Two Types of Disjunctions in Mandarin Chinese*

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Abstract

Recent semantic research has suggested that a declarative disjunction in certain contexts should be interpreted as a conjunction of modal clauses. In contrast, the standard analysis regards an interrogative disjunction as a set of propositions denoted by each disjunct. The relation between these two analyses has not been discussed in the literature, possibly because most languages, including English, have only one disjunctive connective. This paper uses data from Mandarin Chinese, which has both declarative and interrogative disjunctions, and suggests a new semantics for interrogative disjunctions.
Key words: Disjunction, Modality, Conditionals, Mandarin Chinese, Formal semantics

1. Introduction

A disjunction is a logical constant in propositional logic and its truth value has been considered obvious: a disjunctive proposition p or q is true if and only if either p or q is true or both are true. However, recent studies have investigated the behavior of disjunctions in the scope of modal verbs and antecedents of conditionals, and have suggested that disjunctions in natural languages should be analyzed as conjunctions, for example, a list of epistemic possibilities (Zimmermann 2000), a list of alternatives (Geurts 2005), a set of denotations of disjuncts (Simons 2005), and a set of propositional alternatives (Alonso-Oval 2006). In contrast, the interrogative disjunction is analyzed as a set of propositions that is denoted by each disjunct through the standard analysis of formal semantics. This paper examines both recent and standard analyses based on data from Mandarin Chinese, and suggests a new semantics for interrogative disjunctions.

The structure of this paper is as follows: section 2 gives a brief description of Chinese disjunctive connectives; section 3 introduces the recent analysis of disjunctions in modal contexts/antecedents of conditionals, and Chinese declarative disjunctions are examined in their framework; section 4 introduces the standard analysis of interrogative sentences and suggests a new analysis of interrogative disjunctions; section 5 focuses on the alternation of two connectives in Mandarin Chinese and validates the proposal of this paper; and section 6 is the conclusion.

2. Chinese disjunctive connectives

In this section, I briefly describe two disjunctive connectives in Mandarin Chinese, mainly regarding their differences in distribution and alternation in some contexts.

2.1 Two disjunctive connectives

Mandarin Chinese has two types of disjunctions: *haishi* and *huozhe*. *Haishi* forms an interrogative disjunction ($or_{[+Q]}$) and *huozhe* forms a declarative disjunction ($or_{[-Q]}$).

1) Zhangsan lai haishi Lisi lai?

   Zhangsan come or$_{[+Q]}$ Lisi come

   "Which of Zhangsan and Lisi will come?"

2) Zhangsan lai huozhe Lisi lai.

   Zhangsan come or$_{[-Q]}$ Lisi come

   "Zhangsan comes or Lisi comes."

There are several distributional differences between them: first, they select different sentence-final particles; second, they show different scopes relative to syntactic *yes/no*-question markers; and third, only the latter can appear in the scope of adjunct *wh*-phrases.

Let us first observe their semantic selection of sentence-final particles. According to Li and Thompson (1981), Mandarin Chinese has a pair of sentence-final particles, *ma* and *ne*, which appear in complementary distributions for questions.[1] *Ma* is a *yes/no*-question marker and does not co-occur with other interrogative words/phrases, whereas *ne* appears in both declarative and interrogative clauses and adds pragmatic information to them.[2] As the disjunction formed by *haishi* is interrogative, it cannot take other interrogative markers, as shown in (3a). However, as the disjunction formed by *huozhe* is declarative, *ma* can convert it into a *yes/no*-question, as shown in (3b).

3)   a. *Zhangsan haishi Lisi lai ma?

   Zhangsan or$_{[+Q]}$ Lisi come MA

   "Does Zhangsan or Lisi come?"

   b. Zhangsan huozhe Lisi lai ma?

   Zhangsan or$_{[-Q]}$ Lisi come MA

   "Does Zhangsan or Lisi come?"

The other sentence-final particle *ne* is compatible with both *haishi* and *huozhe*, as it only adds pragmatic information to questions/statements. But the information conveyed by *ne* is different between questions and statements: when it appears in interrogative sentences, it adds pragmatic information, as in "with respect to what you have just said, let me ask you …," while in declarative sentences it conveys the pragmatic information "the content of the sentence is the speaker's response to some claim, expectation, or belief on the part of the hearer" (Li

& Thompson 1981: 300). Hence, although both *haishi* and *huozhe* can co-occur with *ne*, the pragmatic information conveyed by *ne* is different, as shown in (4a-b).

4) a. Zhangsan haishi Lisi lai ne?

 Zhangsan or$_{[+Q]}$ Lisi come NE

 "(In that case,) let me ask you whether Zhangsan or Lisi comes?"

 b. Zhangsan huozhe Lisi lai ne.

 Zhangsan come or$_{[-Q]}$ Lisi come NE

 "(You might not expect it, but) Zhangsan or Lisi will come."

Next, we will observe the scope-interaction between the disjunctions and other interrogative markers. Mandarin Chinese has a syntactically composed *yes/no*-question marker *shibushi* (literally *be-not-be*), which asks for the truth value of the proposition. It appears in the sentence-initial position or directly after the subject, and shows the speaker's intense wish to know the truth value of the proposition. In the following pair of examples, both *haishi* and *huozhe* co-occur with *shibushi*.

5) a. Nimen shibushi zhengzai juxing yinghuo wanhui, haishi huazhuang wuhui?[3]

 You-$_{PL}$ be-not-be $_{PROG}$ hold campfire gathering or$_{[+Q]}$ mask ball

 "Is it true that you are holding a campfire? Or (it is true that you are holding) a masked ball?"

 b. Nimen shibushi zhengzai juxing yinghuo wanhui, huozhe huazhuang wuhui?[4]

 You-$_{PL}$ be-not-be $_{PROG}$ hold campfire gathering or$_{[-Q]}$ mask ball

 "Is it true that you are holding a campfire or a masked ball?"

Although two connectives can appear in the clause headed by *shibushi*, their scopes are different, as suggested by the English translations of (5a-b). In (5a), *haishi* functions to add other possible alternatives to the preceding question and is beyond the scope of *shibushi*. In contrast, *huozhe* in (5b) falls under the scope of *shibushi*: the sentence is interpreted as asking for the truth value of the disjunctive statement. In simpler sentences, like (6a-b), the difference between the two connectives is more obvious. In these sentences, there is only one interpretation, i.e., the scope of *shibushi* extends to the end of the sentence. In that case, *haishi* is incompatible with *shibushi*, while *huozhe* is compatible with it.

6) a. *Shibushi Zhangsan haishi Lisi lai?

 be-not-be Zhangsan or$_{[+Q]}$ Lisi come

 "*Is it true that which will come, Zhangsan or Lisi?"

 b. Shibushi Zhangsan huozhe Lisi lai?

 be-not-be Zhangsan or$_{[-Q]}$ Lisi come

 "Is it true that Zhangsan or Lisi will come?"

Lastly, let us observe the interaction between the disjunctions and *wh*-phrases. In the following examples, both *haishi* and *huozhe* are not accepted in *wh*-questions.

7) a. *Shei xihuan Zhangsan haishi Lisi?

    who like Zhangsan or Lisi

    "Who likes which person: Zhangsan or Lisi?"

   b. ?Shei xihuan Zhangsan huozhe Lisi?

    who like Zhangsan or Lisi

    "Who likes Zhangsan or Lisi?"

The ungrammaticality of (7a-b) might be the result of Intervention effects, whereby the disjunctive phrases block the proper interpretation of the argument *wh*-phrases. Beck & Kim (2006) and Tomioka (2007) showed data from German, Korean, and Japanese, and argued that a disjunction acts as an intervener in relation to a *wh*-phrase. It could be said that disjunctions in Mandarin Chinese, like in those languages, act as interveners in relation to *wh*-phrases. However, the two connectives behave differently in relation to adjunct *wh*-phrases: namely, *haishi* demonstrates Intervention effects while *huozhe* does not, as shown in (8a-b).

8) a. *Yige nühaizi, zenme bu xihuan guang jie chi lingshi,

    one-CL girl   why not like stroll street eat snack

    haishi kankan yanqing xiaoshuo ne ?

    or[+Q] look–look love story ne

    "Why on earth doesn't a girl like shopping and eating snacks? Or (does she like) reading love stories?"

   b. Yige nühaizi, zenme bu xihuan guang jie chi lingshi,

    one-CL girl   why not like stroll street eat snack

    huozhe kankan yanqing xiaoshuo ne ?   (Ito 2006: 245)

    or[-Q] look–look love story ne

    "Why on earth doesn't a girl like shopping, eating snacks, or reading love stories?"

Beck & Kim's (2006) explanation of Intervention effects was based on the proposal by Beck (1998). She suggested that the Intervention effects are brought about because focused items are processed by the same interpretational mechanism as *wh*-phrases. She observed that focused items are interpreted by focus operators as they introduce a set of alternatives into the semantic derivation. In this process, a focus operator utilizes the ordinary semantic value of a focused item. In contrast, *wh*-phrases cannot introduce ordinary semantic values, as they have no denotation. As a result, the focus operator fails to interpret the clauses that include *wh*-phrases. Tomioka (2007) also regarded disjunctions as "anti-topic items" and observed that the anti-topicality causes a clash with the focus property of *wh*-phrases. In contrast, I assume that *haishi* always

yields Intervention effects in relation to all kinds of *wh*-phrases, because it has an interrogative mood that is interpreted in the same component as *wh*-phrases, while *huozhe* only brings about Intervention effects in relation to argument *wh*-phrases, because it only has focus property.

2.2 The alternation of two disjunctive connectives

So far, we have discussed the different distribution of *haishi* and *huozhe*. The two disjunctive connectives are different in that only the former has an interrogative mood. But there are some contexts in which they alternate freely, without any change in meaning.

Ito (2014) investigated the distribution in which two disjunctive connectives alternate, and specified four contexts: i) afterthoughts, ii) the scope of negation, iii) the scope of a universal quantifier, and iv) the scope of negation plus a universal quantifier.

i) Afterthoughts

9) Xuyao dazhen ma? Haishi/Huozhe xuyao chi dian yao ne/ma? (Xing 1993: 1–3)

    need injection $_Q$ or$_{[+Q]}$/or$_{[-Q]}$ need eat some medicine $_{NE/Q}$

    "Do I need an injection? Or, do I need to take some medicine?"

ii) The scope of negation

10) Jiang Hua hai meiyou jueding gen ta qu haishi/huo bu qu. (Ito 2014: 5)

    Jiang Hua yet $_{NEG}$ decide with he go or$_{[+Q]}$/or$_{[-Q]}$ negation go

    "Jiang Hua has not yet decided whether she will go with him or not."

iii) The scope of a universal quantifier

11) Yi-tai caidian Jia mai haishi/huo Yi mai dou shi yi-zhong jiage. (Ito 2014: 8)

    one-$_{CL}$ color-TV A buy or$_{[+Q]}$/or$_{[-Q]}$ B sell all be one-kind price

    "One color TV has a fixed price, whenever A buys one or B sells one."

iv) The scope of negation plus a universal quantifier

12) Bulun tian hao haishi/huozhe huai, lang di haishi/huozhe lang gao,

    WULUN weather good or$_{[+Q]}$/or$_{[-Q]}$ bad wave low or$_{[+Q]}$/or$_{[-Q]}$ wave high

    tamen zongshi chuanzhe youyongyi, maizhe dabu zouxiang haitan.

    they always wear-$_{PROG}$ swimsuit take-$_{PROG}$ big-step walk-toward beach

    "No matter the weather is good or bad, no matter the wave is high or low, they always took big steps to the beach with swimsuits on." (Fang 2008: 246)

As Ito pointed out in her study (Ito 2014), *haishi/huozhe* in context (i) are not true disjunctions. They function to cancel the preceding question and introduce another question to the context. This paper does not discuss this type of disjunctive construction. The acceptability of alternation in contexts (ii) and (iii) varies among speakers, while context (iv), which is the sum of (ii) and (iii),

almost always allows alternation. It is also the most frequent context in which two connectives alternate.[5] In this paper, I define the denotation of two connectives in the framework of formal semantics and explain the mechanism of their alternation.

3．Semantics of disjunctions

In propositional logic, a disjunction is true when either disjunct is true or when both disjuncts are true. However, the truth value of disjunctions in modal contexts and in antecedents of conditionals is not so straightforward. For example, disjunctive addition ("add any statement to a given true statement") is supposed to be applied to any statement in propositional logic, but it is not applied to clauses with a modal verb in natural languages. For example, if we apply disjunctive addition to the simple sentences (13a) and (14a), we obtain the disjunctive sentences (13b) and (14b), respectively.

13) a．John went to the beach.
　　b．John went to the beach or went to the cinema.
14) a．You may go to the beach.
　　b．You may go to the beach or go to the cinema.

In these pairs, the statement (13a) entails the statement (13b). Although it might be pragmatically inadequate to utter (13b) when the speaker knows that (13a) is true, the logical entailment relation still holds between them. In contrast, (14a) does not entail (14b). It is obvious that the permission to go to the beach or the cinema is wider than the permission to go to the beach, hence the entailment relation is reversed in this case.

　Disjunctive addition does not seem to be applied to interrogative sentences, either. As interrogative sentences do not have a truth value, no entailment relation can be applied to them, but intuitively asking the interrogative sentence (15a) is quite different from asking the disjunctive question (15b).

15) a．Did you go to the beach?
　　b．Did you go to the beach or go to the cinema?

For this reason, we have re-analyzed disjunctions in interrogative contexts in the same way as those in modal contexts. In this section, we regard previous analyses of disjunctions in modal contexts and antecedents of conditionals, and define the denotation of disjunctions in Mandarin Chinese, respectively.

3.1．Disjunction as a list of epistemic possibilities

Kamp (1973) noted that disjunctions in modal contexts show a "choice effect," which means that a disjunction in the scope of a modal verb is interpreted as a conjunction of clauses with a

modal verb. For example, (16a) includes a disjunction in the scope of the modal verb may, but it is actually interpreted as (16b), i.e., a conjunction of two permissions.

16) ａ．You may go to the beach or go to the cinema.
　　ｂ．You may go to the beach and you may go to the cinema.

However, Kamp also noted that the choice effect is too strong, because it induces a false conclusion if it is combined with disjunctive addition.

17) ａ．Detectives may go by bus.
　　ｂ．Detectives may go by bus or boat.
　　ｃ．Detectives may go by boat.

(17a) is a sentence with a modal verb. Applying disjunctive addition to (17a) yields (17b), and the choice effect on (17b) induces (17c). But (17c) should not be induced from (17a) in any ordinary sense.

　Zimmermann (2000) proposed a solution to this problem. He suggested that a disjunction is a list of epistemic possibilities: namely that a sentence of the form "p_1 [or] p_2 ... or p_n" is interpreted as a set of propositions in which each of "p_1, p_2, ..., p_n" is consistent with the speaker's knowledge.[6] Once we define disjunctions in modal contexts as conjunctions, disjunctive addition does not apply to them, so there is no false induction. Based on this idea, Zimmermann (2000) formalized disjunctions in modal contexts as follows:

18) If $p_1 \cdots p_n$ is translated as $\phi_1 \ldots \phi_n$ respectively, then p_1 or $p_2 \ldots$ or p_n is translated as $\{\phi_1 \cap S_c \neq \emptyset, \phi_2 \cap S_c \neq \emptyset, \ldots, \phi_n \cap S_c \neq \emptyset\}$, where S_c is a set of propositions which constitute the speaker's background knowledge in a context c.[7]

This implies that the denotation of a disjunctive proposition is a set of intersections between the set of worlds in which the denotation of each disjunct is true and the set of worlds in which propositions that constitute the speaker's knowledge are true.

　Similar analyses were proposed by Geurts (2005) and Simons (2005) for disjunctions in modal contexts, and by Alonso-Ovalle (2006) for disjunctive antecedents of conditionals. Simons (2005) defined a disjunction as a set of denotations that each disjunct denotes, i.e., [[a_1 or ... or a_n]] = {[[a_1]],..., [[a_n]]}. Applying Simon's (2005) analysis, Alonso-Ovalle (2006) suggested that *or* introduces a set of propositional alternatives into the semantic derivation, in order to explain the following anomaly observed in disjunctive antecedents.

19) If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop. 　　　　　　　　　　　　　　　　　　　　　　　　　　(Alonso-Ovalle 2006: 2)

The sentence (19) does not sound natural, because the disjunct *the sun had grown cold* is irrelevant to the consequent clause. However, it presents no problem in the standard Boolean analysis of *or*, which obtains "p∨r→q" as the outcome of applying Disjunctive addition to the antecedent of "p→q" like in (20a). Instead, Alonso-Ovalle regarded the disjunctive antecedents as a set of propositions, like in (20b), and explained the anomaly as follows: as "the sun grew cold" is not the reason why "we had a bumper crop," the half of the counterfactual conditional is judged as false; this is the reason why (19) does not sound natural.

20) a. we had good weather ∨ the sun grown cold → we had a bumper crop.
   b. {we had good weather, the sun grown cold} → we had a bumper crop.

This paper uses Zimmermann's (2000) proposal, which clarifies that a disjunction is related to the speaker's knowledge, which could be altered by the hearer's knowledge to interpret the interrogative disjunction.

3.2. Chinese declarative disjunctions

The Chinese declarative disjunction *p huozhe q* also demonstrates the choice effect in modal contexts and antecedents of conditionals, as shown in (21)–(23).

21) a. Zhengfu hui kaizheng xin shui huozhe gaibian qiye suode shui de
   government may start new tax or$_{[-Q]}$ change corporate income tax $_{DE}$
   shiyong shuilü.
   application tax-rate (CCL)[8]
   "The government may start a new tax or change the income tax rate applied to corporates."
   b. Zhengfu hui kaizheng xin shui, ye hui gaibian qiye suode shui de
   government may start new tax also may change corporate income tax $_{DE}$
   shiyong shuilü.
   application tax-rate
   "The government may start a new tax, and also may change the income tax rate applied to corporates."
22) a. Tamen keyi chuangli yige xin hangye huozhe gaibian yige lao hangye.
   they can establish one-$_{CL}$ new business or$_{[-Q]}$ renovate one-$_{CL}$ old business (CCL)
   "They can establish a new business or renovate an old business."
   b. Tamen keyi chuangli yige xin hangye, ye keyi gaibian yige lao hangye.
   they can establish one-$_{CL}$ new business also can renovate one-$_{CL}$ old business
   "They can establish a new business, and also can renovate an old business."
23) a. Ruguo niaor fei zai tianshang, huozhe renmen zou zai zhetiao lushang,
   if bird fly at sky-on or$_{[-Q]}$ human-$_{PL}$ walk at this-$_{CL}$ road-on

dou neng zhaochu yige haokan de yingzi lai. (Ito 2007: 36)

all can reflect-out one-$_{CL}$ beautiful $_{DE}$ reflection come

"If birds fly through the sky or people walk on this road, it would show their beautiful reflections."

b. Ruguo niaor fei zai tianshang, jiu neng zhaochu yige haokan de yingzi

if bird fly at sky-on then can reflect-out one-$_{CL}$ beautiful $_{DE}$ reflection

lai; Ruguo renmen zou zai zhetiao lushang, ye neng zhaochu yige

come if human-$_{PL}$ walk at this-$_{CL}$ road-on also can reflect-out one-$_{CL}$

haokan de yingzi lai.

beautiful $_{DE}$ reflection come

"If birds fly through the sky, then it would show their beautiful reflections; if people walk on this road, it would show their beautiful reflections, too."

(21a) includes a disjunction in the scope of *hui* (*may*), and it is rephrased as a conjunction of the two modal clauses shown in (21b). (22a) includes a disjunction in the scope of *keyi* (*can*) and is rephrased as a conjunction of the two modal clauses shown in (22b). (23a) is an example of the disjunctive antecedents of conditionals. The disjunctive antecedent can be divided up into two conditionals, as shown in (23b). Based on these facts, the Chinese declarative disjunction *p huozhe q* can be interpreted as a list of possibilities that are consistent with the speaker's knowledge, as Zimmermann (2000) suggested for English disjunctions.

24) Zhangsan lai huozhe Lisi lai. = (2)

={Zhangsan-comes $\cap$ S$_c$ $\neq$ $\emptyset$, Lisi-comes $\cap$ S$_c$ $\neq$ $\emptyset$}

So, what could the translation of the Chinese interrogative disjunction *p haishi q* be? In the next section, I introduce the standard analysis of interrogative sentences in formal semantics and discuss whether or not it can be applied to Chinese interrogative disjunctions.

4.　Interrogative disjunctions

4.1.　The semantics of interrogatives

The denotation of interrogative sentences is hard to define, because they do not have truth values. Nevertheless, researchers of formal semantics have been working on the denotation of interrogative sentences since the 1970s. Most of them follow the seminal work of Hamblin (1973) and Karttunen (1977). The following is a summary of their analyses.

Hamblin (1973): a question sets up a choice situation for a set of propositions that count as an answer to it.

Karttunen (1977): a question denotes the set of propositions expressed by its true answer.

Groenendijk & Stokhof (1984): a question can be viewed as a division of the set of possible worlds in which each possible answer to the question is true.

Higginbotham (1996): not only complete but also partial answers should be included in the denotation of questions.

Krifka (2001, 2008, 2010): a question is a set of congruent answers.

Although their definitions are slightly different, their claims agree on the assumption that the denotation of an interrogative sentence is a set of propositions that are possible answers to the questions.

Based on this definition, interrogative sentences can be interpreted as follows. Firstly, we assume that an interrogative sentence consists of a proposition (= the content described by the clause) and a question marker "?" The marker "?" is located at the head of Complementizer Phrase (CP) and the proposition is placed in the complement of C. A *wh*-expression is moved to the SPEC of C, which leaves a trace in the original position, as is usually assumed in generative grammar. An interrogative disjunction is interpreted as "?" and a disjunctive statement.

25) Is it raining? = $[_{CP} [_{C}?][_{IP}$ it is raining $]]$

26) Who comes? = $[_{CP}$ who$_i$ $[_{C}?][_{IP}$ t$_i$ comes $]]$

27) Did John or Bill come? = $[_{CP} [_{C}?][_{IP}$ John came or Bill came $]]$

Secondly, these structures are interpreted as a set of propositions that are congruent answers to the question. Regarding *yes/no*-questions, congruent answers are affirmative and negative propositions. (28) shows the translation rule for *yes/no*-questions, and (29) shows the translation of (25).

28) If X is translated as ϕ,

then $[_{CP} [_{C}?] [_{IP}$ X $]]$ is translated as $\lambda p [p=^{\wedge}\phi \vee p=^{\wedge}\sim\phi]$

where p is a variable over propositions.

29) $[_{CP}[_{C}?][_{IP}$ it is raining $]] = \lambda p [p=^{\wedge}$it-is-raining $\vee p=^{\wedge}$it-is-not-raining$]$

Wh-questions are interpreted as existential quantifiers, and the traces of *wh*-expressions are translated as variables with index. (30) shows the translation rule for *wh*-questions, and (31) shows the translation of (26).

30) If X is translated as P(a),

then $[_{CP} [_{C}?] [_{IP}$ X $]]$ is translated as $\lambda p \exists x[p=^{\wedge}P(x)]$

where p is a variable over propositions and a is a *wh*-expression.

31) $[_{CP}$ who$_i$ $[_{C}?][_{IP}$ t$_i$ comes $]] = \lambda p \exists x[p=^{\wedge}$comes$(x)]$

Interrogative disjunctions are considered to ask for a choice between propositions (von Stechow 1991). (32) shows the translation rule for interrogative disjunctions, and (33) shows the translation of (27).

32) If X is translated as ϕ or ψ,

then $[_{CP} [_C ?] [_{IP} X]]$ is translated as $\lambda\, p[p=^{\wedge}\phi \,\vee\, p=^{\wedge}\psi]$

where p is a variable over propositions.

33) $[_{CP} [_C ?][_{IP}$ John comes or Bill comes $]] = \lambda\, p[p=^{\wedge}comes(j) \vee p=^{\wedge}come(b)]$

As shown in (33), the denotation of interrogative disjunctions is defined in a similar way as the denotation of declarative disjunctions, which was defined in section 3.2: namely, as a set of propositions. This might be the reason why two connectives alternate in the contexts that were shown in section 2.2. However, interrogative disjunctions behave differently in modal contexts and in antecedents of conditionals. The next section will point out the difference between them and propose a new analysis of interrogative disjunctions.

4.2. The semantics of Chinese interrogative disjunctions

If interrogative disjunctions, as well as disjunctions in modal contexts/antecedents of conditionals, denote a set of propositions, we expect their alternation between modal contexts/ antecedents of conditionals. However, this expectation is not attested. *Huozhe* in (21)–(23) cannot be replaced by *haishi*, as shown in (34)–(36).

34) *Zhengfu hui kaizheng xin shui haishi gaibian qiye suode shui de

   government may start new tax or[+Q] change corporate income tax DE

   shiyong shuilü.

   application tax-rate

   "The government may start a new tax or change the income tax rate applied to corporates."

35) *Tamen keyi chuangli yige xin hangye haishi gaibian yige lao hangye.

   they can establish one-CL new business or[+Q] renovate one-CL old business

   "They can establish a new business or renovate an old business."

36) *Ruguo niaor fei zai tianshang, haishi renmen zou zai zhetiao lushang,

   if bird fly at sky-on or[+Q] human-PL walk at this-CL road-on

   dou neng zhaochu yige haokan de yingzi lai.

   all can reflect-out one-CL beautiful DE reflection come (Ito 2007: 36)

   "If birds fly through the sky or people walk on this road, it would show their beautiful reflections."

If *haishi* co-occurs with a modal verb, it tends to be interpreted as beyond the scope of that modal verb. For example, in (37), the modal verb *hui* (may) follows *haishi*, which indicates that

the modal scope is narrower than the disjunction.[9] In (38), *haishi* is preceded by the modal verb *keyi* (can), but the scope of *haishi* is limited to the complement clause of *xuanze* (choose), because the sentence as a whole is interpreted as declarative.

37) Yuzhou shi jiang hui wuzhide pengzhang xiaqu, haishi hui fazhan

   universe be future may endlessly expand go-on or$_{[+Q]}$ may develop

   wei yige hengwentai de yuzhou?   (CCL)

   become one-$_{CL}$ stabilized $_{DE}$ universe

   "Will the universe keep on expanding in the future? Or will it develop into a stabilized universe?"

38) Xu Yinchuan xian choudao yizhi haoqian, keyi youxian xuanze

   Xu Yinchuan first draw-get one-$_{CL}$ good lot can preferentially choose

   zhi hong haishi zhi hei.   (CCL)

   take red or$_{[+Q]}$ take black.

   "Xu Yinchuan drew a good lot, which allowed him to choose to play red or play black preferentially (in the Chinese chess final)."

Therefore, we need more than a set of propositions in order to explain the different distribution of *haishi* and *huozhe*.

  Now let us go back to observe Zimmermann's (2000) analysis, which interprets declarative disjunctions as a set of propositions that are consistent with the speaker's knowledge. It cannot be applied to interrogative disjunctions, as the speaker's background knowledge is irrelevant when one utters a question. Usually, the speaker does not know whether or not the content of the question is true, but supposes that the hearer knows whether or not it is true. Hence, I propose that *p haishi q*? denotes a list of possibilities that are consistent with the hearer's knowledge "H_c." The denotation of interrogative disjunctions is defined as (39), and (40) shows an example of its translation.

39) If $p_1...p_n$ is translated as $\phi_1...\phi_n$ respectively, then [?[p_1 or p_2...or p_n]] is translated as $\{\phi_1 \cap H_c \neq \emptyset, \phi_2 \cap H_c \neq \emptyset,..., \phi_n \cap H_c \neq \emptyset\}$, where H_c is a set of propositions which constitute the hearer's background knowledge in a context c.

40) Zhangsan lai haishi Lisi lai? (= (1))

   =\{Zhangsan-comes $\cap H_c \neq \emptyset$, Lisi-comes $\cap H_c \neq \emptyset$\}

This explains why interrogative disjunctions do not appear in modal contexts. Epistemic modals are restricted to the world that is accessible to the speaker, whereas interrogative disjunctions only require the world accessible to the hearer, not the speaker. In contrast, this does not account for no alternation in the antecedents of conditionals. In conditionals, the worlds that the antecedent introduces are not limited to the world in which the propositions that constitute the

speaker's knowledge are true. In the next section, I will compare two connectives that introduce conditionals, *ruguo* and *wulun*, and show that the proposal here explains the different behavior of *haishi* and *huozhe* in the antecedents of conditionals.

5. Alternation between the scope of negation and a universal quantifier

As mentioned in section 2.2, *haishi* and *huozhe* alternate freely between the scope of negation and a universal quantifier. Typical connectives that introduce this context are *wulun* (no-discuss), *bulun* (not-discuss), and *buguan* (not-care). As there is not much difference between these connectives, except for the degree of informality, we henceforth describe clauses introduced by them as "*wulun*-clauses," and the construction as a whole as "*wulun*-construction." *Wulun*-constructions are also called "unconditional sentences," as they indicate that if any proposition in the *wulun*-clause is true, the proposition denoted by the consequent clause is true.

Wulun-constructions have two notable features. First, the clause introduced by *wulun* is interrogative, or includes more than one alternative. Second, the consequent clause should contain a universal quantifier, such as *dou* (all), *zong* (always), or *yilü* (universally).

41) Wulun shei lai, Wuye dou yiyang reqing zhaodai.
    WULUN who come Wu–Mr. all same kindly welcome   (Ito 2006: 242)
    "Whoever comes, Mr. Wu always welcomes them kindly."
42) Shangshen bulun chuanbuchuan neiyi, zong bu likai yijian xiao pi beixin.
    bust WULUN wear-NEG-wear underwear always NEG spare one-CL little leather vest
    "On the bust, no matter whether he wore the shirt or not, he always could not spare the little
    leather vest."   (Ito 2006: 250)
43) Fan qiu jian de ma, bulun zhongzu, daxiao, yilü dao saimachang bishi.
    generally want recommendation DE horse *WULUN* breed size universally to race-track race
    "Generally horses who want to be recommended, no matter which breed or size, all go to the
    race track and race."   (Ito 2006: 250)
44) Wulun Zhangsan lai haishi Lisi lai, dou mei guanxi.
    WULUN Zhangsan come or[+Q] Lisi come all not relevant
    "It doesn't matter if Zhangsan comes or Lisi comes."

(41) includes a *wh*-question in the *wulun*-clause and *dou* (all) in the consequent clause, (42) a *yes/no*-question (an A-not-A question) in *the wulun*-clause, and *zong* (always) in the consequent clause. The *wulun*-clauses in (43) and (44) introduce alternatives in different ways: (43) through a coordination of noun phrases, and (44) through a disjunctive phrase.

It is obvious that they are all conditionals that might be described as "$\forall$ w[p(w) → q(w)]," but there is debate about the source of their universal quantification. Lin (1997) regarded *wulun* as a generalized union operator and suggested that the universal quantificational force comes from *dou* in

the consequent clause. Cheng & Giannakidou (2006) argued that *wulun* provides intensionalization, so that *wulun-*α denotes an intensionalized α–property and *dou* functions as a definite article to *wulun-*α. In their analyses, *wulun-*α *dou-q* denotes that all individuals that have property α have property *q*. However, as this analysis is aimed particularly at analyzing *wulun*-NP, it is hard to extend it to clausal *wulun*-constructions. He (2011) argued that *wulun* is a universal quantifier and that *dou* is an existential quantifier of an event variable that is introduced by a plural predicate. As the denotation of the *wulun*-construction obtained through He's (2011) analysis is similar to Lin's (1997), we do not discuss it in this paper. In the following section, we will mainly discuss whether or not Lin's (1997) analysis can account for the alternation between connectives in *wulun*-constructions.

Lin (1997) assumed that the clause following *wulun* denotes a set of propositions in accordance with the standard analysis of interrogatives. Subsequently, he argued that the function of *wulun* is to form a generalized union with a set of propositions through the situation variable *s*.

45) Let A be any set of propositions, $\cup A=\{s:\exists p(p\in A)\ \&\ s\in p\}$ (Lin 1997: 63)

He regarded *dou* as a distribution operator, which distributes the set of situations denoted by the *wulun*-clause. Combining these suggestions with Kratzer's (1991) minimal situation analysis of *if*-conditionals, he defines the semantics of clausal *wulun*-constructions as follows:

46) [[Wulun p, dou-q]] is true in a situation *s* if and only if the following holds: $\forall \min_s$ [$s\in \cup[[p]]$ → $\exists s'[s\leq s'\&s'\in[[q]]$]] (Lin 1997: 63)

This indicates that every minimal situation in which a proposition included in the denotation of the *wulun*-clause is true is extendable to a situation in which the proposition expressed by the main clause is true.

If we apply Lin's (1997) analysis to the *wulun*-construction in which *wulun* leads an interrogative disjunction and a declarative disjunction, respectively, we obtain the following semantics:

47) [[Wulun?[$p_1 \vee p_2$], dou-q]] is true in a situation s if and only if the following holds: $\forall \min_s$ [s $\in \cup[[?[p_1 \vee p_2]]]$ → $\exists s'[s\leq s'\&s'\in[[q]]$]]

48) [[Wulun $p_1 \vee p_2$, dou-q]] is true in a situation s if and only if the following holds: $\forall \min_s$ [s$\in \cup[[p_1 \vee p_2]]$ → $\exists s'[s\leq s'\&s'\in[[q]]$]]

As mentioned in sections 3 and 4, both interrogative disjunctions and disjunctive antecedents of conditionals are analyzed as a set of propositions denoted by each disjunct. The generalized union operator $\cup$ is applied on the set of propositions and forms a set of situations in which each proposition is true. So far, Lin's analysis accounts for the alternation between disjunctive connectives. However, his analysis cannot explain the reason why (36), in which an interrogative disjunction appears in the

antecedent of the conditional, is ill-formed. As his analysis is based on the analysis of *if*-conditionals, it should be able to account for the conditionals that are led by connectives other than *wulun*.

Moreover, Ito (2015) showed that the alternation between interrogative and declarative disjunctions is also observed in Finnish and Egyptian Arabic. The alternation is not caused by the specific meaning of *wulun*, but by the context created through the combination of negation and a factive verb that selects an interrogative complement. Factive verbs, like *know*, *discuss*, and *care* presuppose that their complement clauses are true. If we negate a factive verb, we cancel the presupposition brought about by that factive verb. In other words, the truth value of the clause following *wulun* is unknown in this context. As long as the context includes this feature, it allows the two connectives to alternate. For example, in (49), two connectives alternate in the complement clause of the negated factive verb *bu zhidao* (not know), while in (50), the alternation is not allowed, because the factive verb *zhidao* (know) is not negated.

49) Wo shenzhi bu zhidao kaoshi qian yiding yao shao he shui

   I even not know exam before surely should less drink water

   haishi/huozhe gancui bu he shui.

   or$_{[+Q]}$/or$_{[-Q]}$ just not drink water

   "I didn't even know that I should drink less water or just don't drink it before the exam."

50) Erxi ting kusheng jiu zhidao (haizi) e le *haishi/huozh laniao le.

   the–daughter–in–law hear cry then know (child) hungry PERF or$_{[+Q]}$/ or$_{[-Q]}$ pee PERF

   "Once the daughter-in-law heard his cry, she knew (the baby) was hungry or had peed."

Let us summarize the difference between declarative and interrogative disjunctions. Declarative disjunctions need to access the speaker's knowledge, i.e., a set of worlds in which the propositions that constitute the speaker's knowledge are true. In contrast, interrogative disjunctions require access to the hearer's knowledge, i.e., a set of worlds in which the propositions that constitute the hearer's knowledge are true. As conditionals are uttered based on the speaker's knowledge, they are not compatible with interrogative disjunctions.

51) Ruguo p_1 haishi/huozhe p_2 jiu-q

   a．$*\forall w\ [\ w \in \{p_1 \cap H_c \neq \emptyset, p_2 \cap H_c \neq \emptyset\} \rightarrow w \in [[q]]\ ]$　　- *haishi*, via (39)

   b．$\forall w\ [\ w \in \{p_1 \cap S_c \neq \emptyset, p_2 \cap S_c \neq \emptyset\} \rightarrow w \in [[q]]\ ]$　　- *huozhe*,via (18)

However, as *wulun* negates the presupposition that the complement clause is true, it does not matter whether it accesses to the speaker's or the hearer's knowledge.

52) Wulun p_1 haishi/huozhe p_2 dou-q

   a．$\forall w\ [\ w \in \{p_1 \cap H_c \neq \emptyset, p_2 \cap H_c \neq \emptyset\} \rightarrow w \in [[q]]\ ]$　　- *haishi*, via (39)

   b．$\forall w\ [\ w \in \{p_1 \cap S_c \neq \emptyset, p_2 \cap S_c \neq \emptyset\} \rightarrow w \in [[q]]\ ]$　　- *huozhe*, via (18)

In sum, the alternation between *haishi* and *huozhe* in *wulun*-constructions supports the analysis that was proposed in sections 3 and 4.

6. Conclusion

This paper has shown that Mandarin Chinese has both declarative and interrogative disjunctions, and analyzed them in the framework of formal semantics. In formal semantics, disjunctions in modal contexts/antecedents of conditionals are analyzed as conjunctions of clauses with a modal verb, while interrogative disjunctions are analyzed as a set of propositions that are denoted by each disjunct. This paper proposed that declarative disjunctions in Mandarin Chinese are analyzed as a set of propositions that are consistent with the speaker's knowledge, while interrogative disjunctions are analyzed as a set of propositions that are consistent with the hearer's knowledge. Finally, the paper showed that this analysis also explains the alternation of two connectives in *wulun*-constructions.

This conclusion may be extended to the analysis of English disjunctions. The scope-ambiguity which is inherent in *or* might be caused by the assumption that there is only one *or* in English. The assumption that there are two types of disjunctions in any language could lead to a more compelling analysis of disjunctions.

Abbreviations

CL: classifier
DE: the marker of noun modification
MA: sentence-final particle
NE: sentence-final particle
NEG: negation
PASS: passive marker
PERF: perfective
PL: plural
PROG: progressive
WULUN: the connective that introduces *no-matter* contexts

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(Endnotes)

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1 Mandarin Chinese has another sentence-final particle, which is related to interrogative moods, i.e., *ba*. *Ba* has the effect of soliciting the approval or agreement of the hearer with respect to the statement to which *ba* is attached (Li & Thompson 1981). In this paper we do not discuss this particle, as it does not co-occur with *haishi*.

2 Cheng (1994a,b) regarded *ne* as a question operator that unselectively binds *wh*-phrases within its scope. But there are arguments against this theory. First, *ne* is optional in *wh*-questions. Second, *ne* also appears in declarative clauses. Third, interrogative clauses with *ne* convey special pragmatic information.

3 This sentence sounds better if the first clause accompanies the sentence final particle *ne*. The reason might be that *ne* clarifies the clause boundary. The appearance of *ne* before *haishi* assures the hearers that *haishi* is outside of the scope of *shibushi*.

4 The grammatical judgments of (5b) and (6b) vary among native speakers. Some native speakers uniformly feel uncomfortable with the co-occurrence of the *huozhe*-disjunction and any question marker. The reason might be that they show weak Intervention effects.

5 Please see Ito (2006, 2007) and the reference to Ito (2014).

6 A set of propositions A is consistent if and only if there is a world in W in which all propositions of A are true (Kratzer 1981).

7 According to Zimmermann's (2000) notation, a set of propositions that constitutes the speaker's background knowledge in a context c is H_c. As I introduce a set of propositions that constitutes the hearer's background knowledge in a context c, I replace H_c as S_c.

8 CCL: Corpus of Center for Chinese Linguistics, Peking University.

9 In this sentence, *haishi* also takes the scope indicator *shi* (be) at the beginning of the first disjunct, and the modal verb follows it as well.