

LING895 Doctoral Research Paper

**Semantic and Pragmatic Factors in the  
Acquisition of Disjunction:  
Evidence from Chinese and English**

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## 1. Introduction<sup>1</sup>

Acquiring meaning in a natural language is complicated by the fact that the meaning of an utterance consists of two parts: sentence meaning and speaker meaning. The problem is that much of what is communicated goes beyond what is literally expressed in a sentence. If learners acquire the meanings of the lexical items in part on the basis of the discourse contexts in which they are used, it is not at all obvious how they are to know what parts of a sentence's meaning are to be attributed to the semantics and what parts are to be attributed to the pragmatics. This problem is compounded by the fact that languages seem to vary in how the constraints against certain meanings are encoded, i.e., in whether they are semantic or pragmatic constraints. In this paper, we take up a case study of this problem, looking at cross-linguistic differences in the behavior of disjunction. The problem is that certain interpretations that are licit in English appear to absent in Chinese and Japanese. However, it also appears that their absence from Chinese derives from pragmatic considerations, whereas their absence from Japanese derives from semantic considerations. Thus, to the extent that learners use distributional evidence to acquire the semantics of disjunction, we seem to have identified a serious learning problem. The distributions are alike in Chinese and Japanese yet the grammatical factors governing these distributions are distinct in the two languages. Having identified the learning problem, this paper takes a first step towards understanding how learners approach this problem by identifying what they know at age 4. Only by understanding the course of acquisition can we address the learning principles that contribute to acquisition.

The case study revolves around the interaction between negation and disjunction, specifically, when sentential negation interacts with a disjunction in object position. When investigating the interpretation of this interaction in different languages, the interaction of sentential negation and conjunction in object position becomes relevant, as

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the interpretation of the latter interaction sometimes has an effect on speaker's preference in the interpretation of the former interaction.

A simple negated sentence with a disjunct object in natural languages, such as (1) in English, as well as the counterpart sentences in other languages, can in theory be interpreted either with negation excluded from the disjunction as (2a) or with negation included in the disjunction as (2b). Along the same line, a simple negated sentence with a conjunct object, represented by (3) in English, can theoretically be interpreted in either of the two ways, (4a) or (4b). Which interpretation(s) a language allows and disallows in cases like this is determined by language specific factors.

(1) John didn't eat apples or oranges.

(2) a.  $\neg(Pa \vee Pb)$

b.  $\neg Pa \vee \neg Pb$

(3) John didn't eat apples and oranges.

(4) a.  $\neg(Pa \wedge Pb)$

b.  $\neg Pa \wedge \neg Pb$

In English, (2a) is the default way of interpreting negated sentences with a disjunct object, while (2b) can be accessed given special pragmatic conditions; (4a) is the default way of interpreting negated sentence with a conjunct object, while (4b) is normally not accessed. The case in Japanese is different: (2a) is prohibited in a simple negated sentence with a disjunct object, and (2b) is the only way to interpret such sentence; for a simple negated sentence with a conjunct object, (4b) is only interpretation, while (4a) is unavailable.

The case in Chinese<sup>2</sup> is more complex: a negated sentence with a disjunct object has both interpretations, (2a) and (2b). But meaning (2a), which is logically equivalent with

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<sup>2</sup> Mandarin, specifically. All the data we provide in this paper are from standard Mandarin Chinese, and all the facts we discuss about Chinese are about standard Mandarin Chinese.

(4b), is naturally expressed in Chinese with a conjunct object in a negated sentence (some form comparable with (3)). As a result, the interpretation (2a) for a Chinese counterpart sentence of the form (3) is inhibited and only accessed under highly specific discourse conditions. Furthermore, interpretation (4a) is unavailable for a negated sentence with a conjunct object.

Taken these facts together, Chinese disjunction in a negative context therefore appears to have the same grammar as English disjunction, allowing both interpretations (2a) and (2b) (we assume preference is another thing). But the distribution of the interpretation is really like Japanese, in that meaning (2a) is inhibited (i.e., highly dispreferred) in Chinese. This poses a learnability problem for a child learning Chinese, namely, how can he know that he is learning Chinese in this respect (the English type of grammar), not Japanese? In addition, meaning (2b) is in fact associated with some special presupposition, namely, the speaker is not sure which negative disjunct is true. Presumably, the context that satisfies this kind of presupposition is possibly not that common, especially, in a child's input. Consequently, the frequency of the occurrence of negated sentences with a disjunct object that intend this meaning in any language that allow this meaning is low. Moreover, in order for the child to appreciate that the sentence has a given meaning only under certain discourse conditions requires the child to be highly sensitive to the presuppositions of their interlocutors and to have an effective way of identifying when the interpretation that they have assigned to a sentence is at odds with the speaker's intended meaning. This is another problem that a Chinese child faces. Therefore, for Chinese children, the Chinese way of interpreting negated sentence with a disjunct object is not easily extractable from the input. In this paper, we ask what Chinese children know about the interpretation of such sentences, how they know, what more they need to learn, and how they can learn.

Let us look at the basic phenomena of language variance in the interpretation of interacting logical words (negation, disjunction and conjunction) a bit more in detail.

A simple negated sentence with a disjunct object in English, Japanese and Chinese has comparable superficial form. Example (5) (the same as (1)), (6) and (7) represent a sentence of such form in English, Japanese and Chinese, respectively.

(5) John didn't eat apples or oranges.

(6) John-wa ringo ka orenji-wo tabe-natak-ta  
 John-TOP apple or orange-ACC eat-NEG-past  
 Lit<sup>3</sup>. 'John didn't eat apples or oranges.'

(7) Yuehan meiyou chi pingguo huozhe juzi  
 John not-PERF eat apple or orange  
 Lit. 'John didn't eat apples or oranges.'

In these sentences, the disjunction coordinator *or* in English, *ka* in Japanese and *huozhe* in Chinese join two noun phrases in the object position in the surface form. But let us suppose that these coordinators have the basic semantic value as Boolean disjunction  $\vee$ , namely, a relation between two propositions. As a result, in order to interpret negated sentences with a disjunct object, we need two propositional arguments for the disjunction. Both propositions will ascribe the same property *P* to the referent of the two coordinated object noun phrases. The property *P* can either contain negation or exclude negation,

In English, sentence (5) has a default interpretation that is equivalent to (8). The two propositional disjuncts are *John ate apples* and *John ate oranges*. Here, the property *P* that is ascribed to apples and oranges is being eaten by John. Abstractly, the form of (8) is what we gave in (2a), repeated here as (9).

(8) It is not true that: John ate apples or John ate oranges.

(9)  $\neg(Pa \vee Pb)$

In this interpretation, the negation contributed by *not* in (5) is not included in the property

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<sup>3</sup> Short for 'literal'. It introduces the literal translation of sentence in the relevant language to English, and

*P*. Instead, negation is interpreted outside the scope of disjunction. In other words, negation is abstracted out when the property is ascribed to the referent of the object noun phrases. In cases like this, let us say that *the propositional junct*<sup>4</sup> *exclude negation*. By de Morgan's Laws, (9) ((2a)) is logically equivalent to (4b), repeated here as (10), and hence (8) is logically equivalent to (11), which means that John ate neither thing. We call this reading the 'neither' meaning (this interpretation is often called the conjunctive interpretation of disjunction under negation).

(10)  $\neg Pa \wedge \neg Pb$

(11) John didn't eat apples and John didn't eat oranges.

On the other hand, the Japanese sentence (6), which has the similar form as the English sentence (5), cannot be interpreted in a way that is equivalent to (8). It can only be interpreted in a way that is synonymous as (12), which has the abstract form of (2b), repeated here as (13). Here the referent of the two coordinated object noun phrases *apples* and *oranges* each is ascribed the property of *not* being eaten by John. In cases like this, what happened is that negation is contained in the property ascribed to the referent of the object noun phrases. The result is that *both propositional junct* *include negation*, and hence negation is not interpreted outside the scope of disjunction, as the abstract form (13) shows, we call this meaning the 'not this or not that' meaning. Note, this meaning, when expressed in natural language, in addition to the truth conditions it has given logic, is inherently associated with the presupposition that the speaker lacks the complete knowledge of which negative disjunct holds.

(12) John didn't eat apples or John didn't eat oranges.

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the meaning of the sentence does not necessarily match that translation exactly.

<sup>4</sup> We use 'junct' as a cover term to refer to the disjuncts in the disjunction structure and the conjuncts in the conjunction structure.

(13)  $\neg Pa \vee \neg Pb$

We should be aware that although sentences like (5) in English has the default interpretation of (9) (the ‘neither’ meaning), they do not exclude the interpretation of (13) (the ‘not this or not that’ meaning). However, this meaning expressed by (5) in English is subject to the same presupposition as it is expressed in Japanese, which will require richer context. This means, it is possible to force meaning (13) for sentence (5) in pragmatically conducive context (see Han & Romero, 2001), but sentence (5) still prefers meaning (9).

The Chinese sentence (7) is fundamentally ambiguous. It can have both the English (default) way of interpretation and the Japanese way of interpretation. This means, negation can either be included in the propositional junct or excluded from the junct. Which meaning is the preferred interpretation is highly dependent on the context within which the sentence is used. When we disregard the issue of preference, Chinese seems to have the same kind of grammar as English with respect to how a negated sentence with a disjunct object can possibly be interpreted.

Notice, by describing the interpretive facts here as such, we are being theory-neutral with what kind of syntax a negated sentence with a disjunct object has with respect to the two potentially available interpretations. In a semantic ellipsis framework that more or less assumes the generalized conjunction theory (Rooth & Partee, 1982; Partee & Rooth, 1983), semantics is free to build propositions from noun phrases, and the syntax of a negated sentence with a disjunct object with either meaning can be just like the surface form. In a syntactic ellipsis framework (e.g., Schwarz, 1999), the underlying syntactic form for the two interpretations are both unlike the surface form, in either case, both disjuncts are sentential and denote propositions. There are also other ways of explaining the interpretive facts. However, for the purpose of the current paper, we do not need to commit to any particular theory that explains the interpretations, because the learnability problem that we are interested in is associated directly with the interpretive facts.

So far, we observed interpretive contrast among English, Japanese and Chinese in the case of negated sentences with a disjunct object. The crucial difference lies in that Japanese resists the negation-excluding disjunction meaning ‘neither’. There are two hypotheses that could account for this difference between Japanese and the other two languages, both attribute the difference to some language specific factors in Japanese.

One hypothesis says that the unity of negation and verb in Japanese requires that the propositional junct must include negation in interpretation; whereas the separability of negation and verb in English and Chinese allows the junct to exclude negation. This hypothesis predicts that conjunction and disjunction pattern alike in negative context in a specific language across all languages. Alternatively, as suggested by Goro (2004), following Szabolcsi’s (2002) observation about Hungarian disjunction, Japanese disjunction coordinator *ka* has some special property, namely, it is a positive polarity item (PPI) like *some* in English; and this property of *ka* dictates that disjunction is interpreted outside the scope of local negation, generating the obligatory interpretive scheme that negation is always included in the junct<sup>5</sup>. This hypothesis predicts that conjunction and disjunction in negative context need not pattern alike in a given language.

Now let us turn to sentences that contain negation and a conjunct object, and see whether disjunction and conjunction pattern alike in a given language and which of the two hypotheses is supported. Example (14), (15) and (16) represent a sentence of such form in English, Japanese and Chinese, respectively.

(14) John didn’t eat apples and oranges.

(15) John-wa ringo mo orenji mo tabe-natak-ta  
John-TOP apple also orange also eat-NEG-past  
Lit. ‘John didn’t eat apples and oranges.’

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<sup>5</sup> Goro (2004) argued that PPI is a syntactic feature and advocated a movement account for the wide scope interpretation of disjunction over negation. In that framework, disjunction overtly moves outside of the c-commanding domain of negation, and the Japanese sentence (6) is equivalent to this cleft sentence in English: It was apples or oranges that John didn’t eat. In this paper, we use the property of PPI to refer to the property *ka* (as well as *mo...mo...* ‘and’ in Japanese, *he* ‘and’ in Chinese) has that constrains its interpretation with respect to negation. But we do not commit to the syntactic treatment of wide scope interpretation of disjunction in Goro (2004).

- (16) Yuehan meiyou chi pingguo he juzi  
 John not-PERF eat apple and orange  
 Lit. ‘John didn’t eat apples and oranges.’  
 ‘John didn’t eat apples or oranges.’

Each of the three sentences has two conjoined noun phrases as its object. The conjunction coordinator *and* in English, *mo...mo...* in Japanese and *he* join two noun phrases in each instance in the surface form. But, just like how we consider disjunction coordinators in these languages, we suppose the basic semantics of the conjunction coordinators *and* *mo...mo...* and *he* corresponds to Boolean conjunction  $\wedge$ , which is a relation between two propositions. Again, the two propositions ascribe some property *P* to the referent of the coordinated noun phrases. The crucial point is which property is ascribed, the positive property or the property that also contains negation.

The English sentence (14) is by default interpreted as being equivalent to (17), which abstractly maps to (18) (the same as (4a)). The property that is ascribed to apples and oranges is: being eaten by John. Here, negation is not included in the propositional junct and thus interpreted outside the scope of conjunction. This is the same as what we mentioned as *the propositional junct exclude negation*, when we discuss negated sentence with a disjunct object in English. By de Morgan’s Laws, (18) is logically equivalent to (19), and hence (17) has the same truth condition as (20), meaning John didn’t eat both of the two things<sup>6</sup>.

(17) It is not true that: John ate apples and John ate oranges.

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<sup>6</sup> Note, although (18) and (19) are logically equivalent, sentence (17) and sentence (20) in natural language are not exactly interchangeable. Sentence (20) with the negation-including disjunction interpretation has some implication of ‘I don’t know which’, while sentence (16) does not necessarily have this implication. The ‘I don’t know which’ implication is generally associated with the use of disjunction, no matter when the disjuncts are positive or negative. Logic relations in logic only have truth conditions, but when logic relations are represented in natural language with sentences, presuppositions, implications, etc. emerge with the use of the sentences. Let us look at the following two examples in English. While sentence ii (representing the  $\neg(Qa \wedge Qb)$  interpretation) can be continued with the speaker’s reveal of what exactly happened, sentence i (representing the  $[(\neg Qa) \vee (\neg Qb)]$  interpretation) cannot be continued that way.  
 i. #John didn’t eat apples or John didn’t eat oranges. In fact, John only ate apples/didn’t eat apples.  
 ii. John didn’t eat apples and oranges. In fact, John only ate apples.

(18)  $\neg(Pa \wedge Pb)$

(19)  $[(\neg Pa) \vee (\neg Pb)]$

(20) John didn't eat apples or John didn't eat oranges

Unlike the English counterpart sentence (14), both the Japanese sentence (15) and the Chinese sentence (16) are only interpreted in a way that is equivalent to (21), or abstractly, (22) (the same as (4b))<sup>7</sup>. Here, the property ascribed to apples and oranges is *not* being eaten by John, and the property thus contains negation. Hence, negation is interpreted in the scope of disjunction. This is the same as what we called *both propositional junct*s *include negation*.

(21) John didn't eat apples and John didn't eat oranges.

(22)  $[(\neg Pa) \wedge (\neg Pb)]$

Here, in both Japanese and Chinese, a negated sentence with a conjunct object resists the negation-excluding interpretation of conjunction. Considering that a negated sentence with a disjunct object in Chinese does not prohibit the negation-excluding interpretation, disjunction and conjunction in negative context does not seem to behave alike. So the obligatory inclusion of negation in interpreting Neg...Conjunction in Chinese and Japanese as well as Neg...Disjunction in Japanese should not be a property of negation but a property of the particular coordinator. Specifically, following Goro, 2004<sup>8</sup>, conjunction coordinator in Japanese and Chinese are like disjunction coordinator in Japanese in that they are PPIs and thus disallow the interpretative scheme of negation being excluded from the junct for negated sentences with a conjunct object.

The interpretation (22) is the negation-including conjunction meaning, equals to 'neither'. Note, negated sentences with a disjunct object in English has the

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<sup>7</sup> English sentences like (14) do not exclude the interpretation (22), though not the default interpretation.

<sup>8</sup> But see Szabolcsi & Haddican (2004) for alternative view.

negation-excluding disjunction meaning, as shown in (9), which is logically equivalent to (10) (the same as (22) here), that meaning is also the ‘neither’ meaning. In short, the negation-including conjunction interpretation and negation-excluding disjunction interpretation are both the ‘neither’ meaning. In this respect, languages vary with respect to which form to use naturally in conveying the ‘neither’ meaning. While Neg...Disjunction is the natural way in English to express this ‘neither’ meaning, the same meanings is naturally expressed in both Japanese and Chinese by the form of Neg...Conjunction.

Recall we discussed earlier that the construction Neg...*huozhe* in Chinese is ambiguous in that disjunction can either include negation or exclude negation. When negation is excluded from the junct, the interpretation corresponds to the ‘neither’ meaning. Hence, in Chinese, Neg...*huozhe* and Neg...*he*, being minimally different in form and logically related, both can have a ‘neither’ meaning. However, Neg...*he* is the natural way to express this meaning, while Neg...*huozhe* has the ‘neither’ meaning when special context is present (we’ll return to this point in section 2), therefore, Neg...*he* is the better candidate in an unmarked ‘neither’ situation. Consequently, the ‘neither’ meaning of Neg...*huozhe* is greatly inhibited; a sentence containing Neg...*huozhe* in Chinese is normally not perceived as entailing the ‘neither’ meaning, especially when it is used out of context.

Chinese children, when exposed to input like this, might think Chinese is just like Japanese, in that negation is always included in both propositional junct when interpreting negated sentences with a coordinated noun phrase object, no matter whether the coordinator is disjunction or conjunction. Consequently, it could be the case that for Chinese children Neg...*huozhe* never means ‘neither’ but only ‘not this or not that’, while Neg...*he* naturally has the ‘neither’ meaning, just like the case in Japanese. In addition, ‘neither’ is stronger than ‘not this or not that’, this means, the circumstances that make the ‘neither’ meaning true is a subset of the circumstances that make the ‘not both

together’ meaning true. Therefore, if Chinese children think Neg...*houzhe* only means ‘not this or not that’, they might not be recovered to the state that Neg...*houzhe* can also mean ‘neither’. Every time when people use Neg...*houzhe* to mean ‘neither’, children may take it to mean ‘not this or not that’, which is also compatible with the circumstance. Here we see, for Chinese children, the accurate interpretation of *houzhe* in negated sentences is not easy to extract from the input<sup>9</sup>.

Furthermore, the negation-including disjunction interpretation of Neg...*houzhe* in Chinese (the ‘not this or not that’ meaning) seems to require rich contextual information. In normal situations, negation is used when the speaker knows that something expected actually failed to take place (Horn, 1989); while disjunction is used when the speaker is not sure about what exactly happened. These two conditions are somewhat in contradiction (Goro, 2004). Therefore, when a speaker uses Neg...*houzhe* to convey the negation-including disjunction meaning, the context must be in such a way that the speaker knows that (at least) one expectation fails to take place, but he is not sure which one exactly fails to take place. Presumably, situations like this are not that common, especially in the input to children. Moreover, even if it did occur, the child as language learner would have to recognize that his interpretation (negation-excluding disjunction, ‘neither’) differed from the one that the speaker likely intended. And furthermore, even if he did recognize this, he would have to conclude that his grammar is to blame and not the speaker’s understanding of the situation. Then, based on the input, Chinese children might not know that the negation-including disjunction interpretation is available to negated sentences with a disjunct object in Chinese<sup>10</sup>. Again, here we also see that the accurate interpretation of *houzhe* in negated sentences is not easily extractable from the input for Chinese children.

To sum up the learnability problems that Chinese children face: Chinese adults use Neg...*he* to convey the ‘neither’ meaning by default and naturally, they in general avoid

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<sup>9</sup> Maybe some form of indirect negative evidence could solve this problem (See Pearl & Jeff, 2006).

<sup>10</sup> Japanese children should have the same problem.

the use of Neg...*huozhe* to convey this meaning to avoid the potential ambiguity this construction brings; Chinese adults do not use Neg...*huozhe* very often to convey the ‘not this or not that’ meaning, either, because the context within which the meaning is natural is not very common. Consequently, the occurrence of Neg...*huozhe* will be very rare in the input for Chinese children, compared to the occurrence of Neg...*or* in the input for English children. Even when the construction Neg...*huozhe* occurs children need to identify which meaning their interlocutors intend to convey, which requires them to be well aware of the presuppositions associated with the two possible interpretations and also sensitive to the presupposition their interlocutors hold. Therefore, learning the interpretation of negated sentences with a disjunct object for Chinese children is potentially hard. We ask what Chinese children know about Neg...*huozhe* and how they can possibly acquire the correct grammar in this respect.

This paper is organized in the following way. Section 2 reviews the basic conjunction and disjunction phenomena in Chinese, focusing on the two possible interpretations of Neg...*huozhe* in Chinese. Section 3 is concerned with the cross-linguistic differences in the interpretation of interacting negation vs. conjunction and disjunction, the learnability issues related to these differences, as well as previous experimental studies on the acquisition of Neg...Disjunction. Section 4 and section 5 present a series of new experiments we conducted with Chinese- and English-speaking children and adults, examining their interpretation of Neg...Disjunction. Section 6 addresses some issues that remain topics for further research. Section 7 contains the concluding remarks.

## 2. Chinese disjunction and conjunction phenomena

In this section, we will discuss the behavior of Chinese disjunction coordinator *huozhe* and coordinator operator *he* in negative context in details, in comparison with the behavior of the corresponding coordinators in English and Japanese. We want to argue that simple negative sentences containing *he* are linguistically constrained in that the property ascribed to both junctives includes negation, while simple negative sentences containing *huozhe* are pragmatically conditioned in whether the property ascribed to the junctives includes negation or excludes negation. Our focus of this section is how disjunction in negative context is interpreted, but we will start with the conjunction phenomena in Chinese, which is the more straightforward case.

### 2.1. Conjunction in Chinese

The conjunction coordinator *he* in Chinese is the counterpart of *and* in English and *mo...mo...* in Japanese, in that the basic semantics of these coordinators corresponds to Boolean conjunction  $\wedge$ . But *he* in Chinese does not seem to be a cross-categorical coordinator. It normally does not join VPs, and it is clearly not a sentential level coordinator, as shown in the examples from (23) to (26).

(23) ?Zuotian Yuehan chi-le pingguo he he-le piju  
yesterday John eat-PERF apple and drink- PERF beer  
'Yesterday John ate apples and drank beer.'

(24) Zuotian Yuehan chi-le pingguo you he-le piju  
yesterday John eat-PERF apple also drink- PERF beer  
'Yesterday John ate apples and drank beer.'

(25) \*Zuotian Yuehan chi-le pingguo he Mali he-le piju  
yesterday John eat-PERF apple and Mary drink- PERF beer  
'Yesterday John ate apples, and Mary drank beer.'

(26) Zuotian Yuehan chi-le pingguo er Mali he-le piju  
yesterday John eat-PERF apple while Mary drink- PERF beer  
'Yesterday John ate apples, and Mary drank beer.'

Chinese uses *you* ‘also, again’ and *ye* ‘also’ instead of *he* ‘and’ to join two VPs. And the conjunction morpheme sometimes can also be omitted in VP conjunction cases. Sentence (23) and (24) are minimally different in that everything else remains the same except for the coordinator that join two VPs. Sentence (24) uses *you* ‘also, again’ and is grammatical, while sentence (23) uses *he* ‘and’ and is not as good. When two sentences are coordinated, Chinese uses *er* ‘while’ (*erqie* ‘furthermore’, when the subject of the two coordinated sentences is the same) instead of *he* ‘and’ as coordinator. Sentence (25) is bad because *he* is used, while sentence (25) uses *er* ‘while’ and is good<sup>11</sup>. This should not be taken as evidence that *he* is not Boolean, rather, it can well be the case that Chinese have different phonological/morphological realizations of one Boolean conjunction operators in joining different categories.

We still consider *he* as corresponding to Boolean conjunction. In Chinese, *he* is used in affirmative sentences to join noun phrases in both object position and subject position, as in (27) and (28), and it establishes a relation between two propositions. The two propositions in sentence (27) are *John ate apples* and *John ate oranges*, then the property ascribed to apples and to oranges is being eaten by John. When applying Boolean conjunction to the two propositions, sentence (27) means ‘John ate apples, and John ate oranges’, as expected. This meaning of the Chinese sentence (27) is the same as its literal English translation sentence. Extending this way of describing the meaning of coordinated object noun phrases to coordinated noun phrases in subject position, sentence (28) means ‘John ate apples, and Mary ate apples’, which is also the same as its English translation.

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<sup>11</sup> Precisely speaking, Chinese may not have the exact counterpart of English *and* when it is used as a sentential conjunctive coordinator. Normally, two sentences in Chinese are freely coordinated without a coordinator. The coordinator *er* can be used to coordinate two sentences in Chinese and is best translated as ‘while’ or ‘whereas’ in English. The use of *er* instead of null coordinator somehow signals that the propositions the two sentences denote have some contrastive properties.

(27) Yuehan chi-le pingguo he juzi.  
John eat-PERF apple and orange  
'John ate apples and oranges.'

(28) Yuehan he Mali chi-le pingguo.  
John and Mary eat-PERF apple  
'John and Mary ate apples.'

But, *and* in English can sometimes express a non-Boolean conjunction meaning. The Chinese sentences given in (29) and (30) do not have the exact meaning as their English literal translation. In the English translation sentences, *and* is presumably not Boolean.

(29) Yuehan chi-le jidan he nainao  
John eat-PERF egg and cheese  
Lit. 'John ate egg and cheese.'

(30) Yang mao he gou de ren xihuan chongwu.  
own cat and dog DE person like pet  
Lit. 'People who own cats and dogs like pets.'

Sentence (29) doesn't have the meaning that egg and cheese make up a bundle, as the English translation sentence has. In order to convey the bundle meaning, Chinese uses other words like *jia* 'plus' or *pei* 'with', instead of *he*. Sentence (30) means 'people who own cats like pets, and people who own dogs like pets'. While many English speakers take the English literal translation of this sentence to mean 'people who own both dogs and cats like pets'. Conjoined noun phrases with *he* in Chinese seem to behave uniformly in the Boolean conjunction way.

When an affirmative sentence like (27) containing conjunct object is negated, as shown in (31) (the same as example (14) in section 1), we assume that the Boolean conjunction property of *he* does not change. The meaning of the negated sentence (31) is determined by which property is ascribed to the two propositional juncts, specifically, whether negation is contained in the property. As we discussed earlier in section 1,

negated sentences in Chinese with a conjunct object like (31) must be interpreted in a way that negation is included in both propositional juncts, and hence generate the negation-including conjunction interpretation (the ‘neither’ interpretation). The same holds for Japanese. On the other hand, the English literal translation of (31) is interpreted with negation excluded from the juncts, generating the  $\neg(Pa \wedge Pb)$  interpretation (meaning ‘not both together’).

(31) Yuehan meiyou chi pingguo he juzi  
 John not-PERF eat apple and orange  
 Lit: ‘John didn’t eat apples and oranges.’  
 ‘John didn’t eat apples or oranges.’

Negated sentences containing conjunct object like this in Chinese obligatorily has a ‘neither’ meaning<sup>12</sup>, just like the Japanese counterpart sentences; but in English, counterpart sentences normally is interpreted with negation excluded from the conjunction and thus has a ‘not both together’ meaning. Moreover, Neg...*he* is the default and natural way for Chinese speakers to convey the ‘neither’ meaning, just like Japanese speakers use Neg...*mo...mo...* to express the same meaning by default; while in English, speakers use Neg...*or* instead of Neg...*and* to express this meaning naturally.

We observed that the conjunction coordinator *he* in Chinese behaves similarly in negative sentences as *mo...mo...* in Japanese, in that Neg...*he*, like Neg...*mo...mo...*, obligatorily has a negation-including conjunction interpretation, as opposed to the negation-excluding conjunction interpretation of Neg...*and* in English. The obligatory ‘neither’ meaning of Neg...*he*, as well as Neg...*mo...mo...*, is the result of some language specific property of the lexical item *he* and *mo...mo...* with respect to local negation, independent of their semantic value of being Boolean conjunction. Goro (2004)

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<sup>12</sup> We are aware of the fact that sometime Neg...*he* construction can be interpreted with negation excluded from the juncts. However, in those cases, *he* must be marked with special stress or intonation to show that it bears emphatic or contrastive focus. Otherwise, that reading is not available. We want to draw a line between regular *he* and stressed *he*. In this paper, what we are concerned with is the regular, neutral *he*, which is also used as conjunction in unmarked affirmative sentences.

provided extensive evidence that it is just local negation that *mo...mo...* resists taking scope under. It can be interpreted in the scope of higher clause negation (for details, see Goro, 2004). This kind of behavior of *mo...mo...* in English resembles the behavior of *some* in English, which is a PPI. Goro (2004) thus proposed that *mo...mo...* in Japanese is a PPI, which cannot be interpreted in the scope of local negation. Constrained by this property of the conjunction coordinator *mo...mo...*, in the terms we use in this paper, a negated sentence in Japanese containing a conjunct noun phrase coordinated by *mo...mo...* cannot be interpreted with negation excluded from the propositional junct, and must be interpreted with negation included in both junct. The resulting meaning is the ‘neither’ meaning. In fact, *he* in Chinese can also be interpreted in the scope of extra-clause negation, given this, and the parallel behavior of *he* and *mo...mo...* in simple negative context, following Goro (2004), we also propose that Chinese conjunction coordinator *he* is PPI, and the obligatory ‘neither’ meaning yielded by Neg...*he* is caused by this property prohibiting the other alternative interpretive option.

The PPI property of the conjunction coordinator *he* linguistically constrains the interpretation a negated sentence with a conjunct object can have. Specifically, this linguistic property rules out one of the alternative interpretive options such a sentence can theoretically have, and leaves only the negation-including conjunction interpretation of such a sentence available. This constraint then will be in effect for all relevant structures, extra-linguistic factors like a fully conducive context will not be able to activate the unavailable interpretation. This contrasts with the case of *huozhe* in Chinese, which we are now turning to.

## **2.2. Disjunction in Chinese**

As we mentioned in section 1, a negated sentence containing a disjunct object in Japanese must be interpreted in a way that negation is included in both propositional junct, and such a sentence in English is normally interpreted with negation excluded from the junct,

while a sentence like this in Chinese is compatible with both ways of interpretation. In this section, we will lay out the details of the ambiguity of negated sentences containing a disjunct object in Chinese.

First of all, we suppose, as we did in section 1, that *huozhe* in Chinese corresponds to Boolean inclusive disjunction, just like *or* and *ka*<sup>13</sup>. Let us look at an affirmative sentence in Chinese containing *huozhe* first, shown in (32). The sentence means the same as its literal translation in English (and the counterpart sentence in Japanese).

(32) Yuehan chi-le pingguo huozhe juzi  
John eat-PERF apple or orange  
'John ate apples or oranges.'

The meaning is that John ate one of two kinds of fruit, but the speaker is not committed to which. Here, it seems that *huozhe* (as well as its counterpart in other languages) has an exclusive implicature, and the sentence implies that John didn't eat both kinds of fruit. However, we must be aware that the exclusive implicature of a disjunctive coordinator like *huozhe* is derived due to a scalar implicature. While scalar implicature does not exist in logic, it arises in the use of natural language. Sometimes, the effect of scalar implicature is so strong that people may be misled and think some meaning is unavailable, like the case we are now discussing. When speakers communicate, they have some common assumptions, including being cooperative (Grice, 1975). As a result, when the speaker utters sentence (32) or its counterpart in other languages like English and Japanese, the hearer takes it to mean that it is not the case that what exactly happened was that John ate both apples and oranges. The reason is that if the speaker had intended to convey that John ate both kinds of fruit, he could have used the conjunction coordinator *he*, a stronger coordinator than *huozhe*, to convey that meaning. This is the source of the exclusive implicature associated with *huozhe*. In

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<sup>13</sup> Unlike *he*, *huozhe* is a cross-categorial coordinator in Chinese.

addition, the hearer further assumes that the speaker is not certain about what exactly happened, because if the speaker knew exactly which kind of fruit John ate, he could have just said which. A simple sentence involving a disjunct object normally is associated with this kind of presupposition, namely, the speaker's uncertainty about what exactly happened.

Moreover, sentences containing a disjunction coordinator like *or* in English (*huozhe* in Chinese, *ka* in Japanese, etc.) do not exclude the possibility of inclusivity<sup>14</sup>, and the exclusive implicature can be cancelled. Let us imagine the following betting scenario: John likes three kinds of fruit, apples, oranges and bananas; while he doesn't like three kinds of fruit: peaches, pineapples and kiwis. He went a buffet dinner last night. Speaker A and speaker B are talking about John. They both know that the buffet place John went to has four kinds of fruit: apples, oranges, peaches and pineapples. And speaker A can say: *I bet you 5 dollars that John ate apples or oranges* (and its counterpart in Chinese and Japanese). By saying so, speaker A definitely does not want to exclude the possibility that John ate both kinds of fruits. Speaker B, knowing that John actually ate both apples and oranges, cannot say speaker A is wrong. He can respond with something like: *Yes, he did. And in fact, John ate apples AND oranges* (and its counterpart in Chinese and Japanese).

What we want to establish here is that *huozhe* has the full range of truth conditions as Boolean disjunction  $\vee$  in positive context. Now let us look at the situation in negative context.

Sentence (33) (the same as (16) in section 1) is a negated version of (32). Sentences like this are ambiguous in Chinese. They can be interpreted either with negation excluding disjunction as in (34), or with negation included in both junctives as in (35). Remember, as we mentioned in section 1, the English counterpart sentence is normally

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<sup>14</sup> Sometimes, when a sentence with a disjunct object contains some modal expressions (even covertly), the sentence will preferably have a strong inclusive meaning, even a 'both' meaning. For instance, the English sentence *John may have eaten apples or oranges* contains an epistemic modal *may*, the sentence in fact means that John may have eaten apples and John may have eaten oranges. This kind of sentences are beyond what we call 'simple' sentences in this paper and will not be discussed further.

interpreted as (34), while the Japanese counterpart sentence is only interpreted as (35).

(33) Yuehan meiyou chi pingguo huo zhe juzi

John not-PERF eat apple and orange

Lit: 'John didn't eat apples or oranges.'

(34)  $\neg(Pa \vee Pb)$

(35)  $[(\neg Pa) \vee (\neg Pb)]$

Therefore, in Chinese, the speaker can utter sentence (33) and intend either meaning (34) or (35). The hearer needs to determine which meaning the speaker intends.

In the use of a natural language like Chinese, in addition to the truth conditions provided by logic, meaning (35) has the presupposition that the speaker is not sure which positive disjunct ( $Pa$ , or  $Pb$ ) is false. Thus, sentence (33) with meaning (35) intended will have an implication of 'I don't know which'. Assuming the speaker is communicating in a cooperative way (Grice, 1975), if the speaker knew exactly which disjunct is false, he could just say which is false. Therefore, if the situation of the conversation is that the speaker knows exactly what happened, and the hearer is aware of the speaker's such knowledge, the meaning (35) is presumably ruled out by a mismatch between the presupposition and the situation. When the speaker use sentence (33) to describe some circumstance that the hearer knows as well, where it is clear that both positive disjuncts are false, the hearer is inclined toward meaning (34), because this is an accurate description of the circumstance.

The disambiguation task of the hearer is different when he is not sure about the speaker's knowledge about the circumstances described. It could be the case that the speaker knows that both positive disjuncts are false and wants to share this information with the hearer, hence he uses (33) to mean (34). It could also be the case that the speaker only knows that one positive disjunct is false, but he does not know which one is false, and he is informing the hearer with this knowledge; in this case, the speaker uses (33) to mean (35). Note, meaning (34) is logically stronger than meaning (35), in that (34) is true

only when both positive disjuncts are false, while (35) is true when one of the positive disjunct is false, and it is compatible with both positive disjuncts being false. Theoretically, when neither meaning is default, the hearer should not be inclined toward the stronger meaning, if he is conservative. In addition, the stronger meaning (34) can be unambiguously, and just as efficiently, expressed in Chinese by a negated sentence with a conjunct object as (31). The hearer presumably assumes that the speaker would not use an ambiguous sentence to express what he means if he could use an unambiguous sentence that is no more complex than the sentence he used<sup>15</sup> (Grice's Maxim of Manner, Grice, 1975). This means that if the speaker had intended to convey the stronger meaning (34), he could have used the unambiguous sentence (31). Moreover, as will be discussed later in this section, the 'neither' meaning of Neg...*huozhe* seem to require a very specific presupposition. Therefore, in the case when the presupposition is not clearly matched, if the speaker had intended to express the 'neither' meaning, he should have used the presupposition-neutral expression Neg...*he*. Based on the whole reasoning, the hearer will be inclined to meaning (35) in this case.

Now let us look at meaning (35) more carefully. This meaning with disjoined negative proposition says that the speaker knows something is false, but he does not know exactly which is false. The use of negation demands that the speaker knows that what actually happened does not match the expectation; while the use of disjunction demands that the speaker does not know what actually happened. Therefore, the use of negation and disjunction together as disjoined negation requires that the speakers knows something about what actually happened on the one hand and does not know what actually happened on the other hand. This is somewhat contradictory. In order to satisfy the presupposition of the disjoined negation meaning, the context must be such that the contradictory conditions of the use of negation and disjunction are reconciled. For instance, the context could be something like this: there is some outcome, which is

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<sup>15</sup> Chinese has unambiguous ways to express meaning (35), e.g. use two disjoined negative VPs or negative sentences. But those expressions are more complex in form than (33).

known to the speaker as the result of one of the two disjuncts being false, and the process to the outcome is unclear to the speaker. If the conversation is not taken place with such a context set up, the hearer needs to construct such a context for meaning (35). This could potentially be hard. There are Chinese speakers who find it not easy to access this ‘not this or not that’ meaning of sentences like (33), when the sentence is used out of context<sup>16</sup>.

This predicts that Chinese speakers should be able to easily access the ‘not this or not that’ meaning (35) of negated sentences with a disjunct object, when appropriate context is provided to them. And they actually are. Let us first look at sentence (36) (adapted from the examples in Szabolcsi & Haddican, 2004).

- (36)a. Weishenme zheli zheme leng?  
 why here so cold  
 ‘Why is it so cold here?’
- b. Tamen meiyou guan men huozhe chuang  
 they not-PERF close door or window  
 ‘They didn’t close the door or didn’t close the window’

This example involves a mini conversation, and a context is set up. The sentence (36b) is a sentence with a disjunct object, and its meaning is relevant to what is talked about in (36a), namely, it is cold here. As we all know, if someone forgot to close the door or the window or both in a cold day, cold air would come in and result in it being cold inside. Crucially, let us presume that either not closing the door or not closing the window suffices for the result. This means, the cause of the outcome (being cold) is negative and disjunctive (in an inclusive sense), abstractly,  $\neg Pa \vee \neg Pb$  ( $P$ : being closed by them; a: the door; b: the window). Hence, when someone feels the chill as the outcome, he should be able to infer that the cause is  $\neg Pa \vee \neg Pb$ . With the assumption that the speaker says

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<sup>16</sup> Goro (2004) reported that some Japanese speakers find the counterpart sentence of (33) awkward, indicating that they have difficulty access the ‘not this or not that’ meaning of such a sentence, which is the only available meaning.

something truthful with (36b), the hearer should think the sentence describes this kind of cause:  $\neg Pa \vee \neg Pb$ , which corresponds to the ‘not this or not that’ meaning.

This sentence is natural in Chinese and interpreted with negation included in disjunction (the ‘not this or not that’ meaning). Furthermore, the sentence is true if in fact both the door and the window were left open, but the speaker does not know this fact at the time of uttering the sentence. This is because *huozhe* is inclusive-OR and thus compatible with the inclusive meaning of both negative disjuncts being true. Nonetheless, this sentence normally does not invoke the ‘neither’ meaning, because the speaker could have used negated conjunction *Neg...he* if he intended to say that both the door and the window were left open, as we discussed earlier.

This example shows that Chinese speakers easily interpret *Neg...huozhe* as ‘not this or not that’ in appropriate context. The specific context here is that the cause for the outcome involves two disjunctive components which are negative.

Let’s look at another example like this, given in (37) (adapted from examples in Szabolcsi and Haddican, 2004). This time, the conversation involves a degraded sentence

- (37)a. Weishenme ni dui huiyi bu manyi  
why you about meeting not satisfied  
‘Why aren’t you happy about the meeting?’  
?b. Yinwei wo bu xihuan Yuehan huozhe Bide  
because I not like John or Peter  
Lit. ‘Because I don’t like John or Peter.’

Like example (36), this example also has a mini conversation, which sets up a context. It is common sense that not like another person in a meeting could result in a person being upset about the meeting. The other person could be John, or Peter, or someone else. Crucially, either not like John or not like Peter can make the person upset. It is not required in the context that the speaker does not like either man. In this case, the cause for the outcome of being upset about the meaning is negative and disjunctive, namely,  $\neg Pa \vee$

–*Pb*. Based on this causality relation, someone can infer that the person is upset about the meeting because he does not like one of the two people, without knowing exactly who that person is. Hence, the contradicting pragmatic conditions in using both negation and disjunction are resolved, and the presupposition for a disjoined negation meaning is satisfied. Furthermore, the outcome indicates that the cause is  $\neg Pa \vee \neg Pb$ , which is exactly the ‘not this or not that’ meaning. If the speaker is truthful, sentence (37b) should intend this meaning.

However, with *I* as the subject, sentence (34b) describes some of the speaker’s emotional state, namely, not like someone. Normally, when a person talks about his/her own emotional state, he is sure what that is, unless he explicitly uses some kind of modal expression like *maybe* or *possibly* in the sentence. In the conversation given, if the speaker used sentence (37b) with an intended meaning of ‘not this or not that’, the ‘I don’t know which’ implication of that sentence would be in conflict with the speaker’s awareness of his emotional state. Therefore, although here the context itself is appropriate for the ‘not this or not that’ meaning of Neg...*huozhe*, other pragmatic constraints rule out the reading (presumably after this reading is accessed and evaluated). If the conversation were about some person other than the two in conversation, the ‘not this or not that’ reading of Neg...*huozhe* in this context would be natural. Furthermore, the ‘neither’ reading of Neg...*huozhe* of (37b) is in general blocked by the fact that Neg...*he* is a better candidate for the ‘neither’ meaning, as we discussed earlier. Because both possible interpretations of the sentence (37b) are ruled out by some factors, the sentence is itself degraded.

Now let’s go back to (33), repeated here as (38), which does not involve mini conversation. This time, let us make the context salient in the discourse and appropriate for the use of disjoined negation. Imagine such a scenario: John is a child who likes sweet things but hates fruits. One day, his mom said she would reward him if he could eat some fruits. She told him, if he ate some apples, he would get one piece of chocolate; if he ate

some oranges, he would also get one piece of chocolate; and if he ate both kinds of fruits, he would get two pieces of chocolate. We don't know what really happened then, but John had one chocolate afterwards. At this time, we could utter sentence (38).

(38) Yuehan meiyou chi pingguo huozhe juzi  
John not-PERF eat apple and orange  
Lit. 'John didn't eat apples or oranges.'

Sentence (38) is only a truthful description of the circumstance with the 'not this or not that' meaning, because John did get one piece of chocolate, meaning it cannot be the case that John did not eat either kind of fruit. Given this context, this sentence is natural in Chinese, and it is true in the circumstance described. This means that the 'not this or not that' meaning of Neg...*huozhe* is accessed here.

In this case, the context is made very clear that one chocolate as reward John only ate one kind of fruit and didn't eat the other kind. When we see one chocolate instead of two, we can infer that there is one kind of fruit that John didn't eat; and because we didn't see what happened, we don't know which kind of fruit exactly John didn't eat. The presupposition for the use of a disjoined negation is thus satisfied. The knowledge we have about what happened is based on inference, and our lack of the exact knowledge about what happened is the fact. Therefore, the context is conducive to the 'not this or not that' reading of Sentence (38).

Up to now, the distribution of the interpretation of Neg...*huozhe* seems to suggest that Neg...*huozhe* and Neg...*ka* are alike, because Neg...*huozhe* is always interpreted with negation included in both junctives in the above examples. In Jing, Hsu & Crain (2005), we proposed that *huozhe* in Chinese is a PPI, just like *ka* in Japanese. However, when a wider range of scenarios and examples are considered, treating *huozhe* as a PPI as in Jing, Hsu & Crain (2005) turns out to be a misunderstanding, and the fact is that there are clear cases where Neg...*huozhe* means 'neither' by default. Here is one example (inspired by

examples in Szabolcsi and Haddican, 2004).

The university requires that students have registered for either algebra or statistics before they can register for a particular course A. John doesn't know this requirement, and he registered for neither algebra nor statistics. He went to the instructor and asked for permission to register for course A. The instructor looked at John's record and said John can't register for course A, he justified it by uttering sentence (39).

(39) Yinwei ni meiyou xuan daishu huozhe tongji.  
because you not-PERF choose algebra or statistics  
'Because you didn't register for algebra and didn't register for statistics.'

As we talked about earlier, the meaning  $\neg Pa \vee \neg Pb$  expressed in natural language has the presupposition that the speaker is not sure which positive disjunct is false. In this example, the context makes it clear that the speaker (the instructor) knows exactly that both positive disjuncts are false, hence, the presupposition for the meaning  $\neg Pa \vee \neg Pb$  is not satisfied, and consequently, the 'not this or not that' reading of Neg...*huozhe* is not available. Chinese speakers uniformly accept this sentence in this context, suggesting that they interpret Neg...*huozhe* in this sentence as 'neither'. The fact that the conjunctive interpretation of Neg...*huozhe* in this sentence is readily there is presumably determined by the disjunctive positive prerequisite of course A, which can be formulated as in (40).

(40) Ruguo ni xuan-le daishu huozhe tongji ...  
if you choose-PERF algebra or statistics  
'If you registered for algebra or statistics ...'

The two disjuncts in the requirement for registering for course A are positive. Abstractly, the requirement is something like  $(Pa \vee Pb)$ . This means, someone only needs to register for one of the two courses in order to make him eligible for course A. Given this requirement, what could result in John's not being able to register for course A? The

reason must be that the requirement  $(Pa \vee Pb)$  is not met, namely the negation of the requirement is the case, abstractly  $\neg(Pa \vee Pb)$ . This means ‘neither’ positive disjunct holds – John didn’t register for algebra, and he didn’t register for statistics. If he had registered for either, he would be qualified to register for course A, even if he didn’t register for the other. This logical reasoning can be done independent of the instructor’s justification as in sentence (39). As hearers, we expect that the instructor says something truthful, hence his justification should describe the fact  $\neg(Pa \vee Pb)$ , which we can infer from the relation between the outcome and the requirement. Therefore, it is easier for Chinese speakers to access the ‘neither’ reading of Neg...*huozhe* in this example.

This example illustrates that Neg...*huozhe* can have the ‘neither’ reading if appropriate context is given. The specific context here is that the requirement for the outcome is positive and disjunctive, and that the hearer knows (from experience or from inference) exactly that neither of the two positive disjuncts in the requirement is met, and that the hearer is aware that the speaker knows this too.

There are other cases in Chinese where Neg...*huozhe* is naturally interpreted as ‘neither’. One example is given in (41).

(41) Na shi    jiaotong deng meiyou bian    hong-se    huozhe    huang-se  
       that time traffic light not-PERF change red-color    or    yellow-color  
       ‘The traffic light didn’t turn red and didn’t turn yellow at that time.’

In this sentence, *huozhe* joins two noun phrases, in an object-comparable position<sup>17</sup>. Neg...*huozhe* here is uniformly interpreted as ‘neither’ by Chinese speakers. Although no extra context information is given, our world knowledge tells us that the traffic light is normal on one single color at a time. It can turn red, it can turn yellow, it can also turn green, but crucially, it does not turn to any two colors at the same time. Here, the sentence

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<sup>17</sup> We focus on disjoined object noun phrase in negative context in this paper, but presumably, disjunction of other categories works in a similar way, except subjects. The counterpart Chinese sentence of *John or Mary didn’t leave* can only mean [not-leave (John)  $\vee$  not-leave (Mary)].

itself contains ‘rich’ context, and the context is such that the positive expectation is disjunctive.

This somehow resembles the ‘register for course’ case we just talked about, where the prerequisite (parallel to expectation here) is disjunctive. The difference between the two kinds of context is that the disjunctive prerequisite in the ‘register for course’ case is inclusive (meaning a student could have registered both), while the disjunctive expectation in this ‘traffic light’ case is more ‘exclusive’<sup>18</sup>. In any case, the disjunctive positive expectation ( $Pa \vee Pb$ ) here biases the property ascribed to the two propositional disjuncts in interpreting a negated sentence with a disjunct object to be positive. In situations like this, Neg...*huozhe* is more likely to correspond to negating two disjunctive positive components in the expectation  $\neg(Pa \vee Pb)$ , generating the ‘neither’ interpretation.

Here is another example similar to (41), shown in (42). Sentence (42) has two disjointed NPs in an object-comparable position (‘object’ of a *BE*-verb). In this example, it is common sense that an employee of a school is either a faculty member or a staff member in the normal case, not both at the same time. Here, the positive expectation is disjunctive. This sentence is natural, and Neg...*huozhe* is interpreted as ‘neither’ by default.

- (42) Yuehan bu shi zhe-ge xuexiao de laoshi huozhe zhiyuan  
John not be this-CL school DE faculty or staff  
‘John isn’t a faculty member of this school and isn’t a staff member of this school.’

Yet another example involving disjunctive positive expectation is given in (43). In this sentence, the two disjuncts are the adjunct of VP (let us assume disjunction works in the same way cross-categorially), and Neg... *huozhe* is used naturally here, bearing the ‘neither’ meaning. When describe running, we can say someone runs too fast, or too slow,

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<sup>18</sup> The exclusivity here is the result of how the real world normally works, not because *huozhe* itself is exclusive disjunction.

or normal, etc., but we would not say that someone ran both too fast and too slow (in a single event). Here, again, the relevant positive expectation is disjunctive.

(43) Mali meiyou pao tai kuai huozhe tai man  
Mary not-PERF run too fast or too slow  
'Mary didn't run too fast and didn't run too slow'

So far we have discussed a series of cases in Chinese where Neg...*huozhe* is interpreted with negation excluded from the disjuncts and means 'neither'. The generalization about the context for this interpretation is: the positive requirement or expectation is disjunctive. What is important here is that the 'neither' meaning of Neg...*huozhe* seems to be tightly associated with specific presupposition, unlike Neg...*he*, which can express the 'neither' meaning without any specific presupposition. As mentioned earlier in this section, without context, the 'neither' meaning of Neg...*huozhe* (e.g., example (33)) is inhibited also due to the lack of the presupposition associated with this way of interpreting Neg...*huozhe*.

In all the cases we just discussed where Chinese Neg...*huozhe* is interpreted as 'neither', Japanese Neg...*ka* can not be interpreted the same way. It is obvious then that *huozhe* and *ka* is not alike when they are in negative context. This can be explained by the different polarity sensitive of *ka* vs. *huozhe*, following Goro (2004): while Japanese *ka* is a PPI (for details, see Goro, 2004) and requires the interpretation with negation included in the junct, Chinese *huozhe* is not a PPI and can have the interpretation with negation excluded from the junct.

Now let's go back to the 'register for course' case. Given that Chinese uses Neg...*he* to naturally convey the 'neither' meaning, one might wonder whether the instructor in that example can use sentence (44) instead of (39) to justify his refusal for permission, where Neg...*he* instead of Neg...*huozhe* is used.

(44) Yinwei ni meiyou xuan daishu he tongji.  
because you not-PERF choose algebra and statistics  
‘Because you didn’t register for algebra and didn’t register for statistics.’

Meaningwise, sentence (44) can be used. But many speakers believe this sentence has the implication that having registered for both algebra and statistics is the prerequisite for course A. Therefore, in the context given, (39) seems to be more appropriate than (44) in expressing the ‘neither’ meaning and the respective implication about prerequisite.

Interestingly, the same sentence (39) can also be used to express the ‘not this or not that’ meaning, when appropriate context is given. Here is a scenario: The prerequisite for course A is that a student must have registered for both algebra and statistics. John came to Mary and said he was not able to register for course A. He then asked Mary whether she knows why. At this point, Mary, knowing what the prerequisite for course A is, but doesn’t know what courses John has registered, can utter sentence (39), repeated here as (45).

(45) Yinwei ni meiyou xuan daishu huozhe tongji.  
because you not-PERF choose algebra or statistics  
‘Because you didn’t register for algebra or didn’t register for statistics.’

In this case, Mary only knows the prerequisite for course A and the outcome that John was not able to register for course A. Note, the two junctives in the requirement for course A is conjunctive and positive, abstractly,  $(Pa \wedge Pb)$ . The reason why John was not able to register for course A should be that John did not meet the requirement, namely, the negation of the requirement is the fact about John, this, abstractly speaking, is  $\neg(Pa \wedge Pb)$ , which is logically equivalent to  $\neg Pa \vee \neg Pb$ . Given that Mary does not exactly know which courses John registered or did not register, Mary’s knowledge base is compatible with an implication like ‘I don’t know which’. But Mary’s knowledge about the requirement and the outcome make it possible for her to infer what happened: there is at

least one prerequisite course John didn't register for. In order to be cooperative (saying what she thinks is true, by the Maxim of quality, Grice, 1975), Mary should be conservative and cannot commit to the 'neither' meaning with this sentence (which then will be a too strong guess that she lacks appropriate evidence for). Therefore, Mary must intend the 'not this or not that' meaning. In this context, Mary's lack of complete knowledge about what actually happened makes the use of disjunctive felicitous, and her inferred knowledge that what happened involves some mismatch of the fact and the requirement facilitate the use of negation. Therefore, Mary's use of (45) to mean the 'not this or not that' is well-grounded.

The fact that the same sentence (36)/(42) can mean 'not this or not that' in some context and 'neither' in other context suggests that a simple negated sentence with a disjunction is inherently ambiguous. This means the construction Neg...*huozhe* per se is compatible with both interpretations. However, in Chinese, both interpretations seem to be somewhat inhibited without context. Chinese uses Neg...*he* to naturally express the 'neither' meaning, no specific presupposition is associated with the use of Neg...*he* with this meaning, hence it is a better candidate in the 'neither' situation by default. However, Neg...*huozhe* is no less complex in form than Neg...*he*, but the 'neither' meaning of Neg...*huozhe* is associated with special presupposition in Chinese (as compared to the case with Neg...*or* in English, for instance). Consequently, Neg...*huozhe* is in general is a candidate as good as Neg...*he* in a 'neither' situation. Therefore, the 'neither' meaning of Neg...*huozhe* is largely inhibited; this meaning only becomes available with the special presupposition satisfied. On the other hand, negation and disjunction have contradicting presuppositions, therefore, the 'not this or not that' meaning of Neg...*huozhe* is obligatorily associated with some special presupposition, and as a result, this meaning is also somehow dormant. This kind of pragmatic constraint is not language specific though, speakers across different languages would have some degree of difficulty accommodating the 'not this or not that' interpretation for Neg...Disjunction (witnessed

also by the fact that some Japanese speakers find sentence (6) awkward).

Context plays the central role in determining how a Chinese speaker interprets a negated sentence with a disjunct object. If the appropriate context for one of the two interpretations is given, Chinese speakers interpret the sentence more or less the same way toward that interpretation. On the other hand, if the context is unclear, then the hearer must construct appropriate context for either interpretation; consequently, speaker may vary as to which interpretation they eventually get for such a sentence. If the hearer constructs a context that satisfies the presupposition for the ‘neither’ meaning of Neg...*huozhe*, he will interpret the sentence in the ‘neither’ way. If the hearer constructs a context that meets the presupposition for the ‘not this or not that’ meaning, he then will interpret the sentence accordingly. But remember, the ‘neither’ meaning can be unambiguously and naturally expressed in Chinese use an equally efficient form Neg...*he*, given this, we expect Chinese speakers to potentially incline toward the ‘not this or not that’ meaning of Neg...*huozhe*.

We conclude that whether a negated sentence with a disjunct object in Chinese is interpreted with negation included in both juncts or excluded from the juncts is conditioned by pragmatic factors, rather than linguistically determined.

### 3. Typological and learnability issues

This section will be concerned with the differences in the interpretation of negated coordination in Chinese, English and Japanese. What we find out of special interest is that the interpretation of Neg...Disjunction in Chinese has an English grammar in that both interpretative options are available, but a distribution that behaves like Japanese, namely, one of the interpretative options of Neg...Disjunction is inhibited. We argue that this poses a learnability problem for Chinese children in acquiring Neg...Disjunction. Furthermore, the learnability problem gets worse when we look more carefully into the dominant interpretative option for Neg...*huozhe* in Chinese.

#### 3.1. Cross-linguistic variations in the interpretation of negated coordination

In section 2, we have shown that the conjunction coordinator *he* in Chinese in simple negative context behaves like *mo...mo...* in Japanese, not like *and* in English. A negated sentence with an object that has two noun phrases joined by *he* or *mo...mo...* has a natural ‘neither’ meaning in the respective language, which is the only meaning. We proposed that this obligatory meaning is the result of *he* and *mo...mo...* being PPIs, following Goro (2004), that blocks the other alternative interpretative option. In addition, Neg...Conjunction is the default, unmarked way in these languages to convey the ‘neither’ meaning, with no special presupposition. While in English, Neg...Conjunction is not the default way to express the ‘neither’ meaning, and it normally means ‘not both together’. At this respect, Chinese and Japanese stand on a par, contrasting with English.

On the other hand, the disjunction operator *huozhe* in Chinese is not a PPI, not like *ka* in Japanese, but like *or* in English. This is evident from the fact that *huozhe* and *or* in simple negative context can have the ‘neither’ interpretation, while *ka* can not. But unlike *or* in English, Neg...Conjunction in Chinese with *he* as coordinator does not naturally entail a ‘neither’ meaning. This construction is systematically ambiguous between the ‘not this or not that’ reading and the ‘neither’ reading for Chinese speakers. Which

interpretation a speaker associates with Neg...*huozhe* depends on the kind of context that accompanies the construction or that the speaker constructs upon hearing it.

Because *huozhe* is not a PPI, it does not necessarily scope above negation, generating the ‘not this or not that’ meaning (as in the case with *ka*). But, *huozhe* can be interpreted outside of the scope of negation, hence the ‘not this or not that’ reading of Neg...*huozhe* is possible, although it is not readily available for speakers, if no appropriate context is provided. This, as we said in section 1 and section 2, is presumably due to the special presupposition the meaning is associated with, as the result of reconciling the otherwise contradicting pragmatic conditions for negation vs. disjunction. Therefore, the ‘not both’ reading of Neg...*huozhe* is possible but not obligatory. In addition, because *huozhe* is not a PPI, Neg...*huozhe* can be interpreted with negation outside the scope of disjunction, generating the ‘neither’ meaning (as in the case with Neg...*or*). However, Chinese speakers associate Neg...*he* with the ‘neither’ meaning by default, hence, use Neg...*huozhe* to convey the ‘neither’ meaning is marked in Chinese, and this way of interpretation requires satisfaction of special presupposition. Therefore, the ‘neither’ reading of Neg...*huozhe* is possible but not preferred. Taken together, Neg...*huozhe* is compatible with both the ‘not this or not that’ reading and the ‘neither’ reading, with neither reading as default.

Now we see that Neg...Disjunction both in Chinese and in Japanese can have the ‘not both’ interpretation, next we want to examine whether this construction in English can possibly have this interpretation as well.

In Larson (1985), he argued that disjunction can not take scope over negation in English. However, Han & Romero (2001) argued that the inverse scope is possible. They provide such an example: The speaker sent his car to a tire shop for rotation and balance, but the mechanics didn’t finish the work when the speaker had to take the car away. The speaker could utter sentence (46)<sup>19</sup> (example (13) in Han & Romero, 2001). Here,

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<sup>19</sup> The disjuncts in this sentence are verbs, instead of object noun phrases we focused on in this paper. But assuming the basic semantics of negation and disjunction remain unchanged even the category of disjuncts

negation is included in both of the disjuncts, generating the  $(\neg P \vee \neg Q)$  scheme of interpretation (the ‘not this or not that’ meaning), as witnessed by ‘but I don’t know which’. This sentence is compatible with the possible outcome that the mechanics actually didn’t finish any job, assuming the speaker didn’t know this when he uttered the sentence. But, as we pointed out earlier for the cases in Japanese and Chinese, this is because *or* is inclusive disjunction and compatible with the ‘neither’ outcome (inclusive of both negative disjuncts) in an uncertainty scenario. This is different from knowing the actual outcome as ‘neither’ and then negating two positive disjuncts as in this scheme  $[\neg(P \vee Q)]$ .

(46) So, they didn’t rotate or balance the tires, but I don’t know which.

Moreover, in Szabolcsi (2002), she also reported a case where Neg...*or* can be interpreted with negation included in both disjuncts in English, shown in (47) (example (3) in Szabolcsi, 2002). In addition to the normal ‘neither’ reading, this sentence is claimed to have the reading that the speaker thinks that they didn’t close the window or didn’t close the door, but he doesn’t know which one they didn’t close.

(47) Why is it so cold here?

We didn’t close the window or the door.

This is the English counterpart of the example (36)<sup>20</sup> in section 2, where we discussed the appropriate context for the ‘not this or not that’ interpretation of Neg...*huozhe* in Chinese. Given the current example, it seems that the relevant context here not only facilitates the ‘not this or not that’ interpretation of Neg...*huozhe* for Chinese speakers, but also makes it possible for English speakers to access this interpretation of Neg...*or*.

As a matter of fact, all the contexts we have discussed in section 2 in which Chinese

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changes, this sentence is also relevant here.

<sup>20</sup> In (36b), we used 3rd person plural pronoun instead of 1st person plural pronoun used here.

speakers easily interpret Neg...*huozhe* as ‘not this or not that’ also make the this reading of Neg...*or* easier for English speaker to access. This means that a negated sentence with a disjunct object in English ought to be allowed to have the negation-including disjunction interpretation  $[\neg Pa \vee \neg Pb]$ , as in Chinese and Japanese. Then, theoretically, a negated sentence with a disjunct object should be ambiguous in English, too, as in Chinese (but not in Japanese, because *ka* is a PPI). However, most such sentences out of context are not judged by English speakers to be ambiguous; these speakers have a strong preference for the ‘neither’ interpretation, if not the only one. English uses Neg...*or* to naturally convey the ‘neither’ meaning, which does not require much context and is not associated with any special presupposition. Furthermore, negation and disjunction have somewhat contradicting pragmatic conditions for use (Goro, 2004). Hence, the meaning that corresponds to disjunction of negation (the ‘not this or not that’ meaning) requires the resolution of the contradicting pragmatic conditions and thus special presupposition. In order to access the ‘not this or not that’ reading of Neg...*or* with no context given, English speakers need to first deactivate the natural ‘neither’ interpretation, and then construct appropriate context to satisfy the special presupposition the respective meaning is associated with. As anyone can see, this involves much more mental work than simply access the natural interpretation. Therefore, the ‘not this or not that’ interpretation of Neg...*or* in English sentences out of context is highly inhibited, resulting in the uniform preference for the ‘neither’ interpretation of such construction among English speakers.

Although a negated sentence with a disjunct object can be interpreted as  $(\neg Pa \vee \neg Pb)$  in Japanese, Chinese and English, we see some degree of variance across languages in how easy a speaker can access this meaning: presumably, it is easiest for Japanese speakers and hardest for English speakers.

Now, let’s go back to conjunction in these three languages. We have shown that *he* in Chinese and *mo...mo...* in Japanese are PPIs, consequently, a negated sentence with a conjunct object in these two languages are forced to be interpreted as  $(\neg Pa \wedge \neg Pb)$ ,

generating the obligatory ‘neither’ interpretation. In English though, *and* is not a PPI, thus a negated sentence with a conjunct object can be interpreted with negation being excluded from the conjuncts, generating the  $[\neg(Pa \wedge Pb)]$  interpretation, and this is allegedly the default interpretation of such sentences. Then, if we draw an analogy here with the English disjunction case we just talked about, we wonder whether Neg...Conjunction can also have the interpretation with negation included in the conjuncts  $(\neg Pa \wedge \neg Pb)$ , just like counterpart constructions in Chinese and Japanese. In fact, this interpretation is possible in English.

Before we turn to the examples showing the  $(\neg Pa \wedge \neg Pb)$  interpretation of Neg...*and*, we want to point out that we are concerned with the Boolean conjunction *and*, but not with cases where *and* joins two noun phrases which makes up a bundle<sup>21</sup>. We want to test cases with genuine Boolean conjunction *and*. Let’s look at such a case now.

The context is set up like this: the university requires that students have registered for both algebra and statistics before they can register for a particular course A. John doesn’t know this requirement, and he registered for neither algebra nor statistics. He went to the instructor and asked for permission to register for course A. The instructor looked at John’s record and said John can’t register for course A, he justified it by uttering sentence (50).

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<sup>21</sup> For example, we are not concerned with sentences like *John didn’t eat egg and cheese*. In western culture, egg and cheese are often served as a bundle. Therefore, *egg and cheese* can refer to a single unit. When a speaker says *John ate egg and cheese*, we interpret it as meaning John ate a bundle which has egg and cheese in it. And when this sentence is negated, it means that John didn’t eat such a bundle. Hearers can infer that John didn’t eat egg as ingredient and didn’t eat cheese as ingredient from the fact that he didn’t eat the bundle and that the bundle consists of egg and cheese as ingredients. But, this ‘neither’ interpretation does not necessarily come from interpreting *and* and negation in the scheme  $(\neg Pa \wedge \neg Pb)$ . Because, people can say something like *John didn’t eat the no.2 meal on the breakfast menu*, which does not have *and* at all but still implies the same ‘neither’ meaning, if the no.2 meal on the breakfast menu minimally contains the bundle egg and cheese. Recall, this kind of bundle meaning is expressed in Chinese with morphemes other than *he*. In cases like this, although sentences containing Neg...*and* can be inferred to have the ‘neither’ meaning, the meaning does not come from the Neg...*and* interaction per se.

(48) Because you haven't registered for algebra and statistics.

This context is a minimal pair with that in example (39), in that the positive junts in the requirement are conjunctive here and disjunctive there. Abstractly, the prerequisite for course A in this example is  $(Pa \wedge Pb)$ <sup>22</sup>. Sentence (48) is judged by English speakers to be an appropriate justification for the instructor's refusal for permission. In this context, the instructor looked at John's record and should thus know that John registered for neither prerequisite course. Hence, based on his knowledge, the reason for John's ineligibility for course A is more specific than just generally failing to satisfy the positive disjunctive requirement (abstractly,  $[\neg(Pa \wedge Pb)]$ , 'not both together'), namely, failing to satisfy each of the two conjuncts in the requirement (abstractly,  $(\neg Pa \wedge \neg Pb)$ , 'neither'). Therefore, the instructor's justification should convey the latter, more specific reason. Sentence (48) is judge by English speakers to be an appropriate justification in this situation, which suggests that the 'neither' meaning of *Neg...and* is accessed.

This example shows that *Neg...and* can be interpreted with negation included in both conjuncts  $(\neg Pa \wedge \neg Pb)$ . But the 'neither' meaning  $(\neg Pa \wedge \neg Pb)$  of *Neg...and* seems to demand some special contextual information, namely, the requirement or expectation in the presupposition is positive and conjunctive<sup>23</sup>. On the other hand, *Neg...or* is the default and natural way in English to express a 'neither' meaning ( $[\neg(Pa \vee Pb)]$ , logically equivalent to  $(\neg Pa \wedge \neg Pb)$ ), which is not associated with special presupposition, is for the most part a better candidate than *Neg...and* in a 'neither' situation, especially when context is not given or is unclear. In fact, *Neg...and* in English has a default interpretation of  $[\neg(Pa \wedge Pb)]$ , and the  $(\neg Pa \wedge \neg Pb)$  interpretation of *Neg...and* is less preferred.

Let us now summarize the cross-linguistic variations with respect to the

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<sup>22</sup> Note, in the context given, *and* does not conjoin two components of a bundle, since algebra and statistics normally are not offered as bundle or package.

<sup>23</sup> The 'neither' interpretation of *Neg...and* in English is not the main concern in this paper. For more examples in this respect, see Szabolcsi & Haddican (2004).

interpretation of disjunction and conjunction in negative context we have discussed so far using the three tables in (49), (50) and (51).

The table in (49) illustrates the contrastive property of the conjunction coordinator and the disjunction coordinator in each of the three relevant languages. Regarding conjunction, Chinese and Japanese are alike, in that the conjunction coordinator in both languages is a PPI; regarding disjunction, Chinese and English are alike, in that the disjunction coordinator in both languages is not a PPI. English and Japanese are not alike in either case, because the conjunction coordinator and disjunction coordinator in each of the two languages have the same property regarding ‘PPI’, but the respective property in English is the opposite of that in Japanese.

(49)

Operator Language	Conjunction	Disjunction
English	-PPI	-PPI
Japanese	+PPI	+PPI
Chinese	+PPI	-PPI

The table in (50) summarizes the interpretive differences for Neg...Conjunction in English, Japanese and Chinese. Here, Chinese and Japanese are alike, in that the interpretation with negation excluded from the junct is ruled out in both languages, due to constraint from the PPI property of their conjunction coordinators (see (49)). Furthermore, the only interpretative option that is left open for Neg...Conjunction in these two languages, namely,  $\neg Pa \wedge \neg Pb$  (meaning ‘neither’), is natural in both languages; and as a matter of fact, the ‘neither’ meaning is naturally expressed in both languages with Neg...Conjunction. On the other side, Neg...Conjunction in English has a default  $\neg(Pa \wedge Pb)$  interpretation (unavailable in Japanese and Chinese), and the  $\neg Pa \wedge \neg Pb$  of Neg...Conjunction in English is possible but associated with special

presupposition (natural in Japanese and Chinese), as we discussed earlier.

(50) Neg...Conjunction<sup>24</sup>

Language \ Interpretation	$\neg(Pa \wedge Pb)$	$\neg Pa \wedge \neg Pb$
	English	default
Japanese	impossible	natural
Chinese	impossible	natural

The table in (51) summarizes the interpretive differences for Neg...Disjunction in English, Japanese and Chinese, which is the focus of the current paper. At the first glance, it seems that no two languages are exactly alike in this respect. But, if we leave the issue of preference aside, we can see that Chinese and English are alike, in that the grammar allows both interpretations here in both languages; while in Japanese, one of the two interpretations is disallowed. So, grammar-wise, Chinese is no way on par with Japanese.

(51) Neg...Disjunction (from the grammatical perspective)

Language \ Interpretation	$\neg(Pa \vee Pb)$	$\neg Pa \vee \neg Pb$
	English	default
Japanese	impossible	natural
Chinese	possible	possible

However, when we look at the distribution of the interpretations of Neg...Disjunction in these languages, we find another pattern of the cross-linguistic difference. The crucial

<sup>24</sup> Some clarification about terminology use: ‘Default’ refers to the interpretation that is preferred over another alternative interpretation; ‘natural’ refers to the interpretation that is the only option (when the alternative is ruled out); ‘possible’ refers to the interpretation that is available but subject to special context; ‘impossible’ refers to the interpretation option that is ruled out.

language here is Chinese. Although Neg...*huozhe* in Chinese allows the  $\neg(Pa \vee Pb)$  interpretation ('neither'), it is in general not a candidate as good as Neg...*he* in a 'neither' situation. The reason for this has three components, given in (52). Consequently, the  $\neg(Pa \vee Pb)$  interpretation of Neg...*huozhe* may not occur very often, while the  $(\neg Pa \vee \neg Pb)$  interpretation becomes the dominant interpretation of Neg...*huozhe* in use.

(52) *Why isn't Neg...huozhe generally a good candidate for a 'neither' situation?*

- a. The 'neither' interpretation of Neg...*huozhe* is subject to specific discourse constraints, namely, the requirement or the expectation in the presupposition has two positive and disjunctive junct.
- b. Neg...*huozhe* is ambiguous in interpretation, and the two interpretations stand in a scalar relation: the 'neither' interpretation  $\neg(Pa \vee Pb)$  is stronger and more specific than the 'not this or not that' interpretation  $(\neg Pa \vee \neg Pb)$ . The speaker should not commit to the stronger meaning option, if the situation is unknown.
- c. The conjunction coordinator *he* is a PPI, which makes the 'neither' interpretation of Neg...*he* ( $\neg Pa \wedge \neg Pb$ ), logically equivalent to  $\neg(Pa \vee Pb)$ ) natural and context-independent..

Given this, the pattern of the interpretation of Neg...*huozhe* in Chinese shifted the similarity scale toward the Japanese side, when the distribution of interpretation is concerned. English *or* is the default coordinator used in a simple negated sentence in the 'neither' situation; Japanese *ka* will never be used in a simple negated sentence in the 'neither' situation; Chinese *huozhe* will not be used in a simple negated sentence in the 'neither' situation in the normal case. Therefore, the data in Chinese and in Japanese look alike in this respect.

### 3.2. Learnability problems in the acquisition of negated disjunction

The distribution of the interpretation of Neg...*huozhe* in Chinese makes Chinese data look like Japanese. This means, from an acquisition point of view, that the primary linguistic data (PLD) regarding Neg...Disjunction that children are exposed to might be

the same in Chinese and in Japanese. More generally, syntactic properties (the PPI status of an expression of disjunction coordinator), semantic properties (the meaning of that expression) and pragmatic properties (the scales that the expression participates in) can combine in different ways to create a PLD environment that makes two different arrangements of the properties look exactly alike. In the current case, Japanese *ka* is a PPI and thus will never appear in the ‘neither’ situation, Chinese *huozhe* is not a PPI, but the PPI property of *he* makes it a better candidate for the ‘neither’ situation, consequently, *huozhe* will be refrained to appear in the ‘neither’ situation. How could a child tell whether he is learning Chinese or Japanese in this regards?

Based on the input a Chinese child is exposed to, he may think that *huozhe* is a PPI, just like Japanese *ka*, so that Neg...*huozhe* in simple negative sentences cannot be interpreted as  $\neg(Pa \vee Pb)$  and thus does not have the ‘neither’ meaning. This is problematic from a learnability perspective, because once the child assigns *huozhe* a PPI property, he might not be recovered to the correct knowledge the PPI status of *huozhe* in Chinese. The reason behind this is the subset-superset relation of the two interpretations of Neg...*huozhe* in adult Chinese, where *huozhe* is not a PPI.

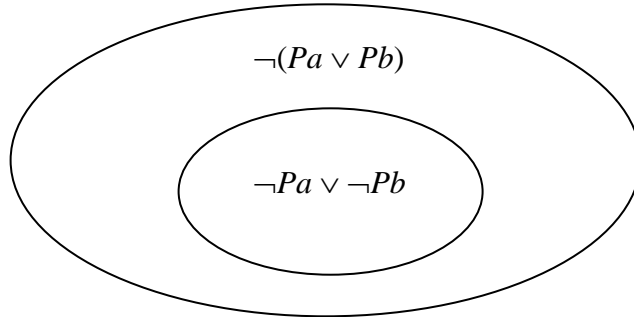
The two interpretations of Neg...*huozhe* are  $\neg(Pa \vee Pb)$  ‘neither’ and  $\neg Pa \vee \neg Pb$  ‘not this or not that’ for adult speakers. The truth conditions of these two interpretations, presented in the table in (53), show that whenever  $\neg(Pa \vee Pb)$  is true,  $\neg Pa \vee \neg Pb$  is true.

(53)

$Pa$	$Pb$	$\neg Pa$	$\neg Pb$	$Pa \vee Pb$	$\neg(Pa \vee Pb)$	$\neg Pa \vee \neg Pb$
1	1	0	0	1	0	0
1	0	0	1	1	0	1
0	1	1	0	1	0	1
0	0	1	1	0	1	1

This means, the circumstances that make a simple negated sentence with a disjunct object (Neg...*huozhe* here) true on the ‘neither’ interpretation is a subset of the circumstances that makes the sentence true on the ‘not this or not that’ interpretation. This subset-superset relation is illustrated in the diagram in (54).

(54)



Assuming negative evidence is in general unavailable to children, if a child learning Chinese concludes from the input that *huozhe* is a PPI and that Neg...*huozhe* cannot be interpreted as  $\neg(Pa \vee Pb)$ , he would be stuck with the  $\neg Pa \vee \neg Pb$  interpretation of Neg...*huozhe*. Because in the cases when people use Neg...*huozhe* with the intention of  $\neg(Pa \vee Pb)$ , the child might think that they intend the  $\neg Pa \vee \neg Pb$  interpretation, because in those circumstances,  $\neg Pa \vee \neg Pb$  is also true<sup>25</sup>, then presumably they could never learn that Neg...*huozhe* can be interpreted as  $\neg(Pa \vee Pb)$ .

On top of this learnability problem Chinese children face, there is another problem Chinese children have in learning the interpretation of Neg...*huozhe*: the  $\neg Pa \vee \neg Pb$  interpretation (‘not this or not that’) of Neg...*huozhe* does not occur often, and this interpretation demands some cognitive capacity that children might still be developing. As we discussed in section 2, the  $\neg Pa \vee \neg Pb$  interpretation of Neg...*huozhe* is associated with some specific context constraints, resulting from the contradicting pragmatic conditions of negation and disjunction. On the one hand, the specific pragmatic

<sup>25</sup> Here, we are specifically talking about truth conditions, leaving the pragmatic conditions for the two interpretations aside.

constraints of this interpretation of Neg...*huozhe* limit the occurrence of this interpretation and consequently the occurrence of Neg...*huozhe* in the PLD environment for children. On the other hand, accommodating the pragmatic constraints requires a relatively complex theory of mind, which takes several years to develop in children (see Wimmer & Perner, 1983; Wellman & Liu, 2004; among others). In what follows, let us elaborate these two aspects.

The specific pragmatic constraints associated with the  $\neg Pa \vee \neg Pb$  interpretation of Neg...*huohze* (more generally, Neg...Disjunction) consist of two parts. One, the speaker's knowledge about what happened must be inferred and incomplete. The speaker must have no exact knowledge about what happened, otherwise, he could have described the more specific situation he knows exactly about. However, there must be some outcome that is necessarily connected with (at least, sometimes also at most) one of the two causes under consideration, so that the speaker, who knows the outcome, can confidently infer that (at least, sometimes also at most) one unidentified cause should be what took place; otherwise, he could have simply expressed his ignorance about what happened. This part satisfies the pragmatic conditions for the use of disjunction. The other part of the constraint is the one (standing for both 'exactly one' and 'at least one') cause that accounts for the outcome must be negative: either something positive in the expectation failed to take place, or something negative in the expectation did happen. This part satisfies the pragmatic conditions for the use of negation.

These specific pragmatic constraints presumably result in that the appropriate context for the  $\neg Pa \vee \neg Pb$  interpretation of Neg...*huohze* does not occur commonly, especially in the input children are exposed to, and is not easy to construction if unknown. Therefore, Chinese children do not have access to pervasive PLD regarding the the  $\neg Pa \vee \neg Pb$  interpretation of Neg...*huohze* in Chinese: the cases where appropriate context is given when this interpretation is intended are not many; and in case where speaker intends this interpretation with no appropriate context given, children may have difficulty

constructing such a context. Then, what does a Chinese child know the  $\neg Pa \vee \neg Pb$  interpretation of Neg...*huozhe*?

In addition, in order for a child to understand that the speaker intends  $\neg Pa \vee \neg Pb$  with Neg...*huozhe*, he must be aware that the context is appropriate for the pragmatic constraints we just discussed, when the context is given. This in fact requires pretty complex cognitive competence.

The child must know that the speaker does not have complete knowledge about what happened, while he himself may have the complete knowledge. So, the child first must know that someone can have a different knowledge about the same thing than himself, and he needs to be able to think and judge from the speaker's perspective. This ability is part of what is called the theory of mind, which generally takes 4 years to develop in children (Wimmer & Perner, 1983; and studies following it). More specifically, the ability we are concerned about here (judgment based on other people's knowledge) is not fully developed until children are 5 years old, as show in the result of the knowledge access task in Wellman & Liu (2004). The study in Wellman & Liu (2004) measured children's knowledge about different aspects of understanding of others' mental states. In the knowledge access task of the experiment, children were asked to judge another person's knowledge, which was different from theirs. Children demonstrated this kind of ability at an average age of 4;6.

Even if the child has the same knowledge as the speaker, the child still has something conceptually complex to deal with before he can interpret the speaker's use of Neg...*huozhe* as  $\neg Pa \vee \neg Pb$ . As we discussed earlier, the certain knowledge about what happened comes from inference, an indirect access of the (partial) fact. This requires that the child can make the inference from the evidence in the outcome, which is potentially a hard task (see some discussion in Papafragou, Li, Choi & Han, to appear). And the relation between the cause and the outcome is also complex, which presumably makes the inference more difficult for children (see Zacks & Tversky, 2001). If it is the

case that the child knows what actually happened, his task is even harder. The child needs to know that the speaker can infer from the outcome, and he needs to give up what he knows about what actually happened and infer the incomplete knowledge about what happened from the speaker's perspective.

The conceptual complexity involved in the  $\neg Pa \vee \neg Pb$  interpretation of Neg...*huozhe* requires a comparable cognitive capacity from the children as a hearer. But young child often lack such capacity. Therefore, the  $\neg Pa \vee \neg Pb$  interpretation of Neg...*huozhe* is not an easy thing to learn for Chinese children.

Taken the two aspects of the problem Chinese children face when learning the  $\neg Pa \vee \neg Pb$  interpretation of Neg...*huozhe* together, we really wonder how they learn this interpretation. The input does not give them abundant chances to be exposed to this interpretation of Neg...*huozhe*, and whenever this interpretation occurs, it comes with a relatively high demand on the children's cognitive ability. This problem is not specifically connected with Chinese though, because the pragmatic constraints associated with the  $\neg Pa \vee \neg Pb$  meaning are general. Consequently, Children learning Japanese and English face this same problem when they learn the  $\neg Pa \vee \neg Pb$  interpretation of Neg...Disjunction in the respective language.

### **3.3. Proposed solution for the learnability problems**

The two learnability problems Chinese children face as we discussed in the last section make it hard for them to acquire the correct grammar of the interpretation of Neg...*huozhe*, because both interpretation options seem to be hard to deduce from the input and may demand complex cognitive ability. In this section, we want to discuss the possible solution for the problems.

As discussed in the last section, we were concerned that Chinese children may conclude from the limited input that Neg...*huozhe* in Chinese is interpreted in the same way as Neg...*ka* in Japanese, where a 'neither' interpretation ( $\neg(Pa \vee Pb)$ ) is not allowed.

If this were the case, Chinese children might never learn that Neg...*huozhe* can mean ‘neither’, because of the effect of the subset-superset relation of the two interpretative options. We were also concerned that Chinese children may have difficulty figuring out that Neg...*huozhe* can mean ‘not this or not that’ ( $\neg Pa \vee \neg Pb$ ) given the input and the conceptual complexity this meaning is associated with.

Remember, with regard to the interpretation of Neg...Disjunction, Japanese is special in the three languages in that there is some language specific constraint (the +PPI status of *ka*) that prohibit one of the two interpretive options to emerge in adult language. Theoretically, we have no reason to believe that universal grammar prohibits either interpretive option. Therefore, we propose that children across languages have both interpretive options available as the initial state of their knowledge about the interpretation of Neg...Disjunction. In addition, because one of the interpretations of Neg...Disjunction,  $\neg Pa \vee \neg Pb$  is conceptually harder than the other one,  $\neg(Pa \vee Pb)$ , we expect that children show a better understanding of the  $\neg Pa \vee \neg Pb$  interpretation and thus interpret Neg...Disjunction this way as default, and that children’s knowledge about the  $\neg Pa \vee \neg Pb$  interpretation will be dependent on the development of their theory of mind and the discourse conditions. One assumption we hold here is that children map the disjunction words in their respective languages to Boolean disjunction  $\vee$  relatively early, so that when they interpret Neg...Disjunction, they can map the correct truth conditions to the  $\neg(Pa \vee Pb)$  interpretation and the  $\neg Pa \vee \neg Pb$  interpretation.

This kind of setting of the interpretation of Neg...Disjunction is how adult English works: the ‘neither’ interpretation is default, and the ‘not this or not that’ interpretation is possible with context. We should expect that children across languages initially behave more or less along this line.

Given this, the learnability problems we talked about that Chinese children seem to face dissolve largely, because children’s interpretation of Neg...Disjunction is not tied to the input, and they have the two interpretations as given. In order to become a competent

Chinese speaker, children need to eliminate their preference of the ‘neither’ interpretation of Neg...*huozhe*. As we discussed earlier, which exact interpretation of Neg...*huozhe* is intended in adult Chinese is determined by pragmatic conditions. Therefore, the target of learning the interpretation of Neg...*huozhe* for Chinese children then is not semantic, but pragmatic in nature. That the properties children need to learn is pragmatic does not make it trivial. There is still a host of stuff for children to learn and it is not at all obvious how one learns it.

English children have basically the same pattern of interpretation of Neg...*or* as English adults already. What they are not as good at is to access the ‘not this or not that’ meaning, which requires more pragmatic knowledge.

Japanese children will have an interpretation of Neg...*ka* that is disallowed in adult Japanese. In order to become a competent adult speaker, Japanese children need to eventually learn from the input that Neg...*ka* cannot be used to convey the ‘neither’ meaning independently of the inclusive disjunction meaning of  $\neg Pa \vee \neg Pb$ . Because of the specific pragmatic conditions associated with the  $\neg Pa \vee \neg Pb$  interpretation in general, the construction Neg...*ka*, which only has the  $\neg Pa \vee \neg Pb$  interpretation, presumably occurs at a low frequency in the input children are exposed to. As a result, Japanese children are expected to learn how to eliminate the  $\neg(Pa \vee Pb)$  interpretation of Neg...*ka* relatively late.

The solution we proposed in this section in fact says that most part of the learnability problems Chinese children seem to face in learning the interpretation of Neg...*huozhe* does not arise; and the part of the problems that is tied to cognitive capacity rather than input will disappear as children’s general cognitive development boosts.

The hypothetical solution proposed here can be tested in experimental investigations. If experiment results show that children with different language background nonetheless prefer the  $\neg(Pa \vee Pb)$  interpretation of Neg...Disjunction and are able to access the  $(\neg Pa \vee \neg Pb)$  interpretation in special context, then our proposed solution here may be on the

right track.

### 3.4. Studies on the acquisition of Neg...Disjunction

There are a lot of experimental studies on children's knowledge about the behavior of English disjunction *or* in different environments. Some researchers, like Beilin & Lust (1975) and Braine & Romain (1981), reported that children can only access a subset of the truth-conditions of disjunction when interpreting *or*; specifically, they lack the inclusive interpretation of *or* and take *or* to be exclusive disjunction. This conclusion has been challenged by Chierchia, Crain, Guasti & R. Thornton. (1998), Crain, Gualimini & Meroni (2000), Gualimini & Crain (2000), among others. These researchers argued with empirical data that children know *or* correspond to Boolean inclusive disjunction. Children's seemingly insensitivity to the inclusivity of *or* in studies such as those in Beilin & Lust (1975) and Braine & Romain (1981) is caused by experimental factors which failed to satisfy the pragmatic conditions for inclusive disjunction. *Or* as a disjunction coordinator in natural language has an exclusive implicature, which is absent with a disjunction operator in logic, therefore, the inclusivity meaning of *or* can only show up when the pragmatic implicature is cancelled. Among the latter series of studies, Crain, Gualimini & Meroni (2000) investigated children's interpretation of *or* in negative context, which is specifically relevant to our topic. Their study showed that children interpreted a negated sentence with a disjunct object as  $\neg(Pa \vee Pb)$  and accessed the full range of truth conditions associated with this interpretation.

Goro and Akiba (2004a) and Goro (2004) investigated Japanese speaking children's interpretation of sentences containing a disjunct object. The experiment results demonstrated Japanese children's non-adult way of interpreting Neg...*ka*, specifically, they interpret Neg...*ka* as  $\neg(Pa \vee Pb)$ , meaning 'neither', while Japanese adults disallow this way of interpretation.

In Jing, Hsu & Crain (2005), there was an experimental study on Chinese speaking

children's interpretation of negated sentences with a disjunct object. In a context that is conducive for the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huozhe*, Chinese adults accessed this interpretation, while Chinese children accessed the  $\neg(Pa \vee Pb)$  interpretation, showing their preference of this 'neither' interpretation in some contexts conducive for the alternative interpretation for Chinese adults.

These studies on children's interpretation of negated sentences with a disjunct object in English, Japanese and Chinese showed that children across the three languages preferred the  $\neg(Pa \vee Pb)$  interpretation of Neg...Disjunction, despite the contrast regarding this interpretation in the respective adult languages. The findings are consistent with our proposal about children's initial state of the interpretation of Neg...Disjunction, discussed in the last section.

However, our proposal has another part, namely, children across languages should not be linguistically constrained to disallow the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...Disjunction. They should have this way of interpretation as given, but because of the specific discourse conditions associated with this interpretation, children can access it only when the context is set up in such a conducive way that the state their cognitive development can accommodate. This implies, the context that is conducive for a  $(\neg Pa \vee \neg Pb)$  interpretation for adults is not necessarily conducive enough for children. Moreover, if children have certain interpretation of a target construction, a carefully designed experiment may show this. But on the other hand, we need to be really careful when we come to the conclusion about children's lack of certain interpretation. The construction we discussed here, Neg...Disjunction, can theoretically have two interpretations, so, accepting one interpretation in certain context does not necessarily mean disallowing the other interpretation all over. Therefore, the previous studies we mentioned investigating children's interpretation of Neg...Disjunction do not really tell us whether children have the  $(\neg Pa \vee \neg Pb)$  interpretation.

The studies in English we just mentioned are not concerned with the  $(\neg Pa \vee \neg Pb)$

interpretation at all, so English children's knowledge about this interpretation is completely unknown. In both the Japanese study and the Chinese study, the ( $\neg Pa \vee \neg Pb$ ) way of interpreting Neg...Disjunction was taken into consideration, and the researchers tried to satisfy the pragmatic conditions associated with this interpretation.

In the Japanese children study by Goro and Akiba (2004a) and Goro (2004), they used a positive lead-in sentence with the test sentence, which is a negated sentence with a disjunct object. This was inspired by Lidz & Musolino (2002, 2006), where they showed that a positive lead-in sentence improved children's performance in interpreting a negative target sentence with another operator (*every* in that case). In addition, in their experiment, Goro and Akiba (2004a) and Goro (2004) also tried to accommodate the pragmatic concerns raised by Gualmini (2003) about the interpretation of a sentence containing negation and another operator (*some* in that case), namely, the positive expectation must be natural and explicitly introduced in the experiment. Moreover, Goro and Akiba (2004a) and Goro (2004) used different rewards as signs to represent different scenarios in the experiment, which set up an outcome-cause relation. Finally, they made sure that the speaker (Kermit as the puppet) of the test sentence could not track what actually happened when he uttered the test sentence, but could infer from the kind of reward in the outcome.

In Jing, Hsu & Crain's (2005) Chinese children study, the positive expectation was naturally set up in the context where the test sentence was uttered and explicitly mentioned, and different rewards were used to indicate different scenarios. Before uttering the test sentence, the speaker (Kermit as the puppet) expressed his lack of attention to what happened and his confidence in inferring what happened based on the reward.

Both the study in Japanese and that in Chinese utilized the Truth Value Judgment Task (hereforth, TVJT, Crain & McKee, 1985; Crain & Thornton, 1998) methodology. Typically, a TVJT experiment involves two experimenters, one experimenter acts out

some stories with toy figures and props, while the other experimenter manipulates a puppet. At the end of each story, the puppet will say a target sentence describes what he thinks has happened in the story, and the child's task is to judge whether the puppet's utterance is true and justify his answer when relevant. This method is good at testing whether children have a specific interpretation with a target construction. But this is only valid with the assumption that the child presented with the test sentence judges it from the puppet's perspective, namely, based on the knowledge of the puppet, who utters the sentence. As we discussed in section 3.2, think and judge from another person's perspective is potentially hard for children. But in most of circumstances where the TVJT methodology is used, the child's perspective and the puppet's align, so that children can just judge the target sentence from his own perspective, and the result of their judgment can still be a valid indication of whether they have the specific interpretation targeted at.

However, in the Japanese study in Goro and Akiba (2004a) and Goro (2004), before the child judged whether Kermit said the right thing about what happened, what actually happened was revealed to him, so his knowledge about what happened at the time of judgment was different from Kermit's knowledge about what happened at the time of utterance. Similarly, in the Chinese study in Jing, Hsu & Crain's (2005), although Kermit said he did not pay attention, the child presumably paid attention and was well aware of what exactly happened, so the child's knowledge is also different from Kermit's about what happened. To take children's judgment of the test sentence in both studies as a valid indication of whether they have the  $(\neg Pa \vee \neg Pb)$  interpretation, we have to assume that children judge the test sentence from Kermit's perspective. But this could not be guaranteed for every child, as judging from another person's perspective is basically hard for children, some children might be better at it than others. If a child was judging Kermit's utterance from his own perspective, then his judgment could not be a good indication of whether he had the  $(\neg Pa \vee \neg Pb)$  interpretation, because for him, the pragmatic conditions associated with the  $(\neg Pa \vee \neg Pb)$  interpretation of

Neg...Disjunction were not fully satisfied, since he knew what exactly happened. And just looking at the results of children's judgment, we would not be able to tell which perspective they took. Therefore, it would be nicer if the experiment setting could make the children's perspective align with the puppet's perspective.

In addition, when we look at the details of the experiment, we are inspired that we could further manipulate the conditions in the experiment to make the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...Disjunction more accessible.

In both the Japanese study and the Chinese study, a typical experiment trial involved an acted-out story, in which some toy characters had a positive goal to achieve, for instance, eating vegetables, lifting up heavy things, etc. And the full satisfaction of the goal was to finish both tasks in the goal (eating both vegetables, lifting up both heavy things,...), in this case, a toy character could get the best reward. The goal was only partially fulfilled if only one of the two tasks was finished, but, partially satisfying the goal was better than totally missing the goal by not finishing any task. So, in the case when only one of the two tasks was finished, the toy character could get a second-level reward; while a toy character would not get any reward if it did not finish any task. Here, the scenario where only one task in the goal was finished is relevant to the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...Disjunction, and this was the context in both studies where the test sentence was uttered.

In such scenario, when we see a second-level reward, we make a positive inference that the toy figure did finish one task ('did this or did that' in this case) and thus get some reward, in contrast with no reward at all; meantime, we also make a negative inference that the toy figure did not finish one of the two tasks ('did not do this or did not do that) and thus only got a second level reward, in contrast with the best reward. In this case, both the positive inference and the negative inference should be straightforward to adults, and we as adults can choose which inference to focus on depending on which contrast we want to make in the discourse. Let us assume a reward in general is something good, it is

not unreasonable to think that the direct and easiest inference people make from a reward is in general something positive as well, and that making inference from the specific kind of reward, especially an inference about something negative, is rather indirect and requires more mental work. Adults should be able to compute both direct inference and indirect inference easily and may not notice the potential mental work difference in making the two inferences. But for children, things may be different. As we discussed in section 3.2, making inference is a way of indirect access to the information and potentially hard for children (Papafragou, Li, Choi & Han, to appear). Thus, it may be easier for children to make a direct inference than an indirect inference, as constrained by children's cognitive development level; consequently, they may prefer the contrast situation that is associated with the direct inference. In the experiment scenario we are concerned with, children may prefer to contrast a second-level reward with no reward instead of with the best reward. If this was true, their perception about what happened was in fact more positive, rather than a clear case of something (not all) positive in the expectation failing to take place – which is the presupposition associated with the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...Disjunction. With this complication factor, the context set up in the experiment story might not be conducive enough for children to access the  $(\neg Pa \vee \neg Pb)$  interpretation, so that they accessed the  $\neg(Pa \vee Pb)$  interpretation and judge the test sentence accordingly.

This hypothesis predicts that it should be easier for children to access the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...Disjunction if the direct inference they make from a reward is something negative. For example, we manipulate the experiment story so that a reward is given to a toy figure if he successfully avoids one mistake, and two rewards are given to the toy figure if he avoids both mistakes in the expectation. Assuming avoid a mistake is conceptually negative and normally expressed in natural language with negative expression like *didn't do something* in English, then one reward can be directly inferred as 'didn't do this or didn't do that', abstractly corresponding to  $(\neg Pa \vee \neg Pb)$ , which is

the interpretation of Neg...Disjunction we are targeting at. In this case, if our hypothesis is right, we should be able to see better performance from children regarding the the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...Disjunction.

Recall, when we discussed the contexts that make it easier and natural for Chinese adults to access the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huohze* in that section 2, we gave example (36), repeated here as (55). The context in this example is such that the cause people infer from the outcome of being cold here is negative, namely, not closing something. This example shows even for adults negative disjuncts in the presupposition help Chinese speakers access the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huohze*.

(55)a. Weishenme zheli zheme leng?

why here so cold

'Why is it so cold here?'

b. Tamen meiyou guan men huozhe chuang

they not-PERF close door or window

'They didn't close the door or didn't close the window'

Therefore, we have reason to believe that it may also be easier for children to access the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...Disjunction. In the next two sections, we will report experimental studies we did in Chinese and in English investigating children's interpretation of Neg...Disjunction, which examine children's awareness of the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...Disjunction.

## 4. Experiments in Chinese

In this section, we will report three experiments we did with Chinese children and adults on their interpretation of interacting logical words, negation, disjunction and conjunction.

### 4.1. Experiment I

Our first experiment was designed to investigate Chinese children's interpretation of negated sentences with a disjunct object (Neg...*huozhe*), which are ambiguous between the  $\neg(Pa \vee Pb)$  interpretation and the  $(\neg Pa \vee \neg Pb)$  interpretation for Chinese adults. With this experiment, we wanted to test our proposal that Chinese children have both interpretative options available, specifically, they prefer the  $\neg(Pa \vee Pb)$  interpretation, but can access the  $(\neg Pa \vee \neg Pb)$  interpretation given conducive context. In addition, we wanted to test the influence different contexts may have on children's interpretation of Neg...*huozhe* vs. on adult's interpretation. In order to do this, based on our discussion about positive goal vs. negative goal, we tested children as well as adults in two conditions. In one of the conditions, the trial stories always involved a positive goal for some toy figures, similar to the Japanese studies in Goro and Akiba (2004a) and Goro (2004) and the Chinese studies in Jing, Hsu & Crain (2005), let us call this condition *the positive goal condition*. In the other condition, the trial stories always involved a negative goal for some toy figures, call this condition *the negative goal condition*. Therefore, in this experiment, we had two factors, each had two levels: age (children vs. adults) and goal (positive vs. negative).

#### 4.1.1. Method

##### *Subjects*

Twelve monolingual Chinese-speaking children (six boys and six girls) participated in this experiment and ranged in age from 3;10 to 4;9 (mean age 4;4). All child subjects attended the Daycare Center Affiliated with Nanjing Forestry University in Nanjing,

China. In addition to children, a control group of twelve Chinese-speaking adults were also tested.

### *Procedure*

In this experiment, we used TVJT, an experimental methodology we already discussed in section 3.4 (for detailed description, see Crain & Thornton, 1998). Given the concern we expressed in section 3.4 about children's potential difficulty in make judgment from another person's perspective, we modified the task in a special way to align children's perspective and the puppet's perspective in the experiment. What we did was to put a curtain at a certain time between the story and the hearers of story, the puppet (Kermit) and the child subject, so that their view about what actually happened was blocked. This made sure that both Kermit and the child did not know from their own experience what happened.

The children were tested individually in a quiet room. Each child was first tested on two simple warm-up stories with the 'curtain trick'. In one of the story, Kermit said something truthful about what happened; in the other story, Kermit said something false about what happened. With this contrast, we showed children that Kermit could be right and could be wrong. Only if a child could make the relevant inference, judge the sentences and justify his answer appropriately, we can move on to the test session with this child. Children who had difficulty responding cooperatively were eliminated from the test session. After passing the screening session, each child would be tested in two sessions, testing the positive goal condition and the negative goal condition, respectively. Half of the children saw the positive goal condition stories first, and the other half received the negative goal condition stories first. In each session, each child would hear seven stories, four of which with target sentences, and the other three with filler sentences. The stories were presented with target stories and filler stories mixed in order. Adult subjects were tested in a similar way.

### *Material*

In a positive goal condition story, labels or rewards were associated with finishing tasks toward a positive goal, like fixing objects, water plants, etc. The story in (56) represents in a typical trail story in the positive goal condition:

(56) Mickey Mouse had a bike and a skateboard. But they were broken. One day, Donald Duck came to visit Mickey Mouse and asked whether he could play with his bike and skateboard. Mickey said he wanted to send them to the garage to have them fixed. Donald was willing to go together. The two friends then sent the bike and the skateboard to the garage.

Mickey said to the boss: Hi boss, can you ask your worker fix my bike and my skateboard? They are broken. The boss said: Sure. But we only have one worker today, so he must fix them one by one. It may take longer. And when he is working, the garage door must be closed. After he fixed one thing, he will hang one red flag on the door; and after he fixed the other one, he will hang another red flag on the door and open the garage door. So, when there are two red flags on the door, you can take your stuff back home.

(Curtain put down)

Mickey and Donald played outside for a while. Donald had to leave, and Mickey decided to go back to the garage.

(Curtain removed)

He talked to the boss: Do you think the worker has fixed my stuff? The boss said: Oh, you came back already! I don't think the worker has fixed anything yet. Let's go and check. They two went to the garage, there is one flag hung on the door. The boss said: Oh, well, the worker has worked very hard, but there is only one flag on the door, he only fixed one thing. You just have to wait a bit longer. Mickey said: ok, see you later!

After the story is over, Kermit would say: the worker hung one flag on the door, I think...

(57) gongren meiyou xiu-hao zixingche huozhe huabanche  
worker not-PERF fix-ready bike or skateboard  
Lit. 'The worker didn't fix the bike or the skateboard.'

The test sentence (57) is a negated sentence with a disjunct object. Sentences like this in

Chinese are ambiguous for adult speakers. Given the situation in the story described, the two alternative interpretations have opposite truth values. Sentence (57) is true on the  $(\neg Pa \vee \neg Pb)$  interpretation ('not this or not that'), since it is the case that the worker fixed one thing and didn't fix one thing, so it is true that he didn't fix the bike or he didn't fix the skateboard; and the sentence is false on the  $\neg(Pa \vee Pb)$  interpretation ('neither'), because it is not the case that the worker fixed neither the bike and the skateboard. Then, if subjects access the  $(\neg Pa \vee \neg Pb)$  interpretation of (57) in this context when they judge the test sentence, we expect that they should accept sentence (57); on the other hand, if subjects access the  $\neg(Pa \vee Pb)$  interpretation of (57) in the context, we expect that they should reject sentence (57)<sup>26</sup>.

Now let us look at the detail of the story described in (56) and see how different experiment goals are satisfied.

In the beginning of the story, Mickey Mouse and Donald Duck had some discussion about the Mickey's bike and skateboard that were broken. This was designed to make the two objects that would be acted upon salient in the discourse. In this specific story, these two objects would be kept in the toy garage at the end of story, so, we had to make sure that the hearers of the story could remember these two objects. The setting with the two objects remaining in the garage at the end of the story was designed to make sure that the hearer had no evidence on which object exactly was fixed, an requirement posed by the pragmatic conditions of the  $(\neg Pa \vee \neg Pb)$  interpretation

Then the bike and the skateboard were sent to the garage to have them fixed. The boss said that only one worker was on duty, and that worker was responsible for fixing both objects, which would take longer. This made the boss's guess later in the story that the worker did not fix anything when Mickey came back reasonable. After this, the boss explained the rules explicitly, namely, one flag on the door meant the worker finished

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<sup>26</sup> As we discussed earlier, no matter whether subjects accept or reject the sentence, what we can say is subject access the corresponding interpretation in that context when judging the specific test sentence; but we cannot say that they just cannot access the alternative interpretation of the test sentence.

fixing one thing, and two flags meant both were fixed. This set up the basis for the inference about what happened from the number of labels (flags in this story), which is necessary as demanded by the pragmatic conditions for the  $(\neg Pa \vee \neg Pb)$  interpretation. Note, the goal for the worker in this story was to fix objects, which was positive. Therefore, given what we discussed in section 3.4, the direct inference from one flag as label would be that the worker fixed something (abstractly, equivalent to  $(Pa \vee Pb)$ ) and the indirect inference would be that there was one object the worker didn't fix (abstractly, equivalent to  $(\neg Pa \vee \neg Pb)$ ).

At this time, the curtain was put down between the target part of story (the garage) and the story hearers, Kermit and the subject. Then what would happen next behind the curtain was unseen to both Kermit and the subjects. This modification of the TVJT served two purposes, which all targeted at satisfying the pragmatic conditions of the  $(\neg Pa \vee \neg Pb)$  interpretation: one, making sure that the subject's perspective about the story aligned with Kermit's perspective; two, both the subject and Kermit did not have direct access to what happened. This is also important. The experimenter acting out the story would manipulate the story setting behind the curtain so that there was one flag on the garage door before the curtain was removed. After Donald had to leave, Mickey went back to the garage. The boss did not expect Mickey to come back and guessed that the worker fixed neither objects due to limited time. If we expected subject to access the  $(\neg Pa \vee \neg Pb)$  interpretation in the context set up by the story, the boss's guess here satisfied the plausible dissent, because the situation that would falsify this interpretation (and thus corresponding to the alternative interpretation  $\neg(Pa \vee Pb)$  of Neg...*huozhe*) was considered in the story.

The actual outcome was revealed when the boss showed Mickey that only one flag was on the door. At this time, the boss reinforced the rule on the association of the number of labels and the number of objects acted upon by saying that one flag meant the worker only fixed one thing. The use of 'only' (*zhi* in Chinese) implies that there was

something still unfixed. This explicit explanation of the outcome would presumably ease children's mental work on the (even direct) inference from label, given that making inference is generally hard (see discussion in section 3.2).

Lastly, before Kermit uttered the target test sentence, he made clear that he was aware of the existence of one flag, which was the basis for his inference (*guess* in children's words). Hence, Kermit explicitly expressed the status of his knowledge about what happened, namely, inferred from the existence of *one* flag. This perspective aligned with the subject's perspective. But whether Kermit would make the right inference was undetermined before his utterance of the test sentence. We assume that subjects knew this, because in the warm-up session we showed that Kermit could be right and could wrong. If Kermit made the right inference in this case, he should somehow express a  $(\neg Pa \vee \neg Pb)$  meaning; if he expressed a  $\neg(Pa \vee Pb)$  meaning, that meant he made the wrong inference. Therefore, judging whether Kermit's utterance was true was in fact judging whether Kermit made the right inference. The subjects would do this unconsciously. But their judgment would show which interpretation of Neg...*huozhe* they accessed upon judging. Specifically, the fact about what happened was  $(\neg Pa \vee \neg Pb)$ , so, if subjects judged the test sentence to be true, they presumably compared the  $(\neg Pa \vee \neg Pb)$  interpretation with the fact, and if they judged the test sentence to be false, they presumably compared the  $\neg(Pa \vee Pb)$  interpretation with the fact.

Contrasting with the positive goal condition, in a negative goal condition story, rewards were associated with successful avoiding mistakes toward a negative goal, like not hitting obstacles, not dropping objects, etc. The story in (58) represents in a typical trial story in such condition:

(58) Bear brother and bear sister came to play a pushing-the-cart game. The judge said: You need to play a pre-game to see whether you can play the real game. See this passage here? I'll make it an obstacle course. In the pre-game, I'll put this bench in the middle. You are supposed to push the cart through this obstacle course. If you don't hit the bench, you can play the real game. Bear sister was very nervous and hit

the bench. Bear brother made it to the end without hitting the bench, so he was able to play the real game.

The judge said: the real game is much harder. Look, now I put two obstacles on the way, this barrel and this rock. It seems that bear brother is very good in pushing cart. Bear brother, if you push the cart through the obstacle course and don't hit the barrel, I'll give you a shell as reward; and if you don't hit the rock, I'll also give you a shell as reward. So, you can get two shells if you don't hit anything. You did really good in the pre-game, try hard this time!

(Curtain put down)

(Kermit said: I am wondering how well bear brother does in the real game.)

(After some time, curtain removed)

Bear brother had one shell. He says: The real game was really harder. I only didn't hit one thing, that's why I got one shell as reward.

At the end of the story, Kermit would say: Bear brother got one shell as reward, I guess...

(59) xiong-gege meiyou zhuang-dao datong huozhe da-shitou  
bear-brother not-PERF hit-at barrel or big-stone  
'Bear brother didn't hit the barrel or the rock.'

The test sentence (59) has exactly the same surface form as (57) in that it is also a negated sentence with a disjunct object. As we discussed earlier and with (57), sentences like this in Chinese are ambiguous for adult speakers. Based on the context given in the story, sentence (59) is true on the  $(\neg Pa \vee \neg Pb)$  interpretation ('not this or not that'), because it is indeed true that bear brother didn't hit the barrel or he didn't hit the rock; and the sentence is false on the  $\neg(Pa \vee Pb)$  interpretation ('neither'), given it is not true that bear brother hit neither objects. Again, subjects are expected to accept sentence (59), if they access the  $(\neg Pa \vee \neg Pb)$  interpretation of (59) in the given context upon judging the sentence; on the other hand, we expect subjects to reject sentence (59), if they access the  $\neg(Pa \vee Pb)$  interpretation of (59) in the context.

If we expected subjects to access the  $(\neg Pa \vee \neg Pb)$  interpretation in the context given in this story, the situation corresponding to the alternative interpretation  $\neg(Pa \vee Pb)$  must be plausible in the story. The pre-game part was designed to for this. It set up the

expectation that bear brother was good at pushing cart around an obstacle, as contrasted with bear sister, and he thus might be able to avoid both obstacles in the real game (hitting neither obstacles, abstractly,  $[\neg(Pa \vee Pb)]$ ). In addition to this, before the real game started, the judge explicitly said bear brother was good at pushing cart and did really good in the pre-game. On the other hand, the judge also said the real game was much harder, so that it is also plausible for bear brother to make mistakes.

The rules for assigning rewards were explained by the judge, so that the hearer (Kermit and the subject) can infer from the reward about what happened even they would not be able to see, this was try to satisfy the pragmatic conditions associated with the  $(\neg Pa \vee \neg Pb)$  interpretation. In this story, if bear brother didn't hit one obstacle, he got one reward, and if bear brother hit neither obstacle, he got two rewards. Hence, the goal for bear brother was not to hit obstacles, which was negative (in the sense of 'not'). Therefore, given what we discussed in section 3.4, the direct inference from one reward would be that bear brother didn't hit something (abstractly, equivalent to  $(\neg Pa \vee \neg Pb)$ ), and the indirect inference would be that there was one obstacle bear brother hit (abstractly, equivalent to  $(Pa \vee Pb)$ ). This contrasts with the situation in the positive goal case and is the crucial different in the two conditions.

How bear brother actually did in the real game was then blocked by the curtain. As in the positive goal case, this targeted at further satisfying the pragmatic conditions of the  $(\neg Pa \vee \neg Pb)$  interpretation. At this time, the experimenter acting out the story would make the toys behind the curtain in such an arrangement so that bear brother had one shell; Kermit, at the other side of the curtain would express his anxiety about the outcome. The action verb in this story (and in other stories as well) was intentionally chosen, it does not refer to an obligatory change-of-state action. At least, the potential change of state caused by the relevant action was one that could be naturally invisible from the appearance of the object acted upon. This means, for example, something that got hit can remain its original appearance, but something that got eaten must disappear. The purpose

of choosing verbs like *zhuang* ‘hit’ in this story was to make sure the hearer could not see what actually happened from the actual outcome<sup>27</sup>, in an effort to satisfy the pragmatic conditions of the  $(\neg Pa \vee \neg Pb)$  interpretation.

After the curtain was removed, it became visible that bear brother got one shell as reward, but it was not visible which obstacle got hit. Bear brother’s explanation about the outcome, that he only didn’t hit one thing and thus got one reward, reinforced the association of the number of reward with the number of obstacles avoided. The use of ‘only’ (*zhi* in Chinese) in his explanation implies that something was hit. This, again, was designed to ease children’s mental work on making inference about what happened from the number of rewards. And Kermit indicated his awareness of the one shell bear brother got before he uttered the test sentence. As we discussed extensively earlier about the positive goal, Kermit’s utterance (an indication of the inference he made) could be right and could be wrong. Based on the judgment subjects made, we could see what interpretation of Neg...*huozhe* they accessed upon judging the test sentence.

The literal English translations of the test sentences used in the positive goal condition and the negative goal condition are listed in (60) and (61), respectively.

- (60) a. The worker didn’t fix the bike or the skateboard.  
b. Mouse didn’t feed the horse or the cow.  
c. The vet didn’t examine the cat or the dog.  
d. Rabbit didn’t water the rose or the sunflower.

- (61) a. Bear brother didn’t hit the barrel or the rock.  
b. Dog didn’t fall off the rack or the balance beam.  
c. The girl didn’t drop the shell or the jewel.  
d. Deer didn’t step on the mud or the branch.

The filler sentences used in both conditions were unambiguous negated sentences without

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<sup>27</sup> To illustrate this point clearer, let us compare the verb *hit* with *smash*. When something got hit, it could have some sign as the result of hitting, but it could also have no visible sign, so from the appearance alone, we do not necessarily see the result of hitting. On the other hand, when something got smashed, it must look smashed on the appearance, so its appearance tells us that an action of smashing acted upon it.

disjunction. A complete set of the filler sentences used in the two conditions are listed in (62) and (63), respectively.

- (62) a. Dad didn't give medicine to the baby.  
b. This girl didn't learn how to draw flowers.  
c. The short robot didn't fly over the spaceship.
- (63) a. Mom didn't finish the dinner.  
b. The gorilla didn't push the train.  
c. The little boy didn't lift the chair.

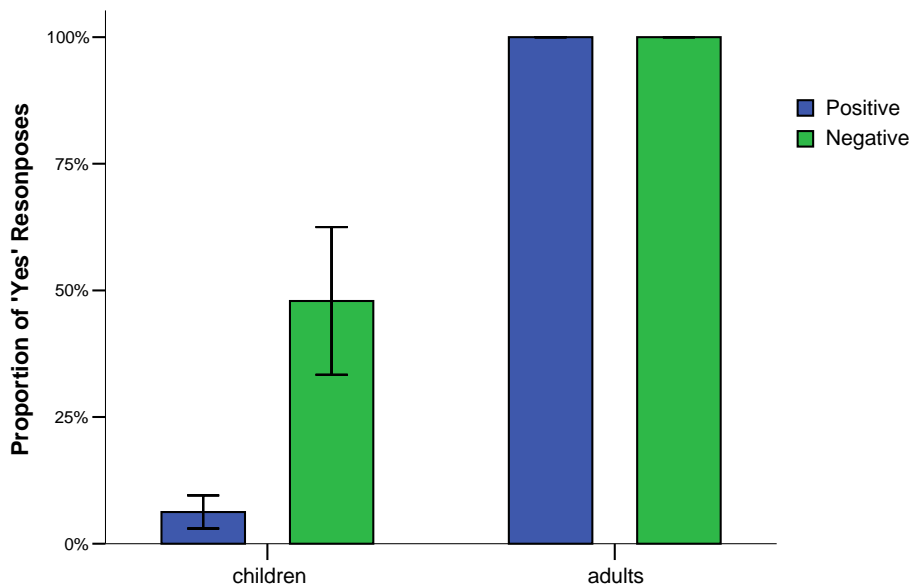
The filler stories were also in a similar setting as the target stories, in that the curtain was put down to block what actually happened, but something about what happened can be inferred from the outcome. In the experiment, we manipulated the filler stories so that these sentences were true sometimes and false sometimes, depending on the answers subjects provided for the target sentences. We tried to avoid the pattern that filler sentences were always of the same truth value and to get some variety in the truth values of all the sentences in a test session.

#### **4.1.2. Results**

In the analyses of the results following, the dependent variance is the proportion of 'yes' (*dui* in Chinese) responses to the test sentences (Kermit's utterances in the stories). The proportion of 'yes' responses were entered into an analysis of variance (ANOVA) with two factors. One factor is age, which was a between subject factor that had two levels (children vs. adults); the other factor was goal, which was a within subject factor that had two levels (positive goal vs. negative goal) as well. The analysis revealed a significant main effect of age ( $F(1, 22) = 86.9, p < .0001$ ), a significant main effect of goal ( $F(1, 22) = 8.59, p < .01$ ) and a significant interaction between age and goal ( $F(1, 22) = 8.59, p < .01$ ). We then conducted planned comparisons to determine the nature of the interaction of the two factors.

In the positive goal condition, we found out that children only accepted the test sentences 6% of the time, while adults uniformly accepted the test sentences 100% of the time ( $t(11) = -28.72, P < .0001$ ). However, in the negative goal conditions, children accepted the test sentences significantly more than in the positive goal condition, namely, 48% of the time<sup>28</sup> (compare to 6% of the time in the positive goal condition,  $t(11) = -2.93, P < .05$ ), and adults also accepted the test sentences 100% of the time (compared with 48% of the time for children,  $t(11) = -3.57, p < .005$ ). See the graph in (66).

(64)

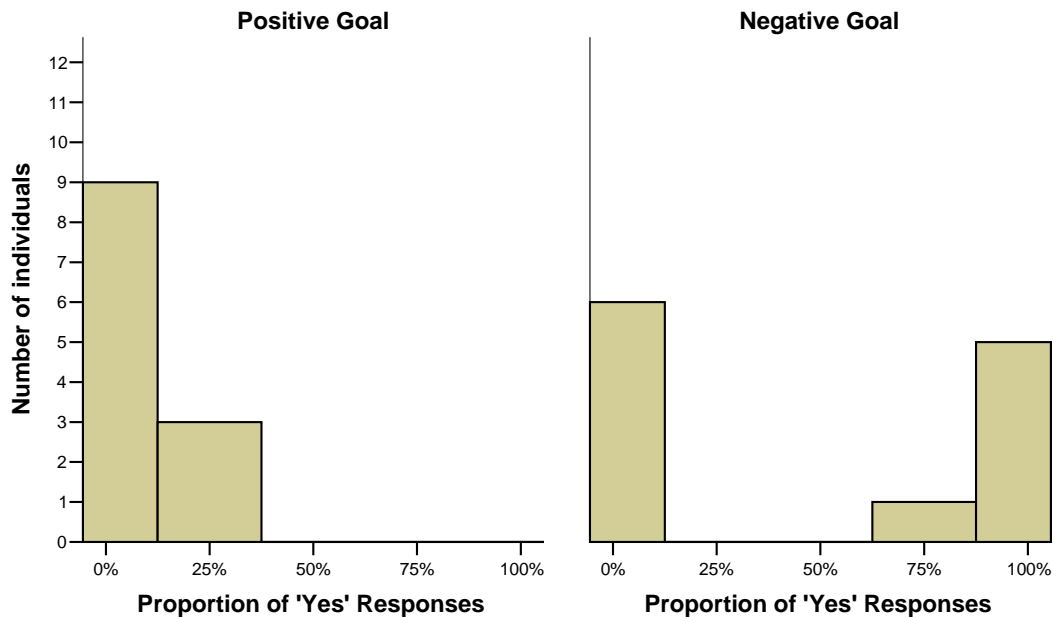


Proportion of 'yes' responses to test sentences containing Neg...*huozhe* for children and adults in both conditions

While children's responses in the positive goal condition were uniform, their responses in the negative goal condition showed a bi-modal distribution, see the histograms in (67), which illustrates the distribution of the individual responses in the two conditions.

<sup>28</sup> Among the twelve children subjects, six children accepted the test sentences relatively consistently (in fact, five accepted all the four test sentences; and one accepted three out of the four test sentences), the other six children never accepted the test sentences.

(65)



Distribution of children's individual proportion of 'yes' responses to test sentence containing Neg...*huozhe* in both conditions

In the positive goal condition, all children rejected the test sentences (94% of the time) and justified their rejection by saying something like 'the worker fixed one thing' or 'there is one flag on the door'. All adults accepted the test sentences and justified their response by saying something like 'the worker didn't fix one thing'. In the negative goal condition, all adults accepted the test sentences and typically said 'bear brother didn't hit one thing' as justification. In this condition, half of the children accepted the test sentences, when they were asked for example what one shell meant, they generally said it meant 'bear brother didn't hit one thing'. The other half of the children rejected the test sentences and justified the rejection by pointing out that bear brother only got one shell as reward and he hit one of the two things.

#### 4.1.3. Discussion

First, the results in this experiment showed that Chinese children's responses to simple

negated sentences with a disjunct object were significantly different from adults in both of the test conditions. While adults in both conditions consistently accepted the test sentences, children almost never accepted the test sentences in the positive goal condition, i.e., 6% of the time (compared with adults at 100% of the time,  $p < .0001$ ), and accepted the test sentences in the negative goal condition only 48% of the time (compared with adults at 100% of the time,  $p < .005$ ). This tells us that Chinese adults easily accessed the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huozhe* in the contexts set up by test stories, namely, the contexts in both conditions are conducive enough for them to access the  $(\neg Pa \vee \neg Pb)$  interpretation and made judgment based on this interpretation of the test sentences; whereas children generally accessed the  $\neg(Pa \vee Pb)$  interpretation of Neg...*huozhe* more easily and judged the test sentences based on this interpretation, namely, the contexts set up by the test stories are not conducive enough for all the children to access the  $(\neg Pa \vee \neg Pb)$  interpretation of the test sentences and make judgment based on this interpretation. This part of what the experiment showed proves that Chinese children prefer the  $\neg(Pa \vee Pb)$  interpretation of Neg...*huozhe* in general, even in contexts where Chinese adults prefer the alternative interpretation.

For adults, stories in both conditions in the experiment were poor contexts to use Neg...*huozhe* meaning  $\neg(Pa \vee Pb)$ , because for them the presupposition associated with this ‘neither’ interpretation of Neg...*huozhe* was not satisfied. They then would presumably reason that the speaker should have used an unambiguous, more natural and presupposition-neutral expression Neg...*he* in Chinese if he intended ‘neither’. Given this, adults were expected to have no problem accessing the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huozhe* in both conditions. But for children, the  $\neg(Pa \vee Pb)$  interpretation of Neg...*huozhe* is presupposition-neutral, hence, Neg...*huozhe* is probably completely interchangeable with Neg...*he* for them on the ‘neither’ interpretation. Then the use of Neg...*huozhe* in an appropriate context for the  $(\neg Pa \vee \neg Pb)$  interpretation would not be one incompatible with the  $\neg(Pa \vee Pb)$  interpretation for children. And, assuming children

are not at the following pragmatic principles to avoid the use of potentially ambiguous expressions due to their lack of complex pragmatic knowledge, we did not expect children in this experiment to behave the same way as adults.

In addition to what we just discussed, more importantly, our experiment discovered a significant difference of children's interpretation of Neg...*huozhe* in the positive goal condition vs. in the negative goal conditions. The average proportion of children's 'yes' responses to test sentences in the negative goal conditions was 48%, significantly higher than in the positive goal condition, i.e., 6% ( $p < .05$ ). It was clear in the experiment that children said 'yes' to the test sentences not because they were unclear about what happened, on the contrary, they could give appropriate justification for their answer. So, children's 'yes' responses should be a valid indication of them successfully accessing the  $\neg(Pa \vee Pb)$  interpretation of Neg...*huozhe*. Furthermore, the 48% was the result of the consistent acceptance of the test sentences from six of the twelve children<sup>29</sup>. This means, for half of the children in the experiment, a negative goal in the presupposition set up a reliable context for them to more easily access the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huozhe* and make judgment about sentences accordingly. Remember, the negative goal condition made the direct inference from one reward the  $(\neg Pa \vee \neg Pb)$  situation. These children's contrastive acceptance rates in the two conditions suggested that the alignment of the direct inference with the target interpretation helped them in accessing the target interpretation.

The details of how these children deactivate the default interpretation of Neg...*huozhe* and judged the test sentences based on the  $(\neg Pa \vee \neg Pb)$  interpretation remain a topic that needs more careful research<sup>30</sup>. But crucially, by showing that half of Chinese children in our experiment could access the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huozhe* in certain context, we doubt about the claim that Chinese children simply

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<sup>29</sup> There was no observed difference in age, gender or sequence of the conditions presented to them in these children from the other half of the children.

<sup>30</sup> See section 6.2 for some suggestion.

do not have this interpretation in their grammar. Although the half of the children in this experiment did not accept the test sentences, as we discussed earlier, this should not be taken as evidence for the claim that children lack the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huozhe* whatsoever, because it could be the case that we were not able to reveal their grammar with the current experiment. Theoretically, there are two possibilities for the behavior of the children who did not access the  $(\neg Pa \vee \neg Pb)$  interpretation in the experiment: one, these children lack that interpretation; and the other, these children have difficulty accessing that interpretation, as a consequence of their pragmatic immaturity. This paper will not be able to answer this question. Our speculation is that they have the interpretation in their grammar, as the other half of the children do, but they are insensitive to the specific pragmatic facilitation for this interpretation in the experiment. We are inclined to accept the proposal that Chinese children innately have both the  $(\neg Pa \vee \neg Pb)$  interpretation and the  $\neg(Pa \vee Pb)$  interpretation of Neg...*huozhe* in their grammar; but they strongly prefer the  $\neg(Pa \vee Pb)$  interpretation as the default and presupposition-neutral interpretation, hence the pragmatically and cognitively harder interpretation  $(\neg Pa \vee \neg Pb)$  becomes dormant and can only be accessed in special circumstances. One of the circumstances that could potentially help reveal the  $(\neg Pa \vee \neg Pb)$  interpretation in children's grammar, as shown by the results of this experiment, is that the presupposition naturally has negative disjunct propositions, but children also differ in how they are sensitive to this facilitation.

The different behaviors of Chinese children and adults in interpreting Neg...*huozhe* raise the question how Chinese children become a competent Chinese speaker in this respect. We believe Chinese children will be able to access the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huozhe* more easily as their cognitive capacity and pragmatic knowledge grow. This growth and the easier access of the alternative interpretation will also make it possible for children to reconsider the default status of the  $\neg(Pa \vee Pb)$  interpretation of Neg...*huozhe*, when they are able to put this interpretation in

comparison with the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huozhe* and the  $\neg(Pa \vee Pb)$  interpretation of Neg...*he*. What remains the same in children on the way to a competent speaker is the grammar of interpreting Neg...*huozhe*.

## 4.2. Experiment II

Our second experiment was a control experiment for experiment I and examined children's interpretation of simple sentences with two negated VP disjuncts (Neg...*huozhe*...Neg), which are unambiguously interpreted as  $(\neg P \vee \neg Q)$  for Chinese adults. The grammar of such sentences in Chinese does not allow any other interpretative option. But because of the specific pragmatic conditions and cognitive requirements associated with the  $(\neg P \vee \neg Q)$  meaning<sup>31</sup> in general, as we discussed in details in section 3, these sentence might be hard for children. So we wonder whether Chinese children behave the same way as adults in interpreting sentences of this form. As in experiment I, this experiment had two factors, age (children vs. adults) and goal (positive vs. negative).

### 4.2.1. Method

#### *Subjects*

We interviewed twelve monolingual Chinese speaking children (seven boys and five girls), who attended the same daycare center as children in experiment I. These children ranged from 3;11 to 4;8 of age, and the mean age was 4;4. Twelve Chinese speaking adults were also tested. One other child was tested but then eliminated from the experiment because she always said 'yes' but could not justify any of her judgments.

#### *Procedure*

This experiment followed exactly the same procedure of experiment I.

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<sup>31</sup>  $(\neg P \vee \neg Q)$  and  $(\neg Pa \vee \neg Pb)$  are just notional differences in this paper, they both represent disjunction of two negative propositions.  $(\neg Pa \vee \neg Pb)$  can be considered as a special case of  $(\neg P \vee \neg Q)$ , in that both propositions in former share something in common. In fact, the test sentences in this experiment are all of the  $(\neg Pa \vee \neg Pb)$  case.

### *Material*

All the stories in this experiment were exactly the same as in experiment I. Therefore, the pragmatic conditions associated with the  $(\neg P \vee \neg Q)$  interpretation were met in the test stories in this experiment, and the plausible dissent was also satisfied.

The filler sentences were also the same as in experiment I. But the test sentences in this experiment involved sentences with two negated disjunct VPs. One sample test sentence in the positive goal condition is given in (66), and one in the negative goal condition is given in (67)

(66) gongren meiyou xiu-hao    zixingche huozhe meiyou xiu-hao    huabanche  
worker not-PERF fix-ready bike    or    not-PERF fix-ready skateboard  
'The worker didn't fix the bike or didn't fix the skateboard.'

(67) xiong-gege meiyou zhuang-dao datong huozhe meiyou zhuang-dao da-shitou  
bear-brother not-PERF hit-at    barrel    or    not-PERF hit-at    big-stone  
'Bear brother didn't hit the barrel or didn't hit the rock.'

The complete sets of test sentences used in the positive goal and negative goal condition are given in their literal translations in English in (68) and (69), respectively.

(68) a. The worker didn't fix the bike or didn't fix the skateboard.  
b. Mouse didn't feed the horse or didn't feed the cow.  
c. The vet didn't examine the cat or didn't examine the dog.  
d. Rabbit didn't water the rose or didn't water the sunflower.

(69) a. Bear brother didn't hit the barrel or didn't hit the rock.  
b. Dog didn't fall off the rack or didn't fall off the balance beam.  
c. The girl didn't drop the shell or didn't drop the jewel.  
d. Deer didn't step on the mud or didn't step on the branch.

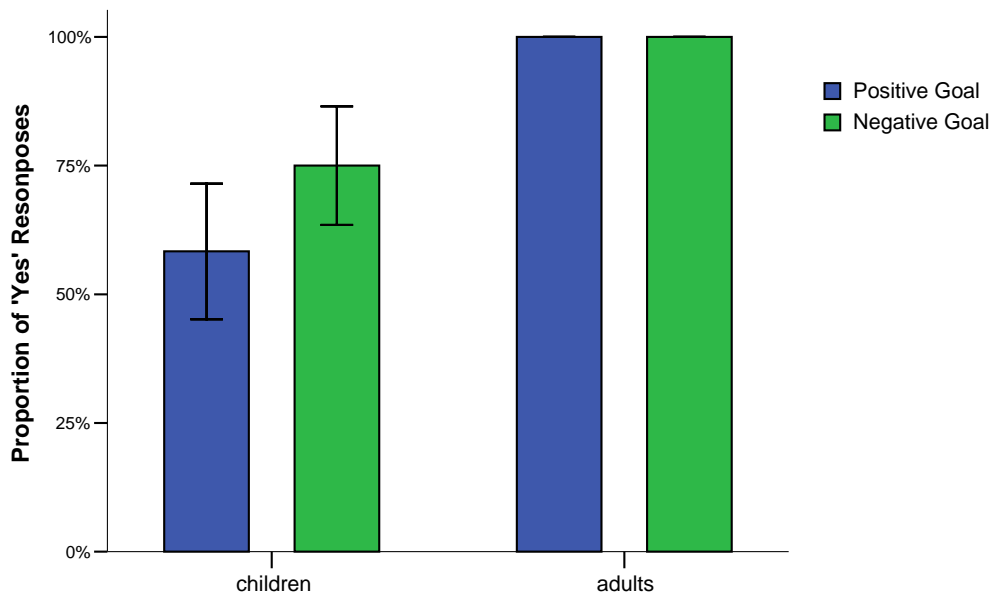
### **4.2.2. Results**

The results of this experiment are analyzed in a similar way as the results of experiment I.

The dependent variance is the proportion of ‘yes’ responses to the test sentences. The proportion of ‘yes’ responses were entered into 2 (children vs. adults) × 2 (positive goal vs. negation goal) analysis of variance (ANOVA). As in experiment I, age factor was a between subject factor, and the goal factor was a within subject factor. The analysis revealed a significant main effect of age ( $F(1, 22) = 8.64, p < .001$ ), a non-significant main effect of goal ( $F(1,22) = 2.84, p > .1$ ) and a non-significant interaction between age and goal ( $F(1,22) = 2.84, p > .1$ ).

In the positive goal condition, adults accepted the test sentences 100% of the time, whereas children only accepted the test sentence 58% of the time ( $t(11) = -3.16, p < .01$ ). In the negative goal conditions, children accepted the test sentence slightly but not significantly more than in the positive goal condition, i.e., 75% of the time (compared with 58% of the time,  $t(11) = -1.68, p > .1$ ), while adults accepted the test sentences 100% of the time ( $t(11) = -2.17, p = .05$ ). See the graph in (70).

(70)

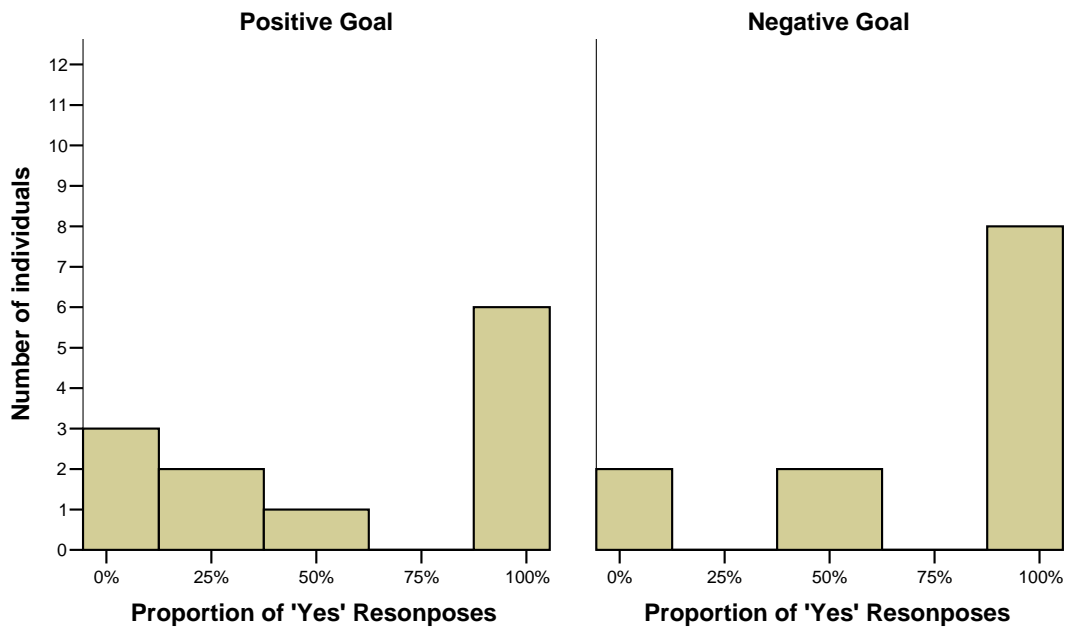


Proportion of ‘yes’ responses to test sentences containing Neg...*huozhe*...Neg for children and adults in both conditions

We found some individual differences on the responses to the test sentences in children.

Specifically, in the positive goal condition, half of the children consistently accepted the test sentences, while the other half accepted the test sentences at most 50% of the time (three children consistently rejected the test sentences). In the negative goal conditions, eight out of twelve children consistently accepted the test sentences, and the other four children accepted the test sentences at most 50% of the time. Therefore, the distribution of proportion of ‘yes’ responses in children in both conditions was bi-modal. See the histograms in (73).

(71)



Distribution of children’s individual proportion of ‘yes’ responses to test sentence containing Neg...*huozhe*...Neg in both conditions

In this experiment, both children and adults justified their responses to the test sentences appropriately by giving relevant explanations similar to what we discussed in section 4.1.2.

#### 4.2.3. Discussion

A simple sentence with two negated VP disjuncts (Neg...*huozhe*...Neg) in Chinese can

only be interpreted as  $(\neg P \vee \neg Q)$ , and what could be inferred from the stories in this experiment thus matched this interpretation. Therefore, adults' acceptance of the test sentences 100% of the time is expected. However, children in this experiment did not accept the test sentences uniformly, as adults did. Some of them rejected the test sentences at least 50% of the time, and the total acceptance rate of the test sentences across children was 58% in the positive condition and 75% in the negative condition. In case when they rejected the test sentence, children justified their answer by contrasting what could be inferred from the stories with the  $\neg(Pa \vee Pb)$  interpretation. This is not expected.

Remember, when we discussed the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huozhe*, some of the pragmatic conditions and cognitive requirements associated with this interpretation have little to do with the form. For example, the hearer of a sentence on this meaning must be able to make direct and indirect inference from the outcome about what happened in order to compare the meaning with situation and then judge the sentence. Therefore, it might be possible that the  $(\neg P \vee \neg Q)$  interpretation per se is potentially hard for children. When this interpretation is connected with more complications, like ambiguity of the relevant sentence, the task will become more demanding. The experiment results in this experiment suggested that some children had difficulties with the  $(\neg P \vee \neg Q)$  interpretation even in unambiguous sentence.

But these children did not behave like they were confused. Instead, they answered the judgment question confidently and gave a justification showing that they actually comparing the  $\neg(Pa \vee Pb)$  interpretation with what can be inferred. The mechanism of how Chinese children interpreted Neg...*huozhe*...Neg as  $\neg(Pa \vee Pb)$  is a mystery to us. The  $(\neg P \vee \neg Q)$  interpretation does include the inclusive meaning, namely when both  $\neg P$  and  $\neg Q$  hold in the actual situation, logically equivalent to  $\neg(Pa \vee Pb)$ . But the inclusive meaning cannot be independent of the  $(\neg P \vee \neg Q)$ . Therefore, if children who rejected the test sentences accessed the inclusive meaning, they should have already accessed the  $(\neg P$

$\vee \neg Q$ ) interpretation and could have judged the sentence accordingly. So, the inclusive meaning of  $(\neg P \vee \neg Q)$  does not seem to explain children's interpretation of Neg...*huozhe*...Neg as  $\neg(P \vee Q)$ .

We have some speculation about what might be happening with children, which requires independent justification. When presented with a sentence in the form of Neg...*huozhe*...Neg as a string of words, Chinese children will hear Neg...*huozhe* first. As this time, they already have a valid string to start interpreting, so, they are somehow garden-pathed. If they do not pay attention to the second negation, they will not be recovered from the garden path and thus mis-parse the Neg...*huozhe*...Neg construction as a simpler construction Neg...*huozhe*. Given the findings in Jing, Hsu & Crain (2005) and in experiment I, children prefer the 'neither' interpretation of Neg...*huozhe* generally. Consequently, the children who mis-parsed the test sentences in this experiment would more likely to access the  $\neg(P \vee Q)$  interpretation.

### 4.3. Experiment III

The last experiment in this series of experimental studies in Chinese was another control experiment for experiment I and tested children's interpretation of simple negated sentences with a conjunct object (Neg...*he*), which are unambiguously interpreted as  $(\neg P \wedge \neg Q)$  (logically equivalent to  $\neg(Pa \wedge Pb)$ ) for Chinese adults. As we discussed in detail in section 2 and section 3, this interpretation of Neg...*he* is both obligatory and natural, and it is not necessarily associated with special presupposition. Therefore, the occurrence of the Neg...*he* should be frequent in children's PLD environment. We expected children to have an adult way of interpretation in this experiment. To align this experiment with the two other experiments, we also tested children and adults in both the positive goal condition and the negative goal condition.

#### 4.3.1. Method

### ***Subjects***

The twelve monolingual Chinese speaking (seven boys and five girls) children participating in this experiment attended the same daycare center as children in the other two experiments. Their mean age was 4;3 (from 3;8 to 4;8). One other child was initially tested, he but refused to give any answer, therefore, we had to eliminate him from the test session. We also interviewed twelve Chinese speaking adults.

### ***Procedure***

This experiment followed exactly the same procedure of experiment I and experiment II.

### ***Material***

All the test stories, filler stories and filler sentences in this experiment were the same as in the other two experiments. But the test sentences in this experiment were simple negated sentence with a conjunct object. One sample test sentence in the positive goal condition is given in (72), and one in the negative goal condition is given in (73)

(72) gongren meiyou xiu-hao zixingche he huabanche  
worker not-PERF fix-ready bike and skateboard  
Lit. 'The worker didn't fix the bike and the skateboard.'

(73) xiong-gege meiyou zhuang-dao datong he da-shitou  
bear-brother not-PERF hit-at barrel and big-stone  
Lit. 'Bear brother didn't hit the barrel and the rock.'

(74) and (75) list the literal English translations of the test sentences used in the positive goal and negative goal condition, respectively.

- (74)a. The worker didn't fix the bike and the skateboard.
- b. Mouse didn't feed the horse and the cow.
- c. The vet didn't examine the cat and the dog.
- d. Rabbit didn't water the rose and the sunflower.

- (75) a. Bear brother didn't hit the barrel and the rock.  
 b. Dog didn't fall off the rack and the balance beam.  
 c. The girl didn't drop the shell and the jewel.  
 d. Deer didn't step on the mud and the branch.

As we discussed in section 4.1.1, the way test stories was designed made both the situation corresponding to  $(\neg P \vee \neg Q)$  and the situation corresponding to  $\neg(Pa \vee Pb)$  (logically equivalent to  $(\neg P \wedge \neg Q)$ ) plausible in the process. The actual outcome would falsify a sentence with the  $\neg(Pa \vee Pb)$  interpretation (equivalent to the  $(\neg P \wedge \neg Q)$  interpretation, which we were concerned in this experiment). Therefore, it was appropriate to use the test sentences in this experiment in the test stories.

#### 4.3.2. Results and Discussion

All the children and adults rejected the test sentences in this experiment 100% of the time, showing that they access the  $(\neg P \wedge \neg Q)$  interpretation (equivalent to  $\neg(P \vee Q)$ , 'neither') of Neg...*he*. No further statistical analysis was done with the results.

As discussed in earlier sections, Neg...*he* is the natural way to convey a 'neither' meaning in Chinese and in general neutral on presupposition (contrasted with the 'neither' interpretation of Neg...*huozhe* and the 'not this or not that' interpretation of Neg...*huozhe*). Presumably, the occurrence of Neg...*he* in the PLD environment for Chinese children is not rare. We did not expect children to have difficulties in this experiment.

However, we must be aware that this obligatory interpretation of the construction Neg...Conjunction for Chinese adults is the result of some special property of the lexical item *he* (the same for *mo...mo...* in Japanese) that blocks the alternative interpretive option. Theoretically, a language should allow both interpretive options, if no such property or others block one option. As we argued in section 3, English is such a language. If we draw an analogy with our proposal about children's initial knowledge about

Neg...Disjunction, we should further propose here that children initially have both interpretive options of Neg...Conjunction available. Because of the subset-superset of the two interpretations of Neg...Conjunction, and the different degree of pragmatic conditions associated with the two interpretations, we should expect children's initial preference in interpreting Neg...Conjunction to be the  $(\neg P \wedge \neg Q)$  interpretation. If this were the case, this experiment would be really parallel to experiment I for children. Nonetheless, we see different results in this experiment and in experiment I. Specifically, while half of the children in experiment I accessed the 'not this or not that' interpretation of Neg...*huozhe*, no children in this experiment accessed this interpretation of Neg...*he*, that is potentially available to children.

Here is one possible way to explain this fact. Children could figure out the PPI status of conjunction coordinator earlier than the PPI status of disjunction coordinator. This may be right, since the +PPI property of conjunction coordinator will prohibit a superset interpretation ('not this or not that'), while the +PPI property of disjunction coordinator will prohibit a subset interpretation ('neither'). It is theoretically easier for children to generalize that certain construction is never associated with superset interpretation than to figure out that certain construction is never used in a subset interpretation circumstance. But whether this is plausible in real learning scenario is unknown.

Alternatively, it may be possible that UG specify the interpretation of Neg...Conjunction differently from the interpretation of Neg...Disjunction, in that the initial state of the interpretation of Neg...Conjunction is more restricted, in a Japanese/Chinese setting. If this were the case, we would not expect any children to access the  $\neg(Pa \wedge Pb)$  interpretation (logically equivalent to  $(\neg Pa \vee \neg Pb)$ ) of Neg...conjunction. This differentiation presumably needs better motivation.

#### 4.4. General Discussion

The three experiments we reported here targeted at testing Chinese children and adult's interpretation of potentially ambiguous sentences (Neg...*huozhe*) with two logically related interpretations and unambiguous sentences with either of the two interpretations (Neg...*huozhe*...Neg, Neg...*he*) in the exact same contexts. Across the experiments, we determined that children behave more like adults in the experiments with unambiguous test sentences. The  $\neg(Pa \vee Pb)$  interpretation in unambiguous sentences seemed to be the clearest case where children had exactly same responses as adults (experiment III); the  $(\neg Pa \vee \neg Pb)$  interpretation, which is associated with specific pragmatic conditions and relatively high requirement on the cognitive capacity, was generally difficulty for children, but this interpretation seemed to be easier to access in unambiguous test sentences than in potentially ambiguous sentences in Chinese (experiment II). For ambiguous test sentences, the manipulation of the discourse context seemed to have an effect on the interpretations children accessed (experiment I). In the positive goal condition, where the  $(\neg Pa \vee \neg Pb)$  meaning corresponded to indirect inference (as discussed in section 3.4), children consistently preferred the alternative  $\neg(Pa \vee Pb)$  interpretation. In the negative goal condition, in contrast, the  $(\neg Pa \vee \neg Pb)$  meaning corresponded to direct inference, children were found to access the  $(\neg Pa \vee \neg Pb)$  interpretation significantly more.

Given the occurrence of Neg...*huozhe* in simple sentences in Chinese and adults' interpretation of Neg...*huozhe*, it is unlikely that children's interpretation of Neg...*huozhe* is directly tied to the input. We proposed in section 3 that universal grammar may allow both interpretive options of Neg...Disjunction as the initial knowledge children across different languages have, furthermore, due to the inherent complexity the  $(\neg Pa \vee \neg Pb)$  interpretation involves, children initially should prefer the  $\neg(Pa \vee Pb)$  interpretation. The results in our experiment I are consistent with this proposal.

Our next goal is to test children and adults in other languages, specifically in English, and see whether English children have similar knowledge about the

interpretation of Neg...Disjunction as Chinese children and whether that matches what English adults know. This will be the topic of next section.

## 5. Experiments in English

In this section we will present two experiments we conducted with English-speaking children and adults that examined their interpretation of sentences containing negation and disjunction.

### 5.1. Experiment IV

This experiment in English was essentially a replicate of experiment I in Chinese. Our goal is to find out whether English children prefer the  $\neg(Pa \vee Pb)$  of Neg...Disjunct, as Chinese children did, whether English adults and children can access the  $(\neg Pa \vee \neg Pb)$  interpretation, whether different contexts made a difference in English speakers' interpretation of Neg...*or*. As in all the Chinese experiments reported in section 4, this experiment here has two conditions, a positive goal condition and negative goal condition.

#### 5.1.1. Method

##### *Subjects*

Twelve English speaking children (eight boys and four girls) aged from 4;4 to 5;0 (mean age was 4;8) participated in this experiment. One other child failed the screening session and was thus not included in the experiment session. The children we tested all attended the Center for Young Children of the University of Maryland at College Park.

We also tested twelve English-speaking adults. One additional adult participated the whole experiment, but he judged 3 out of 6 of the fillers across the two conditions incorrectly (fillers were no way ambiguous), his data was not included in the analysis. Adult subjects in this experiment were all undergraduate students at the University of Maryland at College Park

##### *Procedure*

This experiment adopted the same procedure as experiment I in testing children. But unlike experiment I, in this experiment, adult subjects were shown videotaped versions of all the stories that were presented to the children, individually in a quiet experiment room. They were instructed to indicate their judgment about each of Kermit's utterance on a score sheet.

### ***Materials***

The test stories and test sentences in this experiment were almost identical with experiment I, except that the stories and test sentences were presented in English here and Chinese there. Unlike the Chinese direct translation though, a negated sentence with a disjunct object has a default 'neither' interpretation for adults speakers, which is also the natural way to express the 'neither' meaning. The test sentences were all of this form, such as *the worker didn't fix the bike or the skateboard*. Although the form of the sentences in English is the same as the form of the direct translation sentences in Chinese, given language specific differences, the interpretation of the sentences in various contexts may vary. See (68) and (69) for complete sets of test sentences used in this experiment.

We improved the filler stories and the filler sentences in this experiment in that we made them closely resemble the test stories and test sentences. The filler sentences were simple positive sentences with a disjunct object and thus were interpreted unambiguously as  $(Pa \vee Pb)$ , this was minimally different in form and meaning from the test sentences. The filler stories were also designed to be either a positive goal condition story or a negative goal condition story. Positive goal filler stories were mixed with positive goal test sentences; and negative goal filler stories was mixed with negative goal test sentences. The experimenter acting out the stories would manipulate the outcome of the filler stories so that the truth values of the filler sentences were dependent on subjects' responses to the test sentences, specifically, the truth values of most filler sentences were made

opposite of those of most the test sentences as determined by individual subjects.<sup>32</sup>

The fillers sentences we used in the positive goal condition and the negative goal condition are listed in (76) and (77), respectively

- (76) a. The girl lifted up the chair or the stool.  
b. Mom cooked the soup or the dish.  
c. The tall alien flew over the TV or the computer.

- (77) a. Blue hopped on the broom or the brush.  
b. The boy threw the ball on the cactus or the tree.  
c. Pokemon slipped on the cup or the bucket.

### 5.1.2. Results

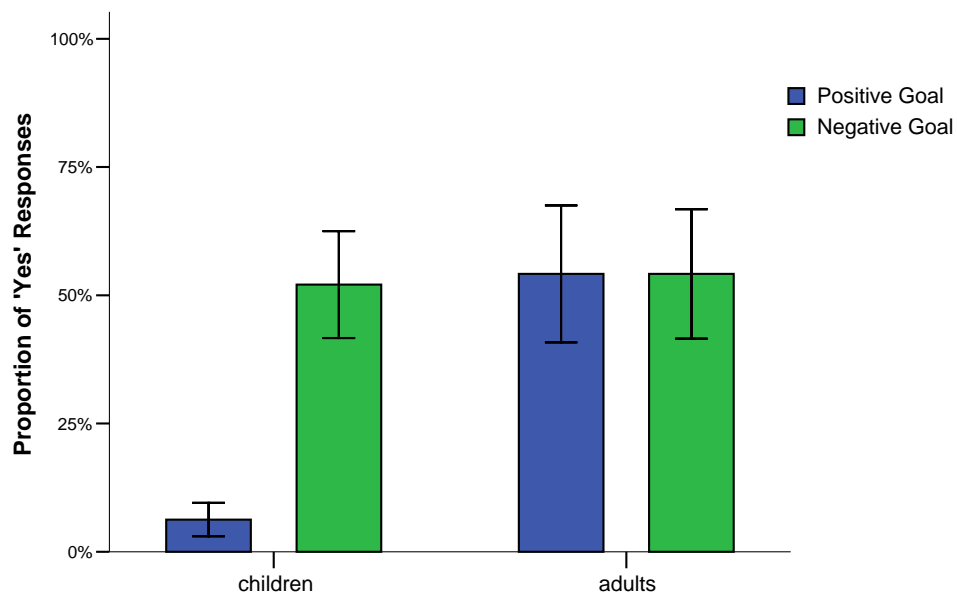
The dependent variable in the analysis below is the proportion of ‘yes’ responses to the test sentences, as in all the Chinese experiments reported in section 4. The proportion of ‘yes’ responses to the test sentences were entered into a 2 (children vs. adults) × 2 (positive goal vs. negative goal) ANOVA. As in the experiments in Chinese, the age factor was a between subject factor, and the goal factor was a within subject factor. The analysis revealed a non-significant main effect of age ( $F(1,22) = 3.08, p > .05$ ), a significant main effect of goal ( $F(1,22) = 20.48, p < .0001$ ), and a significant interaction between age and goal ( $F(1,22) = 20.48, p < .0001$ ).

In the positive goal condition, children almost never accepted the test sentences, i.e., 6% of the time, contrasting with adults, who accepted the test sentences 54% of the time ( $t(11) = -3.53, p < .05$ ). In the negative goal condition, children accepted the test sentences significantly more, i.e., 52% of the time (compared with 6% in the positive goal condition,  $t(11) = -5.01, p < .005$ ), while adults didn’t accepted the test sentence significantly more than children, i.e., 54% of the time ( $t(11) = -0.14, p > .5$ ). See the graph in (78).

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<sup>32</sup> In the videotaped versions of the experiment, we could not predict adults’ response for each test sentence. We made one filler sentence in either condition true and the other two filler sentences

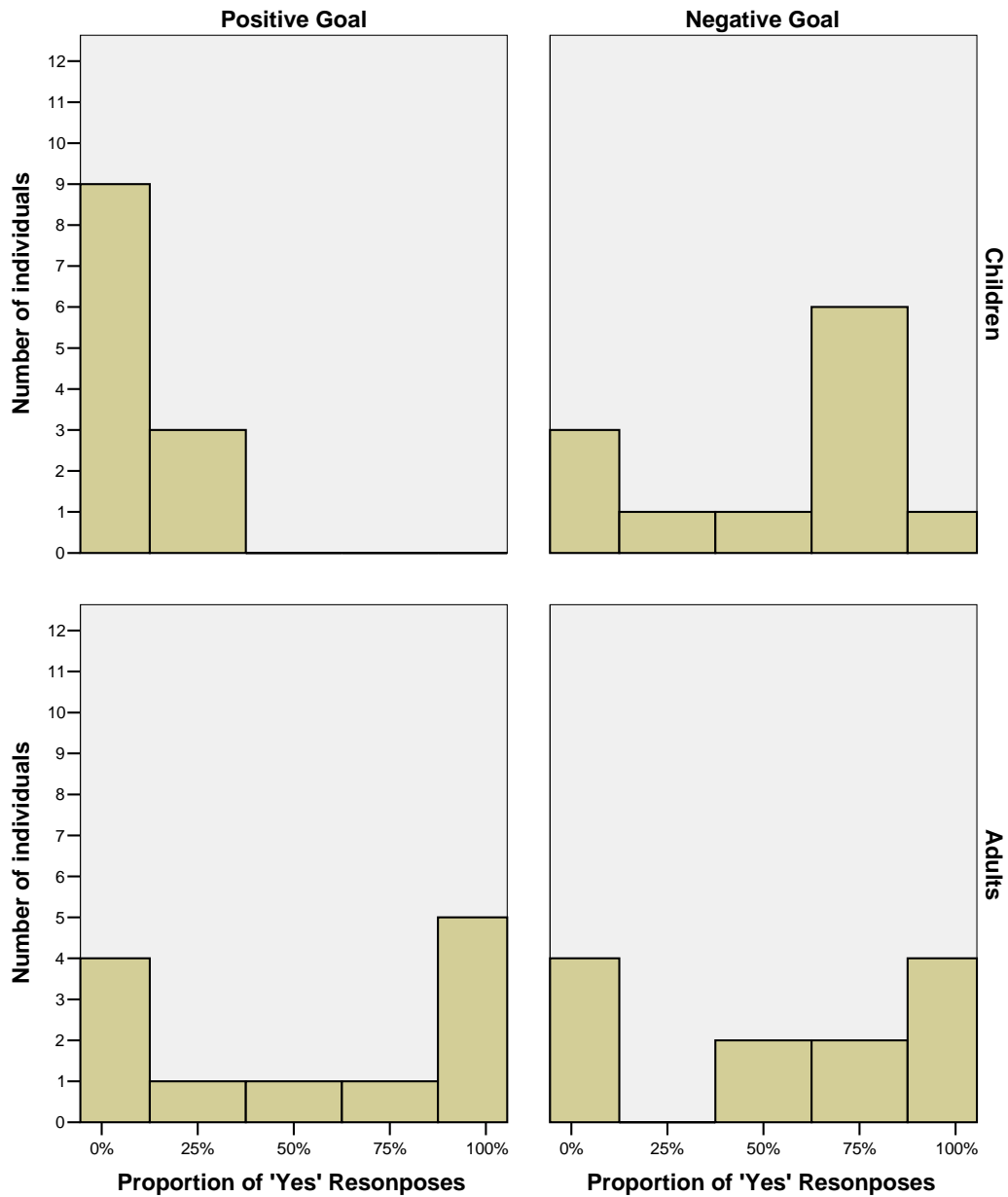
(78)



Proportion of 'yes' responses to test sentences containing Neg...or for children and adults in both conditions

In addition, we find great individual variability in the proportion of their 'yes' responses to the test sentences for children in the negative goal condition and adults in both conditions, in these three cases, the distribution was bi-modal. The distribution of the variations in each case was plotted in (79).

(79)



Distribution of individual proportion of 'yes' responses to test sentence containing Neg...or for children and adults in both conditions

No matter whether children accepted the test sentences or rejected the test sentences, they normally justified their responses appropriately. Two things we noticed in the experiment about children's responses were especially interesting. One is that several children

sometimes responded to the test sentences with a question: Which one? These children eventually accepted the test sentences. The other interesting point we found out was that some children justified their acceptance by explicitly using the target construction *Neg...or*.

### 5.1.3. Discussion

The results of this experiment showed that English children behaved differently in interpreting *Neg...or* in the positive goal condition than adults (accepting the test sentences 6% of the time vs. 54% of the time,  $p < .05$ ). In this condition, children overwhelmingly preferred the  $\neg(Pa \vee Pb)$  interpretation of *Neg...or*, while half of the adults based their judgment on the  $(\neg Pa \vee \neg Pb)$  interpretation of *Neg...or*. In the negative condition, children's acceptance greatly improved to 52% of the time, almost identical to adults' acceptance pattern in this condition – still half of the adults accepted the test sentences. If we look at individual data, we found the half of the adults accepting the test sentences in the positive goal conditions and the half accepting the test sentences in the negative goal condition mostly overlap. This means the pragmatic differences in the test stories in the two conditions did not make a difference in English adults' interpretation of *Neg...or*. The positive goal condition was conducive enough for half of the adults, while the negative goal condition was not conducive enough for the others. On the other hand, the negative goal in the test stories that aligned the direct inference from a reward to the  $(\neg Pa \vee \neg Pb)$  situation helped half of the children judged the test sentences on the  $(\neg Pa \vee \neg Pb)$  interpretation, while they preferred the alternative interpretation  $\neg(Pa \vee Pb)$  in the positive goal condition.

Here, adults should be immune to the pragmatic immaturity problem children have, so the fact that half of the English adult subjects did not base their judgment on the  $(\neg Pa \vee \neg Pb)$  interpretation cannot be attributed to their problem with pragmatics. Recall, Chinese adults in experiment I uniformly accepted the test sentences. In Chinese, the

‘neither’ interpretation is not the preferred interpretation of Neg...*huozhe* for Chinese speakers; and the contexts in the experiments were poor contexts for that interpretation, but good contexts for the alternative ‘not this or not that’ interpretation. Therefore, Chinese adult subjects were expected to choose the context-favorable interpretation and accept the test sentences. For English adults, as Neg...*or* has the default interpretation of  $\neg(Pa \vee Pb)$ , which is presupposition-neutral, adults prefer this interpretation of Neg...*or* over the alternative interpretation in general. But the degree to which they are willing to give up this interpretation for the alternative interpretation may differ. In the specific test situation in our experiment (TVJT), unlike in a conversation situation, Kermit, who uttered the target sentences, could say something wrong. So, subjects’ interpretation of the test sentence was thus not necessarily based on the assumption that the sentence is a truthful statement (inference) about what happened. Subjects could arrive at an interpretation of the test sentence they generally prefer that falsifies the sentence in the context given. Hence, here the setting of the TVJT actually made both interpretations compatible with the same context, with one interpretation making the test sentence true and the other interpretation falsifies it. Adult subjects who were more ready to give up their general preference in interpreting Neg...*or* as the context changed, would be more willing to accept the test sentences as a truthful based on the alternative interpretation. Subjects who strongly preferred the ‘neither’ interpretation might have made their judgment based on this interpretation and refused to accept the test sentences. The speaker variation we found here about the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*or* could presumably be accounted for by the potential different degrees of their preference for the  $\neg(Pa \vee Pb)$  interpretation of Neg...*or*.

Now let us look a bit more at the two interesting cases of children’s responses we just mentioned at the end of last section

In case children asked the question *which one?* after hearing the test sentence, Kermit would say that he didn’t know which one, he only knew what he said – and he

would repeat the test sentence once. Then these children would accept the test sentences and say: You are right. The children's question showed that they somehow misunderstood the task and thought Kermit needed to guess which object exactly. However, his question did show that they accessed the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...or. Hence, the question was consistent with their later acceptance of the test sentences, because in both cases, they accessed the 'not this or not that, I don't know which' meaning of Neg...or

The other interesting case was that some children explicitly used the target construction Neg...or in their justification. For example, after the pushing-the-cart story in the negative goal condition, we asked a child why he thought Kermit was right, the child said because bear brother had one shell. We further asked him what one shell meant, the child said, while pointing to the relevant obstacles: *because he didn't hit one thing...he didn't hit this or this!* Children's utterance with Neg...or intending a 'not this or not that' meaning directly revealed their knowledge about this interpretation of Neg...or.

In fact, we even have some reason to speculate that children's production of Neg...or with  $(\neg Pa \vee \neg Pb)$  interpretation with the might be better than their perception, if their grammar allows this interpretation for the construction. Because from the child's own perspective, it is easier (compared to from another person's perspective) to perceive when the presupposition for the  $(\neg Pa \vee \neg Pb)$  interpretation is satisfied. If the relevant inference he makes is a situation of  $(\neg Pa \vee \neg Pb)$ , he could use any appropriate form in his language to express the  $(\neg Pa \vee \neg Pb)$  meaning, Neg...or is one of those. So, when he use Neg...or with  $(\neg Pa \vee \neg Pb)$  interpretation, he knows what he is doing. But when he interprets Neg...or, he has to get what another person is intending, which is harder, because of all the complications associated with the  $(\neg Pa \vee \neg Pb)$  interpretation and with ambiguous sentences we discussed in this paper. It would be nice if we could design an appropriate elicited production task in the future to directly test children's knowledge on the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...or.

When we compare the results in experiment I and this experiment, we found out that Chinese children and English children behave very similarly in their interpretation of Neg...Disjunction, despite the fact that Chinese adults and English adults behave differently. Remember, while Chinese adults accessed the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*huozhe* and thus accepted the test sentences 100% of the time, English adults only accepted the test sentences 54% of the time. Child in the two languages all preferred the  $\neg(Pa \vee Pb)$  interpretation of Neg...Disjunction in general but can access the  $(\neg Pa \vee \neg Pb)$  interpretation in special context, and, some children were better than others in accessing this generally dispreferred interpretation. The crosslinguistic similarities these children exhibited regarding the interpretation of Neg...Disjunction suggest that children across different language backgrounds have the same initial knowledge about Neg...Disjunction, and they are subject to similar pragmatic and cognitive constraints in learning the interpretation. We predict that Japanese children should behave in a similar way as Chinese and English children, if they are tested in this kind of experiment.

The pattern of English children's interpretation of Neg...*or* already resembles that of English adults' largely, in that both children and adults prefer the  $\neg(Pa \vee Pb)$  interpretation of Neg...*or*, and the  $(\neg Pa \vee \neg Pb)$  interpretation is more easily accessible for some speakers than other. In order to become a competent speaker of English, children just need to fine tune their knowledge about the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...*or*, this can be done along their cognitive development and the accumulation of their pragmatic knowledge.

## 5.2. Experiment V

This experiment replicates experiment II in Chinese and is a control for experiment IV. Like Chinese, simple sentences with two negated VP disjuncts (Neg...*or*...Neg) in English are unambiguous for adult speakers. But the interpretation sentences of this form have is  $(\neg P \vee \neg Q)$ , which is potentially hard for children. We want to see whether the

pragmatic conditions and cognitive requirements this interpretation is associated with will influence children's interpretation of the unambiguous sentences. The two factors in this experiment were still age (children vs. adults) and goal (positive goal vs. negative goal).

### **5.2.1. Method**

#### ***Subjects***

Twelve English-speaking children (five boys and seven girls) participated in this experiment, their age ranged from 4;5 to 5;5 with a mean age of 4;10. Three other children didn't pass the screening session, either because they refused to respond or because they failed in justifying their judgment, so they were not included in the test session. Still another child participated in one of the two sessions but was unwilling to participate in the other session, so his data was excluded from the analysis. As in experiment IV, we also tested twelve English adults.

#### ***Procedure***

This experiment followed exactly the same procedure as experiment IV.

#### ***Material***

All the stories in this experiment were exactly the same as in experiment IV. But both the test sentences and the fillers sentences involved VP disjuncts. The test sentences were direct translations of those used in experiment II in Chinese that had two negated VP disjuncts, such as *the worker didn't fixed the bike or didn't fix the skateboard*. For the complete sets of test sentences used in this experiment in the two conditions, see (68) and (69). The filler sentences in this experiment were minimally different from those in experiment IV, listed in (80) and (81).

- (80)a. The girl lifted up the chair or lifted up the stool.
- b. Mom cooked the soup or cooked the dish.

- c. The tall alien flew over the TV or flew over the computer.
- (81)
- a. Blue hopped on the broom or hopped on the brush.
  - b. The boy threw the ball on the cactus or threw the ball on the tree.
  - c. Pokemon slipped on the cup or slipped on the bucket.

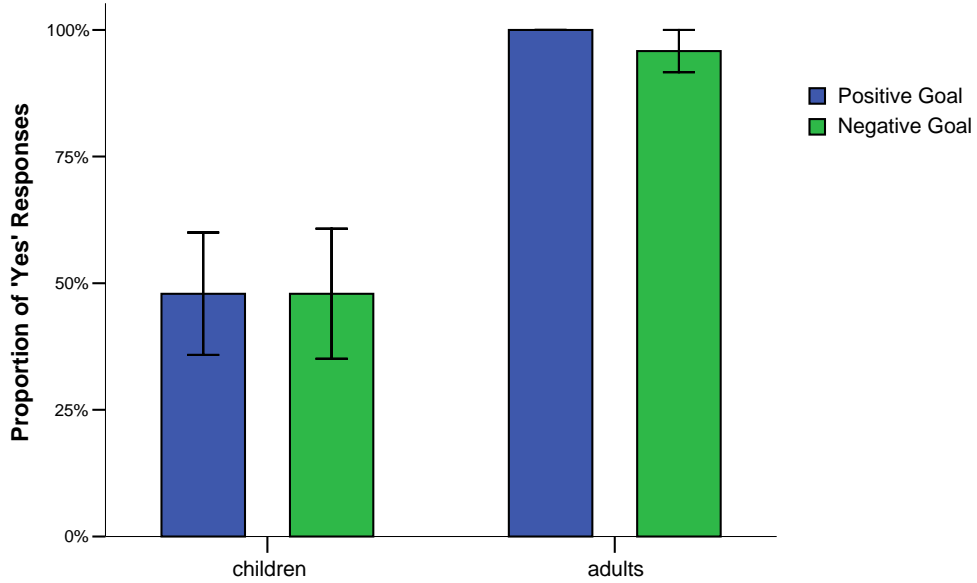
### 5.2.2. Results

As in all other experiment, the dependent variance in the analysis of the results in this experiment was also the proportion of ‘yes’ responses to the test sentences. The proportion of ‘yes’ responses were entered into ANOVA with a between subject factor of age (children vs. adults) a within subject factor of goal (positive goal vs. negative goal). The analysis revealed a significant main effect of age ( $F(1,22) = 23.62, p < .0001$ ), a non-significant main effect of goal ( $F(1,22) = .074, p > .5$ ) and a non significant interaction of age and goal.

In this experiment, in the positive goal condition, while adults accepted the test sentences 100% of the time, whereas children only accepted them 48% of the time ( $t(11) = -4.3, p = .001$ ); similarly, in the negative goal condition, while adults accepted the test sentences 96% of the time, children only accepted them 48% of the time ( $t(11) = -3.96, p = .002$ ). See the graph in (82).

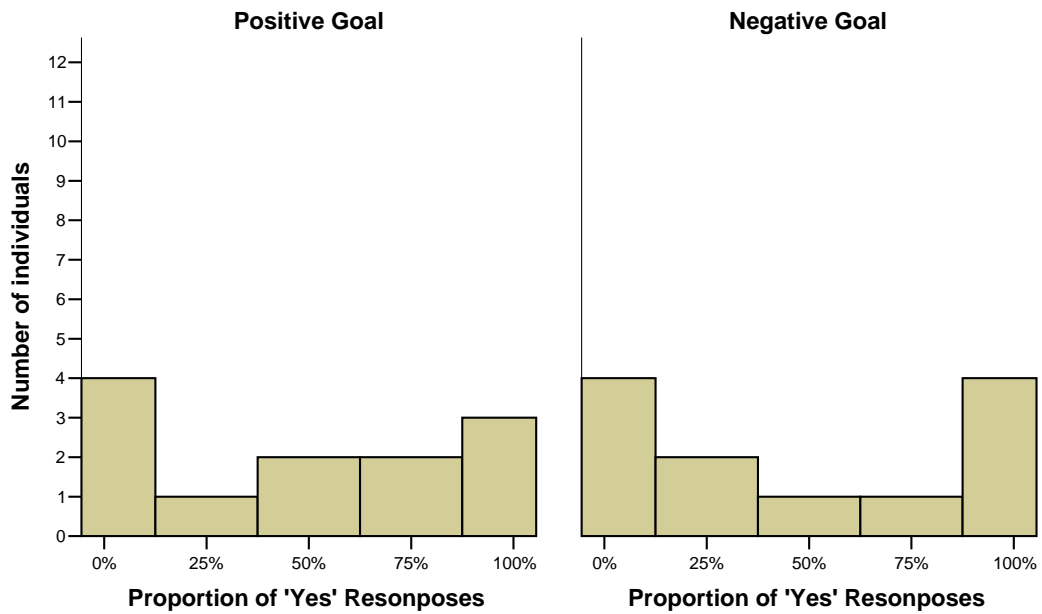
Moreover, the individual data showed that there were great subject variations. The histograms in (85) show the distribution of the proportion of ‘yes’ responses in children in both conditions. In both cases, the distribution was bi-modal.

(82)



Proportion of 'yes' responses to test sentences containing Neg...or...Neg for children and adults in both conditions

(83)



Distribution of children's individual proportion of 'yes' responses to test sentence containing Neg...huozhe...Neg in both conditions

### 5.2.3. Discussion

The results of this experiment revealed children's non-adult way of interpreting simple sentences with two negated VP disjuncts, which was presumably caused by the pragmatic and other non-linguistic factors associated with the adult way of interpretation ( $\neg P \vee \neg Q$ ) and the form of the sentences. As we discussed in 4.2.3, our speculation about possible mis-parsing of the test sentences together with children's preference for the 'neither' interpretation for the sentences after mis-parsing could apply here, too.

### 5.3. General discussion

The two English experiments we reported in this section are replicates of the first two Chinese experiments we reported in section 4. In these two experiments, in the exact same context, we tested English children and adults on their interpretation of a potentially ambiguous sentence with Neg...*or* and an unambiguous sentence with Neg...*or*...Neg.

The findings revealed a similar pattern of interpreting the ambiguous Neg...*or* in English and the ambiguous Neg...*huozhe* in Chinese, in children, but not in adults. Children from both languages preferred the 'neither' interpretation in general, and some children could access the 'not this or not that' interpretation in the negative goal condition, being aided by the alignment of this interpretation with the direct inference in that condition. Chinese adults, presumably having no preference for the 'neither' interpretation of Neg...*huozhe* uniformly based their judgment on the 'not this or not that' interpretation. On the other hand, English adults, having different degrees of preference for the 'neither' interpretation of Neg...*or*, showed two radically different patterns, as illustrated by the bi-modal distribution of their responses. What this predicts is that children of other languages, such as Japanese, should behave similarly as Chinese and English children in interpreting Neg...*ka*.

The experiment results empirically argue against the claim that the ( $\neg P \vee \neg Q$ )

interpretation of Neg...*or*, which involved interpreting disjunction outside the scope of negation, is impossible in English. We showed that this interpretation could be accessed in conducive contexts both for English adults and children. Even though not all subjects based their judgments on this interpretation in the experiment, we could not say that these people did not have such interpretation in the grammar – because it might be the case that the current experiment methodology was not able to reveal that knowledge.

In additions, children in both languages tended to associate a non-adult interpretation to an unambiguous sentence with Neg...Disjunction...Neg. We speculated that children in both cases mis-parsed the sentence as Neg...Disjunction, potentially ambiguous; and because of their preference for the ‘neither’ interpretation of Neg...Disjunction, the ‘neither’ interpretation of Neg...Disjunction...Neg became visible. The non-adult interpretation is definitely not input-bound. And we think it is due to general processing constraints, pragmatic conditions and other non-language-specific factors. Then we would expect children in other languages that have comparable constructions to show similar interpretation pattern. This can only be shown with further experimental studies, which goes beyond the scope of this paper.

## **6. Remaining problems and further issues**

This section will discuss some issues relevant to the learnability issues we are interested in this paper, which we are unable to investigate well in the time being. So, they will be further issues we would like to tackle on.

### **6.1. Analysis of input**

With the studies we reported in this paper, we wanted to show that children's knowledge about the interpretation of interacting negation and disjunction is not necessarily input bound, so that they will not experience the potential learnability problems we are concerned with in section 3. Therefore, there must be some innately specified knowledge in this respect, together with the constraints posed by the development of general cognitive capacity in children and the specific pragmatic conditions certain interpretation is associated with, which will result in children's non-adult behavior in interpretation.

But in this paper, we only provided empirical evidence that in some experiment settings children's interpretation of Neg...Disjunction is different from that of adults. It would be better if we could provide data about actual input to children that can illustrate the mismatch between the interpretation in the input and the interpretation children have. Remember, the potential learnability problems we raised that Chinese children may face when interpreting Neg...*huozhe* are partially related to our presumptions of the input. The argument about the learnability issues would be more convincing if we could provide analysis of the input Chinese children are exposed to regarding Neg...*huozhe*.

However, we are constrained by the input data available to us at the moment. This problem is specifically relevant to Chinese.

We searched the CHILDES database (MacWinney & Snow, 1985) on Chinese data. The amount of the data is limited, about 100 short files. Each small file contains a segment of conversations involving a different child. Given this feature of the data, we really cannot see much about the input for any specific child. In addition, a lot of the files

contain repeated data, because they involve an investigator telling the same stories to different children. Furthermore, many of the data were collected in a setting that is unnatural as a PLD environment, for example, when an investigator went to a child's home to ask the child questions or observe others asking the child questions.

In the available data, we found these: the disjunction coordinator *huozhe* occurred four times in a positive context (e.g., 'peeled shrimp or dried shrimp'); and *huo*, the short form of *huozhe*, occurred three times in the same question addressing to different children (i.e., 'white, or grey, right?'); and the construction *bu...huo* ('not...or') occurred 25 times in the files, but they were in virtually the same sentence (i.e., 'Dragon does not allow other animal to swim, drink or do other things in the pond') presented to different children.

Based on these findings, it is true that the occurrence of Neg...*huozhe* in the data is rare. But as we just discussed, the data is not representative for children's input, we cannot conclude that this construction is rare in children's input. Furthermore, there is in fact only one single occurrence of Neg...*huozhe*, thus we cannot determine based on this which interpretation of Neg...*huozhe* is preferred in children's input.

We are trying to find better methods and resources to investigate Chinese children's input on the interpretation of Neg...*huozhe*.

## 6.2. Disambiguation strategy

Although we proposed that both the  $(\neg Pa \vee \neg Pb)$  interpretive option and the  $\neg(Pa \vee Pb)$  interpretive option are innately specified for a negated sentence with a disjunct object (Neg...Disjunction), we did not explicitly take stocks on whether both interpretations are necessarily activated and compared over upon interpreting such as sentence. It is both logically possible to disambiguate a sentence by selecting the appropriate interpretation after comparing the two available interpretations based on the context (the selection strategy) or by generating the appropriate interpretation directly according to the context

(the generation strategy)

When we said that children prefer the  $\neg(Pa \vee Pb)$  interpretation of Neg...Disjunction in general and could access the  $(\neg Pa \vee \neg Pb)$  interpretation in special context, we did not make a choice between the two ways of disambiguation. But we are aware that in some cases one strategy seems to be easier than the other, especially for children.

In a normal conversation case, where we normally assume the conversation partner says truthful things, our reasoning upon hearing a potentially ambiguous sentence then is something like this: this sentence is a truthful description (inference) about what happened, based on what happened, let me see what the sentence means. In this case, a generating strategy of disambiguation will then activate the appropriate interpretation; a selection strategy of disambiguation will highlight the appropriate interpretation and deactivate the inappropriate interpretation (which presumably corresponds to a false description). Both seem to be equally economical.

On the other hand, in a TVJT experiment setting, what Kermit said could be wrong. Therefore, when we hear a test sentence, we should reason like this: what can be inferred about what happened is X, and this sentence means Y, is Y equal to X? Let us make the case specific, for example, when we tested Chinese children's interpretation of Neg...*huozhe*. In the positive goal case, the direct inference from one label is the  $(Pa \vee Pb)$  situation, and the direct negation of this then is the  $\neg(Pa \vee Pb)$ , corresponding to the default interpretation they have on Neg...*huozhe*. At this time, if they generate this interpretation accordingly or they generate this interpretation as their default interpretation of Neg...*huozhe*, they can finish the judgment by rejecting the sentence (this is in fact what all children did in the experiment). In the negative goal case, the direct inference from one reward is  $(\neg Pa \vee \neg Pb)$ . if children generate this interpretation of Neg...*huozhe*, they can finish the judgment by accepting the test sentence (this explains why negative goal improved children's acceptance of the test sentence in the

experiment); if children in this case still choose to generate the default interpretation they have on Neg...*huozhe*, they need to do some more work but should be able to reject the sentence at the end. On the other hand, if children assume the selection strategy, their task in both conditions is much more complex. Even if they can successfully compare both interpretations with the direct and indirect inference in the story, they may be left with a dilemma, since they can reject the test sentence on its one interpretation and accept the test sentence on the other interpretation. Therefore, we incline toward a generation strategy of disambiguation, at least for children when they are in a TVJT or similar setting. And this strategy makes sense for children, since they may have difficulty maintaining two interpretations of a sentence at the same time due to limit of memory or other cognitive constraints.

If this reasoning about children's mental process involved in the experiment were right, then children actually were interpreting the potentially ambiguous test sentences as unambiguous sentences in each instance. Then ambiguity for children would mean certain interpretation in certain context and other interpretation in other context, but normally not two interpretations at the same time. Furthermore, our proposal that children prefer the  $\neg(Pa \vee Pb)$  interpretation of Neg...Disjunction in general and could access the  $(\neg Pa \vee \neg Pb)$  interpretation in special context, could be paraphrased as: children in general generate the  $\neg(Pa \vee Pb)$  interpretation upon hearing Neg...Disjunction, and can generate the  $(\neg Pa \vee \neg Pb)$  interpretation in special context.

However, this hypothesis about children's disambiguation strategy still needs to be tested independently. And we are not assuming adults necessarily use this strategy. Adults could have both options and chose which one to use in different circumstances.

## 7. Concluding remarks

This paper has been concerned with the learnability problems Chinese children potentially could face when they interpret simple negated sentences with a disjunct objects (Neg...*huozhe*). Namely, how Chinese children can learn the correct grammar, given that they are exposed to an impoverished and potentially misleading input in this respect. Our proposal for avoiding this problem is to invoke the innate mechanism and make both interpretive options of Neg...Disjunction available as the default knowledge for children. This makes Chinese children innately equipped with the correct grammar. What they need to learn then are pragmatic constraints the two interpretations of Neg...*huozhe* are subject to in Chinese, which they need to catch up with the general cognitive development.

The specific pragmatic conditions and complex cognitive requirements generally associated with the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...Disjunction make this interpretation dispreferred in the two possible interpretations for children. The main goal of the experiments we have reported was to reveal children's knowledge about the  $(\neg Pa \vee \neg Pb)$  interpretation of Neg...Disjunction, assuming it is made available by UG.

Given the experiment results, although both Chinese children and English children in general preferred the  $\neg(Pa \vee Pb)$  interpretation of Neg...Disjunction, about half of them could access this interpretation in the context where there was a negative goal. ('not doing something' is good). This finding provided empirical evidence against a general deficit grammar account for children's preference to the  $\neg(Pa \vee Pb)$  interpretation of Neg...Disjunction, but for a pragmatic, cognitive constraints-based account as advocated in this paper.

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