* presupposition of *dou* is satisfied and the *even* flavor is trivialized.

Things change when there are more than three students in the context. Suppose there are four (90). In this case, there is a proposition q in C entailing the preajcent; *dou*'s presupposition then cannot be satisfied and the sentence is thus infelicitous in the context.

(90) $$C_{>3} = \left\{ \begin{array}{l} \text{there are 4 students such that each bought a book } (= q), \\ \text{there are 3 students such that each bought a book } (= \pi), \\ \text{there are 2 students such that each bought a book,} \\ \text{there are 1 students such that each bought a book,} \end{array} \right\}$$

In other words, to get an *even*-less *dou* in (86), the context has to contain exactly 3 students[26]. In this way, we have derived the definiteness effect (and the distributive effect) of *dou* in (86) from its *even* presupposition.

Finally, we turn to collective interpretations. With a collective reading of (86), the prejacent and its alternative propositions do not stand in an entailment relation; thus *dou*'s *even* presupposition cannot be trivialized. Then we predict the sentence can only be used in a context where the prejacent is the most unlikely one within C. It turns out that it is very difficult to find a context where it is unlikely that a group of three students together bought a book, and that's why the most salient reading of (86) is the distributive + definite

[26]What happens when there are less than 3 students in the context? In such a context, C won't contain the prejacent, which is ruled out by the Focus Interpretation Principle in Rooth 1992 which requires the prejacent to be always in C.

one[27].

On the other hand, if we increase the number of books, the resulting sentence begins to have the collective + *even* reading (91).

(91) san-ge xuesheng dou mai.le shi.ben shu.
three-CL student DOU buy.ASP ten.CL book
'The three students each bought 10 books.'

Or 'A group of three students bought 10 books, which is unlikely.'

(91) has a distributive + definite *even*-less reading and a collective + *even* reading; both are predicted by our proposal. The former involves alternatives based on sums while the latter alternatives based on groups/atoms.

To summarize, *even*-less *dou* shows both the distributive effect and the maximality effect. Lin's (1998) distributive operator analysis captures the former but not the latter, while Giannakidou & Cheng's (2006) maximality operator analysis only captures the latter. Our proposal captures both of the effects, by deriving them from *dou*'s *even* presupposition.

3.4.4 Groups vs. covers

Our analysis of *dou* shares many of the same assumptions as Liao 2011, where she claims (following Mok & Rose 1997) that there is only one *dou* which has 'even' as its semantics, and that the distributive effect of *dou* is a trivialization of its 'even' meaning. However, our implementation is very different from hers. Liao uses the notion of *cover* to analyze the distributive/collective distinction (Schwarzschild 1996), while the present analysis adopts the Link-Landman approach, with ↑. This turns out to have non-trivial empirical consequences.

Let's first see how a *cover*-based analysis of distributivity/collectivity works. In Schwarzschild's theory, a generalized distributive operator Dis_{COV} (92) always appears between a plural NP and its VP, and choices of covers determine whether we get a

[27] There also seems to be a competition-blocking effect between *dou* and another FP *cai* (which we are not sure about how to gloss). To express the meaning that as many as three students only bought one book, which is unlikely, we would use [three students *cai* buy *le* one book].

distributive or a collective reading.

(92) $[\![Dis_{COV}]\!] = \lambda P_{et} \lambda X_e . \forall y \in COV \wedge y \leq X \rightarrow P(y)$

In our setting using sums, a cover (COV) of a sum X is a set of parts of X whose sum is X (in other words, a cover is a partition of a sum that allows overlaps). For example, both $\{a, b, c\}$ and $\{a \oplus b \oplus c\}$ are COVs of $a \oplus b \oplus c$; the former gives rise to distributive readings, while the latter collective ones.

Further, Schwarzschild takes the COV in (92) to be a free variable (of type $\langle e, t \rangle$) determined by context[28]. Essentially, this allows contexts to modify the quantificational domain of the $\forall$ introduced by Dis_{COV}.

Let's look at a concrete example (93).

(93) a. John and Mary lifted the piano.

b. Dis_{COV}(lifted the piano)$(j \oplus m)$

c. $\forall y[(y \in g(COV_1) \wedge y \leq j \oplus m) \rightarrow \text{lifted the piano}(y)]$

(93a) is ambiguous (or vague according to Schwarzschild) between a distributive reading and a collective one. In Schwarzschild's theory, both of the readings have the LF in (93b) and the truth-condition in (93c); the meaning difference is captured by assigning different values to COV_1. With $g(COV_1) = \{j, m, \ldots\}$, we get the distributive reading, while with $g(COV_1) = \{j \oplus m, \ldots\}$ (without j or m in the set), we get the collective reading.

There is a crucial difference between a cover-based analysis and an analysis using groups. In the former, the distinction between collectivity and distributivity is captured entirely within VPs, while in the latter, both NPs (to which $\uparrow$ applies) and VPs (to which the distributive operator applies) are responsible for the distinction. Below, we suggest that theories (such as Dis_{COV}) where the distributive/collective distinction is only encoded in

[28]Following Schwarzschild (1996: 72), we take COV to cover the whole domain (instead of the plurality the VP is predicated of). COV has a role similar to domain restriction: they both restrict the quantification domain of a quantifier in certain ways.

VPs cannot easily handle certain collective-among-alternatives situations. Consider (94)[29].

(94) a. Even/*dou* [Jil, Mary and Sue]$_F$ can't lift the piano.

b. EVEN[*can't lift the piano*$(\uparrow j \oplus m \oplus s)_{\mathrm{F}}$]

c. EVEN[Dis_{COV1}(*can't lift the.piano*)$(j \oplus m \oplus s_{\mathrm{F}})$]

(94a) has a collective reading where we compare the likelihood of π: *j, m and s together can't lift the piano* with that of its alternatives such as ψ: *j and m together can't lift the piano*.

The present theory (94b) captures this by allowing $\uparrow j \oplus m$ to be an alternative of $\uparrow j \oplus m \oplus s$, thus capturing the collectivity of ψ and the collectivity of π at the same time. But a Dis_{COV} analysis cannot get the two collectivities. Crucially, since Dis_{COV} does not receive focus , the COV variable cannot vary among the alternatives of $j \oplus m \oplus s$. Yet a single COV_1 doesn't work: the collectivity of π requires $g(COV_1) = \{j \oplus m \oplus s\}$ (assuming that j, m, s are the only individuals in the context to simplify discussion), while the collectivity of ψ requires $g(COV_1) = \{j \oplus m, \ldots\}$. Since the two requirements cannot both be satisfied, a Dis_{COV} analysis (including Liao's analysis of *dou*) is unable to capture this collective reading of (94a).

Intuitively, the problem of Dis_{COV} is that the $_{COV}$ variable is within the VP, thus does not receive focus and cannot vary. This contrasts with $\uparrow$, which applies to the NP, thus receives focus and can vary across alternatives.

On the basis of the above we claim that Liao's unified account of *dou* does not have the same empirical overage as ours.

3.5 Conclusion

This chapter has developed and motivated a particular view on how to analyze 'ambiguities' of focus sensitive operators. Versatility of a focus particle is analyzed as the possibility of associating the FP with varieties of alternatives. Two particular varieties have been identified: sum-based alternatives and atom-based ones. Together with novel analyses of

[29] (94a) stands in for both the English sentence and its Mandarin counterpart using *dou*; we also move *dou* to the top to make it parallel to English *even*.

Mandarin *jiu* as ONLY$_{weak}$ and *dou* as EVEN, the limited theoretical options derive a large array of facts.

The chapter has also drew attention to the integration of semantics of plurality into alternative semantics. While the relevance of the atom/sum distinction to alternative sensitive operators has been observed by Dayal 1996 and motivates her answerhood operator, it is still not a common practice to think about pluralities in the context of focus particles. The chapter has demonstrated how Link, Landman's theory of pluralities combined with Rooth's theory of focus association, has offered an explanation to the relevance of focus particles (especially *dou*) to distributivity/collectivity in Mandarin.

Finally, facts of focus association might also help us decide between theories of pluralities. In Subsection 3.4.4, we have given a preliminary case from focus association that favors groups over covers. More research is definitely needed to decide between the two theoretical options.

Chapter 4

More exclusives

4.1 Introduction

This chapter illustrates how the semantics of *jiu* proposed in Chapter 3 helps us understand two additional phenomena.

First, *exclusive (dis)-harmony B* (Chen 2005, 2008): exclusives such as Mandarin *zhi/jiu* (and to a lesser extent English *only*) cannot be associated with *more than n* but are fine with *less than n*.

(1) Exclusive-(dis)harmony-B

a. jiu/zhi(you) budao shi ge ren lai.
only/only less-than 10 CL people come
Only less than 10 people came to the party.

b. *jiu/*zhi(you) chaoguo shi ge ren lai.
only/only more-than 10 CL people come
Intended: '*Only more than 10_F people came to the party.'

Furthermore, when associated with *less than n*, *jiu/zhi* are nonexclusive.

(2) Yuehan shangge yue zhi/jiu zheng le budao 500 dao, keneng 400 dou budao
John last month only/only earn ASP less.than 500 dollar, probably 400 even less.than
'John only earned less than $500 last month, probably even less than $400'

Section 4.2 below discusses what's special about *jiu/zhi* associated with *less than n*. It argues that in these cases, *jiu/zhi* combine with alternative sets containing only propositions already entailed by the prejacent. Since there are no propositions not entailed by the prejacent, nothing gets negated by *jiu/zhi*.

The second phenomenon to be discussed in this chapter (section 4.3) is the puzzle of *too many onlys* in Mandarin Chinese. The puzzle can be illustrated by the sentence below, where two *only*s seem to cancel out each other's exclusive effect.

(3) Too Many *onlys*

zhi/jiu	yumi	jiu	shou	le	wubai	gj
ONLY	corn	ONLY	yield	ASP	500	kg

Corn alone yielded 500 kg.

$\not\Rightarrow$Rice didn't yield 500 kg.

An analysis is offered which following Chapter 3 takes the obligatory non-exhaustiveness of the above sentence to result from contrastive topics. Because of the CT, the two *only*s need to be non-exclusive: the second *jiu* (the one to the right of *yumi* 'corn') can be non-exclusive due to its nature of being ONLY_{weak}, while the first *zhi/jiu* can be non-exclusive by having scope internal to the DP.

In sum, the phenomena discussed in this chapter provides further support for the account of Mandarin *jiu* discussed in the previous chapter. The facts reported here also constitute a unified phenomenon — they are all about non-exclusive exclusives. Different species of non-exclusive ONLYs are identified, which provides a new perspective on how exclusives behave in natural languages.

4.2 Exclusive (dis)harmonies

Before discussing exclusive-(dis)harmony, let me mention a related phenomenon – *dou*-(dis)harmony, noticed by Chen (2005).

4.2.1 *Dou* (dis)harmony

Chen 2005, 2008 observes that Mandarin *dou*[1] is compatible with quantifiers describing large quantities such as *henduo* 'many' (4a), but not with small-quantity quantifiers such as *henshao* 'few' (4b).

(4) *Dou*-(DIS)HARMONY

a. Zuotian juhui, henduo ren dou lai le.
yesterday party, many people DOU come ASP
'Yesterday, many people came to the party.'

b. *Zuotian juhui, henshao ren dou lai le.
yesterday party, few people DOU come ASP
Intended: 'Yesterday, few people came to the party.'

Chen names this phenomenon *dou*-(dis)harmony and offers an explanation based on a context-dependent expected value s_c. Specifically, *dou* carries a presupposition that the number of 'NPs' (*people* in (4)) that 'VP' (*came to the party* in (4)) – falls above the expected value s_c.

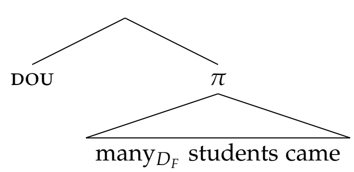
Since "*few* NP VP" is true iff the number of 'NPs' that 'VP' falls below s_c (Partee 1988), contradicting the high-rank presupposition of *dou*, *dou* is incompatible with *few*.

In a parallel manner, the compatibility of *dou* and *many* is explained by taking "*many* NP VP" to be true iff the number of 'NPs' that 'VP' falls above s_c[2].

[1] Chen takes the *dou* under discussion to be a distributive operator following Lin 1998.

[2] Chen's (2005) analysis of *dou*-(dis)harmony is certainly compatible with our proposal of *dou* as EVEN: we just need to add Chen's presupposition into *dou*'s lexical entry and take it to be a peculiar property of *dou* (notice that the presupposition also needs to be stipulated in Chen's own analysis; it does not seem derivable from any other properties of *dou*). However, I would like to suggest a different explanation of *dou*-(dis)harmony that reduces it to *dou*'s *even*-flavor. Let's take the lexical entries of *many*/*few* in Partee 1988 and assume they trigger domain alternatives when associated with *dou*, similar to what we did with *every*. Below n is a large fraction in the context, approximating the idea of the expected value s_c.

(5)



a. $[\![\pi]\!] = |\lambda x.\text{came}(x) \cap \text{students} \cap D| > n * |\text{students} \cap D|$

b. $[\![\pi]\!]_{Alt} = \{|\lambda x.\text{came}(x) \cap \text{students} \cap D'| > n * |\text{students} \cap D'| : D' \subset D\}$

4.2.2 Exclusive (dis)harmonies

Exclusive (dis)harmony-A

Mandarin exclusive particles (*jiu*, *zhi(you)* 'only') exhibit the opposite pattern from *dou* (already mentioned in Chen (2005)). Specifically, they are compatible with quantifiers denoting small quantities such as *few* (6a) but not with those denoting large quantities such as *many* (6b). We call this *exclusive (dis)harmony-A*.

(6) EXCLUSIVE-(DIS)HARMONY-A

a. Zuotian juhui, jiu/zhi henshao ren lai.
yesterday party, only/only few people come
'Yesterday, only few people came to the party.'

b. *Zuotian juhui, jiu/zhi henduo ren lai.
yesterday party, only/only many people come
Intended: '*Yesterday, only many people came to the party.'

An analysis based on Chen 2005 is conceivable for exclusive (dis)harmony-A. All we have to assume is that Chinese exclusives carry a low-rank presupposition that its 'NP'-associate that 'VP' falls below the expected value s_c. This is actually the *mirative particle* analysis of English *only* in Zeevat 2008, where the core meaning of *only* is 'less than expected'[3].

First, notice that (5a) and its alternatives in (5b) do not stand in an entailment relation: *many students came* has no entailment relation with *many male students came*. So following Crnič 2014, we check their plausibility relation to see whether EVEN – what *dou* means in our account – can be licensed. Now suppose that when talking about who will come, our attention always moves from people that are likely to come (a smaller domain D') to the inclusion of people that are not so likely to come (a bigger domain D). Then, since $|\lambda x.\text{came}(x) \cap \text{students} \cap D'| > n * |\text{students} \cap D'|$ is more likely than $|\lambda x.\text{came}(x) \cap \text{students} \cap D| > n * |\text{students} \cap D|$, we predict EVEN can be licensed. For *few*, the situation reverses: since $|\lambda x.\text{came}(x) \cap \text{students} \cap D'| > n * |\text{students} \cap D'|$ is less likely than $|\lambda x.\text{came}(x) \cap \text{students} \cap D| > n * |\text{students} \cap D|$, we predict EVEN not to be licensed. Intuitively, this says *many students came* is more likely to be true in a small domain (consider a singleton domain that contains a person who came) than in a big domain, while *few people came* is more likely to be true in a big domain than in a small domain (again consider a singleton domain that contains a person who came). I think this is plausible. Notice this reasoning crucially relies on how subdomain alternatives should look like: we don't just consider any random $D' \subset D$; we start from D's that are realistic, that is, D's that are more likely to satisfy the nuclear scope. I hope to work this out in more detail in the future.

[3] I will not try to offer an account of exclusive-(dis)harmony-A here. See Alxatib 2013 for some discussion.

Exclusive (dis)harmony-B

We further discover Exclusive (dis)harmony-B: Mandarin exclusives are compatible with modified numeral *budao n* "less-than *n*" (7a), but not with *chaoguo n* "more-than *n*" (7b).

(7) Exclusive-(dis)harmony-B

a. jiu/zhi(you) budao shi ge ren lai.
only/only less-than 10 CL people come
Only less than 10 people came to the party.

b. *jiu/zhi(you) chaoguo shi ge ren lai.
*only/only more-than 10 CL people come
Intended: '*Only more than 10_F people came to the party.'

Exclusive (dis)harmony-B cannot be explained by Chen's (2005) analysis which crucially relies on the expected value s_c. This is because the standard semantics (Hackl 2000, Nouwen 2010) of modified numerals such as *more/less-than n* simply does not involve a context-dependent s_c.

(8) Modified Numerals

a. $[\![\text{more than } 10]\!] = \lambda D.\text{max}(D) > 10$

b. $[\![\text{less than } 10]\!] = \lambda D.\text{max}(D) < 10$ (cf. Nouwen 2010: (13))

Compare (8) with a recent proposal for *many/few* in Solt (2014): s_c is encoded in the latter but not in the former, and thus Chen's analysis cannot be extended to (7).

(9) *Many* and *few*

a. $[\![\text{many}]\!] = \lambda D.\text{max}(D) > s_c$

b. $[\![\text{few}]\!] = \lambda D.\text{max}(D) < s_c$ (cf. Solt 2014: (9))

The rest of this section explores an explanation of Exclusive (dis)harmony-B.

4.2.3 Towards an explanation

Universal Density of Measurement and Maximization failure

Based on their Universal Density of Measurement (UDM), Fox & Hackl (2006) provides an analysis for *only*'s incompatibility with *more than n* (cf. (7b)), which we adopt to explain half of our Exclusive (dis)harmony-B puzzle.

(10) Universal Density of Measurement

a. The UDM

Measurement scales needed for natural language semantics are always dense.

b. Density

A scale S is dense iff for any two degrees d_1 and d_2 on S, there is a degree d_3 between d_1 and d_2:

$\forall d_1 \forall d_2((d_1 < d_2) \rightarrow \exists d_3(d_1 < d_3 < d_2))$

Specifically, we take the standard semantics of English *only* (Horn 1969, Schwarzschild 1994) as in (11) and we assume *jiu/zhi* have the same semantics as English *only*[4]; with UDM, we will run into a contradiction when we combine *only/jiu/zhi* with *more than* n_F, and a contradiction like this gives rise to ill-formedness (Gajewski 2002). The reasoning is given in (12).

(11) Semantics of *only/jiu/zhi*

$only_C(p)$ presupposes $p(w) = 1$[5] — Prejacent presupposition

if defined, it asserts $\lambda w \forall q \in C[q(w) \rightarrow p \subseteq q]$ — Exclusive assertion

(12) Fox and Hackl's reasoning:

[4] C in (11) is the quantificational domain of *only* and it is restricted by focus: focus on an expression a triggers alternatives which share with a the same semantic type (Rooth 1985). C is required to be a subset of the set of propositions obtained by replacing the focus part of the prejacent with its alternatives (Rooth 1992). Finally, I set aside the difference between *jiu* (ONLY_{weak}) and *zhi* (ONLY_{strong}) in this section for convenience: all of the propositional C's in this section contain only propositions that have entailment relation between each other, and in these cases ONLY_{weak} and ONLY_{strong} deliver the same result.

[5] Neither Fox & Hackl's reasoning nor my reformulation needs to assume that the prejacent is presupposed. The reasoning goes through as long as the prejacent is entailed, that is, it could be asserted instead.

$*$*only more than* 10_F *people came* = (7b)

a. (7b) presupposes p: more than 10 people came

b. (7b) asserts q: it's not the case that more than n people came, with $n>10$;

c. p entails r: there were $10+\epsilon$ people coming;

d. because of UDM and r: more than $10+\epsilon/2$ people came;

e. but according to q and the fact that $10+\epsilon/2>10$: it's not the case that more than $10+\epsilon/2$ people came;

f. contradiction.

There is a simpler way of looking at the above reasoning (cf. Chierchia (2013) on NPI): first, it is a fact that for any $n>10$, *more than n people came* entails *more than 10 people came*; next, because of *only*, it's not the case that more than n people came, for any $n>10$; but negating all these stronger alternatives means that exactly 10 people came, which contradicts the prejacent.

There is also a more general way of looking at this, which sees (7b) as an instance of *maximization failure* (Fox 2007b, cf. the negative island literature).

Roughly, maximization failure happens when a maximization operator (*only* in our case) fails to pick out the correct greatest element (the prejacent of *only* in our case) when applied to a (algebraic) set. Consider (7b). *Only* basically says that there is a unique strongest true proposition within its alternative set and it is *only*'s prejacent (=all alternative propositions not weaker than the prejacent are false), but this requirement cannot be satisfied: suppose that 14 people came (based on what the prejacent in (7b) means); the set of true alternative propositions is {... more than 9 people came$\supset$ <u>more than 10 people came</u>[6] $\supset$ more than 11 people came ...}. Because of density, this set (interval) is not right bounded, thus no greatest element and maximization fails. Since 14 is arbitrarily chosen, maximization always fails and the use of *only* is infelicitous.

[6]Underlining singles out the prejacent.

Problem with *less than n*

Exclusive-(dis)harmony-B has two parts, the harmony part (7a) and the disharmony part (7b). We have looked at how Fox & Hackl (2006), Fox (2007b) explain the disharmony part, but what about the harmony part?

It turns out that they predict exclusives are equally bad with *less than n*, thus failing to explain their compatibility in Mandarin Chinese, illustrated again in (13).

(13) Exclusive-harmony-B

jiu/zhi(you) budao shi ge ren lai.
only/only less-than 10 CL people come
'Only less than 10 people came to the party.'

The reasoning sketched in (14) is exactly parallel to the case of *more than n*.

(14) An incorrect prediction

a. *only* in (13) says that *less than 10 people came* is the strongest proposition;

b. (13) also presupposes that less than 10 people came; let's say actually 8 people came.

c. now the set of true alternative propositions is
{ ... less than 9 people came⊂ less than 10 people came ⊂ less than 11 people came... }

d. Because of density, this set (interval) is not left bounded; thus no greatest element.

e. since 8 is arbitrarily chosen, maximization always fails.

f. (13) is incorrectly predicted to be bad.

The rest of the section is devoted to tackling this problem. Here is the idea in a nutshell: we will propose that *only/jiu/zhi(you)* can restrict an alternative set (interval) $C = \{\ldots$ less than 9 people came⊂ less than 10 people came ⊂ less than 11 people came... } into a Restricted alternative set C'= [less than 10 people came ⊂ less than 11 people came... }.

The new set (interval) has a strongest element, i.e., the prejacent; thus no maximization failure.

Before we explain why exclusives can do this with *less than n* but not with *more than n*. Let's look at the scalar/evaluative component of *only/jiu/zhi(you)*. It turns out that the restricting function of exclusives mentioned above are independently needed for analyzing their scalarity.

4.2.4 *Only*'s scalar presupposition

Only and its Mandarin counterparts *jiu/zhi* trigger scalar inferences (cf. Zeevat 2008, Klinedinst 2005, Alxatib 2013, Coppock & Beaver 2014), illustrated by (15) for English *only* and (16) for Mandarin *jiu/zhi(you)*.

(15) The scalar inference of *only*

a. 10 people came, which was a lot.

b. #Only 10 people came, which was a lot.

(16) The scalar inference of *jiu/zhi*

a. you shi ge ren lai, zhen duo!
HAVE ten CL people come, really many
'10 people came, which were a lot.'

b. #jiu/zhi you shi ge ren lai, zhen duo!
only/only HAVE ten CL people come, really many
Intended: #only 10 people came, which was a lot.

(15a)/(16a) are good because 10 people can either be many or few, depending on the context. But (15b)/(16b) sound contradictory because the *only/jiu/zhi(you)* carry a scalar meaning that the people that came were few, which contradicts the content of the following relative clause.

To formally represent the scalar reading, we propose to assign *only/jiu/zhi(you)* a presupposition that requires the focus associated with *only/jiu/zhi(you)* to be ranked lower on a scale R than its any other alternatives[7]. Formally, this is represented in (17).

(17) SCALAR PRESUPPOSITION of *only/jiu/zhi(you)*

$\forall x \in C_e[x \neq [\![\text{focus}]\!] \rightarrow [\![\text{focus}]\!] <_R x]$

(18) SCALAR PRESUPPOSITION of *even*

$\forall q \in C_{\langle s,t\rangle}[q \neq [\![\text{prejacent}]\!] \rightarrow [\![\text{prejacent}]\!] <_{likely} q]$

(17) follows a common way of capturing the scalar presuppositions of scalar FPs like *even* (Karttunen & Peters 1979) and *already/still* (Krifka 2000)[8]. To take *even* for instance, the only difference between (17) and (18) is that the former ranks individuals while the latter propositions. By ranking the prejacent of *even* as the bottom of a likelihood scale we obtain the inference that the prejacent is the least likely. Similarly, by ranking 10 as the bottom of the *number* scale, we obtain the inference that 10 is a small number. The contrast shown in (15) and (16) is thus captured.

But there is a problem (pointed out by Roger Schwarzschild, for which I am grateful.): we are actually using a superlative semantics to capture an evaluative intuition, which is not quite right. To witness, that 10 is smaller than any of its alternatives on a number scale does not mean 10 is small (perhaps all of them are big numbers), just as John is the tallest does not mean John is tall.

To fix this, we posit a requirement (19) which says that the context dependent expected value s_c (Kennedy 1999) should always be included in the restricted alternative set induced by *jiu/zhi*. Intuitively, this is plausible, since the restricted alternative set tries to capture the idea of *alternatives under consideration* (Krifka 2000), and the expected value seems to always qualify as one of them.

(19) EXPECTED VALUE ALWAYS UNDER CONSIDERATION

$\exists x \in C[x \neq [\![\alpha]\!] \wedge \mu_R(x) = s_c]$

[7]This is what we did in Chapter 3. In particular, §3.2.4.2.

[8]Krifka 2000 is interested in German *schon/noch* 'already/still', which contribute *early/late* scalar inferences. Krifka's way of capturing these scalar inferences is exactly like our (17). For example, *schon* is truth-conditionally vacuous but presupposes that its associate is ranked earlier than all the other alternatives.

Let me illustrate. From [John *zhi/jiu* earned less than \$500$_F$ last month] we infer that \$500 is a small amount of money. We obtain this inference because *jiu/zhi* presupposes that \$500 is smaller than all its alternatives; but these alternatives also include the expected value s_c, so \$500 is smaller than s_c; thus it is indeed a small amount.

Restricted Alt

To capture the scalar component of *only*, we have essentially restricted the Rooth-style alternative set triggered by focus to an (ordered) subset C' of which the focus value is the bottom. Restricted Alt is the key to the above-mentioned exclusive-harmony-B puzzle.

Consider *jiu/zhi* with *less than* n_F in (20) .

(20) *jiu/zhi* less than 10_F people came.

Restricted Alt: $10 < 11 < 12 < \ldots$

C: [less than 10 people came$\subset$ less than 11 people came,...}

Maximization applies successfully; the prejacent is the strongest proposition.

In (20), the presupposition of *jiu/zhi* in (17) restricts the alternative set of 10$_F$ into {10,11,12,...}. Because *less than 10 people came* entails *less than n people came* for any $n \geq 10$, the prejacent is indeed the strongest proposition in the new set; thus *jiu/zhi*'s requirement (its assertion (11)) is satisfied and *jiu/zhi* is compatible with *less than* n_F.

More than n_F behaves differently, illustrated in (21).

(21) **jiu/zhi* more than 10_F people came.

Restricted Alt: $10 < 11 < 12 < \ldots$

C: [more than 10 people came$\supset$ more than 11 people came,...}

Maximization fails, because the problematic alternatives are still in the set.

In (21), the presupposition of *jiu/zhi* in (17) again restricts the alternative set of 10$_F$ into {10,11,12,...}. However, in this case *more than 10 people came* is entailed by *more than n people came* for every $n \geq 10$, and thus the prejacent can never be the strongest proposition due to density. As a result, *jiu/zhi*'s requirement is not satisfied and exclusive disharmony B follows.

Trivialization

The essence of our story is that we allow the exclusive component of *jiu/zhi* to be trivialized/vacuous (a discussion of this point can also be found in §3.2.4.).

(22) *jiu/zhi* less than 10_F people came.

Restricted Alt: $10 < 11 < 12 < \dots$

C : [less than 10 people came ⊂ less than 11 people came,... }

Exclusive Assertion in (11) applies vacuously.

This is correct, since *jiu/zhi*, when associated with *less than* n_F, is indeed nonexclusive. Consider the following dialogue.

(23) A: Zuotian Yuehan jiu/zhi chi le budao [san]$_F$ ge pingguo?
yesterday John only/only eat LE less-than 3 CL apple
'Yesterday, Did John eat only less than 3 apples?'

B: Dui. qishi lian liang ge dou budao.
Right. actually even 2 CL even less-than
'Yes, actually he ate even less than 2.'

In (23), B uses *dui* 'right' to affirm the proposition p that *John only ate less than 3 apples* but then he adds a proposition q that *John ate less than 2 apples*; this is impossible if the *only* in p were exclusive: being exclusive, it would negate q according to the standard semantics of *only* (11), for q asymmetrically entails the prejacent of p that *John ate less than 3 apples*.

(23) contrasts with (24), where the *jiu/zhi* is exclusive, and thus the contradiction.

(24) A: Zuotian Yuehan jiu/zhi chi le [san]$_F$ ge pingguo?
yesterday John only/only eat LE 3 CL apple
'Yesterday, Did John eat only 3 apples?'

B: #Dui. qishi ta chi le si ge.
Right. actually he eat LE four CL

'# Yes, actually he ate 4.'

The contrast between (23) and (24) follows from our proposal. While the exclusive component of *jiu/zhi* is trivialized (by their scalar presupposition) in the case of *less than* n_F as in (22), it stays intact in the case of bare numerals, illustrated in (25).

(25) John *jiu/zhi* ate 3_F apples.

Restricted Alt: $3 < 4 < 5 < \ldots$

C : [John ate 3 apples⊃ John ate 4 apples,...}

Exclusive Assertion: John didn't eat n apples for every $n \geq 3$

Not everyone agrees that the assertion of *only*-like exclusives can be trivialized (see for example, Beaver & Clark 2008, Alxatib 2013). They would have a non-vacuity condition built into the lexical entry of *only*, for example: the prejacent of *only* (or its negation) cannot entail all of its alternatives.

They base their non-vacuity claim on cases like *He only saw* [*every student*]$_F$: because *he saw every student* entails all the other alternatives (or its negation), non-vacuity is violated, and thus the sentence is bad.

But scalar presupposition as in (17) can also explain this: *every student* just cannot be the bottom of any alternative set.

Furthermore, it needs to be mentioned that trivialization of a covert *only* is essential in Chierchia 2013 to explain the distribution of weak NPIs like *any* (on its NPI use). Roughly, *any* triggers alternatives and needs a covert *only* to 'exhaustify'/'tame' them. In positive contexts, the covert *only* gives rise to contradiction, and thus *any* is not licensed; on the other hand, in negative contexts, the covert *only* is trivialized, and thus no contradiction and ill-formedness for *any*.

Finally, English *only* is not very comfortable with *less than n*[9] We might take this fact to suggest that English *only* (not the covert one) does not allow its exclusive component to be

[9]Judgments come from several native speakers I consulted and an anonymous PLC reviewer. However see Alxatib 2013 for different judgments.

trivialized.

In other words, (26a) and (26b) are both bad, but for different reasons. This might explain why people tend to feel a difference between (26a) and (26b).

(26) a. *Only more than 10_F people came. Contradiction

b. ??Only less than 10_F people came. Trivialization

But crucially, Mandarin *jiu/zhi* are fully compatible with *less than* n_F, suggesting they do not have a non-vacuity condition built into their semantics.

4.2.5 Summary

We have discussed two types of exclusive (dis)harmonies in Mandarin. Exclusive-(dis)harmony-A— *only* is compatible with *few* but not *many*, and exclusive-(dis)harmony-B— *only* is compatible with *less than n* but not *more than n*. We suggest Exclusive-(dis)harmony-A can be explained along the lines of Chen 2005.

We further propose that Exclusive-disharmony-B can be explained by Maximization failure (Fox 2007b). But Maximization failure rules out Exclusive-harmony-B as well. We then propose to use a scalar presupposition of *jiu/zhi/only* to restrict the standard Roothian focus alternative set. This presupposition achieves two things: it captures the scalar meaning of *only*, and it allows maximization to work with *less than n*, by filtering out problematic alternatives.

4.3 Too many *only*s

4.3.1 The puzzle of too many *only*s

The sentence below seems boring by this point. Recall from Chapter 3 that *zhi* is ONLY_{strong} and *jiu* ONLY_{weak}. They both produce an exclusive meaning when alternatives of corn in (27) are {corn, corn⊕rice...}.

(27) zhi/jiu yumi shou le wubai gongjin
only/JIU corn yield ASP 500 kg

Only corn yielded 500 kg.

⇒Rice didn't yield 500 kg. EXCLUSIVE

Surprisingly, when another *jiu* is added after the subject *yumi* 'corn', the entire sentence becomes non-exclusive. The only difference between (27) and (28a) is the extra *jiu* after *corn*; yet the latter but the not the former can have the continuation in (28b) without causing a contradiction.

(28) Too Many *onlys*

a. zhi/jiu yumi jiu shou le wubai gongjin,
only/JIU corn JIU yield ASP 500 kg
'Corn alone yielded 500 kg.'

⇏Rice didn't yield 500 kg. NON-EXCLUSIVE

b. dami ye shou le wubai gongjin.
rice also yield LE 500 kg
'Rice also yielded 500 kg.'

The rest of the section provides an explanation of this puzzle, based on our account of non-exclusive *jiu* in chapter 3. Before doing that, I would like to introduce some way to talk about the exclusives in (28a). I will call the exclusive that comes before the associate (that's the *corn*) zhi_A/jiu_A and the *jiu* that comes after the associate jiu_B.

4.3.2 Contrastive Topic

As is discussed in detail in Chapter 3, we take the *yumi* 'corn' in (28a) to be a contrasitve topic, for it is associated to the left of jiu_B and we have argued that associates to the left of *jiu* are CTs. One piece of supporting syntactic evidence is that we can put sentential adverbs and the Yes-No-Question operator *shi-bu-shi* 'be-not-be' after *yumi* 'corn'. Since these things occupy high syntactic positions, *yumi* must be high in the structure as well, presumably at a Topic position.

(29) Topic

a. zhi/jiu yumi$_{CT}$ **jingran/juran** jiu shou le wubai gongjin.
only/JIU corn surprisingly/obviously JIU yield ASP 500 kg
'Surprisingly/obviously, corn alone yielded 500 kg.'

b. zhi/jiu yumi$_{CT}$ **shi-bu-shi** jiu shou le wubai gongjin?
only/JIU corn be-NEG-be JIU yield ASP 500 kg
Is it the case that corn alone yielded 500 kg?'

In the above sentences, we marked the CT-status of *jiu*'s associates by CT-markers. CTs trigger pragmatic effects, in particular, the anti-exhaustiveness presupposition in (30).

(30) $[\![\text{CT}(\pi)]\!]$ is defined only if $\exists q \in C[\pi \not\subseteq q \wedge \diamond q]$

In words: a sentence π containing a CT presupposes that an alternative q not entailed by π is possibly true. [Wagner 2012: (46)]

Since CT carries the non-exhaustiveness presupposition in (30), the entire sentence containing the CT need to be non-exclusive with respect to the CT position. This further requires that both *zhi*$_A$/*jiu*$_A$ and *jiu*$_B$ should produce no exclusive meanings such as *things other than corn did not yield 500kg* in (28a).

Next we discuss how *zhi*$_A$/*jiu*$_A$ and *jiu*$_B$ can both be non-exclusive.

4.3.3 *jiu*$_B$ and atom-based alternatives

In chapter 3, we analyzed non-exclusive *jiu* as ONLY$_{wealk}$ combining with atom-based alternative sets. Since the alternative sets contain no propositions strictly stronger than the prejacent, ONLY$_{weak}$ has no exclusive effect. Here we follow that analysis. Below, (31) is semantics of *jiu* (we set aside its presupposition for now).

(31) $[\![\text{jiu}(\pi)]\!]$ is true iff $\forall q \in C[q \subset [\![\pi]\!] \rightarrow \neg q]$

Together with a atom-based based alternative set such as $\{\mathsf{corn}, \mathsf{rice}, \mathsf{potato}\}$[10], *jiu*$_B$ is non-exclusive.

[10] Landman's group operator can also turn sums into atoms. $\{\uparrow \mathsf{corn}, \uparrow (\mathsf{rice} \oplus \mathsf{corn}) \ldots\}$ is also compatible with non-exclusive *jiu*. See below for discussion.

4.3.4 zhi_A/jiu_A and DP-internal scope

I propose that zhi_A/jiu_A can also be nonexclusive because they can have DP-internal scope and thus have no truth-conditional effect on the meaning of the whole sentence. The idea is inspired by Coppock & Beaver's (2014) analysis of *minimal sufficiency readings* of English *just*, illustrated in (32) (from Coppock & Beaver 2014: (83)).

(32) **Just** the thought of him sends shivers down my spine.

English *just* is an exclusive — *John invited just Mary and Sue* roughly equals to *John invited only Mary and Sue*. *Just* however does not produce an exclusive inference in (32). (32) does not imply that nothing other than the thought of him sends the shivers; rather, it suggests his presence or touch would certainly send shivers, and the thought of him is (minimally) sufficient to induce the effect, thus the name *minimal sufficiency readings*.

Coppock & Beaver take the *just* in (32) to have scope within the subject. Roughly, (32) means 'something that is just the thought of him sends shivers down to my spine', an intuitively correct characterization. Notice in the paraphrase *just* takes effect within the relative-clause modifier of the real subject *something* and does not make any comment on the VP predicate — whether something else sends shivers down to my spine, thus the non-exclusiveness of *just*.

To compositionally derive the above meaning, Coppock & Beaver first takes the *just* in (32) to be a property-modifier derived from its propositional use. This is in line with their general idea of treating exclusives as cross-categorial items, similar to Partee & Rooth's (1983) treatment of *and*. Concretely, *just* has the semantics of P-ONLY in (33), which takes in a property P and returns a modified property[11] that holds of any individual a iff ONLY$(P(a))$ is true, where ONLY is just the canonical sentential *only* we have been talking about.

[11]In (33) P is of type $\langle e,t\rangle$. It is actually better to treat P as of type $\langle e,st\rangle$. See Chapter 2 footnote 7 for discussion. Simplification is made here for convenience, and we assume that there is a way to derive sets of propositions in Heim-Kratzer-Fintel's intensional framework (Heim & Kratzer 1998: §12, von Fintel & Heim 2011).

(33) $[\![\text{P-ONLY}]\!] = \lambda P_{\langle e,t \rangle} \lambda x.[\![\text{ONLY}]\!](P(x))$

Now *just* need a property, but its sister *the thought of him* is not. Coppock & Beaver proposes to use type-shift (Partee 1986): first, $\sigma x.\mathsf{thought.of.him}(x)$ is LIFTed to a quantifier of type $\langle et, t \rangle$. The result $\lambda P.P(\sigma x.\mathsf{thought.of.him}(x))$ is then shifted to the property of being identical to $\sigma x.\mathsf{thought.of.him}(x)$ — $\lambda y.[y = \sigma x.\mathsf{thought.of.him}](x)$[12].

(34) TYPE SHIFT

a. $[\![\text{the thought of him}]\!] = \sigma x.\mathsf{thought.of.him}(x)$

b. $[\![\text{LIFT}]\!] = \lambda x \lambda P.P(x)$

c. $[\![\text{BE}]\!] = \lambda Q \lambda x.Q(\lambda y[x = y])$

Now we have a property that *just* can combine with. Combining P-ONLY with the property $\lambda y.[y = \sigma x.\mathsf{thought.of.him}(x)]$ we get a modified property, which however cannot combine directly with the denotation of the VP *sends shivers down my spine*. Coppock & Beaver proposes to type-shift the modified property into an existential quantifier, using Partee's A, a covert existential determiner essentially.

(35) MORE TYPE SHIFT

$[\![\text{A}]\!] = \lambda P \lambda Q \exists x[P(x) \wedge Q(x)]$

Feeding the modified property to A, we finally get the denotation of *just the thought of him* (36a), which is of quantifier-type and happily combines with *sends shivers down my spine*.

(36) a. $[\![\text{just the thought of him}]\!] =$
$\lambda P \exists y[[\![\text{ONLY}]\!](y = \sigma x.\mathsf{thought.of.him}(x)) \wedge P(y)]$

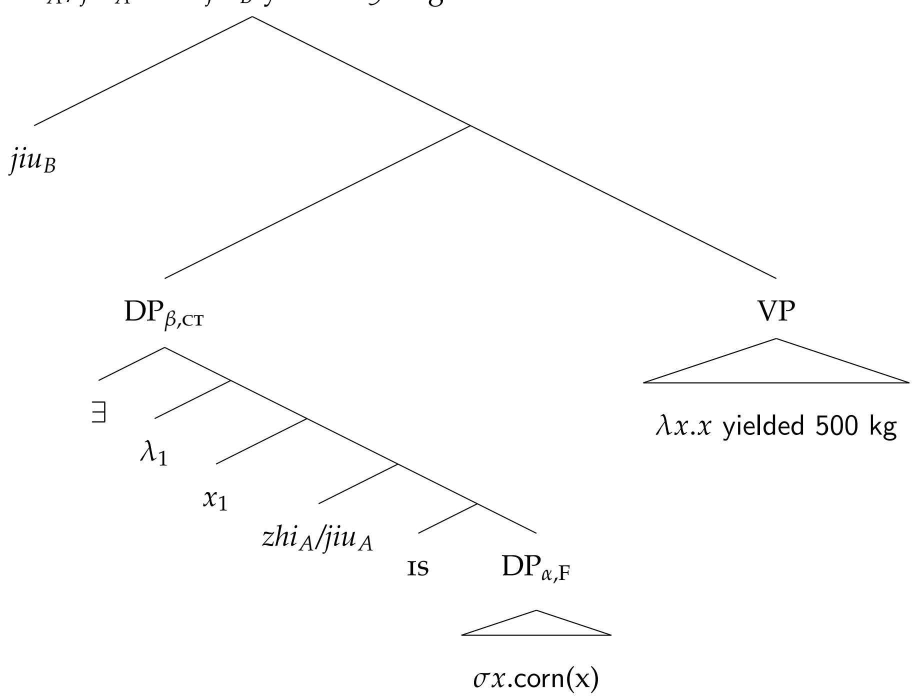
b. $[\![\text{just the thought of him sends shivers down to my spine}]\!] = 1$ iff $\exists y[[\![\text{ONLY}]\!](y = \sigma x.\mathsf{thought.of.him}(x)) \wedge \mathsf{sends.shivers.down.spine}(y)]$

[12]It's unclear to me why Coppock & Beaver chooses to apply LIFT and then BE, instead of just applying Partee's IDENT. Perhaps this has to do with presupposition and Partee's idea of being *natural*.

The final result (36b) provides a intuitively correct characterization of the minimal sufficiency reading: something that is only the thought of him sends shivers down to my spine. The *only* has scope internal to the DP *something*.

I adopt Coppock & Beaver's insight that exclusives can take argument-internal scope, but I implement the idea in a slightly different way. Instead of using type-shifting, I use covert syntactic elements. Specifically, I assume that there is a overt IS interpreted as $\lambda x \lambda y . x = y$[13] that appears between a covert x_i and *yumi* 'corn', which (being a bare NP) is interpreted as a definite (Dayal 2004, 2013). The LF for a too-many-ONLYS sentence (28a) is shown below.

(37) zhi_A/jiu_A corn jiu_B yielded 500kg



In (37), the outer DP - DP_β - is the CT, and it contains a sentential constituent [*x only* IS *the corn*$_F$], within which zhi_A/jiu_A takes scope and is associated with the focus-bearer *the corn*$_F$. The entire sentence has the truth-condition in (38).

(38) (28a) = 1 iff there exists an x, which is only the corn, such that x yielded 500 kg.

[13] IS simply encodes Partee's IDENT.

Furthermore, presuppositions of both zhi_A/jiu_A and jiu_B are satisfied, by considering alternatives of *corn* to be corn ⊕ rice and corn ⊕ potato, all of which presumably would yield more output than corn[14].

Finally notice the difference between Coppock & Beaver 2014 and the analysis proposed here. In my analysis, the CT has a sentential sub-constituent, while in Coppock & Beaver 2014 no clausal structure is posited and type-shifting does all the job. I believe that the clausal-analysis is more compatible with the Mandarin facts. As was discussed in chapter 2, *zhi* and *jiu* are both adverbs, and they never appear within simple nominal arguments. This differs from English exclusives such as *only* that are able to appear within DPs acting as an adjective. To get an adjectival ONLY in Mandarin Chinese, a different item *weiyi* 'only' has to be used (39c) (the *de* below is just a modification marker that occurs between a modifier and the nominal it modifies).

(39) ADJECTIVAL-ONLY

a. John is the only teacher.

b. *Lisi shi zhi/jiu de laoshi.
Lisi BE only/JIU DE teacher
Intended: 'Lisi is the only teacher.'

c. Lisi shi weiyi de laoshi.
Lisi BE only DE teacher
'Lisi is the only teacher.'

4.3.5 Some consequences

The above analysis makes several predictions, two of which we discuss in this subsection.

First, since jiu_B can restrict the scope of a preceding zhi_A/jiu_A, it should also be able to restrict scope of other operators. This is a correct prediction. Negation can also be restricted within the CT preceding *jiu*. Consider the following pair.

(40) NARROW SCOPE NEGATION

[14]Recall from chapter 3 that non-exclusive *jiu* corresponds to collective readings. Do these alternatives predict collective readings? It will be shown below that they do, with an $\uparrow \exists$ that encodes collectivity.

a. mei jigè ren neng taiqi zhejia gangqin
NEG several people can lift this piano
'It's **not** the case that many people can lift this piano.'

b. mei jige ren jiu neng taiqi zhejia gangqin
NEG several people JIU can lift this piano
'The piano can be lifted by [$_{NP}$ a group that does **not** consist of many people].'

In (40a), negation has sentential scope and the sentence implies that the piano is heavy since not many people can lift it. Adding *jiu* as in (40b) completely changes the meaning — now it implies that the piano is not heavy for it can be lifted by a group consisting of not many people; assigning negation a narrow scope within the CT (enforced by *jiu*) correctly captures this meaning.

Second, recall from Chapter 3 that non-exclusive *jiu* correlates with collective readings — for *jiu* to have no exclusive effect, the alternative set has to be atom-based, and predication over atoms amounts to collective readings. Thus we predict the too-many-*onlys* sentences discussed above should have collective readings. This is also a correct prediction.

(41) NON-EXCLUSIVE⇝COLLECTIVE

zhi/jiu yumi he dami jiu shou le wubai gongjin
only/JIU corn and rice JIU yield ASP 500 kg
'Corn and rice alone yielded 500 kg.' COLLECTIVE READING

Compare (41) with (42): the former has multiple ONLYS, is non-exclusive and has a collective reading, while the latter has a single ONLY, is exclusive and has a distributive reading.

(42) EXCLUSIVE⇝DISTRIBUTIVE

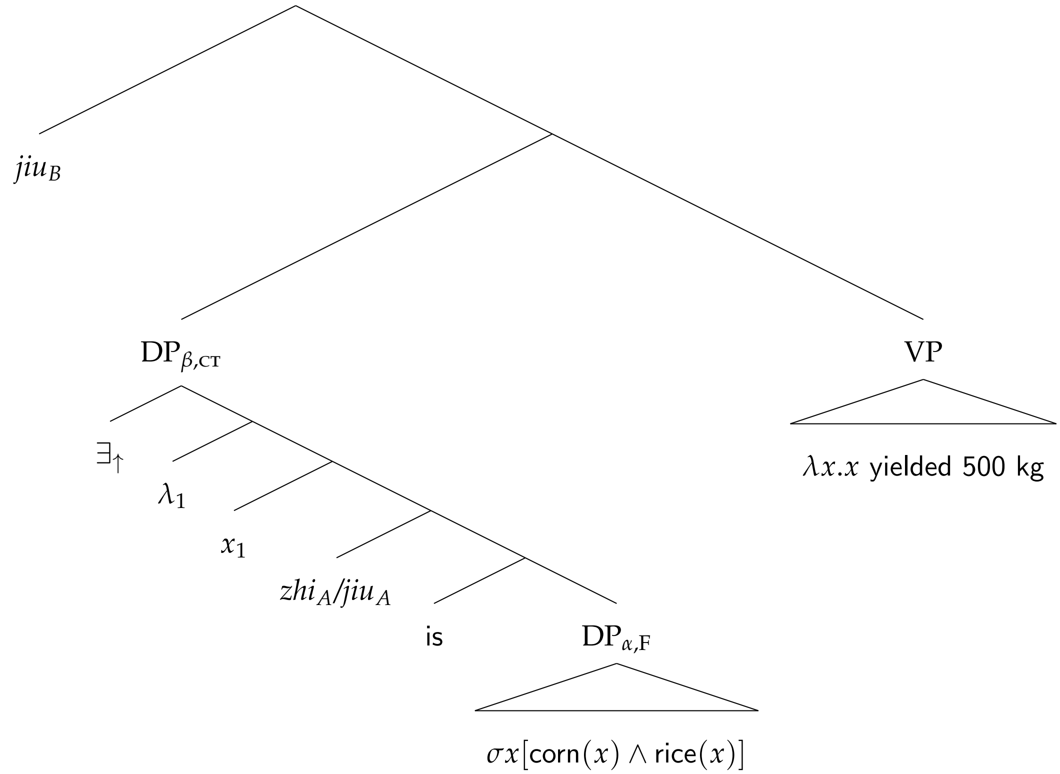
zhi/jiu yumi he dami shou le wubai gongjin
only/JIU corn and rice yield ASP 500 kg
'Only corn and rice yielded 500 kg.'

We can capture the collective reading of (41) using the collective existential $\uparrow\exists$ in (43), with the LF of (41) being (44). The reader can check (or consult Chapter 3...) that a collective and non-exclusive reading is predicted, compatible with the non-exhaustiveness of the CT.

(43) COLLECTIVE EXISTENTIAL

$[\![\exists_{\uparrow}]\!] = \lambda P \lambda Q \exists x[P(\uparrow x) \wedge Q(\uparrow x)]$

(44) zhi_A / jiu_B corn and rice jiu_B yielded 500kg



(45) $[\![(41)]\!]$ is true iff there exists a group which only consists of corn and rice, and that group, which is a small group, yielded 500 kg.

Finally, I would like to mention that there are non-exclusive *only* in English that result from argument-internal scope, besides the examples discussed in Coppock & Beaver 2014.

(46) a. John opened the safe with only a screwdriver.≠ [Rooth 1985: 135]

b. John only opened the safe with a screwdriver.

(46) is interpreted as John opened the safe with [$_{DP}$ something that is only a screwdriver], *only* having internal scope within the PP.

Interestingly, not every PP can restrict *only* in the above way. Consider the following contrast.

(47) a. John read the book for only an hour.=
John only read the book for an hour.

b. John finished the book in only an hour. ≠
??John only finished the book in an hour.

The equivalence in (47a) indicates that *for*-adverbials are not restricted in the same way as *in*-adverbials shown by the non-equivalence in (47b). This is left as a research topic for future.

4.4 Conclusion

In this chapter, we discussed varieties of non-exclusive ONLYS in Mandarin Chinese and English. Nonexclusive ONLYS are rarely discussed in the literature. The chapter fills this gap with both empirical discoveries and theoretical proposals that shed light on how the semantics of ONLY should be set up to capture its nonexclusive uses and the cross-linguistic variations. The following table summarizes non-exclusive exclusives of different species discussed here and in chapter 3.

Non-exclusive by	Topicalization	Narrow Scope	Entailed alternatives
zhi/only	No	Yes	Yes
jiu	Yes	Yes	Yes

A note on change of topics

The last two chapters mainly focused on focus particles. Unified accounts of *jiu* and *dou* (with an emphasis on accounting for systematic 'ambiguities' within the Mandarin focus particle system) were proposed where each particle was associated with varieties of alternatives. Consequences of the proposal were explored, some uncovered by previous accounts.

The next three chapters involve a change of the topic and *wh*-conditionals enter the stage. As already mentioned in Chapter 1, *wh*-conditionals pose a threat for a unified analysis of Mandarin *wh*-items. The rest of the thesis picks up the challenge and offers two slightly different accounts of *wh*-conditionals, both of which take *wh*-conditionals to be an interrogative construction. Crucially, Dayal's answerhood operator, which is sensitive to varieties of alternatives, underlines both accounts and provides explanation for various interrogative properties of *wh*-conditionals such as uniqueness, maximality and minimality.

Chapter 5

Mandarin *wh*-conditionals: challenges and facts

5.1 Introduction

Wh-conditionals refer to a type of construction found in Mandarin (Cheng & Huang 1996, Chierchia 2000) and Udihe[1] (Nikolaeva & M.Tolskaya 2001: 763, Baek 2016: Chapter 6), the defining property of which is that they contain one or more *wh*-phrases in the antecedent clause matched by an equal number of seemingly co-varied *wh*-phrases (as (1a) suggests) in the consequent[2]. Below, (1) is a Mandarin illustration, where paraphrases (1a) (Cheng & Huang 1996, Chierchia 2000) and (1b) (Crain & Luo 2011, Huang 2010) indicate two ways of thinking about its semantics, while (2) a Udihe example from Nikolaeva & M.Tolskaya 2001: 763.

(1) Zhangsan qing le shei, Lisi jiu qing le shei.
Zhangsan invite ASP who, Lisi JIU invite ASP who

a. If Zhangsan invited X, Lisi invited X.

b. Lisi invited who(ever) Zhangsan invited.

(2) Ni galakta-mi ni b'a.
who seek-SIM.CVB who find
'Whoever seeks finds.'

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[1] A Tungussic language spoken in the southern part of Russian Far East. In (2), *mi* is a simultaneous.converb (SIM.CVB) (Baek 2016), a verbal suffix indicating subordination.

[2] The names *antecedent* and *consequent* as well as *wh-conditional* presuppose that we are taking *wh*-conditionals to be a type of conditional (Cheng & Huang 1996, Lin 1996, Chierchia 2000), which however is debatable (Huang 2010, Crain & Luo 2011). We nevertheless have to start somewhere. I will in this section assume following Cheng & Huang, Lin, Chierchia that *wh*-conditionals are conditionals, postponing discussion to later sections.

The current chapter concerns Mandarin *wh*-conditionals, but instead of going immediately after them, we will start with a general (though brief) introduction to Mandarin *wh*-phrases. As will be clear in a minute, our endeavor to keep a unified account of Mandarin *wh*-expressions (one of the themes of the thesis being No Functional Homonyms) creates certain challenges for analyzing *wh*-conditionals.

Besides their role in interrogatives as question words (3a), Mandarin *wh*-expressions have non-interrogative uses: they are interpreted as simple indefinites below negation (3b), as epistemic indefinites in the presence of modals (3c), and they contribute to universal force in the *wh-dou* combination in (3d)[3].

(3) **Mandarin *wh*-expressions** [cf. Chierchia & Liao 2014: 1]

a. Zhangsan qing le shei?
Zhangsan invite ASP who
'Who did Zhangsan invite?' INTERROGATIVE

b. Zhangsan mei qing shei.
Zhangsan NEG invite who
'Zhangsan didn't invite anyone.' NEGATIVE

c. Zhangsan haoxiang chi le shenme.
Zhangsan seem eat ASP what
'Zhangsan might have eaten something.' EXISTENTIAL

d. Zhangsan shenme dou gei le ni.
Zhangsan what DOU give ASP you
'Zhangsan has given you everything.' UNIVERSAL

Crucially, Mandarin *wh*-phrases are restricted in their distribution (in words familiar to syntacticians, they need 'licensing'): they are fine with negation (and other standard DE operators), modals and some focus adverbs like *dou* 'even', *ye* 'also', but are ungrammatical in positive episodic contexts (4). They are Polarity Sensitive Items (PSIs)[4] (Cheng 1997, Lin 1996, Liao 2011).

[3] A fact that I will have to leave to future research.

[4] We construe the term PSI very broadly as including negative polarity items like *ever*, free choice items like *any/irgendein* as well as epistemic indefinites, following Chierchia 2013.

(4) **Mandarin *wh*s as PSIs**

*Zhangsan qing le <u>shei</u>.
Zhangsan invite ASP who
Intended: 'Zhangsan invited <u>someone</u>.'

The polarity-sensitive property of Mandarin *wh*-phrases poses the following challenge to a successful analysis of *wh*-conditionals: if the *wh*-phrases therein are PSIs (as the literature suggests, eg. Cheng & Huang 1996: 133, Chierchia 2000: 36-37), how could they be licensed in the consequent of a conditional, a straightforward upward-entailing context?

Irene Heim (pc. to Cheng & Huang) already expresses this concern (Cheng & Huang 1996: 133). The usual response one can find in the literature is that both the antecedent-*wh* and the consequent-*wh* are licensed – as polarity items – by a covert unselective binder (Cheng & Huang 1996: 133, Chierchia 2000: 36-37). This now seems unsatisfactory in view of our deepened understanding of the polarity system, due to Chierchia 2013.

A second challenge is more specific to the Chierchia-style system of PSIs (Chierchia 2013), within which a unified analysis of Mandarin *wh*-phrases is presented in Liao 2011 and Chierchia & Liao 2014. In Chierchia's system, PSIs are essentially existentials (that obligatorily trigger alternatives), but how could an existential start to sound like a definite (or a bound pronoun) – by co-varying with an antecedent-*wh* – in the consequent of a *wh*-conditional?

Bearing these two questions in mind, we will look at *wh*-conditionals in more detail. Specifically, in this chapter a wide range of semantic properties of *wh*-conditionals are identified which we show speak against the existing accounts of the construction (even taking into consideration imaginable additions and modifications). In the next two chapters two new proposals are provided, both of which are based on the core idea that the *wh*-clauses in a *wh*-conditional are genuine questions, while the entire construction encode a particular relation between them. Properties exhibited in this chapter are shown to receive principled explanation in these two accounts.

The rest of the chapter is structured as follows. In Section 5.2, I familiarize the reader with the basics of Mandarin *wh*-conditionals. In Section 5.3 I review the theoretical options pursued in the literature. In Section 5.4 several phenomena concerning the semantic properties of *wh*-conditionals are uncovered, and their significance to an adequate analysis of *wh*-conditionals discussed. I conclude the chapter in Section 6.1 by summarizing the semantic properties to be explained in later chapters.

5.2 Basics of *wh*-conditionals

The most distinguishable feature of a *wh*-conditional is that its antecedent and consequent contain equal number of *wh*-phrases. There are several initial observations to make regarding these *wh*s. First, any *wh*-phrase can participate in *wh*-conditionals. In other words, the set of *wh*-phrases found in *wh*-conditionals is equivalent to the set of those found in constituent questions (5). Some examples are provided in (6).

(5) ***wh*-phrases in *wh*-conditionals**

	Questions	*wh*-conditionals
shei 'who'	√	√
shenme 'what'	√	√
naer 'where'	√	√
shenme.shihou 'when'	√	√
zenme 'how'	√	√
duoshao 'how much'	√	√
weishenme 'why'	√	√
nage/shenme+ NP 'which/what+NP'	√	√
duo+Adj/Adv 'how much + Adj/Adv'	√	√

(6) a. [$_A$... HOW.MUCH...], [$_C$... HOW.MUCH ...].

Duoshao qian gou chi kaoyao, wo jiu gei ni duoshao qian
how.much money sufficient eat roast.duck, I then give you how.much money

'I will give you the amount of money that is sufficient to eat roast duck.'

b. [$_A$... WHY...], [$_C$... WHY ...]. [Wen 1997: 7]

Zhangsan weishenme bu qu, wo jiu weishenme bu qu.
Zhangsan why NEG go, I then why NEG go
'I will not go for the same reason that Zhangsan will not go.'

c. [A . . . WHICH+NP. . .], [C . . . WHICH+NP . . .].

Zhangsan qing na.liang.ge.ren, Lisi jiu qing na.liang.ge.ren.
Zhangsan invite which.two.CL.person, Lisi then invite which.two.CL.person
'Whichever two persons Zhangsan invites, Lisi invites them.'

Second, a *wh*-conditional can have in principle any (even) number of *wh*-phrases (7).

(7) **Multiple *wh*s**

a. [A . . . WHO . . . WHAT. . .], [C . . . WHO . . . WHAT . . .].

Shei xiang chi shenme, shei jiu ziji.dongshou zuo shenme.
who want eat what, who then self.do make what
'If someone wants to eat something, she makes it by herself.'

b. [A . . . WHO. . . WHEN. . . WHERE. . . WHAT. . .],

[C . . . WHO. . . WHEN. . . WHERE. . . WHAT. . .].

Shei daying shenme-shihou zai shenme-difang deng shei, shei jiu
who promise what-time at what-place wait who, who then
yinggai shenme-shihou zai shenme-difang deng shei.
should what-time at what-place wait who
'If someone promises to wait for someone sometime at some place, he should wait for her at that time at that place.'

[Wen 1997: 6]

Third, the main predicates involved in the antecedent and the consequent of a *wh*-conditional do not have to be identical. Several examples listed above (eg. (6a) and (7a)) already illustrate the point. Furthermore, an antecedent-*wh* does not need to occupy the same syntactic position as its co-varied consequent-*wh* does. In (8a), the antecedent-*wh* is a subject while its consequent-*wh* an object; in (8b), the antecedent-*wh* is a possessor while its consequent-*wh* an embedded subject.

(8) **Different positions**

a. [A . . . SUBJECT.WH. . .], [C . . . OBJECT.WH . . .].

na.yi.ge da, Lisi jiu na le na.yi.ge.
which.one.CL big, Lisi then take ASP which.one.CL

'Lisi took the big one.[5]'

b. [A . . . POSSESSOR.WH. . .], [C . . . SUBJECT.WH . . .].

Shei de gezi zui gao, wo jude shei jiu yinggai dang lingdui.
who DE height most tall, I think who then should serve leader

'I think the tallest person should be the leader.'

Finally, note that all of our examples so far have *jiu* in the consequent. Here are some general remarks about *jiu* in conditionals. A Mandarin conditional (an ordinary conditional, not *wh*-conditional!) usually has in its consequent an adverb *jiu* (Chao 1968, Li & Thompson 1981, Hole 2004), which is standardly glossed as 'then' and assumed to be a conditional marker with no obvious semantic contribution (see eg. Cheng & Huang 1996: 127). (9) illustrates this use of *jiu*: without *jiu*, a juxtaposition of two clauses in Mandarin is interpreted conjunctively (9a), while adding *jiu* turns a (logical) conjunction into a conditional (9b).

(9) ***Jiu* as a conditional marker**

a. A shi hong qiu, B shi lan qiu.
A be red ball, B be blue ball

'Ball-A is red, and ball-B is blue.'

b. A shi hong qiu, B **jiu** shi lan qiu.
A be red ball, B then be blue ball

'If ball-A is red, then ball-B is blue.'

c. Ruguo A shi hong qiu, B kending (jiu) shi lan qiu.
if A be red ball, B must then be blue ball

'If ball-A is red, ball-B must be blue.'

Jiu is also optional when other conditional markers are around. This is the case in (9c), where *ruguo* 'if' and a modal occur in the sentence.

[5] *De* is a modification marker that appears between a noun and its modifiers (adjectives, possessors, relative clauses, etc.) in Mandarin.

Back to *wh*-conditionals, the fact that *jiu* also appears in the consequent of *wh*-conditionals without making any obvious semantic contribution and that it is also optional (Cheng & Huang 1996: 127) — in all of our examples, *jiu* can be omitted without a meaning change — suggests that the *jiu* in *wh*-conditionals, as is in the case of ordinary conditionals, simply marks conditionality. We seem to have a piece of morphological evidence showing that *wh*-conditionals are real conditionals.

A natural question to ask at this moment is whether the conditional *jiu* is the same exclusive *jiu* discussed in the first part of the thesis. I will assume they are, though nothing that I will say about *wh*-conditionals hinges on this. To be exact, there is only one *jiu* — ONLY_{weak}. While it is not responsible for making two clauses into a conditional, its semantics is such that if it occurs in a conditional, it ends up being apparently semantically inert, when we assume that *jiu* takes scope over the entire conditional and the antecedent is F-marked. In other words, $[\![\text{ONLY}_{weak}[A_F > C]]\!] = [\![A > C]\!]$, $>$ being the conditional connective. This is because (i), under the standard analysis of conditionals (Stalnaker 1968, Lewis 1973), conditional antecedents are non-monotonic, and (ii) ONLY_{weak} only negates logically strictly stronger alternatives. Since there is no stronger alternative by (i), ONLY_{weak} has no effect by (ii). Notice that this only explains *jiu*'s apparent semantically inert meaning *if* its prejacent is a conditional. It does not explain why Mandarin Chinese uses *jiu* to mark conditionality (though see Liu forthcoming for an attempt based on the weak-exclusive semantics of *jiu*). Of course it is also possible that there is a separate *jiu* that marks conditionality. The issue bears further discussion, but I hope to have shown that there are plausible ways to maintain the no functional homonyms hypothesis for *jiu* in *wh*-conditionals. For now, however, we turn our attention back to the *wh*-phrases in this construction.

This ends our initial description of Mandarin *wh*-conditionals. As the reader might notice, almost nothing we have said so far concerns the meaning of *wh*-conditionals. This is intended so, since what a *wh*-conditional means is itself debated. We will start to get involved in such a debate in the next section.

5.3 Previous analyses

Two very different conceptualizations of *wh*-conditionals have been proposed in the literature. One sees *wh*-conditionals as involving donkey binding (Cheng & Huang 1996, Chierchia 2000), the other relativization (Huang 2010, Crain & Luo 2011)[6]. The two approaches assign distinct semantics to *wh*-conditionals, to which we turn now.

5.3.1 Donkey binding

Those who assimilate *wh*-conditionals to conditional donkey sentences (Cheng & Huang 1996, Chierchia 2000) take the relation between the *wh*-phrases to be one of co-variation, based on the intuitively felt equivalence between the *wh*-conditional in (10a) and the paraphrase in (10b) or (10c).

(10) **Co-variation**

a. Zhangsan qing le <u>shei</u>, Lisi jiu qing le <u>shei</u>.
   Zhangsan invite ASP who, Lisi JIU invite ASP who

b. If Zhangsan invited X, Lisi invited X.

c. If Zhangsan invited Bill, Lisi invited Bill &

   if Zhangsan invited John, Lisi invited John &

   ...

Just like donkey sentences such as *If Pedro has a donkey*^{x}*, he beats it*$_x$, the co-variation shown in (10a) does not require syntactic c-command. To capture it, Cheng & Huang 1996 and Chierchia 2000 both resort to unselective binding – a mechanism proposed for analyzing donkey sentences (Heim 1982, Kamp 1981). For Cheng & Huang, *wh*-phrases in a *wh*-conditional are treated as Heimian variables ($[\![shei]\!] = \lambda x.\mathsf{animate}(x)$) and a (possibly covert) quantificational adverb unselectively bind them. For Chierchia, the *wh*-items are existential quantifiers, but can be *existentially disclosed* (Dekker 1993) and thus bound by the quantificational adverb in a *wh*-conditional. Both Cheng & Huang and Chierchia agree that (10a) should receive the truth-condition in (11).

[6] More syntactically oriented approaches include Bruening & Tran 2006, Cheung 2006.

(11) $[\![(10a)]\!]$=1 iff $\forall_x[\mathsf{invite}(\mathsf{zs},x) \rightarrow \mathsf{invite}(\mathsf{ls},x)]$

5.3.2 Relativization

Instead of seeing *wh*-conditionals as donkey sentences, Huang 2010 and Crain & Luo 2011 take them to be kin to correlatives.

A correlative, exemplified in (12a) by a Hindi example (Dayal 1996: 12), is a bi-clausal structure that fits into the schema in (12b).

(12) **Correlatives**

a. jo laRikiyaaN khaRii haiN ve lambii haiN
which girls standing are they tall are
'The girls who are standing are tall.'

b. [$_{\text{correlative.clause}}$ ... *wh* ... (*wh*) ...] [$_{\text{main.clause}}$ ... dem... (dem) ...]

c. [$_{\text{antecedent}}$ ... *wh* ... (*wh*) ...] [$_{\text{consequnet}}$ ... *wh* ... (*wh*) ...]

The similarity between *wh*-conditionals and correlatives is obvious: both of them contain *wh*-items in their first clauses[7], the difference being that a correlative has demonstratives/pronouns in its main clause while they are *wh*-phrases in the case of *wh*-conditionals.

Based on the similarity, Huang 2010, Crain & Luo 2011 take *wh*-conditionals to be a type of correlative. The standard treatment of correlatives, following Dayal 1996 is to take the antecedent/correlative-clause as a lifted definite (cf. Jacobson's (1995) treatment of free relatives) and the consequent/matrix-clause as the predicate, the two composed by functional application. In the case of *wh*-conditionals, the antecedent in (10a) will denote $\lambda P.P(\sigma x[\mathsf{invite}(\mathsf{zs},x)])$ and the consequent $\lambda x.\mathsf{invite}(\mathsf{ls},x)$ (Crain & Luo 2011: 173, Huang 2010: 46). The resulting truth-condition is given in (13). Such analyses are called FR-based analyses in the rest of the thesis.

(13) $[\![(10a)]\!]$=1 iff $\mathsf{invite}(\mathsf{ls},\sigma x[\mathsf{invite}(\mathsf{zs},x)])$[8]

[7] *jo* according to Dayal 1991 is a relative morpheme distinct from interrogative pronouns. The gloss of it as 'which' comes from Dayal 1996: 12. Nevertheless, *wh*-morphology is cross-linguistically used in correlatives (see Lipták 2009 for cross-linguistic data).

[8] This is the official semantics Crain & Luo 2011: 173 give (see also Luo & Crain 2011: (52e)), under their

With this minimal background on *wh*-conditionals, we turn to the details of the semantic properties of *wh*-conditionals next. We will show neither of the analyses sketched above can fully capture the meaning of *wh*-conditionals.

5.4 Semantic properties of *wh*-conditionals

The data to be discussed in this section are structured into four parts. In the first part, I look at the debate between unselective binding and FR/correlative. A preliminary result based on the definite behavior of the antecedent (maximality §5.4.1, quantificational invariability §5.4.2 and uniqueness §5.4.3) is reached that favors treating *wh*-conditionals as a kind of correlative. Next in part 2, I modify the correlative-based account by incorporating von Fintel et al.'s (2014) informativity-based maximality operator and a rule of existential shift inspired by Caponigro 2004, to handle minimal *wh*-conditionals §5.4.4 and mention-some *wh*-conditionals §5.4.5. In part 3, properties of the consequent are discussed. In view of consequent exhaustivity and consequent uniqueness §5.4.6, a FR-based equative analysis is entertained. However, in part 4, I present additional data that question the status of Mandarin *wh*-clauses as semantic definites §5.4.7 and data that suggest the relation between the antecedent and the consequent cannot be one of identity §5.4.7 and should be treated as asymmetric §5.4.8. Together, these facts cast serious doubts on treating *wh*-conditionals as FR-based equatives. A new proposal is thus called for.

5.4.1 Maximality

Let's consider again the semantics assigned by the two types of analyses mentioned in the previous section. Below, (14b) represents the truth-condition assigned by unselective binding while (14c) the one assigned by free.relative/co-rrelative. The two are actually equivalent in the case of (14a), for Lisi invited all Zhangsan's invitees iff Lisi invited the maximal group of people that Zhangsan invited (*invite* is cumulative and distributive on its object position). Universal and maximality are neutralized here.

(19e). Their informal paraphrase, which points to treating *wh*-conditionals as equatives, does not match their semantics. The equative analysis is discussed later in the chapter.

(14) **Universal vs. maximality**

a. Zhangsan qing le shei, Lisi jiu qing le shei.
Zhangsan invite ASP who, Lisi JIU invite ASP who

b. $[\![(14a)]\!]=1$ iff $\forall_x[\text{invite}(\text{zs}, x) \rightarrow \text{invite}(\text{ls}, x)]$ Unselective binding

c. $[\![(14a)]\!]=1$ iff $\text{invite}(\text{ls}, \sigma x[\text{invite}(\text{zs}, x)])$ Correlative

However, there are cases where the two can be distinguished. Consider (15) (based on (23a) from Lin 1996: 231).

(15) **Maximality**

a. Nimen dian-li you duo.da de shenshan, jiu na ge duo.da de gei wo.
you strore-in have how.big DE shirt then take CL how.big DE to me
'Give me one of the biggest shirt that your store has.'

b. $\forall d$[your store has shirts d-big in size $\rightarrow$ give me a shirt d-big in size]

c. give me a shirt σd[your store has shirts d-big in size]-big in size

As the gloss indicates, (15a) asks the addressee to give the speaker a d-big shirt such that d is the maximal degree possessed by the shirts in the store. This is predicated by the FR-based analysis (15c), where the maximality operator σ delivers precisely the maximal degree, but not by the unselective binding analysis in (15b), which instead requires that for every degree d such that the store has d-big shirts, the addressee should bring the speaker one shirt of that degree, an incorrect result.

5.4.2 Quantificational invariability

The previous subsection suggests that the antecedent of a *wh*-conditional should be closed by a maximality operator, not by the universal carried by some default quantificational adverb. This immediately leads us to expect there should be no quantificational variability when it comes to adverbs of quantification[9]. On the other hand, unselective binding

[9]This is to assume that adverbs of quantification are able (at least sometimes) to quantify over individuals (eg. Lewis 1975). I will adopt this view for concreteness. The fact (to be shown in this subsection) that *wh*-conditionals do not exhibit real quantificational variability then suggests their antecedents are σ-closed. There is another approach that treats quantificational adverbs as exclusively (in any context) quantifying over situations (eg. Heim 1990, von Fintel 2004, Elbourne 2005). But in the situation-approach, we still

predicts the opposite: since the antecedent is an open sentence, quantification variability should be easy to obtain. Now we look at the behavior of *wh*-conditionals with respect to quantificational adverbs in detail.

Consider (16), where we replace the covert universal assumed by unselective binding with an overt adverb of quantification.

(16) Tongchang, Zhangsan xihuan shei, jiu hui dui shei tebie hao.
usually, Zhangsan like who, then will to who very nice.
Usually, Zhangsan treats who he likes very well.

≈ Zhangsan treats most people that he likes very well.

(16) seems to show *quantificational variability effects* (QVE), in the sense of Lewis 1975[10] and unselective binding naturally accounts for this, as in (17).

(17) $[\![(16)]\!]$=1 iff $\mathsf{Most}_x[\mathsf{like}(\mathsf{zs}, x)][\mathsf{treat.well}(\mathsf{zs}, x)]$

How do FR-based accounts handle QVE? Details aside, there are two types of proposals for QVE with FRs/correlatives in the market. One treats the FRs in the case of QVE as expressing an open sentence and thus amenable to unselective binding (Berman 1994), with a mapping algorithm that maps the FR into the restriction of the adverbial quantifier. This analysis would assign (17) as the truth condition of (16).

The other type of analyses treats QVE in FRs as (exclusively) quantifying over situations and thus maintains the standard definite semantics of FRs (Dayal 1995). But which situations? Dayal wants minimal situations that contain individuals denoted by the FR

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need to distinguish between whether it is an indefinite in the restriction $Q_{adv}[\lambda s.\exists x \ldots][\lambda s. \ldots]$ or a definite $Q_{adv}[\lambda s.\sigma x \ldots][\lambda s. \ldots]$ (these two presumably have different behaviors). The discussion in this subsection according to this view can be taken to suggest that *wh*-conditionals belong to the latter category.

[10]Typical Mandarin donkey sentences having indefinites in the antecedent and pronouns in the consequent behave the same:

(i) Tongchang, (ruguo) Zhangsan xihuan yi.ge.ren, jiu hui dui ta tebie hao.
usually, (if) Zhangsan like one.CL.person, JIU will to him very nice.
'Usually, if Zhangsan like a person, he treats him very well.'
≈ Zhangsan treat most people that he likes very well.

(uniqueness relativized to each minimal situation), as in (18).[11]

(18) $[\![(16)]\!]$=1 iff $\textsf{Most}[\lambda s_{\textsc{min}}.\textsc{in}(\sigma x.\textsf{likes}(\textsf{zs}, x, s), s)]$
$[\lambda s \exists s'.s \leq s' \wedge \textsf{treat.well}(\textsf{zs}, \sigma x.\textsf{likes}(\textsf{zs}, x, s), s')]$[12]

In (18), since each minimal situation contains only one individual, quantifying over them amounts to quantifying over individuals. QVE thus obtains.

However, not every *wh*-conditional shows QVE. Consider (19).

(19) Tongchang, Zhangsan qing <u>shei</u>, Lisi jiu qing <u>shei</u>.
usually, Zhangsan invite who, Lisi then invite who
Lisi usually invites who Z invites.

$\not\approx$ Lisi invites most people that Z invites.

Unselective binding gives wrong truth conditions for (19), as shown in (20).

(20) $[\![(19)]\!]$=1 iff $\textsf{Most}_x[\textsf{invite}(\textsf{zs}, x)][\textsf{invite}(\textsf{ls}, x)]$

According to (20), (19) is true iff Lisi invites most of Zhangsan's invitees, which is a meaning the sentence does not have. Instead, the sentence can only mean for most relevant situations, Lisi invited *the* people Zhangsan invited. The two are different: suppose that there were three inviting situations/events in the past; in every situation/event, there was exactly one person that Zhangsan invited but Lisi didn't. In this case, (19) is false (they never invited the same group of people!) but (20) is most likely to be true. It is clear then that *tongchang* 'usually' quantifies over situations in this case.

Adding a situation variable to (20), as in (21), does not save unselective binding. Intuitively, we want to quantify over situations that are large enough to hold all of Zhangsan's invitees given a particular inviting event. (21), which breaks big situations into

[11] Being a variant of Dayal 1995, Hinterwimmer 2008 takes FRs (in the case of QVE) to denote *kinds* and propose that adverbs quantify over situations that contains realizations of the kind denoted by the FR. What we will say applies to such a proposal as well.

[12] $\lambda s_{\textsc{min}}.P(s)$ picks out the set of minimal situations that satisfy P. This and the extension relation $\leq$ presuppose a space of situations having a mereological structure (Kratzer 1989, Fine 2012).

smaller individual-situation pairs, would be too fine-grained.

(21) $[\![(19)]\!]$=1 iff $\mathsf{Most}_{x,s}[\mathsf{invite}(\mathsf{zs}, x, s)][\mathsf{invite}(\mathsf{ls}, x, s)]$

Other adverbs of quantification behave the same. (22) cannot mean Lisi invites someone that Zhangsan invites, which is far too weak.

(22) Youshi, Zhangsan qing <u>shei</u>, Lisi jiu qing <u>shei</u>.
sometimes, Zhangsan invite who, Lisi then invite who
'Lisi sometimes invites who Z invites.'

$\not\approx$ Lisi invites someone that Z invites.

How about FR-based analyses? Berman's (1994) proposal equals to unselective binding, so it will not work. It turns out that Dayal's (1995) analysis, as in (23), fares no better.

(23) $[\![(19)]\!]$=1 iff $\mathsf{Most}[\lambda s_{\textsc{min}}.\textsc{in}(\sigma x.\mathsf{invite}(\mathsf{zs}, x, s), s)]$
$[\lambda s \exists s'.s \leq s' \wedge \mathsf{invite}(\mathsf{ls}, \sigma x.\mathsf{invite}(\mathsf{zs}, x, s), s')]$

It is obvious why (23) fails: we want large situations that contain all of Zhangsan's invitees given an inviting event, but the minimality condition in (23) breaks big situations into minimal ones which contain only singular individuals[13], and thus it does not help the matter.

The contrast between (16) and (19)[14] has an analog in the plurality literature. Consider (25) (Lasersohn 1995, Schwarzschild 1996, Champollion 2010, a.o.).

(25) **Shoes vs. suitcases**

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[13]To illustrate, a s_1 where Zhangsan invites John is strictly smaller than a s_2 where Zhangsan invites John and Mary, and both s_1 and s_2 satisfy $\lambda s.\textsc{in}(\sigma x.\mathsf{invite}(\mathsf{zs}, x, s), s)$. They satisfy the condition by being a situation where the individual(s) Zhangsan invites in that situation is in that situation

[14]The corresponding English FRs seem to behave the same. If that's true, what I suggest below as an explanation to the contrast between (16) and (19) applies to English FRs as well.

(24) a. What you find at a yard sale is often junk. (Caponigro 2003) QVE
b. Usually, John invites who Bill invites. No QVE

a. The shoes cost fifty dollars.

b. The suitcases weigh fifty pounds.

While (25a) has a reading that each pair of shoes costs fifty dollars, (25b) does not. The latter can only mean that each suitcase weighs fifty pounds or all of them together do so.

To account for the type of quantificational variability exhibited in (25), Schwarzschild 1996 proposes that there should be a context dependent free variable C that represent how we divide up the universe of discourse into smaller groupings, as in (26).

(26) a. $[\![(25a)]\!]$=1 iff $\forall x[C(x) \wedge x \leq \mathsf{the.shoes} \rightarrow \mathsf{fifty.dollars}(x)]$

b. $[\![(25b)]\!]$=1 iff $\forall x[C(x) \wedge x \leq \mathsf{the.suitcases} \rightarrow \mathsf{fifty.pounds}(x)]$

Since shoes typically come in pairs, the C in (26a) consists of pairs of shoes, and the reading that each pair of shoes costs $50 follows. Out of the blue, suitcases do not have this option.

We can bring in the same context dependency to adverbs of quantification. Assuming a FR-based analysis of *wh*-conditionals for now, I propose (27).

(27) a. $[\![(16)]\!]$=1 iff $\mathsf{Most}[\lambda s.C(s)][\lambda s.\mathsf{treat.well}(\mathsf{zs}, \iota x.\mathsf{likes}(\mathsf{zs}, x, s), s)]$

b. $[\![(19)]\!]$=1 iff $\mathsf{Most}[\lambda s.C(s)][\lambda s.\mathsf{invite}(\mathsf{ls}, \iota x.\mathsf{invite}(\mathsf{zs}, x, s), s)]$

The contrast between (16) and (19) is similar to the contrast between shoes and suitcases. Since a liking situation typically contains a single liked person while an inviting situation contains multiple invitees, the former but not the latter can be reduced to quantification over individuals. Thus, pseudo-QVE happens with the former but not the latter.

Can the same mechanism save unselective binding? For example, we might have (28), which is equivalent to (27b) (*invite* is cumulative and distributive on its object position).

(28) $[\![(19)]\!]$=1 iff $\mathsf{Most}_s[C(s)][\forall x[\mathsf{invite}(\mathsf{zs}, x, s) \rightarrow \mathsf{invite}(\mathsf{ls}, x, s)]]$

But (28) is not an *unselective* binding account any more. The inner universal selectively binds the individual variable while the outer *most* selectively binds the situation variable.

It's time to summarize. We have seen that *wh*-conditionals do not allow QVE (19), quantificational adverbs in the case of *wh*-conditionals only quantify over situations, and pseudo-QVE such as (16) happens when the situations quantified over all contain single individuals. This picture casts serious doubt on analyses based on unselective binding, for which QVE is the main motivation. Standard FR-based analyses that take quantificational adverbs to exclusively quantify over atomic/minimal situations cannot capture the complexity of the data either; contextually determined quantificational domains (similar to Schwarzschild's cover) need to be employed.

5.4.3 Uniqueness

A FR-based analysis also leads us to some form of uniqueness effect within *wh*-conditionals, because of the uniqueness presupposition carried by definites/σ. This is a nice prediction. Consider (29), where we replace *shei* 'who' in (1) with *na liang.ge.ren* 'which two.persons':

(29) **Quantized *wh*-phrases → uniqueness**

Zhangsan qing le na.liang.ge.ren, Lisi jiu qing le
Zhangsan invite ASP which.two.CL.person, Lisi then invite ASP
na.liang.ge.ren.
which.two.CL.person
Whichever two persons Zhangsan invited, Lisi invited them.

(29) has a presupposition that Zhangsan invited exactly two persons[15]. Notice that (29) is an episodic past statement. The corresponding multi-cases *wh*-conditional (30) (notice that it does not have the aspectual marker *le*) also shows uniqueness, but one that is relativized to each inviting event/situation — for every inviting event under discussion, Zhangsan invites exactly two persons. This result can be obtained once we have (i) an analysis of how the base case in (29) works, (ii) how adverbs of quantificaiton behave (which quantify over situations in the case of *wh*-conditional, a conclusion we

[15]English FRs seem to behave the same: *whichever two win the game should buy me a drink* presupposes that there will be exactly two winners.

already arrived at from the previous subsection), and (iii) how presuppositions project over quantitifers. For simplicity, we will not discuss (30) in any detail but focus on the base case in (29) instead.

(30) Yizhi.yilai Zhangsan qing na.liang.ge.ren, Lisi jiu qing na.liang.ge.ren.
Always Zhangsan invite which.two.CL.person, Lisi then invite which.two.CL.person
'Lisi always invites whichever two persons Zhangsan invites.'

It is easy to see that unselective binding does not capture uniqueness. Consider the meaning it would assign to (29):

(31) $\forall_X[(\mathsf{invite}(\mathsf{zs}, X) \wedge \mathsf{2.persons}(X)) \rightarrow (\mathsf{invite}(\mathsf{ls}, X) \wedge \mathsf{2.persons}(X))]$

We may debate about whether the $\forall$ in (31) carries an existential import (a lower-bounding presupposition) (Strawson 1950) , but certainly it does not specify exactly how many individuals should satisfy its restriction. In other words, uniqueness, which amounts to both lower-bounding and upper-bounding, cannot be captured by $\forall$.

A FR-based analysis in (32)[16] captures this uniqueness presupposition.

(32) $\mathsf{invite}(\mathsf{ls}, \sigma X.(\mathsf{invite}(\mathsf{zs}, X) \wedge \mathsf{2.persons}(X)))$

To see why uniqueness is captured, we need to look into the semantics of σ/definiteness. Following Sharvy 1980 and Link 1983, we take σ to be presuppositional: $\sigma x.P(x)$ is defined only if the mereological sum of all the individuals that satisfy P is itself in P[17]; if defined, it denotes that mereological sum.

[16]In (32), I suppress the situation variable (motivated in the previous subsection to handle adverbs of quantification) in the absence of adverbial quantifiers. I also treat *na liang.ge.ren* 'which two.CL.persons' in the consequent as an unanalyzed variable X. We could also take the consequent-*na liang.ge.ren* to be $X \wedge \mathsf{2.persons}(X)$, in which case the entire consequent will come out as $\lambda X.\mathsf{invite}(\mathsf{ls}, X) \wedge \mathsf{2.persons}(X)$ and the resulting *wh*-conditional $\mathsf{invite}(\mathsf{L}, \sigma X.(\mathsf{invite}(\mathsf{zs}, X) \wedge \mathsf{2.persons}(X))) \wedge \mathsf{2.persons}(\sigma X.(\mathsf{invite}(\mathsf{zs}, X) \wedge \mathsf{2.persons}(X)))$. Since the second conjunct of this truth-condition is vacuously true, this is equivalent to (32).

[17]We write $\sigma x.P(x)$ for $\sigma(\lambda x.P(x))$ and don't distinguish sets and their characteristic functions. We also use : and . to enclose presuppositions (Heim & Kratzer 1998).

(33) $\sigma = \lambda P : \bigoplus P \in P. \bigoplus P$

Feeding (33) into (32), we get uniqueness. To illustrate, consider Zhangsan invites 3 persons a, b and c; in this case, the P is $\lambda X.(\mathsf{invite}(\mathsf{zs}, X) \wedge \mathsf{2.persons}(X)) = \{\mathsf{a} \oplus \mathsf{b}, \mathsf{a} \oplus \mathsf{c}, \mathsf{b} \oplus \mathsf{c}\}$; however, $\bigoplus P = \mathsf{a} \oplus \mathsf{b} \oplus \mathsf{c}$ and is not a member of P; σ's presupposition is thus not satisfied. In general, for quantized predicates (Krifka 1989) such as $\lambda X.(\mathsf{invite}(\mathsf{zs}, X) \wedge \mathsf{2.Persons}(X))$ to combine with σ, the predicate has to be a unit set, that is, to contain a unique member.

In sum, uniqueness in *wh*-conditionals is captured by FR-based-analyses[18] but not by unselective binding. It seems that we have nailed down the FR-based analysis as *the* correct analysis of *wh*-conditionals. Unfortunately the matter is not so simple; from the next subsection on, we will turn to semantic and pragmatic properties that are still problematic for standard FR-based analyses. But before that, I would like to clarify again the uniqueness presupposition of *wh*-conditionals we have been discussing in this subsection, by comparing it with the uniqueness usually associated with donkey sentences (see especially Kadmon 1990).

A comparison with donkey-sentences

(34) from Kadmon 1990: (42) has been claimed to carry "an implication of absolute uniqueness" (Kadmon 1990: 302). Is this the same uniqueness observed in *wh*-conditionals?[19]

(34) If there is a doctor in London, he is Welsh.

Before answering the question, I would like to make a simplification. To avoid confronting the E-type vs. dynamic-semantics debate (at least for now) on donkey anaphora[20], let's consider (35), where the pronoun is replaced by an explicit definite. The uniqueness implication stays the same (I hope).

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[18] Actually the consequent also carries uniqueness: (29) presupposes that Lisi invites exactly 2 persons. This cannot be captured by the correlative analysis sketched in this subsection, but is related to the exhaustive flavor to be discussed in §5.4.6.

[19] I thank Simon Charlow for asking me to be explicit about this.

[20] For a dynamic analysis of uniqueness effects, see (Brasoveanu 2008).

(35) If there is a doctor in London, the doctor is Welsh.

What kind of uniqueness implication does (35) carry? It seems that (35) as an entire sentence presupposes that there is at most one doctor in London ($[\![\text{doctor}]\!] \leq 1$), a weak-uniqueness presupposition in the terminology of Coppock & Beaver 2015. In other words, existence is not presupposed but only entertained as a possibility. This is expected under (i) the standard Fregean treatment of definites where both existence and weak-uniqueness are presupposed, and (ii) those presuppositions arsing in the consequent of a conditional but entailed by the antecedent are filtered out (Karttunen 1973). In (35), the definite in the consequent triggers both existence and weak-uniqueness; since existence is entailed by the antecedent, the entire sentence only inherits the weak-uniqueness as its presupposition.

In contrast, a *wh*-conditional presupposes both existence and weak-uniqueness ((29) presupposes *Zhangsan actually invited exactly two persons*, but not *if Zhangsan invited anyone, he invited exactly two persons*), and this is predicted by the FR-based analysis, where a presupposed maximality itself is encoded in the antecedent of a *wh*-conditional.

Interim summary

The table in (36) summarizes our discussion so far, where UB stands for unselective binding and F/C free.relative/correlative. An interim conclusion is reached that favors treating Mandarin *wh*-conditionals as a type of correlative.

(36)

	UB	F/C
Maximality	$*$	$\surd$
Quantificational invariability	$*$	$\surd$
Antecedent uniqueness	$*$	$\surd$

5.4.4 Minimality

Consider (37), which has a upward scalar predicate *gou* 'sufficient' (see Beck & Rullmann 1999 for discussion of *sufficient* and other upward scalar predicates).

(37) **Upward scalar predicates → minimality**

Duoshao qian gou chi kaoyao, wo jiu gei ni duoshao qian
how.much money sufficient eat roast.duck, I then give you how.much money

a. I will give you the (minimal) amount of money that is sufficient to eat roast duck.

b. ≠for every d such that d-amount of money is sufficient to eat roast duck, I will give you money of d-amount.

c. ≠I will give you the maximal amount of money that is sufficient to eat roast duck.

Intuitively, (37) means that I will give you the (minimal) amount of money that is sufficient to eat roast duck. Unselective binding, which delivers (37b), obviously does not capture this.

Even FR-based analyses that rely on classical σ does not work: σd. [d-amount of money that is sufficient to eat roast duck] will take us to (37c), which fares no better.

We may change the semantics of σ to save FR-based analyses. (38) is a recent proposal by von Fintel et al. 2014 which tries to modify σ to accommodate upward-scalar predicates.

(38) **Informativity-based σ^I**

$\sigma^I x.P(x)$ is defined in w only if there is a unique individual a such that $P(a) = 1$ in w, and for all b such that $P(b) = 1$ in w, $\lambda w.P(a) = 1$ in $w \subseteq \lambda w.P(b) = 1$ in w. The reference of $\sigma^I x.[P(x)]$ (when defined) is a.

$\sigma^I x.P(x)$ also encodes a uniqueness presupposition, but instead of checking whether there is a unique individual in P that has everything else in P as its mereological part, it checks whether there is a unique individual in P that is more informative given P than any other individuals in P. Given two individuals a, b and a predicate P, how do we determine which one is more informative? We check the entailment between the corresponding propositions $\lambda w.[P(a) = 1 \text{ in } w]$ and $\lambda w.[P(b) = 1 \text{ in } w]$: a is more informative than b given P iff the former proposition (asymmetrically) entails the latter. Then, if this new uniqueness presupposition is satisfied, $\sigma^I x.P(x)$ will have this most informative individual as its reference.

σ^I applied to the minimal *wh*-conditionals in (37) delivers (39).

(39) $[\![(37)]\!]$ =1 iff $\mathsf{I.give.you}(\sigma^I d.\mathsf{sufficient.for.roast.duck}(d))$

In (39), $\sigma^I d.\mathsf{sufficient.for.roast.duck}(d)$ picks out the minimal amount of money that is sufficient to eat roast duck, because the smaller d gets, the more informative it becomes (that is, for all $d \leq d'$, $\lambda w.[d$ is sufficient for roast duck in $w] \subseteq \lambda w.[d'$ is sufficient for roast duck in $w]$). We get the correct interpretation in (37a) and minimal *wh*-conditionals are explained.

The reader may consult von Fintel et al. 2014 to see that σ^I does not differ from the classical σ in cases of downward-scalar predicates such as $\lambda x.\mathsf{invite}(\mathsf{ls}, x)$. Our previous results concerning maximality §5.4.1 are therefore retained.

5.4.5 Mention-some

Consider (40), the antecedent of which is interpreted existentially[21].

(40) <u>nar</u> neng maidao jiu, wo jiu qu <u>nar</u>.
where can buy liquor, I then go where
'I will go where I can get liquor.'

a. = I will go to some place(s) where I can get liquor.

b. ≠ I will go to (all) the places where I can get liquor.

(40) intuitively means (40a): I will go to some place where I can get liquor. An σ(or σ^I)-based definite (or unselective binding with covert universal) however can only get us (40b). A similar example is given in (41), which obviously does not mean that I will marry all the rich people.

[21]For English existential free relatives, see Caponigro 2003, Sternefeld 2009, Hinterwimmer 2013, Chierchia & Caponigro 2013.

(41) shei you qian, wo jiu jia gei shei.
who have money, I then marry to who
'I will marry someone who is rich.'

To handle these mention-some *wh*-conditionals, we may add *existential shift* inspired by Caponigro's (2003) way of handling existential free relatives (which again is built on Partee 1986, Chierchia 1998b, Dayal 2004) into our toolbox: first, we shift the consequent into $\lambda P.\exists x[\textsc{place}(x) \wedge \text{I.go.to } x \wedge P(x)]$; we do not apply σ to the antecedent-predicate $\lambda x.\textsc{place}(x) \wedge \textsc{at}(\text{a.liquor.store}, x)$ but feed it directly into the shifted existential. The resulting (42) adequately captures (40).

(42) $[\![(40)]\!] = 1$ iff $\exists x[\textsc{place}(x) \wedge \text{I.go.to}(x) \wedge \textsc{at}(\text{a.liquor.store}, x)]$

Existential shift obviously overgenerates[22]; to witness, none of the other *wh*-conditional examples dicussed above can be interpreted existentially. We will discuss possible constraints on existential *wh*-conditionals in §6.2.5, after we present our analysis in §6.1.

Interim summary

The table in (43) again summarizes our discussion, where F/C$^+$ is the modified correlative analysis, which incorporates von Fintel et al.'s (2014) informativity-based maximality operator and a rule of existential shift inspired by Caponigro 2003.

(43)

	UB	F/C	F/C$^+$
Maximality	$*$	$\surd$	$\surd$
Quantificational invariability	$*$	$\surd$	$\surd$
Antecedent uniqueness	$*$	$\surd$	$\surd$
Minimality	$*$	$*$	$\surd$
Mention-some	$*$	$*$	$\surd$

[22] Chierchia & Caponigro 2013 makes this point for free relatives. To be fair, Caponigro 2003 discusses ways to constrain the distribution of existential free relatives. In particular, in Caponigro's analysis, free relatives are λ-abstracts/sets (with *wh*-words being set-restrictors) that undergo type-shift before combining with the matrix predicate. According to the ranking in Dayal 2004, existential shift is ranked lower than σ-shift, and thus existential free relatives are rare.

5.4.6 Exhaustivity and consequent uniqueness

The consequents of *Wh*-conditionals are interpreted exhaustively. Consider (44), where the exhaustive flavor is indicated by the *only/exactly* in the gloss.

(44) Chi duoshao, jiu cheng duoshao.
eat how.much, then fill how.much
Fill the plate with *only/exactly* the amount of food that you will eat.

Neither unselective binding nor our modified correlative analysis captures this. Both of them deliver a reading that can be roughly paraphrased as *fill the plate with the amount of food that you will eat*, weaker than (44).

The exhaustive flavor does not seem due to pragmatic strengthening. First, neither universal statements nor correlatives (Hindi correlatives for example) or English free relatives are strengthened in this way. Second, the exhaustive flavour does not disappear in downward entailing contexts, in contrast to other pragmatic strengthening phenomena such as scalar implicatures which usually disappear in such contexts (Horn 1989, Chierchia 2013). Consider (45), where (44) is embedded under negation.

(45) Zhangsan meiyou [$_{wh\text{-conditional}}$ chi duoshao, cheng duoshao].
Zhangsan not eat how.much, fill how.much
Zhangsan didn't fill the plate with *only/exactly* the amount of food that he would eat.

The embedded *wh*-conditional in (45) is naturally interpreted exhaustively (indicated by the *only/exactly* in the gloss), suggesting a semantic way of capturing it.

A FR-based *equative* analysis captures the exhaustive flavor. Instead of taking the consequent of a *wh*-conditional as a λ-abstract/predicate, we could take it to be another free-relative (a definite); then the relation between the antecedent-FR and the consequent-FR is that of identity. The meaning obtained this way is in (46).

(46) $\sigma x.\text{you.eat}(x) = \sigma x.\text{you.fill.the.plate.with}(x)$

(46) captures the exhaustive flavour: the food with which you fill the plate has to be exactly the food you eat, not more (= exhaustivity).

Exhaustivity in *wh*-conditionals has also been discussed elsewhere. Wang 2016 treats *wh*-conditionals as a bi-conditional ($[\![P(wh), Q(wh)]\!] = 1$ iff $\forall x[[\![P]\!](x) \leftrightarrow Q(x)]$ Wang 2016: 74), which is equivalent to (46) for all of the examples Wang dicusses. Below, (47) is an interesting example from (Wang 2016: 69).

(47) shenme pianyi, Zhangsan jiu mai le shenme.
what cheap, Zhangsan then buy ASP what
'All things Zhangsan bought are cheap.'

Consider the meaning (47) conveys. Its antecedent receives an existential interpretation — Zhangsan bought *some but not all* things that are cheap. But its consequent is interpreted exhaustively — *all* things Zhangsan bought are cheap (or equivalently Zhangsan *only* bought cheap things). Wang uses this example to illustrate the existence of what we call exhaustivity here, but she fails to explain how the bi-conditional semantics she entertains can be weaken to $\forall x[\mathsf{cheap} \leftarrow \mathsf{Zhangsan.bought}(x)]$. The FR-based equative analysis we are considering, where the quantification force of the antecedent and that of the consequent can be manipulated separately, offers a way. In (47), the σ-closed consequent, after combining with an identity relation, goes through existential shift (see the previous subsection) and combines with the antecedent which remains open and not σ-closed, the end result being $\exists X[\mathsf{cheap}(X) \land X = \sigma X.\mathsf{Zhangsan.bought}(X)]$, an intuitively correct meaning for (47).

Finally, notice that an FR-based equative analysis also captures the consequent uniqueness presupposition (footnote 18). Our previously discussed (29), repeated here as (48), besides the antecedent uniqueness presupposition *that Zhangsan invites exactly two persons*, also carries a consequent uniqueness presupposition *that Lisi invites exactly two persons*. An FR-based equative analysis captures this uniqueness presupposition with a second σ.

(48) Zhangsan qing le na.liang.ge.ren, Lisi jiu qing le
Zhangsan invite ASP which.two.CL.person, Lisi then invite ASP
na.liang.ge.ren.
which.two.CL.person

'Whichever two persons Zhangsan invited, Lisi invited just them.'

It needs to be noted that consequent uniqueness is different.from/independent.of exhaustivity. This may not be obvious in (48), since what is presupposed by consequent uniqueness is also asserted by exhaustivity (*Lisi only invited who Zhangsan invited* & *Zhangsan invited exactly two persons* $\rightarrow$ *Lisi invited exactaly two persons*), but we can distinguish them by embedding (48) under presupposition holes such as questions, negaton and possibility modals. The question in (49) below does not assert that Zhangsan and Lisi invited the same group of people but still conveys that Lisi invited exactly 2 persons, and this can only be obtained by consequent unqiueness.

(49) Shi-bu-shi Zhangsan qing le na.liang.ge.ren, Lisi jiu qing le
BE-NEG-BE Zhangsan invite ASP which.two.CL.person, Lisi then invite ASP
na.liang.ge.ren?
which.two.CL.person
'Is it true that the two people Lisi invited are the two people Zhangsan invited?'

Interim summary

Based on data concerning exhaustivity and consequent uniqueness in *wh*-conditionals, we have established that *wh*-conditionals are not simple-minded correlatives. We have thus turned to a FR-based equative analysis. (50) summarizes.

(50)

	UB	F/C	F/C$^+$	EQUATIVE
Maximality	*	√	√	√
Quantificational invariability	*	√	√	√
Antecedent uniqueness	*	√	√	√
Minimality	*	*	√	√
Mention-some	*	*	√	√
Exhaustivity	*	*	*	√
Consequent uniqueness	*	*	*	√

Next, we will however present several pieces of evidence that speak against the FR-based equative analysis. They suggest that (i) the antecedent and the consequent of a *wh*-conditional do not behave like free relatives, and (ii) the relation between the antecedent and the consequent cannot be that of equation.

5.4.7 Interaction with conjunctions

First, a FR-based equative analysis takes Mandarin *wh*-conditionals as involving relativization. However, outside *wh*-conditionals, *wh*-words are never used in any form of relativization such as relative clause formation or (single) free relatives. Below, (51a) illustrates how a typical Mandarin relative clause works. Roughly, Mandarin relatives clauses occur before their head nouns, with a modifier marker *de* appearing in between. The head noun can also be omitted as in (51b), resulting a structure similar to English free relatives (see Aoun & Li 2003: chapter 5 for a detailed discussion of these null-head relative clauses). Crucially, no relative pronouns can be used. As shown in (51c) and (51d), adding a *wh* simply causes ungrammaticality (either with or without *de*). This is surprising given that the equative analysis is *based on* free relatives[23].

(51) **No *wh* in Mandarin relativization**

a. Zhangsan qing.le [$_{DP}$[$_{rel.clause}$ Lisi qing.le de] ren].
Zhangsan invite.ASP Lisi invite.ASP DE people
'Zhangsan invited the people that Lisi invited.'

b. Zhangsan qing.le [$_{DP}$[$_{null\text{-}head.RC}$ Lisi qing.le de]].
Zhangsan invite.ASP Lisi invite.ASP DE
'Zhangsan invited who Lisi invited.' [cf. Cheng & Huang 1996: (78)]

c. *Zhangsan qing.le [$_{DP}$[$_{rel.clause}$ Lisi qing.le shei (de)]] ren.
Zhangsan invite.ASP Lisi invite.ASP who DE people

d. *Zhangsan qing.le [$_{DP}$[$_{free.relative}$ Lisi qing.le shei (de)]].
Zhangsan invite.ASP Lisi invite.ASP who DE

For the sake of argument, let's grant that there are free relatives in Mandarin, and

[23]The point is also stressed in Cheng & Huang 1996: §6.1 as motivation for not adopting a correlative analysis for *wh*-conditionals.

specifically, free relatives only appear in pairs in *wh*-conditionals. Even this would not work, as the following data involving conjunction in *wh*-conditionals show.

There are several connectives in Mandarin that correspond to English *and*. The most frequent one is *he*. As shown in (52a)-(52e) and discussed in Chao 1968: 8.4.2 and Lü 1980: 615 (page references are to Lü 1999), *he* can only conjoin noun phrases and is thus glossed as 'and$_T$' ($_T$ stands for *terms phrases*) — using *he* to conjoin VPs and clauses as in (52d) and (52e) gives rise to ungrammaticality. Crucially, *he* cannot be used to conjoin *wh*-clauses in a *wh*-conditional (52f).

(52) **Term conjunction**

a. Zhangsan [he] Lisi
Zhangsan and Lisi
'Zhangsan and$_T$ Lisi' — Proper names

b. Zhangsan qing de [he] Lisi qing de
Zhangsan invite DE and$_T$ Lisi invite DE
'Who Zhangsan invited and who Lisi invited' — Null-head RCs

c. henduo xuesheng [he] yixie laoshi
many student and$_T$ some teacher
'Many students and some teachers' — Quantifiers

d. *Zhangsan tou.teng [he] outu
Zhangsan head.ache and$_T$ vomit
Intended 'Zhangsan has a headache and vomits.' — VPs

e. *Jintian meiyou xiayu, [he] tianqi hen liangshuang
today NEG rain, and$_T$ weather very cool
Intended 'It is not raining and the weather is very cool.' — Clauses

f. ***Wh*-clauses are not terms**

*shei tou.teng, [he] shei outu, shei jiu yao jinxing jiancha.
who head.ache, and$_T$ who vomit, who then should take examination

Nevertheless, *wh*-clauses in *wh*-conditionals can still be conjoined, and in these cases, we can use *yiji* or *haiyou*, both of which can be glossed as 'and'. See (53) for an example.

(53) **Conjunction of *wh*-clauses in *wh*-conditionals**

shei tou.teng, yiji/haiyou shei outu, shei jiu yao jinxing jiancha.
who head.ache, and who vomit, who then should take examination

'Those who have headaches and those who vomit should take the examination.'

Interestingly, besides their ability to conjoin term phrases (55a), *yiji* and *haiyou* can be used to conjoin questions (both matrix and embedded (55b)), but they are not very comfortable conjoining (declarative) clauses (55c)[24].

(55) **Behavior of *yiji/haiyou***

a. CONJOINING TERMS

Laochen, Xiaoli yiji/haiyou lingwai liang.wei tongshi zai hui.shang
Laochen, Xiaoli and_T other two.CL colleagues at meeting.at
xianhou fayan.
successively speak

'Laochen, Xiaoli and two other colleagues spoke successively at the meeting.'

b. CONJOINING QUESTIONS

Wo xiang.zhidao shei tou.teng yiji/haiyou shei outu.
I want.know who head.ache and_Q who vomit

'I wonder who have headaches and who vomit.'

c. ??CONJOINING CLAUSES

Jintian meiyou xiayu, ??yiji/??haiyou/erqie tianqi hen liangshuang.
today NEG rain, and weather very cool

Intended 'It is not raining and the weather is very cool.'

[24] The judgment of (55c) is not clear. I myself don't like conjoining declarative clauses using *yiji/haiyou*; for me, a different AND *erqie* has to be used, also shown in (55c). In the literature, Lü 1980: 615 (page numbers from Lü 1998) says *yiji* can conjoin 'clauses', however, all of his examples use embedded questions. Finally, it seems that *erqie* (the one that conjoins clauses) is also able to participate in *wh*-conditionals, illustrated in (54).

(54) shei tou.teng, erqie shei outu, shei jiu yao jinxing jiancha.
who head.ache, and who vomit, who then should take examination

'Those who have headaches and vomit should take the examination.'

What is surprising about (54) is its interpretation. Instead of collecting all individuals that have headaches or vomit as in (53), *erqie* seems to instruct us to collect individuals that both have headaches and vomit (again, the judgment is not stable). Since my argument in the main text relies on interactions between *wh*-phrases and the two connectives *he* and *yiji/haiyou*, I leave how *erqie* works and its interaction with *wh*-conditionals to another occasion.

What can we learn from this set of data? From the fact that the term-connective *he* 'and$_T$' cannot be used to conjoin the *wh*-clauses in *wh*-conditionals, it may be concluded that these *wh*-clauses are anything but terms (type *e* or $\langle et, t\rangle$). They are thus unlikely to be free relatives (essentially a definite), as needed by a FR-based equative analysis. Furthermore, the fact the *wh*-clasues can be conjoined by *yiji*/*haiyou* which also conjoin questions suggest that the *wh*-clauses are really interrogative clauses. We will pick up this hint when we develop our own proposals.

5.4.8 Non-coreferentiality

As Lin 1999 points out, the two *wh*s in a *wh*-conditional do not always co-refer[25]. Consider (56); it does not mean *that the shirt I will choose IS the one you choose* according to an FR-based equative analysis. Instead, the two shirts need only to match each other for the sentence to be true in the context described in (56). More specifically, suppose that the girl is going to buy the Hermione-shirt that is hanging on the wall right in front her; then the boy had better buy the Ron-shirt that hangs next to it[26].

(56) [StoreX sells matching shirts for young couples. A couple came in. The boy said to the girl:]

ni	xuan	nage,	wo	jiu	genzhe	ni	xuan	nage.
you	choose	which.one,	I	then	follow	you	choose	which.one

I will choose a shirt that matches what you choose.

Here are two more examples that illustrate the same point.

(57) **Non-coreferentiality**

a. [Zhangsan and Lisi together bought a desk and a chair.]

[25]Lin works within the unselective binding paradigm, so he can talk about assignments of values to the *wh*s in a *wh*-conditional and whether they co-refer. In the terms of a FR-based equative analysis where the *wh*-phrases are relative pronouns, the observation is that the antecedent and the consequent do not always co-refer.

[26]Hermione-Ron and Harry-Ginny are couples in *Harry Potter*.

Zhangsan mai.le na.zhang zhuozi, Lisi jiu mai.le na.ba yizi.
Zhangsan buy.ASP which.CL desk, Lisi then buy.ASP which.CL chair
'Lisi bought a chair that matches the desk that Zhangsan bought.'

b. Zhangsan jian shenme ren jiu shuo shenme hua.
Zhangsan see what people then say what words
'What Zhangsan says depends on who his addressee is.'

Even (58a), modified from our very first example (1), can be interpreted non-coreferentially[27]. It can be understood as being true in the scenario described in (58b), where Zhangsan and Lisi, as colloquium organizers at separate linguistics departments, never invited the same speaker, and yet a matching relation between their invitees exists.

(58) a. Yizhi.yilai Zhangsan qing shei, Lisi jiu qing shei.
always Zhangsan invite who, Lisi then invite who
'Who Lisi invites always match who Zhangsan invites.'

b.

Invitation	Invitees_Z	Invitees_L
1st	N. Chomsky	M.A.K Halliday
2nd	Danny Fox	J. R. Martin
3rd	Mary	John

Now to the analysis. Lin 1999, which takes *wh*-conditionals to be an unselective-binding construction, proposes that non-coreferential *wh*-conditionals involve quantification over *kinds* (Carlson 1977, Chierchia 1998b). This is not so likely for (56): how could a Hermione-shirt and a Ron-shirt form a natural kind, excluding a Harry-shirt (which forms another kind with a Ginny-shirt)? If something has to be quantified over, it seems that we are quantifying over contextually-determined pairs of shirts. But kinds are not sensitive to contexts.

For the sake of the argument, let's grant that kinds can be contextually determined as pairs of shirts. When a kind is combined with a stage-level predicate like *chosen by me*, its individual instantiations are existentially bound (by eg. Chierchia's (1998b) Derived Kind

[27] I thank an anonymous reviewer for SALT 26 for providing me with this example. The scenario in (58b) (with the names N. Chomsky, M.A.K Halliday, Danny Fox, and J. R. Martin) is also due to the reviewer. Note that M.A.K Halliday and J. R. Martin are presumably famous functional syntacticians. Mary and John are assumed to be two random linguists, one a generative linguist, the other a functionalist.

Predication), as in (59) (cf. Lin 1999: 580). But existential binding does not guarantee that the boy and the girl buy the same number of shirts.

(59) $\forall k_{pairs.of.shirts}.[\exists x[\mathsf{R}(x,k) \wedge \mathsf{the.girl.choose}(x)] \rightarrow$
$\exists y[\mathsf{R}(y,k) \wedge \mathsf{the.boy.choose}(y)]]$

Suppose that the girl is going to buy two identical Hermione-shirts while the boy will only buy one Ron-shirt. The sentence in (56) will be false but (59) true, because the existential binding over objects in (59) neutralizes the number difference.

And it is not obvious, of course, how an FR-based equative analysis, which requires strict identity, could handle these data, even adjusting to kinds.

5.4.9 Asymmetry

The relation between the antecedent and the consequent – whatever it is – seems to be one that is asymmetric. Assuming for the purpose of current discussion that the antecedent and the consequent are both free relative definites, we find that the identity of the consequent can be questioned but not that of the antecedent (cf. Wen 1998: 11). The following contrast (60)-(61) illustrates the asymmetry[28].

(60) $*$**Questioning the antecedent**

Q: Zhangsan qing le shei?
Zhangsan invite ASP who
'Who did Zhangsan invite?'

A: *Zhangsan qing le shei, Lisi jiu qing le shei.
Zhangsan invite LE who, Lisi then invite LE who
'If Zhangsan invited X, Lisi invited X.'

(61) $\surd$**Questioning the consequent**

[28] I thank Veneeta Dayal and Ivano Caponigro for discussion of this. My explanation of the asymmetry differs from how they would pursue the issue. Roughly, they would like to have a pragmatic story, where the antecedent and the consequent have different status in the information structure — for example, the entire antecedent could occupy a topic position, which might explain why it cannot be questioned. The explanation I will adopt however is a semantic one, which relies on the intuition that the consequent of a *wh*-conditional *depends on* its antecedent. Since you can answer a question by specifying what it depends on but not what it results in, the asymmetry (60)-(61) is explained. Details follow.

Q: Lisi qing le shei?
Lisi invite ASP who
'Who did Lisi invite?'

A: Zhangsan qing le shei, Lisi jiu qing le shei.
Zhangsan invite LE who, Lisi then invite LE who
'If Zhangsan invited X, Lisi invited X.'

An equative advocate will have difficulty explaining the asymmetry, for an identity relation is obviously symmetric.

Another aspect of the asymmetry is the strong intuition discussed in the literature that the consequent *depends on* the antecedent in a *wh*-conditional (see for example Cheng & Huang 1996: 6.2, Lin 1996: 274-5, Huang 2010: 3.3.3). This intuition has been explored to explain the oddness of (62).

(62) *Shei zhan zai nali, shei jiu hen gao.
who stand in there who then very tall
Intended 'The person who is standing there is tall.'

(63) jo laRkii khaRii hai vo lambii hai
which girl standing is she tall is
'The girl who is standing is tall.'

(62) is a direct translation of the famous Hindi correlative example (63) from Dayal 1991: (3a). The fact that (62) is bad shows *wh*-conditionals are not simple correlatives. Specifically, they encode a causal dependence relation according to Lin 1998 and Huang 2010. Lin 1996: 275 explicitly states the generalization that 'two *wh*-clauses which do not have a causal dependence cannot form a bare conditional'[29]. Since there does not seem to be any causal link between someone's standing and her being tall (in normal contexts), (62) feels bad.

While I agree that there should always exist a dependence relation between the antecedent and the consequent, I do not think it has to be a causal one. Consider our very first *wh*-conditional example, repeated here as (64). (64) can be read without a causal link:

---

[29] Lin's bare conditionals are just our *wh*-conditionals.

Zhangsan and Lisi may have never heard of each other; they simply invited the same guests, by accident.

(64) Zhangsan qing le shei, Lisi jiu qing le shei.
Zhangsan invite ASP who, Lisi then invite ASP who
'If Zhangsan invited X, Lisi invited X.'

I would like to suggest that (64) can encode an epistemic dependence: whether you know who Lisi invited depends on whether you know who Zhangsan invited, because someone just told me that they invited the same group of people. But why is Zhangsan placed into the determinant, not Lisi? Perhaps Zhangsan is your friend and is more epistemically prominent.

Next let's turn to Lin's (1996) example (62), which he argues is bad due to a missing causal link. Now the question is: why (62) cannot be read epistemically? I believe the explanation lies in the appearance of *hen*, which somehow is not happy with a *wh*-conditional, regardless of whether it is interpreted causally or epistemically. While a more explanatory discussion of this fact has to wait for another occasion, (65) and (66) below add support to such a claim. Suppose that someone is *hen.gao* 'tall' iff she is taller than 180 cm (or taller than average). (65) and (66) are both equivalent to (62), but the former two don't have *hen* and can be (felicitously) read either causally (there is hidden stepping stool over there) or epistemically (the teacher has grouped the students according to their heights and all the tall students are standing over there).

(65) Shei zhan zai nali, shei jiu gaoyu 180 limi.
who stand in there who then taller 180 cm
'The people who are standing there are taller than 180cm.'

(66) Shei zhan zai nali, shei de shengao jiu gaoyu pingjunzhi.
who stand in there who DE height then taller average
'The people who are standing there are taller than average.'

Finally, a dependence relation is asymmetric[30]: that *a* depends on *b* is different from

[30]The term 'asymmetric' has to be read loosely, not in its mathematical sense where an asymmetric relation

that b depends on a. It can be used to explain the Question-Answer asymmetry in (60)-(61). Consider the Q-A pairs in (67) and (68). The generalization is that one can answer a question by specifying what it depends on but not what it determines. The Q-A asymmetry in (60)-(61) is explained.

(67) Q: Who did John invite?

A_1:#Who Bill invited depends on who John invited.

A_2:#That determines who Bill invited.

(68) Q: Who did Bill invite?

A_1: Who Bill invited depends on who John invited.

A_2: That depends on who John invited.

Here is a brief interim summary. In the last three subsections, we have presented evidence showing that a FR-based equative analysis might not be the right way to go: the fact that *wh*-clauses in a *wh*-conditionals cannot be conjoined by and_T suggests they are not argumental definites; the relation between the antecedent and the consequent – if it is a relation between individuals – does not need to be one of identity, and has to be asymmetric, further speaking against treating *wh*-conditionals as a type of equative.

5.5 Conclusion

It's time to summarize the various semantic properties of *wh*-conditionals discussed in this chapter. This is done in (69). Note that ? indicates that there is currently no explanation of the relevant fact but a way out is conceivable.

(69) **Semantic properties of *wh*-conditionals**

R is such that $\forall a, b(R(a,b) \rightarrow \neg R(b,a))$. *'depend on'* in the mathematical sense is neither symmetric nor asymmetric.

	UB	F/C	F/C$^+$	EQUATIVE
Maximality	$*$	$\surd$	$\surd$	$\surd$
Quantificational invariability	$*$	$\surd$	$\surd$	$\surd$
Antecedent uniqueness	$*$	$\surd$	$\surd$	$\surd$
Minimality	$*$	$*$	$\surd$	$\surd$
Mention-some	$*$	$*$	$\surd$	$\surd$
Exhaustivity	$*$	$*$	$*$	$\surd$
Consequent uniqueness	$*$	$*$	$*$	$\surd$
Interaction with conjunction	?	$*$	$*$	$*$
Non-coreferentiality	$*$	$*$	$*$	$*$
Asymmetry	?	?	?	$*$
Unification of Mandarin *wh*s	$*$	$*$	$*$	$*$

It is easy to see from (69) that none of the existing analyses (with potential modifications) could explain the full range of data. Crucially, all existing accounts fail to explain the use of *wh*-morphology in *wh*-conditionals: unselective binding fails because it needs to license *wh*-phrases – being polarity items – in the consequent of a conditional, and the free.relative-based accounts fail because they need *wh*-phrases to be relative pronouns, a possibility unlikely for Mandarin. New analyses are thus called for.

The next two chapters develop two slightly different proposals for Mandarin *wh*-conditionals. In both accounts, *wh*-clauses are taken to be genuine questions and *wh*-conditionals as a construction that encodes a certain dependency relation between them. This kind of interrogative-based (or Q-based) account immediately offers a solution to the *wh*-puzzle we started with: the *wh*-words in a *wh*-conditional are simply interrogative pronouns (not polarity items or relative pronouns), which are licensed in the same way Mandarin *wh*-items are used in questions.

The two accounts differ in their implementations. In the first account, *wh*-conditionals are taken to be genuine conditionals, and the dependency relation between the questions denoted by the *wh*-clauses is derived from the relation between the antecedent and the consequent of a real conditional. Standard Hamblin/Karttunen semantics of questions are retained while a situation-based analysis of conditionals is adopted to keep track of the individuals that constitute the short answer of a question. In the second account, the conditional status of *wh*-conditionals does not play an important role. The relation between the two questions is directly written into the semantics of *wh*-conditionals, which holds between two questions if their short answers match[31]. To represent short answers, a variant of the functional/categorial approach to question is proposed where a question is a set of structure meanings.

Now we turn to the first Q-based account of *wh*-conditionals.

[31]I thank Gennaro Chierchia for urging me to explore this idea.

Chapter 6

Proposal-A: *wh*-conditionals as interrogative conditionals

6.1 Developing the proposal

In this chapter, we explore the idea that *wh*-conditionals are interrogative conditionals. The basic idea is very simple: *wh*-conditionals are conditionals that embed questions, one in the antecedent and one in the consequent. The intuition we are trying to capture is that answers to the antecedent question already contain information to answer the consequent question. We implement the idea by assuming:

(i) Interrogative clauses are interpreted as Hamblin/Karttunen questions.

(ii) The dependency relation is just the relation one finds between the antecedent and the consequent of a standard conditional. Specifically, we will assume a semantics of conditionals/counterfactuals that uses exemplifying situations (Fine 2012), which helps us keep track of the individuals that exist in a situation.

(iii) Since conditionals work with propositions and the *wh*-clauses are questions, which are sets of propositions, answerhood operators (Heim 1994, Dayal 1996, Beck & Rullmann 1999) are utilized to resolve the type mismatch.

In sum, *wh*-conditionals are interrogative conditionals.

6.1.1 *Wh*-clauses as Hamblin/Karttunen-questions

We take the *wh*-clauses in *wh*-conditionals to be questions and adopt a Hamblin/Karttunen semantics of questions (Hamblin 1973, Karttunen 1977), where a question denotes a set of propositions — the set of its possible answers. To illustrate, suppose that there are exactly three people besides Zhangsan in the domain — Bill, Mary and Sue, and that inviting is irreflexive; then the question in (1) denotes the set of propositions in (2).

(1) Who did Zhangsan invite?

(2) $[\![(1)]\!] = \left\{ \begin{array}{l} \lambda s.\text{Zhangsan invited Bill in } s, \\ \lambda s.\text{Zhangsan invited Mary in } s, \\ \lambda s.\text{Zhangsan invited Bill} \oplus \text{Mary in } s, \end{array} \right\}$

Note that we take propositions to be sets of situations (not worlds), since we are going to adopt a situation-based semantics of conditionals in the next subsection.

6.1.2 Dependency expressed by conditionals

We take the dependence relation between the antecedent and the consequent of a *wh*-conditional (discussed in §5.4.9) to be based on a relation expressed by standard conditionals.

The classical semantics of conditionals is based on possible worlds and similarity relations among them (Stalnaker 1968, Lewis 1973); following Stalnaker 1975, we also take all conditionals (indicative and subjunctive/counterfactuals) to have the same core semantics, as in (3).

(3) $[\![\text{if } p \text{ then } q]\!] = 1$ at $w*$ iff all of the closest-to-$w*$ worlds in which p is true are worlds in which q is true.

Kratzer 1979, 1981b, 2012 present a semantics of conditionals based on premise sets as in (4). (4) is shown to be equivalent to (a version of) similarity-based ordering semantics (Lewis 1981).

(4) $[\![\text{if } p \text{ then } q]\!] = 1$ at $w*$ iff every way of adding as many (propositional) facts of $w*$ to p as consistency allows reaches a point where the resulting set logically implies q. Kratzer (2012: 180).

For the purpose of capturing the intuitively felt covariation of the two *wh*s in a *wh*-conditional, we adopt a semantics of counterfactuals due to Fine 2012, which uses situations/states[1].

(5) ⟦if p then q⟧ = 1 at $w*$ iff any possible outcome of an $p-$state at $w*$ contains a $q-$state.[2]

We may modify (5) in a way that brings out its similarity to the premise semantics in (4). Instead of adding premises into the antecedent proposition (its unit set), we use premises to enlarge our antecedent-situation. The resulting (6) is the semantics we will adopt for Mandarin conditionals, marked by *jiu*.

(6) ⟦p *jiu* q⟧ = 1 at $s*$ iff $\forall s[s \in \textsc{min}\{s : p(s) = 1 \wedge C_{s*}(s) = 1\} \rightarrow q(s) = 1]$,
where C is conversational background.[3]
In words: a Mandarin conditional [p *jiu* q] is true at $s*$ iff every minimal situation s such that p is true at s, coupled with the conversational background C obtained at $s*$, is also a situation in which q is true.

Note that the semantics for conditionals in (6) looks slightly different from the standard

[1]Three points need mentioning: first, Fine's situation semantics of counterfactuals is not concerned with donkey binding but aims at providing a general theory of conditionals just as Stalnaker/Lewis/Kratzer — his main motivation for using situations is to invalidate substitution of logically equivalent antecedents and to validate simplification of disjunctive antecedents. Second, Fine's situation-semantics and Kratzer's (2014) situation-semantics have many differences (Fine To appear). But these differences are not relevant for our purposes so we choose to work with Kratzer's formulation. Some terminology: whenever Fine says s is a p-state or s exactly verifies p, Kratzer says s exemplifies p. Whenever Fine says s inexactly verifies p, Kratzer says p is true in s (and sometimes we will say s supports p). Finally, to make another simplification, we will talk about exemplifying situations and minimal situations interchangeably, which is justified in our case for we are not going to talk about propositions that are divisive (such as propositions involve mass nouns and negative noun phrases). Standard definition of minimality based on part-of applies for now, but will be revised later.

[2]Formally, $w \mid A > C$ if $u \Vdash\!> C$ whenever $t \Vdash A$ and $t \rightarrow_w u$ (Fine 2012: 237), where $>$ is the counterafactual symbol, $\Vdash$ exact verification, $\Vdash\!>$ inexact verification, and $t \rightarrow_w u$ means extending t to u according to facts (cf. Kratzer's premise set) in w.

[3]Two points need mentioning: first, we need the outmost MIN because we have decided to choose Kratzer-style non-exact situation semantics and classical $\wedge$. If we were to choose Fine-style exact situation semantics and non-classical $\wedge$, the MIN would not be necessary. A non-classical situation semantics $\wedge$ looks like this: s verifies $A \wedge B$ iff s is the fusion $s_1 \sqcup s_2$ of a state s_1 that verifies A and a state s_2 that verifies B. Second, for simplicity, we are making a version of the Limit Assumption and the Unique Assumption (Stalnaker 1968); that is, for any $s*$ there is exactly one maximal premise set that is compatible with p; we write (the conjunction of) the maximal premise set as C_{s*}.

situation semantics of conditionals used in the donkey anaphora literature (Berman 1987, Heim 1990, von Fintel 1994, Elbourne 2005). Donkey-situation-semantics usually assigns (7) as the semantics of conditionals (see von Fintel 2004: (9)).

(7) $[\![$if p then $q]\!] = 1$ at $s*$ iff
$$\forall s[s \in \textsc{min}\{s : p(s) = 1 \wedge C_{s*}(s) = 1\} \rightarrow \exists s'[s \leq s' \wedge q(s') = 1]]$$

(6) is stronger than (7): (7) checks whether we can extend an antecedent situation into a consequent one, while (6) instructs us to construct a situation s based on the antecedent and the conversational background, and then to check whether s supports the consequent. Formally, since (6) can be obtained by strengthening the $\leq$ on the right hand side of $\rightarrow$ in (7) into $=$ (and consequents of $\rightarrow$ are upward-entailing), (6) is stronger. While motivation for (7) comes entirely from donkey anaphora, the semantics in (6) is in the tradition of Lewis-Stalnaker-Kratzer and aims to provide a general theory of conditionals/counterfactuals. It is interesting to note that entirely different considerations lead to similar results. Finally, for our purposes, it is important not to use (7). This is because we will be trying to keep track of the individuals that exist in a situation, but allowing situation-extension — adding more individuals into a situation, that is — will make the task difficult[4].

6.1.3 Answerhood operators as the glue

There is a tension here. Our semantics for conditionals works with propositions but the *wh*-clauses are sets of propositions. How to get from sets of propositions to propositions? We resort to answerhood operators (Heim 1994, Dayal 1996, Beck & Rullmann 1999). Specifically, we adopt Dayal's answerhood operator in (8), for its sensitivity to varieties of alternatives and ability to deal with uniqueness (see Chapter 1 for an introduction of Dayal's answerhood operator and §6.2.3 for its application in *wh*-conditionals).

(8) $$\textsc{Ans}(Q)(s*) = \iota p \in Q[p(s*) = 1 \wedge \forall q \in Q[q(s*) = 1 \rightarrow p \subseteq q]]$$

[4]For similar uses of non-extensional situation/event semantics of conditionals, see Schwarz 1998 for an analysis of German reduced conditionals that employs a matching relation between situations/events, following Rothstein 1995.

Given an evaluation situation $s*$, applying Ans to a question Q gives us the most informative proposition p in Q that is also true in $s*$, if there is such a p (if no such p exists, Ans(Q)($s*$) is undefined). To illustrate, suppose we are looking at last night's party s_{party}, and the host Zhangsan invited exactly two guests, Bill and Mary. In this case, applying Ans to the question in (9) and s_{party} gives us the proposition *that Zhangsan invited Bill and Mary*, as in (11).

(9) Who did Zhangsan invite?

(10) $$[\![(9)]\!] = \left\{ \begin{array}{l} \lambda s.\text{Zhangsan invited Bill in } s, \\ \lambda s.\text{Zhangsan invited Mary in } s, \\ \lambda s.\text{Zhangsan invited Bill} \oplus \text{Mary in } s, \\ \ldots \end{array} \right\}$$

(11) $\textsc{Ans}([\![(1)]\!])(s_{party}) = \lambda s.\text{Zhangsan invited Bill and Mary in } s$

The proposition in (11) can be embedded under a semantics of conditionals/counterfactuals that uses situations. We now turn to such a semantics.

6.1.4 *wh*-conditionals as interrogative conditionals

Now we can try to derive the meaning of *wh*-conditionals from the general semantics of Mandarin conditionals in (6), as in (12).

(12) **Semantics of *wh*-conditionals:** First try

$[\![\textsc{Ans}(Q_A)(s*)\ \textit{jiu}\ \textsc{Ans}(Q_C)(s*)]\!] = 1$ in $s*$

iff $\forall s[s \in \textsc{min}\{s : \textsc{ans}(Q_A)(s*)(s) = 1 \wedge \textsc{pre}(Q_C)(s) = 1\} \rightarrow$

$\textsc{ans}(Q_C)(s*)(s) = 1]$

In words: every minimal situation that supports the answer to Q_A in $s*$ and the presupposition of Q_C supports the answer to Q_C in $s*$.

The connection of (12) to (6) is obvious. In both of them, we check whether every situation that exemplifies the antecedent coupled with the conversational background also supports the consequent. There are two differences: first, *wh*-conditionals embed questions while ordinary conditionals embed propositions; this motivates the use of answerhood operators in the case of *wh*-condtionals to get propositons from question denotations. Second, differing from ordinary conditionals, *wh*-conditionals can be seen as having a nearly empty conversational background C – it has only the presuppostion of the consequent in it. This isn't very hard to imagine, since conditionals do have different modal flavors (Kratzer 1981a, 2012), captured by varying choices of coversational backgrounds. *Wh*-conditionals are in this sense, a species of conditionals.

Next, notice the use of PRE in (12), which is a presupposition extractor. Here, we follow Karttunen & Peters 1976 in taking questions to carry existential presuppositions, and (12) says that the minimal antecedent s we select has to support both the antecedent answer and the existential presupposition of the consequent question. This is plausible, since presuppositions can be seen as requirements on prior contexts (and thus on the situations constructed out of them), and antecedents of conditionals are prior contexts for their consequents.

To see how (12) behaves, we need to determine what are the minimal situations that support both the antecedent answer and the consequent presupposition. Let's consider a concrete example (13).

(13) Zhangsan qing le shei, Lisi jiu qing le shei.
Zhangsan invite ASP who, Lisi then invite ASP who
'Lisi invited whoever Zhangsan invited.'

Suppose at last night's party $s*_{13}$ Zhangsan invited exactly John and Mary. We first check what are the situations $s \in S_{13}$ that support both the antecedent answer and the consequent presupposition (without being minimal for now). There are many such situations: s_1= ZHANGSAN-INVITED-JOHN-MARY-&-LISI-INVITED-JOHN-MARY-SUE[5] belongs to S_{13}, for s_1 supports both *Zhangsan invited John and Mary* (the antecedent answer) and

[5]We use small capitals to refer to situations. ZHANGSAN-INVITED-JOHN-MARY-&-LISI-INVITED-JOHN-MARY-SUE is the situation that exemplifies/minimally-supports the proposition *that Zhangsan invited John and Mary, and Lisi invited John, Mary and Sue*.

Lisi invited someone (the consequent presupposition); similarly, s_2= ZHANGSAN-INVITED-JOHN-MARY-&-LISI-INVITED-JOHN also belongs to S_{13}.

Now we check the minimal situations within S_{13}, MIN(S_{13}). Standard MIN used in situation semantics is based on part-of relation $\leq_s$ between situations.

(14) $\text{MIN}(S) = \{s \in S : \forall s' \in S(s' \leq_s s \rightarrow s' = s)\}$

Unfortunately, The part-of MIN in (14) does not work for our case. MIN(S_{13}) delivers only situations where Zhangsan invited John and Mary but Lisi invited exactly a single person. For example, $s_1 \notin \text{MIN}(S_{13})$ because there is a situation s_3 =ZHANGSAN-INVITED-JOHN-MARY-&-LISI-INVITED-SUE in S_{13} that is a proper part of s_1; instead, $s_3 \in \text{MIN}(S_{13})$. This cannot be right: presumably we want s_4 =ZHANGSAN-INVITED-JOHN-MARY-&-LISI-INVITED-JOHN-MARY to be in MIN(S_{13}), but part-of MIN does not allow that.

I suggest we use a cardinality-based $\text{MIN}_{\#}$.

(15) $\text{MIN}_{\#}(S) = \{s \in S : \forall s' \in S(|s'| \leq |s| \rightarrow |s'| = |s|)\}$

$\text{MIN}_{\#}$ checks the cardinality of the atomic participants — these are *thin particulars*, individuals abstracted away from their properties — of a situation[6]. For example, $|s_1|$ = 5 since there are 5 participants — zs, john, mary, ls, sue, while $|s_4|$ = 4 since there are 4 — zs, john, mary, ls; consequently s_4 but not s_1 has a chance of being in $\text{MIN}_{\#}(S_{13})$.

It turns out that the minimal number of participants an s in S_{13} can have is 4: every s in S_{13} supports the antecedent answer, so they all have zs, john, mary, and to support the consequent presupposition they include ls as well. As a result, every s in $\text{MIN}_{\#}(S_{13})$ has 4 atomic participants. There are exactly seven such situations in $\text{MIN}_{\#}(S_{13})$.

[6] $\text{MIN}_{\#}$ is related to one of the two aspects of minimality – the *individual minimality* – discussed in Van Benthem 1989. Individual minimality itself comes from *Logic Programming* (Lloyd 2012). For instance, Prolog programs are supposed to 'contain no individuals/objects except for those which are explicitly named in the language of the program' (Van Benthem 1989: 334).

$$\text{(16)} \quad \textsc{min}_{\#}(S_{13}) = \left\{ \begin{array}{l} \text{Zs-invited-J-M-\&-Ls-invited-J,} \\ \text{Zs-invited-J-M-\&-Ls-invited-M,} \\ \text{Zs-invited-J-M-\&-Ls-invited-J-M,} \\ \text{Zs-invited-J-M-\&-Ls-invited-Zs,} \\ \text{Zs-invited-J-M-\&-Ls-invited-Zs-J,} \\ \text{Zs-invited-J-M-\&-Ls-invited-Zs-M,} \\ \text{Zs-invited-J-M-\&-Ls-invited-Zs-J-M,} \end{array} \right\}$$

(16) still does not quite work. The semantics for *wh*-conditionals in (12) would require every s in (16) to support the consequent answer. This cannot happen since the consequent answer (relativized to an evaluation situation) is usually unique.

I propose that the antecedent situations, besides being in $\textsc{min}_{\#}(S_{13})$ (that is, besides being the minimal situations that satisfy both the antecedent answer and the consequent presupposition), have to satisfy two more constraints.

The first constraint comes from the idea that the presupposition of the antecedent question (*that Zhangsan invited someone*) alone should not provide any information that contributes to answering the consequent question — for if it were able to, a simpler form such as *Lisi invited Zhangsan* would have been used to answer the consequent question. In other words, we should discard any situation in S_{13} where *that Lisi invited Zhangsan* comes out true. Essentially, this is a constraint that favors constructing the antecedent situations using new instead of old (presupposed) information. In the text, I will not try to formalize the constraint but simply use No.Old to represent it[7]. (17) below illustrates how it works.

$$\text{(17)} \quad \textsc{min}_{\#}(S_{13} \cap \text{No.Old}(s)) = \left\{ \begin{array}{l} \text{Zs-invited-J-M-\&-Ls-invited-J,} \\ \text{Zs-invited-J-M-\&-Ls-invited-M,} \\ \text{Zs-invited-J-M-\&-Ls-invited-J-M,} \end{array} \right\}$$

[7]Formalizing No.Old is doable. First, we take the set of situations that support the presuppositions of Q_A and Q_C – $\{s : \textsc{pre}(Q_A)(s) \wedge \textsc{pre}(Q_A)(s)\}$. We then apply $\textsc{min}_{\#}$ to the set as what we did to S_{13}; this gives us the unit set {Zs-inivted-Ls-&-Ls-invited-Zs} $= \textsc{min}_{\#}\{s : \textsc{pre}(Q_A)(s) \wedge \textsc{pre}(Q_A)(s)\}$. Finally, No.Old in the case of S_{13} requires that none of the situations in S_{13} contain a subsituation that itself is a subsituation of any situation in $\textsc{min}_{\#}\{s : \textsc{pre}(Q_A)(s) \wedge \textsc{pre}(Q_A)(s)\}$. This is complicated, and I believe an intuitive understanding of No.Old suffices.

The second constraint has to do with the idea that the antecedent should not contain redundant information. In other words, every bit of information (except for the presupposed ones) conveyed by the antecedent should be used to construct the antecedent situation. This can be translated as a maximality requirement: among the situations in (17) constructed from previous steps, the largest one gets selected since it contain the most information.

Putting everything together, we have (18) as the semantics of *wh*-conditionals, with the underlined part encoding the maximality requirement.

(18) **Semantics of *wh*-conditionals:** Second try

$[\![\text{ANS}(Q_A)(s*)\ \textit{jiu}\ \text{ANS}(Q_C)(s*)]\!] = 1$ in $s*$ iff

$\forall s[[s \in \textsc{min}_{\#}\{s : \textsc{ans}(Q_A)(s*)(s) = 1 \wedge \textsc{pre}(Q_C)(s) = 1 \wedge \text{No.Old}(s)\} \wedge$

$\underline{\neg\exists s'[s' \in \textsc{min}_{\#}\{s : \textsc{ans}(Q_A)(s*)(s) = 1 \wedge \textsc{pre}(Q_C)(s) = 1\} \wedge s <_s s']]}$

$\rightarrow \textsc{ans}(Q_C)(s*)(s) = 1]$

Applying (18) to $s*_{13}$, we get the set of antecedent situations {Zs-invited-J-M-&-Ls-invited-J-M}. (18) then requires every situation within the set to support the consequent answer. We correctly predict that Lisi cannot invite people other than John and Mary.

There is a last concern: suppose that in a different scenario $s*_{14}$ Zhangsan invited John and Mary, but Lisi invited only John. The intuition is that (13) is false in this case. Our semantics so far predicts the contrary: the minimal antecedent situation s we get (with the two constraints just discussed) is Zs-invited-J-M-&-Ls-invited-J-M. s supports the consequent answer *that Lisi invited John*, and thus the *wh*-conditional in (13) is incorrectly predicted to be true. To deal with this problem, I propose that *wh*-conditionals further require that the minimal antecedent situation we get does not contain subsitutations that themselves support both the antecedent answer and the consequent answer. This is represented as the underlined part in (19).

(19) **Semantics of *wh*-conditionals:** Official

$[\![\text{ANS}(Q_A)(s*)\ \textit{jiu}\ \text{ANS}(Q_C)(s*)]\!] = 1$ in $s*$ iff

$$\forall s[[s \in \textsc{min}_{\#}\{s : \textsc{ans}(Q_A)(s*)(s) = 1 \wedge \textsc{pre}(Q_C)(s) = 1 \wedge \textsc{No.Old}(s)\} \wedge$$
$$\neg\exists s'[s' \in \textsc{min}_{\#}\{s : \textsc{ans}(Q_A)(s*)(s) = 1 \wedge \textsc{pre}(Q_C)(s) = 1\} \wedge s <_s s']]$$
$$\rightarrow [\textsc{ans}(Q_C)(s*)(s) = 1 \wedge$$
$$\underline{\neg\exists s''[s'' <_s s \wedge \textsc{ans}(Q_A)(s*)(s'') = 1 \wedge \textsc{ans}(Q_C)(s*)(s'') = 1]}]]$$

(19) solves the problem with $s*_{14}$: the antecedent situation Zs-INVITED-J-M-&-Ls-INVITED-J-M contains a subsituation Zs-INVITED-J-M-&-Ls-INVITED-J that supports both the antecedent answer (*that Zhangsan invited John and Mary*) and the consequent answer (*that Lisi invited John*), violating the underlined part in (19), and thus the *wh*-conditional is predicted to be false in this scenario.

The formula in (19) is complicated, but I believe a large part of it should belong to pragmatics, such as old information does not count, every bit of new information should be used, and no redundant information should be provided. We will background these components in the following discussion, trading perspicuity for precision. The semantics of *wh*-conditionals will thus just look like the one in (20).

(20) $[\![\textsc{Ans}(Q_A)(s*)$ *jiu* $\textsc{Ans}(Q_C)(s*)]\!] = 1$ in $s*$
iff $\forall s[s \in \textsc{min}\{s : \textsc{ans}(Q_A)(s*)(s) = 1 \wedge \textsc{pre}(Q_C)(s) = 1\} \rightarrow$
$\textsc{ans}(Q_C)(s*)(s) = 1]$

It's time to summarize our proposal. Our guiding idea in this section is that *wh*-conditionals are interrogative conditionals, with the simple meaning that the answer to the antecedent question contains enough information to answer the consequent question. To cash out this intuition, we adopt situation semantics as a way to encode partial information and to keep track of the individuals that exist (or are added) in(to) a situation; then a *wh*-conditional basically says the best situation we construct out of the antecedent answer — with minimization, presuppositions from the consequent question and some pragmatic enrichment such as old information is dispreferred and every bit of new information counts — also support the consequent answer. Crucially, with the set-up described in this subsection, the best situation is usually a situation where the short answer of the antecedent question and that of the consequent question coincide, which explains the felt co-variation between the *wh*s in a *wh*-conditional. Apart from being intuitively appealing, the proposal explains the various semantic properties of *wh*-conditionals discussed in §5.4 in a natural way, to which we now turn.

6.2 Explaining the properties in detail

The semantics proposed in the last section is a Q+A+C analysis, where Q stands for questions, A answers and C conditionals. The Q-part will explain the use of *wh*-morphology in *wh*-conditionals and their interaction with certain conjunctions. The A-part will mainly explain maximality, minimality and unqiueness. The C-part will basically explain the asymmetry and the non-coreferentiality observed in *wh*-conditionals. This is sketched in (21) with details to follow.

(21) **Explaining properties of *wh*-conditionals**

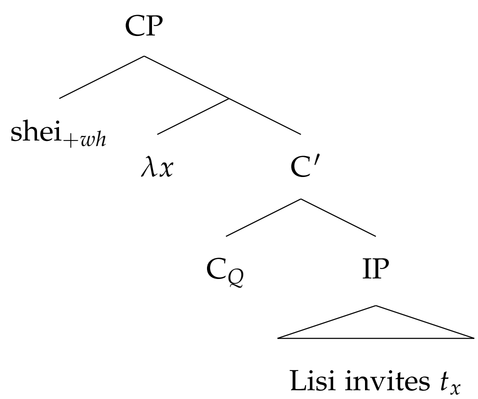
Maximality	A
Quantificational invariability	Q+A
Antecedent uniqueness	A
Minimality	A
Mention-some	Q+A
Exhaustivity	Q+A+C
Consequent uniqueness	A
Interaction with conjunction	Q
Non-coreferentiality	C
Asymmetry	C
Unification of Mandarin *wh*s	Q

6.2.1 Licensing of *wh* and interaction with conjunctions

Our analysis based on questions immediately explains the *wh*-licensing puzzle: *wh*-words in *wh*-conditionals (especially the consequent *wh*s) are actually question words, not the type of polarity sensitive items that need downward entailing contexts (negative polarity items) or modal licensing (free choice items).

Even better, our analysis of *wh*-conditionals makes possible a unified analysis of Mandarin *wh* items. We follow Chierchia & Liao's (2014) proposal that all Mandarin *wh*s are existentials: question-*wh* and polarity-*wh* share the same existential semantics, their difference being that polarity *wh*s obligatorily trigger (domain) alternatives and thus need covert ONLY to exhaustify them (Chierchia 2013), while question *wh*s do not trigger alternatives but need to appear in an interrogative context (in syntactic parlance, its +*wh* feature needs to be feature-checked by a question C head). We call the latter Karttunen-existentials, and the former Chierchia-existentials. One of the claims made in the chapter is that the *wh*s in *wh*-conditionals are Karttunen-existentials. To be concrete, (22) gives a way to compose the question meaning of *Lisi qing shei?* 'who does Lisi invite?' using Karttunen-existentials (Karttunen 1977, Dayal 2016) and the LF (with covert *wh*-movement) proposed by Huang 1982.

(22)



a. $[\![\text{IP}]\!] = \lambda s.\text{ls invites } x \text{ in } s$

b. $[\![\text{C}_Q]\!] = \lambda q.p = q$

c. $[\![\textit{shei}]\!] = \lambda P \exists x[\text{people}(x) \wedge P(x)]$

d. $[\![\text{CP}]\!] = \exists x[\text{people}(x) \wedge p = \lambda s.\text{ls invites } x \text{ in } s]$

$\xrightarrow{\lambda-\text{abstraction over } p} \lambda p \exists x[\text{people}(x) \wedge p = \lambda s.\text{ls invites } x \text{ in } s]$

The question denotation thus obtained is further embedded under the answerhood operator in (8) and the semantics of conditional in (6).

Our proposal that treats the *wh*-clauses in *wh*-conditionals as questions also explain their interaction with certain conjunctions. As shown in §5.4.7, *he* 'and$_T$' cannot be used to conjoin the *wh*-clauses in a *wh*-conditional. This is expected since the *wh*-clauses are questions and *he* can only conjoin term phrases but not questions[8]. The connectives *yiji/haiyou* can be used in *wh*-conditionals because of their ability to connect questions.

It needs to be mentioned that a simple intersective *and* cannot be used to conjoin Hamblin-questions: $[\![$Who did Zhangsan invite?$]\!] \cap [\![$Who did Lisi invite?$]\!] = \emptyset$. We need a point-wise *and*. (24) is a possible entry for *yiji/haiyou* on their question-conjoining use.

(24) $[\![Q_1 \textit{ yiji/haiyou } Q_2]\!] = \{p : \exists q_1 \exists q_2 [q_1 \in Q_1 \wedge q_2 \in Q_2 \wedge p = (q_1 \wedge q_2)]\}$

6.2.2 Quantificational invariability

As discussed in §5.4.2, *wh*-conditionals with quantificational adverbs do not exhibit quantificational variability (pseudo-quantificational-variability is quantification over minimal situations that have one-to-one correspondence with atomic individuals). This is expected under our proposal. Our *wh*s are existentials used in questions, and thus cannot be bound by adverbs of quantification.

Based on the discussion in §5.4.2, we propose that quantificational adverbs in *wh*-conditionals quantify over pragmatically determined subsituations of a topical situation (cf. Beck's (2012) analysis of comparative correlatives). Consider our previously discussed example involving quantificational adverbs (19), repeated here as (25).

(25) Tongchang, Zhangsan qing <u>shei</u>, Lisi jiu qing <u>shei</u>.
usually, Zhangsan invite who, Lisi then invite who
Lisi usually invites who Z invites.

$\not\approx$ Lisi invites most people that Z invites.

[8] Here is an example:

(23) Zhangsan wen Lisi qu mei qu Beijing, ∗he/yiji/haiyou ta mai.le shenme.
Zhangsan ask Lisi go not go Beijing, and he buy.ASP what
'Zhangsan asks whether Lisi went to Beijing and what he bought.'

(26) $[\![(25)]\!]$=1 at $s*$ iff

$\text{Most}[\lambda s.s \in Cov(s*), \lambda s.[\![\text{Ans}(Q_A)(s)\ jiu\ \text{Ans}(Q_C)(s)]\!] = 1 \text{ at } s]$

(25) has (26) as its analysis. In (26), we are looking at a plural situation $s*$ that has as its parts subsituations s where Zhangsan and Lisi both threw a party. Then (26) requires that for most s, the information needed for answering the antecedent question (*who did Zhangsan invite at s?*) is enough to support the consequent question (*who did Lisi invite at s?*). Since we are quantifying over party-situations, which do not necessarily contain only one individual, no quantificational variability is observed.

6.2.3 Uniqueness, maximality and minimality

Our answerhood operator, adopted from Dayal 1996, is both presuppositional and informativity-based, and thus explains both uniqueness in *wh*-conditionals and maximal/minimal *wh*-conditionals.

First uniqueness. (27) (repeated from (29)) shows the uniqueness presupposition in *wh*-conditionals: both Zhangsan and Lisi are presupposed to invite exactly two persons.

(27) Zhangsan qing na.liang.ge.ren, Lisi jiu qing na.liang.ge.ren.
Zhangsan invite which.two.CL.person, Lisi then invite which.two.CL.person
Whichever two persons Zhangsan invites, Lisi invites them.

In our proposal, both the antecedent and the consequent have an ANS applied to a question, and this gives rise to uniqueness for both. We illustrate how this is achieved by considering the antecedent. Suppose there are three people John, Mary and Sue in the domain and *invite* is irreflexive. The antecedent question in (27) has the denotation in (28).

(28) $$[\![\text{which 2.persons does Z invite?}]\!] = \left\{ \begin{array}{l} \lambda s.\text{Z invites John} \oplus \text{Mary in } s, \\ \lambda s.\text{Z invites John} \oplus \text{Sue in } s, \\ \lambda s.\text{Z invites Mary} \oplus \text{Sue in } s \end{array} \right\}$$

Next, ANS applied to the question in (28) and to the evaluation index $s*$, delivers the presupposition that there is a proposition in the question set that is true at $s*$ and entails all the other true-at-$s*$ propositions in the question set (see (8) for the formalization – intuitively, the presupposition just requires that the most informative answer be in the question denotation).

Now suppose Zhangsan invites three people, John, Mary and Sue, in $s*$. All the propositions in (28) are true-at-$s*$ propositions, but none entails the other, and thus there is no proposition in the question set that is true at $s*$ and entails all the other true-at-$s*$ propositions in the question set. The presupposition of ANS is not satisfied. In general, for the presupposition of ANS to be satisfied in (28), John has to invite exactly 2 persons. This is how we derive uniqueness in *wh*-conditionals by using Dayal's answerhood operator.

Next maximal/minimal *wh*-conditionals. See (29)/(30), repeated from (15)/(37).

(29) Nimen dian-li you duo.da de shenshan, jiu na ge duo.da de gei wo.
you strore-in have how.big DE shirt then take CL how.big DE to me
'Give me one of the biggest shirt that your store has.'

(30) duoshao qian gou chi kaoyao, wo jiu gei ni duoshao qian
how.much money sufficient eat roast.duck, I then give you how.much money
'I will give you the (minimal) amount of money that is sufficient to eat roast duck'.

(29)/(30) are captured by our proposal using Dayal's answerhood operator. ANS applied to the antecedent question in (29)/(30) picks out the most informative true proposition in the question set.

In (29), this involves the maximal d such that there are d-big shirts in the store. The conditional part then says that the situation contains this maximal d should be able to support the consequent answer; thus the addressee should give me a shirt of d-big.

In (30), the minimal amount of money d_{MIN} that is sufficient to eat roast duck (for all amount of money d, d' such that $d < d'$, d *is sufficient to eat roast duck* $\subset$ d' *is sufficient to eat roast duck*) is involved. The conditional part then says that the situation contains d_{MIN} should be able to support the consequent answer; thus I will give you the minimal amount of money that is sufficient to eat roast duck.

Notice that (30) also carries the exhaustive flavor *I will give you exactly/only the minimal amount of money that is sufficient to eat roast duck* (again, this is not an implicature, since embedding it under negation does not cancel the exhaustivity), to which we turn next.

6.2.4 The exhaustive flavor

The exhaustive flavor is captured by our proposal. Consider the previously discussed (44), repeated here as (31).

(31) Chi duoshao, jiu cheng duoshao.
eat how.much, then fill how.much
Fill the plate with **only**/**exactly** the amount of food that you will eat.

Suppose in $s*$ Lisi would eat exactly 1 pound of rice but he filled his plate with 1.5 pounds of rice. (31) is false in $s*$ according to our proposal. This is because the minimal situation that supports the antecedent question contains exactly 1 pound of rice, which is unable to support the consequent answer which involves 1.5 pounds of rice. For (31) to be true in $s*$, Lisi would have to fill his plate with only 1 pound of rice. In other words, (31) has the exhaustive flavor according to our proposal.

It is interesting to note that our proposal has used a weak exhaustive answerhood operator to capture the so called strong exhaustiveness (strong exhaustiveness adds to weak exhaustiveness, which only contains positive information, the negative inference of *only*) (Groenendijk & Stokhof 1982). This is due to our use of minimal/exemplifying situations. Within a situation semantics, we can say that p is a strong exhaustive answer to Q in $s*$ iff the exemplifying/minimal situation of p also exemplifies $\textsc{ans}(Q)(s*)$, while p is a non-exhaustive answer to Q in $s*$ iff there is an s which is an extension of the exemplifying situation of p and s exemplifies $\textsc{ans}(Q)(s*)$. This way of capturing strong exhaustiveness is similar to the position Dayal 2016 takes: p is a strong exhaustive answer to Q at w iff p is the proposition expressed by $\textsc{ans}(Q)(w)$. For how to combine situation semantics with Groenendijk & Stokhof's semantics of questions, see Kratzer 2014.

6.2.5 Mention-some *wh*-conditionals

Existential/mention-some *wh*-conditionals have a natural correspondence to mention-some questions.

(32) <u>nar</u> neng maidao jiu, wo jiu qu <u>nar</u>.
where can buy liquor, I then go where
'I will go to some place where I can get liquor.'

We use a variant of Beck & Rullmann's (1999) ANS3 (33), which they propose to capture mention-some questions, to analyze existential *wh*-conditionals[9].

(33) $\text{ANS}(Q)(s*) = \lambda P \exists p[P(p)(s*) = 1 \wedge Q(p) \wedge p(s*) = 1]$

When applied to an embedded mention-some question Q, ANS3 requires Q to quantifier raise above the embedding predicate. For example, *John knows where you can buy gas* has the LF in (34).

(34) [ANS3(where.you.can.buy.gas) [λp [John knows t_p]]]

In our story, questions are embedded in conditionals, since we don't want questions to move out of the antecedent of a conditional, we need to modify (33). The simplest way is to use choice functions (Reinhart 1997). Our ANS_{some} in (35) applied to a question Q at $s*$ will pick out one (among many) true-at-$s*$ proposition in the question set. Conditionals then can work with the proposition thus obtained. Finally, we may choose to existentially close the choice function at the top. The resulting truth condition of (32) is (36), which roughly says that the place I will go (right now) is some place where I can get liquor, an intuitively adequate characterization of (32).

(35) $\text{ANS}_{some}(Q)(s*) = f_{CH}(\lambda p[Q(p) \wedge p(s*) = 1])$

(36) $[\![(32)]\!] = 1$ in $s*$ iff $\exists f_{CH} \forall s[s \in \text{MIN}_{\#}\{s : f_{CH}(\lambda p[Q_A(p) \wedge p(s*) = 1]) \wedge \text{PRE}(Q_C)(s) =$

[9] Our account is compatible with other ways of capturing the mention-some reading of questions, such as by appealing to pragmatic principles or partial answers. See Dayal 2016: §3 for relevant discussion.

$1\} \to \textsc{ans}(Q_C)(s*)(s) = 1]$

Of course, the use of $\textsc{ans}_{some}$ should be constrained to avoid over-generation (not every question allows mention-some answers and not every *wh*-conditional allows existential interpretation), but these contraints are not well understood in the mention-some question literature (see Dayal 2016 for relevant discussion). But at least one prediction is made within our analysis: since *wh*-conditionals are built out of questions, whenever a question cannot receive a mention-some answer, the corresponding *wh*-conditional does not have an existential interpretation (the reverse does not hold since a *wh*-conditional might have its own constraints not discussed here which would block certain mention-some questions). As far as I can see, this is a correct prediction. For example, a question like (37) never allows a mention-some answer, and correspondingly the *wh*-conditional built out of it (our previously discussed (29)/(27)) never has an existential interpretation.

(37) Q: Zhangsan qing le na.liang.ge.ren?
Zhangsan invite ASP which.two.CL.persons
'Which two persons did Zhangsan invite?'

A: #John and Mary, or Bill and Sue.

This is (one of the many places) where our proposal has an advantage over a free-relative based analysis, which would use entity level existential shift to explain existential *wh*-conditionals and thus has no obvious way to capture their affinity to mention-some questions.

6.2.6 Non-coreferentiality

(38), repeated from (56), is an example where the two *wh*s in a *wh*-conditionals do not seem co-referential.

(38) [StoreX sells matching shirts for young couples. A couple came in. The boy said to the girl:]

ni	xuan	nage,	wo	jiu	genzhe	ni	xuan	nage.
you	choose	which.one,	I	then	follow	you	choose	which.one

I will choose a shirt that matches what you choose.

Our proposal based on relations between situations (instead of relations between individuals) allows for the extra flexibility to handle non-coreferentiality: suppose the girl will buy the Hermione-shirt; the minimal antecedent situation *s* will consist of *the girl, the Hermione-shirt* and *the boy*; since the boy cannot buy a Hermione-shirt because of a contextual sortal mismatch (because boys don't buy girls' shirts!), the Hermione-shirt's male counterpart the Ron-shirt is added to *s* (we can say that a matching function between shirts is salient enough in the context to be added into *s*; after all, conditionals and modal expressions are highly context-dependent), and that is the shirt the boy is going to buy.

6.2.7 Asymmetry

Conditionals are asymmetric — *if p* then *q* is different from *if q* then *p*. Furthermore, it turns out that a conditional can be used to answer a question about its consequent but not one about its antecedent (39)-(40). This is parallel to the Q-A asymmetry we observe with *wh*-conditionals and the verb *depend on* (see §5.4.9), and our analysis that treats *wh*-conditionals as a type of conditional make possible a unified analysis of the phenomena.

(39) Q: Will it rain tomorrow?
A: #If it rains tomorrow, I will stay at home.

(40) Q: Will you stay at home tomorrow?
A: If it rains tomorrow, I will stay at home.

6.2.8 Taking stock

The proposal for *wh*-conditionals as interrogative conditionals naturally accounts for all of their semantic properties discussed in §5.4, but for one remaining issue — the matching requirement, which requires the number and form of the *wh*s in the antecedent of a *wh*-conditional equal the number and form of the *wh*s in the consequent (Cheng & Huang 1996: 132).

Both unslective binding based analyses and FR-based analyses are claimed to have an explanation of the matching requirement. For unselective binding, it follows from the ban on vacuous binding (Cheng & Huang 1996: 135), and for FR-based analyses, it could follow from the requirement that a generalized quantifier over *n*-place predicates (the antecedent-denotation) needs to be applied to a corresponding *n*-place predicate (the consequent-denotation) (cf. Dayal 1996 on correlatives), or from a similar requirement by the identity relation under an FR-based equative analysis.

However, notice that all the proposals mentioned here could only explain why the number of the *wh*s need to match. Form-match, such as *shui* 'who' mismatching *na xieren* 'which people', *na ge danshenhan* 'which bachelor' mismatching *na ge wenhui nanzi* 'which unmarried man' and so on receives no principled semantic explanation. Especially notice that *which bachelor* is semantically identical to *which unmarried man*, yet the two do not match (*John invited which bachelor, Bill JIU invited which unmarried man), casting doubt on an explanation that depends entirely on semantics.

Our current proposal does not have the resources to explain the matching effect, for our semantics of *wh*-conditionals is based on a general theory of conditionals and ordinary conditionals do not exhibit such an effect.

I would like to suggest that the explanation of the matching effect lies not in semantics proper, but in discourse felicity conditions (see Huang 2010: 129-130 for a similar proposal).

Here is a rough idea: *wh*-words in questions are inherently focused (Kiss 1995: 23, Haida 2008), and this is also true of the *wh*s in *wh*-conditionals. Being focused, they trigger discourse requirements that are similar to the question-answer congruence discussed in Rooth 1992 (a congruent answer to a *wh*-question must have F-marking on the constituent corresponding to the *wh*-phrase), and the discourse requirement could explain the matching requirement. But I have to leave this to another occasion.

6.3 Conclusion

In this chapter, a proposal for *wh*-conditionals as interrogative conditionals has been developed and various semantic properties of *wh*-conditionals discussed previously have been shown to follow. The *wh*-puzzle we started out with has also received an adequate explanation and a unified analysis of Mandarin *wh*-items based on Chierchia's existential semantics of polarity items and Karttunen's existential semantics of interrogative pronouns has been retained.

Despite all the pros, the use of minimal situations to keep track of individuals — specifically, the individuals that constitute the short answer of a question — feels indirect and complicated. We may want to try a more direct route which explicitly captures the requirement of a *wh*-conditional that the short answer of the antecedent question and that of the consequent question should be identical. We turn to such an alternative proposal in the next chapter.

Chapter 7

Proposal-B: *wh*-conditionals as interrogative dependency

7.1 Introduction

We have been trying to categorize *wh*-conditionals as a type of real conditional, with the standard assumption that conditionals denote relations between propositions. In this chapter, we will develop an alternative analysis, where the conditional status of *wh*-conditionals is (almost) given up. *Wh*-conditionals are treated as encoding a special dependency relation between questions. We will call this analysis a Q+D account, with Q standing for questions and D dependency.

7.2 Dependency as relations between questions

We will start with an intuitive understanding of *dependency*, based on Ciardelli 2016b. Here is a motivating example from Ciardelli 2016b: §1.1.

Suppose that a certain disease triggers two symptoms S_1 and S_2, the latter much more serious than the former. Suppose next the disease can be cured by a certain treatment T, which however carries some risk. Since symptom S_2 is more serious, T is always prescribed if S_2 is found. However, if the patient only presents S_1, T is only prescribed when the patient is in good overall physical condition. Now we feel that a dependency relation between the following three questions in (1) holds and we can use the sentence in (2) to describe the relation.

(1) Q_S: What symptoms does the patient present?

Q_C: Is the patient in good physical condition?

Q_T: Will the treatment be prescribed?

(2) Whether the treatment will be prescribed depends on what symptoms the patient presents and whether the patient is in good physical condition.

A dependency relation is thus a relation between questions, as (2) suggests, and it holds between two questions Q_1 and Q_2 — Q_1 depends on Q_2 to be specific — in a context c, iff settling Q_2 implies settling Q_1 in c, or equivalently (3)

(3) Q_1 depends on Q_2 in a context c iff every way of settling Q_2 implies a way to settle Q_1 in c . [cf. Ciardelli 2016b: §2.4]

To illustrate, in the hospital scenario, every way of settling Q_S and Q_C contextually implies a way that Q_T is settled. Suppose the patient only shows symptom S_1 (which settles Q_S) and she is not in good physical condition (which settles Q_C); then according to the hospital protocol (which belongs to the contextual information), she will not be treated (which settles Q_T). Thus a dependency relation between Q_S, Q_C and Q_T obtains.

It turns out that Ciardelli's semantics of dependency is too week. Consider a different hospital where the same disease always receives treatment T, regardless of whether the patient shows S_1 or S_2, and regardless of whether or not s/he is in good physical condition. In this case, no dependency should hold between the three questions Q_T, Q_S and Q_C, and yet (3) predicts Q_T depends on Q_S and Q_C. This is because it is indeed the case that every way of settling Q_S and Q_C in c implies a way Q_T is settled. It is even stronger than that — Q_T is always settled in c.

The problem (3) encounters is reminiscent of the matching problem discussed in Rothstein 1995, concerning examples like (4).

(4) Every time the doorbell rings, John opens the door.

Intuitively, (4) requires there to be at least as many door-openings as bell-ringings. But the standard first order representation (5a) does not capture this — it can be true even when there are multiple bell ringings but only one door opening.

(5) a. $\forall s[\text{bell.ring}(s) \rightarrow \exists s'[\text{door.open}(s')]]$

b. $\forall s[\text{bell.ring}(s) \rightarrow \exists s'[\text{match}(s, s') \wedge \text{door.open}(s')]]$

To capture this, Rothstein proposes to use matching functions, as in (5b). The idea is: for every door-opening, we check whether there is corresponding bell-ringing. Importantly, matching relations are highly context-dependent: they are "supplied in context, sometimes pragmatically and sometimes on the basis of linguistic material in the sentence" (Rothstein 1995: 23). In (4), it is a "response function, where each door-opening is mapped onto the bell-ringing to which it is a response" (Rothstein 1995: 23). It could also be simply temporal coincidence, as in *Every time Bill buys a donkey, John sells one* (Rothstein 1995: (45b)). But not every relation can be a matching relation. What is relevant for us is that a matching relation with domain D and co-domain R cannot map all x in D to the same a in R.

Following Rothstein's idea, we assume that a dependency relation between questions needs to encode a matching relation as well, as in (6). In our problematic hospital example, since every way of settling Q_S and Q_C (together with available contextual information) implies the same way to settle Q_T — treatment will be prescribed, that is. The matching relation is violated and no dependency holds.

(6) Q_1 depends on Q_2 in c iff every way of settling Q_2 in implies a **matching** way to settle Q_1 in c.

Notice that we have not made precise what it means to *settle a question*. We turn to the semantics of questions and their answers to be used for the Q+D analysis of *wh*-conditionals next.

7.3 The significance of short answers

It might be useful to step back and think about what our semantics of questions is intended to do. Consider the *wh*-conditional in (7).

(7) Zhangsan qing le shei, Lisi jiu qing le shei.
Zhangsan invite ASP who, Lisi JIU invite ASP who

'Lisi invited whoever Zhangsan invited.'

Based on our discussion in Chapter 5 and 6, both the antecedent and the consequent of a *wh*-conditional are questions. Furthermore, for (7) to be true, the short answers of the two questions at the actual world are felt to be identical[1], which suggests that we need to access the information about short answers of questions after questions are formed. It is however unclear how to achieve this in the standard Hamblin/Karttunen framework where questions are sets of propositions and answers are propositional (sets of worlds) (see Zimmermann's argument below). Specifically, it is unclear how to get from a set of worlds where Zhangsan invited John and Mary (suppose that is the answer to *who did Zhangsan invite?*) to the individual $\mathsf{j} \oplus \mathsf{m}$.

In §7.4 we will develop a semantics for questions that will address the issue raised in connection with *wh*-conditionals. For the sake of completeness, however, I will now introduce some background on how short answers have been discussed in the literature.

A question such as the one in (8) can be answered by either a full clause as in (8a), or a seemingly bare nominal (8b). The former is a full answer while the latter a fragment answer.

(8) Q: Who did John invite?

a. John invited Mary.

b. Mary.

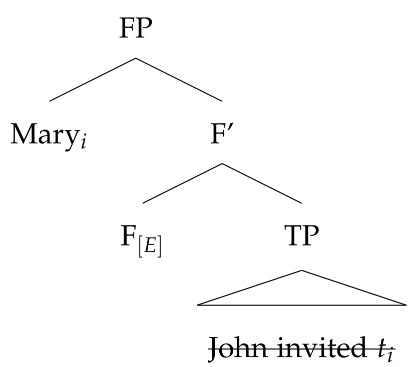
By *short answers*, I mean the *denotation* of a fragment answer, if the fragment answer is indeed an individual-denoting expression. Notice that different from how the term is used in the literature (where 'short answers' are interchangeable with 'fragment answers'), I use 'short answers' as a semantic notion, distinguishing it from the purely syntactic 'fragment answers'.

Short answers are involved in analyses of fragment answers as in Ginzburg & Sag

[1] The two full answers — *Zhangsan invited John and Mary* and *Lisi invited John and Mary* — are obviously not equivalent.

2000 and Jacobson 2016. In these accounts, fragment answers such as (8b) are truly bare and interpreted as e-type individuals (or their shifted generalized quantifiers). Questions receive lambda-abstracts — such as $\lambda x \lambda w : \mathsf{persons}(x).\ \mathsf{invite}_w(\mathsf{j}, x)$ for the question in (8) — as their denotations. Accordingly, (propositional) full answers result from applying the meaning of the question to the meaning of the short answer.

However, not everyone agrees that (8b) is bare. In the ellipsis approach to fragment answers (Merchant 2004, Weir 2014), (8b) is underlyingly clausal, with movement and ellipsis deriving its bare form on the surface, illustrated in (9). In this account, (8b) and (8a) receive the same (propositional) analysis and short answers do not play a distinguished role.

(9)


The current chapter stays neutral between a bare analysis (Ginzburg & Sag 2000, Jacobson 2016) and an ellipsis analysis (Merchant 2004, Weir 2014) of fragment answers. In other words, (8b) by itself does not provide decisive support for incorporating the notion of short answers into semantic theorizing.

There is however a place for short answers, argued by Chierchia & Caponigro (2013), Xiang (2016), in the analysis of free relatives.

(10) John invited [$_{\text{FR}}$ who Bill invited].

A free relative as in (10), being an argument of the verb *invited*, obviously denotes an individual (or its lifted generalized quantifier) (Jacobson 1995, Dayal 1997). Nevertheless, it has a form similar to interrogatives, and as is argued by Chierchia & Caponigro and

Xiang, it should have a question as its semantic core as well. Their main argument is based on Caponigro's Generalization (Caponigro 2003).

(11) **Caponigro's Generalization**

If a language uses the *wh*-strategy to form both questions and free relatives, the *wh*-words found in free relatives are always a subset of those found in questions. Never the other way around. Never some other arbitrary relation between the two sets of *wh*-words.

Caponigro's Generalization receives a natural explanation within an analysis in which free relatives are semantically derived from questions. As illustrated in (12), since free relatives are derived from questions (not the other way around) and the route from questions to free relatives could be partial, the *wh*-words found in free relatives could only be a subset of those found in questions.

(12) **Explaining Caponigro's Generalization**

Free relatives

↑ (Partial)

Questions

Short answers play an important role in such question-based analyses of free relatives. The conversion from a question denotation (standardly assumed to be a set of propositions of type $\langle st, t\rangle$) to a free relative denotation (of type e or its lifted type $\langle et, t\rangle$) can be described as the short answerhood operator.

Defining short answers (and the corresponding short answerhood operator responsible for shifting question denotations to their short answers) however is not straightforward in the Hamblin-Karttunen framework where questions are sets of classical propositions. To see the challenge, consider Zimmermann's argument[2]. Take any property P (of type

[2]I thank Gennaro Chierchia for sharing with me a letter from Ede Zimmermann to Ivano Carponigro, where I found this argument. A more formal version of the argument appears in Zimmermann 1985: §5. The original argument is directed at Groenendijk & Stokhof's analysis, but it carries over to any sets-of-propositions

$\langle s, et \rangle$) and an arbitrary bijective function f of type $\langle e, e \rangle$. Then form a new property P_f by putting: $P_f(w)(x) = 1$ iff $P(w)(f(x)) = 1$, for any individuals x and worlds w. If follows that the two properties P and P_f are distinct if f is not the identity function. However, for any such f, the corresponding questions *who has P?* and *who has P_f?* coincide, on the Hamblin-Karttunen account: since f is bijective, the propositions of the form *x has P* are the propositions of the form *x has P_f*. As a result, the two underlying properties P and P_f cannot be distinguished and reconstructed from the question. The two short answers — $\sigma x.P(w)(x)$ and $\sigma x.P_f(w)(x)$ arguably — cannot be reconstructed either.

We will return to Zimmermann's argument after we present the double access semantics of questions in the next subsection.

7.4 Questions as sets of structured meanings

The semantics of questions we will be considering is double access since information of both short answers and propositional answers is available from the question denotation. Interestingly, only a minor departure from the standard Hamblin/Karttunen picture is needed — questions are still sets of their possible answers, only that answers are not sets of possibles worlds anymore.

7.4.1 A double access semantics of questions

One of the most basic desiderata in developing a semantics of questions is to account for Q-A pairs like (13). An English speaker obviously knows the meaning of the Q in (13), and thus she knows that A_1 but not A_2 or A_3 is a possible answer to the Q. Generalizing, to know the meaning of an interrogative sentence is to know what counts as a answer. Thus the slogan *questions as answerhood conditions* (Hamblin 1973).

(13) **Q-A pairs**

Q: Who did Zhangsan invited?

A_1: Zhangsan invited Mary.

account, including the standard Hamblin-Karttunen one.

A_2:#Zhangsan slept well last night.

A_3:#Obama is the president.

One of the standard approaches to the semantics of questions treats a question as a set of propositions (Hamblin 1973, Karttunen 1977) and a possible answer (a proposition) as a member of the set. In the case of *who did Zhangsan invite*, the set is the set of propositions of the form *that Zhangsan invited x*, where *x* is any individual in the context. Since the proposition *that Obama is the president* is not in the set, A_3 is not a possible answer to the Q.

There is a second type of Q-A pair. Consider (14).

(14) **Q-A pairs**

a. Q_1: Who did Zhangsan invited?

A_1: John invited Mary_F.

A_1': #Zhangsan_F invited Mary.

b. Q_2: Who invited Mary?

A_2: #Zhangsan invited Mary_F.

A_2': Zhangsan_F invited Mary.

As is shown in (14), a possible answer to a *wh*-question must also have $_F$-marking (indicated by prosodic prominence) on the constituent corresponding to the *wh*-phrase.

Taking questions to be sets of propositions and $_F$ to trigger alternatives (Rooth 1985) needs a *separate* constraint to capture this second type of answerhood condition (Rooth 1992) (for 'Zhangsan invited Mary_F' and 'Zhangsan_F invited Mary' encode the same proposition as their ordinary semantic values), which is referred to as the principle of Q-A Congruence in (15).

(15) Q-A Congruence (Rooth 1992)

$[\![Q]\!] \subseteq [\![A]\!]_{Alt}$

In words: the denotation of the question has to be a subset of the alternative semantic value of its answer.

Since $[\![Q_1]\!] \subseteq [\![A_1]\!]_{Alt}$ but $[\![Q_1]\!] \not\subseteq [\![A'_1]\!]_{Alt}$, A_1 but not A'_1 is a felicitous answer to Q_1. The same explanation applies to Q_2 and A_2/A'_2.

Having a separate constraint (besides set membership) is somewhat unsatisfactory. Below I will try to develop an alternative account which sticks to the idea that a question is the set of its possible answers.

We start with the semantics of the answers in (14) that have F-markings. Instead of taking the meaning of 'Zhangsan invited Mary$_F$' as consisting of an ordinary semantic value and a focus semantic value, we following Jacobs 1983, von Stechow 1990, Krifka 1992 treat it as having a structured meaning as its denotation. A structured meaning of an expression with F-marking is a pair of meanings whose first element is the focus denotation and the second the denotation of the rest of the expression. (16) illustrates.

(16) **Structured meaning**

$[\![$Zhangsan invited Mary$_F]\!] = \langle \mathsf{mary}, \lambda x \lambda w.\mathsf{zs\ invited}\ x\ \mathsf{at}\ w \rangle$

$[\![$Zhangsan$_F$ invited Mary$]\!] = \langle \mathsf{zs}, \lambda x \lambda w.x\ \mathsf{invited\ mary\ at}\ w \rangle$

Next, we stick to the idea that a question is a set of its possible answers. Since an answer denotes a structured meaning, a question will denote a set of structured meanings (Heim 1994: §8)[3], every member of which has as its first element a possible value of the *wh*-constituent and as its second element the denotation of the rest of the question without the *wh*-part, as in (17).

(17) **Questions**: a set of structured meanings

$[\![$Who did Zhangsan invite?$]\!]$

$$= \left\{ \begin{array}{ll} \langle \mathsf{john}, & \lambda x \lambda w.\mathsf{Zhangsan\ invited}\ x\ \mathsf{at\ w} \rangle, \\ \langle \mathsf{mary}, & \lambda x \lambda w.\mathsf{Zhangsan\ invited}\ x\ \mathsf{at\ w} \rangle, \\ \langle \mathsf{john} \oplus \mathsf{mary}, & \lambda x \lambda w.\mathsf{Zhangsan\ invited}\ x\ \mathsf{at\ w} \rangle \end{array} \right\}$$

[3] This is exactly what Heim (1994) proposes at the end of that paper. However it seems that this part of Heim's proposal has not been picked up in the literature.

In this setting, Q-A congruence is checked by simply asking whether the structured meaning denoted by the potential A is a member of the question denotation. Since $[\![$Zhangsan invited Mary$_F]\!]$ but not $[\![$Zhangsan$_F$ invited Mary$]\!]$ is a member of $[\![$Who did Zhangsan invite?$]\!]$, A_1 but not A_1' is a possible answer to the question in (14a).

We can also define *the* answer of a question relativized to a world, which uses Dayal's answerhood operator Ans and is thus named the Dayal-answer.

(18) **Dayal-answer:** a possible answer of Q is a focus-background pair $\langle \mathsf{F}, \mathsf{B} \rangle$ belonging to Q; A Dayal-answer at w is the unique $\langle \mathsf{F}, \mathsf{B} \rangle$ that is the strongest true answer at w.

$\mathsf{Ans}(Q)(w) = \iota \langle \mathsf{F}, \mathsf{B} \rangle \in Q[(\mathsf{B})(\mathsf{F})(w) = 1 \land \forall \langle \mathsf{F}', \mathsf{B}' \rangle \in Q[(\mathsf{B}')(\mathsf{F}')(w) = 1 \rightarrow \mathsf{B}(\mathsf{F}) \subseteq \mathsf{B}'(\mathsf{F}')]]$

Finally, (19) defines what is to settle a question.

(19) **To settle a question:**

a. an answer $\langle \mathsf{F}, \mathsf{B} \rangle$ settles a question Q at w iff $\langle \mathsf{F}, \mathsf{B} \rangle$ is the Dayal-answer at w.

b. an answer $\langle \mathsf{F}, \mathsf{B} \rangle$ is a possible settlement of a question Q iff there is a world w such that $\langle \mathsf{F}, \mathsf{B} \rangle$ is the Dayal-answer at w.

In general, since (i) the semantics of questions as sets of structured meanings is a variant of the categorial/functional approach to questions where question meanings are analyzed as functions that, when applied to the meaning of the answer, yielded a proposition, and (ii) the functional approach has more expressive power than the proposition-set approach (Krifka 2001), notions that can be defined in a proposition-set approach are also definable in the approach we are entertaining here.

Finally, the semantics of questions proposed here is double access: the denotation of the short answer of a question can be directly read off its Dayal-answer, which is just the F-part of the latter. Zimmermann's argument does not apply either. The two questions discussed at the end of §7.3 *who has P?* and *who has P_f?* simply do not have the same denotation in this account: they have different B-parts to start with (one being P the other P_f).

Crucially, the extra expressive power of accessing the short answer of a question is needed to provide an adequate semantics of Mandarin *wh*-conditionals. But before turning to *wh*-conditionals, I would like to motivate the current semantics of questions by showing (i) structured meanings are probably needed for analyzing focus, (ii) since interrogatives cross-linguistically involve focus-marking, structured meanings should be incorporated into question semantics as well, and (iii) the indefiniteness of *wh*-items (also a signature of question words cross-linguistically) — specifically, their existential semantics — plays a role in generating a *set* of such structured meanings.

7.4.2 Motivating structured meanings

Arguments have been made in the literature for incorporating structured meanings into a theory of focus (von Stechow 1990, Krifka 1992) and into question semantics (von Stechow 1990, Heim 1994, Krifka 2001, Barker 2016). I will in this subsection briefly mention two such arguments, one concerning hyper-intensionality and the other concealed questions. I will discuss my own motivation for using structured meanings in the next two subsections.

First, compared to structured meanings, an alternative semantics for focus (Rooth 1985) is not hyper-intensional enough[4]. Consider the heart/kidney problem (Blok 1993) (a similar example is also discussed in Krifka 2006, and I believe Heim's student/spouse example (Heim 1994: 141) has the same flavor). Suppose that everything with a heart also has kidneys, and that kidneys are alternatives to hearts; then *John only has [a heart]*$_F$ is predicted by alternative semantics to be equivalent to *John only has [kidneys]*$_F$ and to *John only has [a heart and kidneys]*$_F$, for in possible world semantics, the three prejacents and their alternative sets are intensionally indistinguishable. This is counter-intuitive, for the former two are obviously false and yet the third is contingent. A structured meaning approach to focus does not have this problem, for hearts and kidneys are distinct objects

[4]This point is already noted in footnote 13 of Rooth 1985: p85. A through discussion appears in Zimmermann 2016. Another possible solution to the hyper-intensionality problem is to use property theory (Chierchia 1984), suggested by Rooth.

and $\langle$a.heart, λx.John has $x\rangle$ and $\langle$a.heart and kidneys, λx.John has $x\rangle$ are different.

Second, for reasons unrelated to focus, Barker (2016) proposes that the semantics of questions should incorporate structured meanings. His arguments concern concealed questions, which are syntactic DPs that can be interpreted as if they were questions, as in (20a), interpreted roughly as (20b) (for discussion of concealed questions, see Baker 1968, Heim 1979, Romero 2005, Nathan 2006, Aloni & Roelofsen 2011, Frana 2013). Crucially, not every DP makes good concealed questions — compare (20a) with (20c). The basic generalization, according to Barker (himself drawing observations from Löbner 1981, Nathan 2006, Caponigro & Heller 2007), is that only relational DPs such as *Mary's birthday*, *Bill's favorite drink*, *the capital of China*... — but not sortal DPs such as *the brick*, *Bill's rose* and *Bill* ... — can act as good concealed questions. To account for the paradigm, Barker proposes that questions are built out of focus-background structures $\langle$F, B$\rangle$, and since relational DPs (but not sortal ones) provide such a structure — for example ⟦Mary's birthday⟧ = $\langle$day, born-on(john)$\rangle$, they make good questions.

(20) Concealed questions

a. John found out [$_{DP}$ Mary's birthday].

b. John found out [$_{Q}$ what Mary's birthday is].

c. *John found out the brick/Bill's rose/Bill.

In the next two subsections, I spell out my own motivation for building structured meanings into the semantics of focus and questions.

Locally scalar particles

Structured meanings provide more information than alternative semantics does, but Rooth (1996) claims that natural languages do not need this extra expressive power. Consider the famous hypothetical *tolfed*.

(21) **Rooth's hypothetical *tolfed*** [Rooth 1996: (17)]

a. I tolfed [that [he]$_F$ resembles her] $\equiv$ I told him that he resembles her.

b. I tolfed [that he resembles $[\text{her}]_F$] $\equiv$ I told him that he resembles her.

c. I tolfed [that $[\text{he}]_F$ resembles $[\text{her}]_F$] $\equiv$ I told him and her that he resembles her.

d. $[\![\text{tolfed}]\!] = \lambda\langle F, B\rangle\lambda x.\mathsf{told}(x, F, B(F))$

The idea is that *tolfed* is definable in a structured meaning theory as in (21d) but not in alternative semantics. However, as Rooth claims, focus-sensitive operators like *tolfed*, which allows for access to the semantic value of the focused item, are not attested in natural languages.

I disagree with Rooth on this point. If the analysis of *jiu* proposed in chapter 3 is on the right track, *jiu* is precisely a focus-sensitive operator whose semantics makes reference to the denotation of the focused item. (22) restates the analysis of *jiu* discussed in chapter 3.

(22) $[\![jiu]\!] < \mathsf{F}, \mathsf{B} >$ is defined only if:

$\forall x \in Alt(\mathsf{F})[x \neq \mathsf{F} \rightarrow \mathsf{F} <_R x]$ Scalarity

(Focus as the bottom.)

if defined,

$[\![jiu]\!] < \mathsf{F}, \mathsf{B} > = \lambda w \forall q \in C[q \subset \mathsf{B}(\mathsf{F}) \rightarrow \neg q(w)]$ Exclusivity

where, $C \subseteq \{q \mid \exists x.(x \in Alt(\mathsf{F}) \wedge q = \mathsf{B}(x))\}$

(Strictly stronger alternatives are false.)

The scalar component of *jiu* in (22) clearly makes reference only to the semantic value of the focused item (without referring to the background), and *jiu* is thus a locally scalar particle. Crucially, local scalarity is important to an understanding of the polarity-sensitive behavior of *jiu* (see the discussion of exclusive (dis)-harmony in Chapter 4).

It seems that an adequate analysis of English *only* also needs to take structured meanings into consideration. Consider (23).

(23) a. John only [$_{\text{VP}}$ lost 3_F rounds].

b. John only [$_{\text{VP}}$ won 3_F rounds].

Suppose that John and Bill completed a competition with six rounds in total and that there was no tie for any single round. Then the two VPs in (23) are intensionally indistinguishable, and so are their alternative sets (for every alternative *that John lost n rounds* in the set of (23a) there is an equivalent one *that John won 6-n rounds* in the set of (23b)). But the two differ in meanings: (23a) conveys that John did a good job while (23b) implies the opposite. This distinction cannot be captured under Rooth's alternative semantics, but can be approached under structured meanings, for the two backgrounds differ: $\langle 3,\ \lambda n.\text{john lost } n \text{ rounds}\rangle \neq \langle 3,\ \lambda n.\text{john won } n \text{ rounds}\rangle$.

In sum, it seems that there are after all focus-sensitive operators in natural languages that make reference to semantic values of the (narrowly) focused items, and a double access theory such as structured meanings is thus needed for a theory of focus interpretation.

Focus in questions

If focus needs structured meanings, questions need them as well, since question words are cross-linguistically focused (Kiss 1995, Haida 2008, AnderBois 2012). Below, examples from Yucatec Maya (AnderBois 2012: (1)) and Hungarian (Kiss 1998: 249) illustrate.

(24) [máax]$_F$ uk' le sa'-o'
someone/who drink.AGENT.FOCUS the atole-DISTAL
'Who drank the atole (a traditional beverage)?' Yucatec Maya

(25) A huzat [melyik szoba ablakait] törte be?
the draft which room's windows.ACC broke in
'The windows of which room did the draft break?' Hungarian

a. [melyik szoba ablakait] törte be a huzat?

b. ∗[melyik szoba ablakait] a huzat törte be?

c. ∗[melyik szoba ablakait] be törte a huzat?

d. ∗ a huzat [melyik szoba ablakait] be törte?

Both Yucatec Maya and Hungarian mark focus by moving it to a designated position, and question words need to move there as well. In Yucatec Maya, this is the sentence-initial position and in Hungarian the immediate preverbal position. Additionally, the focus status of the question word in Yucatec Maya is shown by the verb in the so-called agent focus form in (24).

While views on the contribution of focus in questions differ between analyses — AnderBois takes focus to convey an existential presupposition in questions while Haida claims it adds exhaustiveness, it is certain that a question semantics needs to take focus into consideration. In our account, focus plays the same role both within and outside questions — it generates a $\langle \mathsf{F}, \mathsf{B} \rangle$ structure.

7.4.3 The set perspective, indefiniteness and compositionality

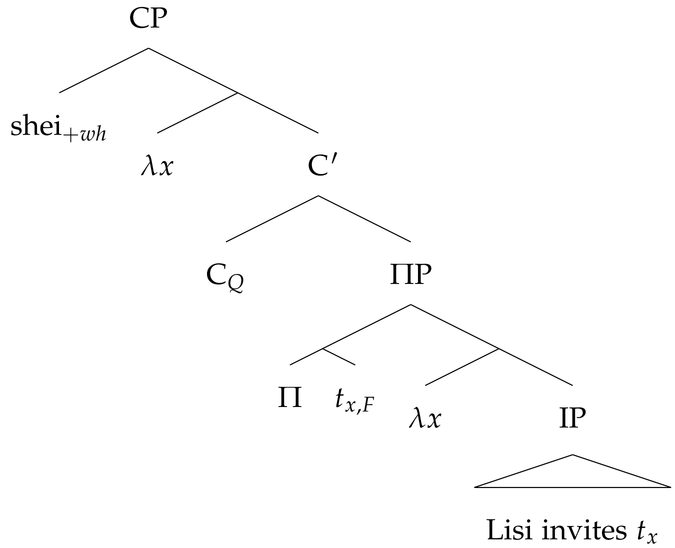
Following Hamblin 1973, I take a set perspective — that is, questions are sets of their answers — to be essential to an analysis of questions. For instance, under a set perspective, the difference between embedding verbs such as *believe* that do not take interrogatives as their complements and verbs like *know* and *wonder* that can (or must) embed interrogatives can be explained by assuming that the former take propositions (or whatever declarative statements denote) as their arguments while the latter sets of propositions (or sets of whatever declarative statements denote) (Uegaki 2015). Answerhood operators are also conceptually natural under a set perspective. For example, Dayal's answerhood operator is just a combination of a maximality operator (which turns a set into a set of its maximal members) and a description operator ι. The naturalness of such a operator can also be witnessed by its applicability across domains — Sharvy/Link's σ for definite article (and von Fintel et al.'s (2014) updated version of it) and Stalnaker's selection function used in conditional semantics are just its variants in different semantic domains, and crucially, all of them work with sets.

Furthermore, I propose that the indefiniteness of question words — another signature of interrogatives cross-linguistically (Haspelmath 1997, Bhat 2000, Haida 2008) — plays a role in forming such a set. The idea essentially comes from Karttunen (1977) (and its modern implementations, see especially Ciardelli et al. 2016[5]): an interrogative C_Q head forms a singleton set of propositions (or whatever declarative sentences denote) by Partee's

[5]Thanks to Simon Charlow for discussion of this point.

Ident basically, and an existential quantifier denoted by the question word quantifies in and enlarges such a set. (26) illustrates one way of implementing this basic idea.

(26)



a. $[\![\text{IP}]\!] = \lambda s.\text{ls invites } x \text{ in } s$

b. $[\![\Pi]\!] = \lambda x \lambda P.\langle x, P\rangle$

c. $[\![\Pi\text{P}]\!] = \langle x, \lambda x \lambda w.\text{Lisi invited } x \text{ at } w\rangle$

d. $[\![\text{C}_Q]\!] = \lambda \pi'.\pi = \pi'$

e. $[\![\text{C}']\!] = 1 \text{ iff } \pi = \langle x, \lambda x \lambda w.\text{Lisi invited } x \text{ at } w\rangle$

f. $[\![\textit{shei}]\!] = \lambda P \exists x[\text{people}(x) \wedge P(x)]$

g. $[\![\text{CP}]\!] = 1 \text{ iff } \exists x[\text{people}(x) \wedge \pi = \langle x, \lambda x \lambda w.\text{Lisi invited } x \text{ at } w\rangle]$

$$\xrightarrow{\lambda-\text{abstraction over } p} \lambda \pi \exists x[\text{people}(x) \wedge \pi = \langle x, \lambda x \lambda w.\text{Lisi invited } x \text{ at } w\rangle]$$

$$= \left\{ \begin{array}{ll} \langle \text{john}, & \lambda x \lambda w.\text{Lisi invited } x \text{ at w}\rangle, \\ \langle \text{mary}, & \lambda x \lambda w.\text{Lisi invited } x \text{ at w}\rangle, \\ \langle \text{john} \oplus \text{mary}, & \lambda x \lambda w.\text{Lisi invited } x \text{ at w}\rangle \end{array} \right\}$$

A few remarks. First, both focus and indefiniteness are employed to derive a question meaning. Focus is responsible for structuring the meaning of a sentence radical (the IP) into a focus-background pair. Specifically, in (26), Π is just a pair-forming operator[6], movement of the focus phrase to the complement of Π (or to its specifier; nothing hinges

[6]This way of forming $\langle \mathsf{F}, \mathsf{B}\rangle$ is suggested in Rooth 1996. A different way that projects $\langle \mathsf{F}, \mathsf{B}\rangle$ from the focused item all the way up is proposed in Krifka 1992.

on this) helps create the partition.

Next, the focus phrase further moves to the Spec of the interrogative C_Q head which turns the $\langle \mathsf{F}, \mathsf{B} \rangle$ into an identity statement, a classical proposition. The indefinite *shei* 'who' is then interpreted, existentially binding the individual variable in the F part of the $\langle \mathsf{F}, \mathsf{B} \rangle$. Finally, λ-abstracting over the π variable (ranging over $\langle F, B \rangle$) returns a set of structured meanings.

It is interesting to note that in the derivation, variables get focused and they are actually hidden in the background from their binders higher up in the tree. Specifically, by forming the focus-background pair $\langle x, \lambda x \lambda w.\mathsf{Lisi\ invited}\ x\ \mathsf{at}\ w \rangle$, x in the background is bound by the λ in the background and remains bound even after potential higher binders come in. In other words, only the x in the focus is free for higher binders. It is currently unclear to me what else follows from this result.

Summarizing, in this section, we have developed and motivated a double access semantics of questions where a question denotes a set of structured meanings. The semantics makes use of two signatures of interrogatives cross-linguistically: focus and indefiniteness; the former creates a structured meaning $\langle \mathsf{F}, \mathsf{B} \rangle$ while the latter helps generate a set of such meanings. The semantics also has more expressive power than the classical Hamblin/Karttunen account in that it provides information both on the short answers and on the full answers of a question, which is precisely what we need for an analysis of *wh*-conditional, to which we turn next.

7.5 *Wh*-conditionals encode a special dependency relation

We take the antecedent and the consequent of a *wh*-conditional to be questions, and the entire *wh*-conditional as encoding a particular dependency relation between the two questions. Specifically, *wh*-conditionals have the semantics in (28)[7], with c representing a

[7] (28) uses a formulation of dependency different from Ciardelli's (2016b), both of which are shown below.

(27) a. Q_1 depends on Q_2 in c iff every way of settling Q_2 in c implies a **matching** way to settle Q_1 in c. (Ciardelli 2016b)

b. Q_1 depends on Q_2 in c iff for every world in c the way of settling Q_2 at w **matches** the way of settling Q_1 at w. This section

Stalnakerian context set and wh.match specifying identity of the F-part of two answers.

(28) $[\![Q_A \textit{ jiu } Q_C]\!]$ is true at a world w in a context c

iff $\forall w \in c : \mathsf{wh.match}(\mathsf{Ans}(Q_1)(w), \mathsf{Ans}(Q_2)(w))$

where two answer wh.match iff their F are identical.

Now it is clear why we need to treat questions as sets of $\langle \mathsf{F}, \mathsf{B} \rangle$ pairs — it allows us to keep track of the F-part of a full answer, which corresponds to the short answer of the question, as *Mary* in (29) is (with the assumption that *Mary* is indeed a DP with an entity denotation. See §7.3.). Then, two questions can stand in a certain relation because a particular relation holds between their short answers, and this is precisely what a *wh*-conditional conveys.

(29) Q: Who did Zhangsan invite?

A: Mary.

Finally, (28) correctly captures the truth-condition of *wh*-conditionals. Suppose that Zhangsan in the actual world only invited Mary, while Lisi only John. Then *Zhangsan invited who, Lisi jiu invited who* is false, because the actual world certainly belongs to the context set and thus there is a world such that the two Dayal-answers of the two questions at that world do not wh.match.

Recall that *wh*-conditionals can be read causally (Lin 1996) and epistemically (§5.4.9). This is represented by having different c for the *wh*-conditional — a metaphysical c for the former while an epistemic c for the latter.

7.6 Explaining the properties

In this section, I briefly discuss how the Q+D analysis could explain various semantic properties of *wh*-conditionals. The table below is to remind the reader of the properties

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Unfortunately I am at the current stage unable to give a proper comparison of the two, partly because Ciardelli uses an entirely different semantic framework — inquisitive semantics. What is important for our purposes is that (27b) works well for *wh*-conditionals, and I remain silent on whether it should be used as a representation of dependency relations in general.

discussed in §5.4.

(30) **Properties of *wh*-conditionals**

wh-licensing
Interaction with conjunction
Quantificational invariability
Maximality
Minimality
Antecedent uniqueness
Consequent uniqueness
Mention-some
Exhaustivity
Non-coreferentiality
Asymmetry

First, ***wh*-licensing** is expected, since the *wh*-clauses in *wh*-conditionals are still questions and the *wh*-words still Karttunen-existentials. The status of the *wh*-clauses being questions also explains the interaction of *wh*-conditionals with certain **conjunctions**: the *wh*-clauses cannot be conjoined by *he* which only works with term phrases, but they can be conjoined by *yiji/haiyou*, which can take questions as their inputs. We also anticipate **quantificational invariability** since the *wh*-phrases are not open variables (at least not out of their questions) that are not amenable to quantification from quantificational adverbs.

Next, **maximality, minimality, and uniqueness** are also accounted for since Dayal's answerhood operator Ans, which is informativity-based and presupposes uniqueness, still forms the basis of the semantics of *wh*-conditionals in this account. One difference between the current analysis and the account discussed in the previous chapter is that Ans now work with sets of structured propositions instead of sets of propositions, but this is only a minor departure, since we can always get the intended set of propositions from the corresponding set of structured propositions $\langle \mathsf{F}, \mathsf{B} \rangle$, by combining each F with its B and collecting the results.

Exhaustivity is also expected. Suppose I say to Zhangsan '*eat how much, then fill the plate with how much*', and Zhangsan filled his plate with 1.5 pounds of rice but later only ate 1 pound; Zhangsan did not fulfill the requirement issued by the *wh*-conditional, for the two Dayal-answers $\langle \text{1.pound.of.rice}, \lambda x.\text{zs.ate } x\rangle$ and $\langle \text{1.5.pounds.of.rice}, \lambda x.\text{zs.filled } x \text{ on.his.plate}\rangle$ simply do not wh.match.

Third,the affinity of **mention-some** *wh*-conditionals to mention-some questions is captured and both can be accounted for by allowing the possibility of settling certain types of questions non-exhaustively. An implementation using choice functions is conceivable, similar to what we did in §6.2.5.

Next, **non-coreferentiality** can be accommodated by loosening the wh.matching requirement. Instead of defining wh.matching between two answers as strict identity of their Fs, we could say that two answers are wh.matched if a function maps the F of one to that of the other, while making the identity function as the default.

Asymmetry could also be explained by exploring the dependency intuition, on which the current analysis is based. A *wh*-conditional can be used to answer an interrogative questioning the consequent of the *wh*-conditional but not one that questions its antecedent, because the consequent question depends on the antecedent question.

Finally, let me mention the **matching effect** again. In the current analysis, a restatement of the matching effect is attainable, which requires that the number of the Fs of the antecedent answer equal that of the consequent. However, this constraint does not seem derivable from the basic idea underlying the current analysis that *wh*-conditionals encode dependency relations, for the latter do not have this constraint in general — witness a sentence containing the verb *depend on* "Who visits who depends on who is giving the order". Neither is it clear how to account for the *form-matching* such as *which bachelor* mismatching *which unmarried man* in this account. I will leave this issue as unresolved[8].

[8] In general, I will leave for future investigation *wh*-conditionals with multiple pairs of *wh*s. Related literature includes correlatives with multiple *wh*s (Dayal 1996, Bittner 2001, Gajewski 2008), and multiple constituent questions (see Dayal 2016: §4 and references cited therein).

7.7 Comparison, conclusion and implication

Let me briefly compare the two proposals for *wh*-conditionals developed in the last two chapters. First of all, the two share the same core idea that *wh*-conditionals express relations between questions. Intuitively, the relation holds between the questions if their short answers are identical. The two proposals differ as to how to represent this relation. The first tries to derive it from the general semantics of conditionals, and then situations and minimization over situations are needed to keep track of the individuals that constitute the short answers. The second directly writes the relation into the semantics of the construction. *Wh*-conditionals are then seen as a grammatical device that encodes a particular interrogative dependency. Instead of using situations, the semantics of questions is enriched (as sets of structured meanings) to adequately represent the relation.

Unfortunately no definite answer can be reached at this stage regarding which of the two proposals points to a better route to *wh*-conditionals, but some results and implications can still be discussed.

Empirically, our discussion has established that a question perspective is essential to an adequate understanding of Mandarin *wh*-conditionals. The claim is supported by a wide range of interrogative properties exhibited by *wh*-conditionals such as the use of *wh*-morphology, informativity-sensitivity, uniqueness and so on. This question perspective sets our analysis apart from the existing proposals and points to a new line of research.

Suppose a question perspective is correct. Investigating *wh*-conditionals is theoretically instructive in the following ways.

First, suppose *wh*-conditionals are real conditionals. They constitute another phenomenon where we can explore the interaction between alternatives and conditionals, which has been observed in unconditionals (Rawlins 2013), conditionals with disjunctive antecedents (Alonso-Ovalle 2009), conditional questions (Isaacs & Rawlins 2008) and *if*-conditionals in general (Starr 2014). Furthermore, while the other phenomena all involve interaction of conditionals with a single set of alternatives, the option of embedding two alternative sets within a conditional semantics has not been discussed previously. Our Q+A+C proposal illustrates how this could be done. Finally, to deal with the interaction, we could either *lift* the conditionals so that they directly work with sets of alternatives (Ciardelli 2016a), or *lower* the alternative sets to single propositions that standard semantics of conditional can work with. The Q+A+C proposal illustrates the second possibility.

Second, suppose instead *wh*-conditionals are not real conditionals but simply grammaticalize dependency relation. They could then be used as a probe into the semantics of *dependency*, recently discussed in detail in Ciardelli 2016b. It needs to be mentioned that Ciardelli only discusses dependency relations between yes-no questions; our Q+D account illustrates how a dependency relation could be represented between constituent questions. Last but not least, just as embedded questions offer hints on the semantics of questions in general (see especially George 2011), embedding two questions under a *wh*-conditional (or simply under English verbs such as *depend on*, *determine*) may help us choose between different theories of questions. If the Q+D analysis is on the right track, *wh*-conditionals offer support for the functional/categorial approach to questions.

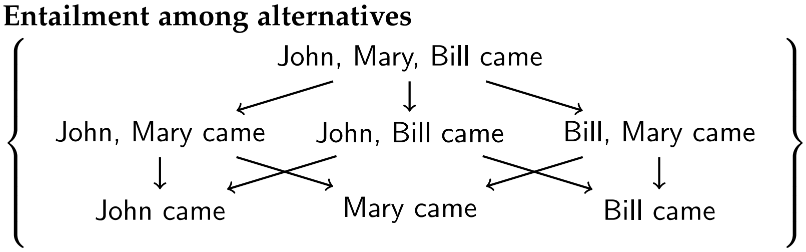
Chapter 8

Concluding remarks

In this work, I have put alternatives to some novel uses. Alternatives (including questions, which are just sets of propositional alternatives) have been employed to account for Mandarin *jiu*, *dou* and *wh*-conditionals, the latter two of which had been popularly thought to involve quantification (over individuals) instead. An alternative-perspective has led us to a wide range of their properties uncovered by previous accounts.

I have also tried to emphasize *varieties of alternatives*, which yields uniqueness in questions (Dayal 1996) and *wh*-conditionals, and systematic 'ambiguities' of Mandarin focus particles. Varieties of alternatives, in the line pursued in this dissertation, was taken to mean that different sets of alternatives may have distinct properties, to which some alternative-sensitive-operators/exhaustification-operators are sensitive. For example, a (propositional) alternative set may either have, as in (1), or lack, as in (2), an entailment relation among its alternatives. Exhaustification operators such as Dayal's Ans, Mandarin *jiu* and *dou* are sensitive to this difference, giving rise to maximality vs. uniqueness in questions and *wh*-conditionals, exclusive vs. non-exclusive ONLY, and *dou*'s distributive effect vs. its *even*-flavor. Analyses exploring the distinction were proposed for *jiu* and *dou* in chapter 3. Accounts of *wh*-conditionals based on questions and Dayal's answerhood operator were proposed and discussed in chapter 5-7.

(1) **Entailment among alternatives**



(2) **No entailment among alternatives**

$$\left\{\begin{array}{l}\text{President Obama came,}\\ \text{My uncle in Japan came,}\\ \text{My roommate came,}\end{array}\right\}$$

A propositional alternative set usually has a designated member, denoted by the ordinary semantic value of the sentential alternative trigger, called the prejacent. This gives us alternative sets where the prejacent entails all the other alternatives – (3) – or alternative sets with the prejacent being the weakest, as in (4). The contrast between the two varieties has helped us understand many polarity phenomena (e.g. Chierchia 2013) and in the current thesis exclusive (dis)-harmonies, discussed in chapter 4.

(3) **Prejacent strongest**

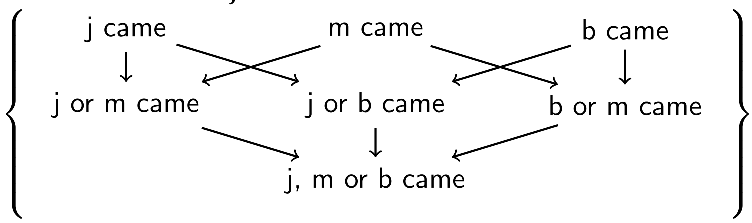
$$\left\{\begin{array}{l}\underline{\text{John earned less than \$400}}\text{, (strongest)}\\ \text{John earned less than \$500,}\\ \text{John earned less than \$600,}\\ \ldots\end{array}\right\}$$

(4) **Prejacent weakest**

$$\left\{\begin{array}{l}\underline{\text{John earned more than \$400}}\text{, (weakest)}\\ \text{John earned more than \$500,}\\ \text{John earned more than \$600,}\\ \ldots\end{array}\right\}$$

Particularly interesting are cases where there is a unique weakest element in the alternative set — for example, an alternative set closed under disjunction as in (5). When the prejacent refers to the weakest in such a set, the set usually has problems with most (if not all) exhaustificaiton operators (ONLY, EVEN…), which either gives rise to NPI-type ungrammaticality or transformation of the set into one that triggers free choice effects (see Chierchia 2013). Why is there no exhaustificaiton operator in natural languages that picks out (or requires its prejacent to be) the weakest element in a set? I guess the answer has to do with Gricean reasoning and how exhaustificaiton operators are lexicalized from pragmatics. This is left for future research.

(5) **Closed under disjunction**



In general, alternatives have been employed to analyze various phenomena in natural languages, including focus and focus particles (Rooth 1985), questions (Hamblin 1973, Karttunen 1977), indeterminate pronouns (Shimoyama 2001, Kratzer & Shimoyama 2002), indefinites (Kratzer & Shimoyama 2002, Charlow 2014), disjunctions (Mandy 2005, Alonso-Ovalle 2006), implicatures (Chierchia 2006, Fox 2007a, Chierchia et al. 2012), polarity items (Krifka 1995, Chierchia 2013), subject matters (Lewis 1988, Yablo 2014). I hope the current thesis has demonstrated the fruitfulness of exploring alternatives and varieties of alternatives in Mandarin Chinese and cross-linguistically.

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