

## ABSTRACT

Title of dissertation: PRAGMATIC COMPUTATION IN LANGUAGE  
ACQUISITION: EVIDENCE FROM DISJUNCTION  
AND CONJUNCTION IN NEGATIVE CONTEXT

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This dissertation discusses contributions from pragmatic factors to children's behavior in interpreting scopally ambiguous forms. In particular, we look at children's interpretation of negated sentences involving disjunction in the object (Neg...Disjunction). Languages like English and Chinese allow scope interaction between negation and disjunction of this kind of strings and thus two corresponding interpretations: the narrow scope disjunction interpretation (the NSD, meaning "neither") and the wide scope disjunction interpretation (the WSD, meaning "not this or not that"); but languages like Japanese only allow the WSD. Previous studies found out that children of different languages accessed the NSD instead of the WSD given "not this or not that" scenarios (e.g., Crain, Gualmini & Meroni 2000; Goro & Akiba 2004a; Jing, Crain & Hsu 2005) and concluded that preschool children systematically lack the WSD in their grammar. However, given the fact that the WSD is pragmatically more complex than the NSD in general and the well documented observations that children's immature capacity in pragmatic computation sometimes

masks their linguistic competence (e.g., Gualmini 2004; Musolino & Lidz 2006), the findings in previous studies could reveal children's strong preference toward the NSD rather than their lack of the WSD.

Four main experiments are reported in this dissertation, which aim to test the hypothesis that children's grammar can generate the WSD and that children can access this interpretation when the relevant pragmatic computation is facilitated. With various kinds of experimental manipulations to facilitate children's pragmatic computation, we observed that children accessed the normally dispreferred WSD more often, when the "not this or not that" meaning was made more directly relevant in the context, when explicit disambiguating information was present in the discourse, after they were trained to be more sensitive to the "not this or not that" aspect of the context, and after they immediately experienced the use of certain alternative form (Neg...Conjunction) to express the "neither" meaning (corresponding to the NSD of Neg...Disjunction).

The findings in these experiments reveal children's hidden grammatical knowledge of the WSD and highlight the role of pragmatic computation in the acquisition of meaning.

PRAGMATIC COMPUTATION IN LANGUAGE ACQUISITION:  
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IN NEGATIVE CONTEXT

by

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## Chapter 1: Introduction

In the generativist approach to language (e.g., Chomsky 1981, 1986, 1995, etc.), linguistics have concluded that children are born with innate, universal knowledge to acquire language. But it is apparent that there are whole arrays of things children need to learn before they become mature speakers of a language. The question then is what kinds of knowledge universal grammar (UG) provides language learners and how different factors contribute to children's successful learning. Generally speaking, the central task in learning a language is to map form onto meaning. This is no trivial task. When a linguistic form is used, its meaning is subject to both linguistic (i.e., syntactic and semantic) and pragmatic factors. From a linguistic perspective, the basic compositional meaning of a form depends on the meaning of its individual components and how the components are combined. For example, *John called Mary* means "John called Mary", but not "John hugged Mary" or "Mary called John". Also determined by linguistic factors, an expression can invoke inferential meaning by comparison to other expressions in the language, known as entailment. Entailment relation is a semantic relation based on truth conditions of relevant sentences, roughly speaking, sentence A entails sentence B if B is true whenever A is true. For instance, *John called his girlfriend* (A) entails *John called a woman* (B), but not vice versa; because whenever John called his girlfriend (i.e., whenever A is true), he called a woman (i.e., B is true), but when John called a woman (i.e., when A is true), it is not necessarily the case that he called his girlfriend (i.e., B is

not necessarily true). In addition to meanings due to compositional properties and entailment relations, an expression can carry implicational meaning due to pragmatic considerations, which are tightly related to the interactive understanding between the speaker and the hearer about the use of linguistic forms. An example illustrating this point is this: *John likes some professors in the department* is semantically compatible with a scenario where John likes all professors in the department, but this sentence implicates “It is not the case that John like all professors in the department”; because if the speaker intends to convey that John likes all professors in the department, she presumably would have used the more specific expression *John likes all professors in the department*. The picture about meaning is even more complicated when cases of ambiguity are considered. In natural languages, sometimes the same surface string can have multiple compositional meanings for instance because of different covert combinatory possibilities that share the same phonological consequence. For example, the sentence *The detective didn't find more than two suspects* can mean “the detective found two or fewer suspects” and can also mean “there were two or more suspects the detective didn't find”, caused by two possible scopal relations between negation and the quantified noun phrase object. In cases like this, which meaning is intended with such a string depends on the context, and the hearer needs to decipher the speaker's intended message based on her integration of relevant discourse information. In natural language learning environment, children always learn to map form onto meaning in discourse context. This means, the input children are exposed to about meaning involves

compounds of meanings from different aspects, and no explicit distinction among the aspects is introduced. Children have to be able to tease the different kinds of meaning apart and attribute them to the appropriate components.

Logical expressions such as negation, disjunction and conjunction in natural languages are often believed to share basic core semantic content with their respective counterparts in formal logic. In this case, each logical expression has its own semantic meaning; and also participates in entailment relations within other expressions. In addition, the use of these logical expressions is subject to general pragmatic considerations, which adds implicational meaning to them. Moreover, a single string containing more than one logical expression sometimes is compatible with more than one compositional meaning, due to multiple possible covert scopal relations between the elements; and which specific meaning is intended with the string will depend on the discourse context. Children learning logical expressions have to map the respective lexical items to the logical counterparts, understand the use of each logical expression, and resolve potential ambiguities caused by interactions of logical expressions, utilizing discourse resources. Beyond this, they also have to pay attention to language-specific factors that contribute to the behavior of these logical expressions and their interactions. Overall, children's knowledge of the meaning of logical expressions and their interactions seem to be tied to the development of their capacity in both the linguistic aspect and the pragmatic aspect. In this respect, what children know exactly at certain age constitutes a piece in their language development course, based on which we could explore the

principles and constraints that govern language acquisition in different (e.g., linguistic and pragmatic) domains.

This dissertation is primarily concerned with children’s knowledge about the meaning of simple negative sentences involving a disjunct object (Neg...Disjunction), such as *John didn’t eat the apple or the orange*. This kind of sentences could potentially allow two interpretations, corresponding to the two possible scopal relations negation and disjunction can have: negation having scope over disjunction, or disjunction having wider scope than negation. We focus on the wide scope disjunction interpretation here, i.e., “John didn’t eat the apple or John didn’t eat the orange”. This interpretation is grammatically licit in the languages currently investigated, but sentences under this meaning are associated with more complex conditions of use than those with the alternative interpretation (i.e., the narrow scope disjunction interpretation, “John ate neither the apple nor the orange”). Previous studies concluded that children in different languages systematically lack this interpretation as a matter of grammar. We use experimental methods to investigate English-speaking and Chinese-speaking children’s knowledge of this interpretation when they are 4 year old to reveal children’s hidden grammatical knowledge in this respect and identify the pragmatic factors that contribute to children’s non-adult behavior. This introduction will present the cross-linguistic differences regarding the interpretation of negated sentences involving disjoined and conjoined objects, specify the basic pragmatic framework this dissertation assumes and discuss the pragmatic uses of sentences containing logical expressions, briefly introduce

previous findings about children’s knowledge regarding the meaning of logical expressions, and lastly, lay out the organization of this dissertation.

## 1.1 Logical expressions in cross-linguistic context

### 1.1.1 Cross-linguistic interpretative contrasts of interacting logical words

A simple negated sentence with a disjunct object (Neg...Disjunction) in natural languages, such as the three sentence below in English, Japanese and Mandarin Chinese, respectively, involves a sentential negation and a disjunction word coordinating two noun phrases in the object at the surface string level.

(1) John didn’t eat the apple or the orange.

(2) John-way ring ka orenji-wo tabe-natak-ta  
John-TOP apple or orange-ACC eat-NEG-PAST  
Lit<sup>1</sup>. “John didn’t eat the apple or the orange.”

(3) Yuehan meiyou chi pingguo huozhe juzi  
John not-PERF eat apple or orange  
Lit. “John didn’t eat the apple or the orange.”

Let us suppose that disjunction words, such as *or* in English, *ka* in Japanese and *huozhe* in Chinese have the basic semantic value as the Boolean disjunction connective<sup>2</sup>, namely,

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<sup>1</sup> Short for ‘literal’. It introduces the English literal (“word by word”) translation of the foreign sentence, but the interpretive pattern of the foreign sentence differs from that of the English translation sentence: either it lacks some interpretation the translation sentence (string) allows, or it does not have the default interpretation of the translation sentence as default.

<sup>2</sup> This does not exclude the possibility that some languages also have disjunction words that do not correspond to Boolean disjunction.

a relation between two propositions. This entails that a disjunct noun phrase object is mapped to coordination of two propositional arguments at the interpretation level, which ascribe the same property  $P$  to the referent of the two NPs (i.e.,  $Pa \vee Pb$ ). The exact content of  $P$  will essentially be determined by how the sentence is analyzed and how meaning is derived. When the two disjointed object NPs in a negated sentence are ultimately mapped to propositional coordination, the two propositions can in principle either include the negation in the proposition or leave the negation out. When the propositions do not include negation, sentence (1) has an abstract translation as in (4a) and can be paraphrased as in (4b). Under this mapping, disjunction is interpreted in the scope of negation, thus Neg...Disjunction basically means that neither positive proposition holds. I call this interpretation *the narrow scope disjunction interpretation* (NSD), and sometimes also the “neither” interpretation; sentence under this interpretation is sometimes referred to as  $S_N$ .

(4) Narrow scope disjunction interpretation (NSD)

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

b. It is not the case that John ate either the apple or the orange.

Alternatively, when the propositions include negation, this translates sentence (1) to the abstract form of (5a), and the sentence is paraphrased as (5b). Here, disjunction is interpreted as taking wide scope than negation, and Neg...Disjunction means at least one of the negative propositions holds. I call this interpretation *the wide scope disjunction*

*interpretation* (WSD), or, the “not this or not that” interpretation. When the sentence is interpreted under this meaning, I refer to the sentence as  $S_w$ .

(5) Wide scope disjunction interpretation (WSD)

a.  $\neg Pa \vee \neg Pb$

b. John didn't eat the apple or John didn't eat the orange.

When individual languages are concerned, these two potentially available interpretations are subject to language-specific constraints. Consequently, languages differ in how the interpretative pattern of Neg...Disjunction looks like. I am aware of at least three different patterns.

English allows both the NSD and the WSD of Neg...*or*, but the default interpretation is the NSD. This means, more or less, when sentence (1) is presented to English speakers without any context given, they will most likely report the meaning given in (4). This has been taken as evidence against the existence of the WSD of Neg...Disjunction in general in English (e.g., Larson 1985). However, some other researchers have defended such interpretation in English by extending the data basis, saying that when appropriate contexts are provided, the WSD of Neg...Disjunction is available to English speakers (Szabolcsi, 2002, Han & Romero 2004). I will report some experimental findings that support the existence of this interpretation in English speakers in chapter 3. Nevertheless, the NSD of Neg...Disjunction is uniformly and overwhelmingly preferred by English speakers.

Neg...Disjunction construction in Japanese is interpreted differently. The English default interpretation of simple Neg...Disjunction sentences, i.e., the “neither” interpretation, is impossible in Japanese. The Japanese sentence in (2) is a literal translation of the English sentence in (1), but it can only mean that John didn’t eat the apple or John didn’t eat the orange (i.e., the WSD). Goro & Akiba (2004a), following Szabolcsi (2002), proposed that the Japanese disjunction word *ka* is a positive polarity item (like *some* in English) and resists being interpreted within the scope of local negation. As a result, disjoined NP object in a simple negated sentence in Japanese is obligatorily mapped to two disjoined negative propositions.

Chinese represents yet another pattern of how Neg...Disjunction is interpreted. In Chinese, like in English, both the NSD and the WSD are possible for Neg...Disjunction. But unlike English, the NSD is not the default interpretation: without given context, speakers are often equivocal about which interpretation to assign<sup>3</sup>. The Chinese sentence in (3), a literal translation of the English sentence (1), if uttered out of context, can be interpreted differently by different speakers at different times, depending on what kind of situations they construct for such an utterance.

So far I have presented three different ways languages behave with respect to the interpretation of Neg...Disjunction<sup>4</sup>. The patterns are summarized in the table in (6). In this dissertation, I focus on English and Chinese, where Neg...Disjunction is ambiguous.

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<sup>3</sup> Nonetheless, from the grammatical perspective, the interpretation of Neg...Disjunction in Chinese is the same as English.

<sup>4</sup> While each of these three languages I refer to here is not alone in its respective category, I do not know for a fact that all world languages fall within these three categories.

(6) Table 1: Interpretive patters of Neg...Disjunction<sup>5</sup>

Language \ Interpretation	$\neg(Pa \vee Pb)$	$\neg Pa \vee \neg Pb$
English	✓✓	✓
Japanese	✗	✓
Chinese	✓	✓

Similar to Neg...Disjunction, if we assume conjunction words such as *and* in English basically correspond to Boolean conjunction connective<sup>6</sup>, a simple negated sentence such as the English sentence in (7) with a conjunct object (Neg...Conjunction) could in theory allow the two surface coordinated object NPs to map to two conjoined propositions in two directions: negation excluded from the propositional conjunct, as in (8), or included in the propositional conjunct, as in (9). The two interpretations corresponding to these two ways of mapping are called *narrow scope conjunction interpretation* (NSC), and *wide scope conjunction interpretation* (WSC).

(7) John didn't eat the apple and the orange.

(8) Narrow-scope conjunction interpretation (NSC)

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

b. It is not the case that John ate both the apple and the orange.

<sup>5</sup> In this chart, ✓ stands for “allowed”, ✗ for “disallowed”, and ✓✓ for “default”.

<sup>6</sup> This does not say that all conjunction words in natural languages necessarily correspond to Boolean conjunction. Moreover, the same lexical conjunction word in a language that is basically Boolean can sometimes be used in a non-Boolean way, such as *and* in English, e.g., *John and his brother look alike*; *egg and cheese is the best-selling food here*; *one needs to differentiate between fact and fiction*; etc.

(9) Wide-scope conjunction interpretation (WSC)

a.  $\neg Pa \wedge \neg Pb$

b. John didn't eat the apple and John didn't eat the orange.

Languages differ with respect to which option(s) of the two they allow. While English Neg...Conjunction allows both options and has the NSC as the default interpretation, Neg...Conjunction sentences in both Japanese and Chinese resist the NSC. The Japanese sentence in (10) and Chinese sentence in (11) correspond to the English sentence in (7) literally, but they only allow the WSC and mean that John ate neither the apple nor the orange. Compared to *and* in English, the Japanese conjunction word *mo...mo...* and the Chinese conjunction word *he* are more restricted in their interpretation when interacting with negation. The origin of this contrast between English on the one hand and Japanese and Chinese on the other hand could reside in some positive polarity property of the lexical items that prevent them from being interpreted within the scope of negation (e.g., Goro & Akiba 2004a; Goro 2004, 2007), along the same line as the disjunction word *ka* in Japanese<sup>7</sup>. The differences in interpretive pattern of Neg...Conjunction in these three languages are summarized in (12), combined with the interpretive contrasts regarding Neg...Disjunction in these languages I just demonstrated.

(10) John-wa ringo mo orenji mo tabe-natak-ta

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<sup>7</sup> This is a working assumption taken in this dissertation, which we do not plan to defend (but see section 5.3.1 for some discussion on this issue). Szabolcsi & Haddican (2004) proposed that the narrow scope conjunction of Neg...Conjunction is related to the plurality of conjoined NPs, rather than the positive polarity property.

John-TOP apple also orange also eat-NEG-PAST  
 Lit. “John didn’t eat apple and orange.”  
 “John ate neither the apple nor the orange.”

- (11) Yuehan meiyou chi pingguo he juzi  
 John not-PERF eat apple and orange  
 Lit. “John didn’t eat apples and oranges.”  
 “John ate neither the apple nor the orange.”

(12) Table 2: Interpretive patterns of Neg...Disjunction and Neg...Conjunction<sup>8</sup>

Language \ Interpretation	Neg...Disjunction		Neg...Conjunction	
	$\neg(Pa \vee Pb)$	$\neg Pa \vee \neg Pb$	$\neg(Pa \wedge Pb)$	$\neg Pa \wedge \neg Pb$
English	✓✓	✓	✓✓	✓
Japanese	✗	✓	✗	✓
Chinese	✓	✓	✗	✓

Logically speaking,  $\neg(Pa \vee Pb)$  (i.e., the NSD of Neg...Disjunction) and  $\neg Pa \wedge \neg Pb$  are in mutual entailment relation (i.e., the WSC of Neg...Conjunction), as illustrated in the truth table in (13). When they are true, the circumstance must be that both  $Pa$  and  $Pb$  are false, i.e., a “neither” scenario. This means, a “neither” meaning can in principle be expressed with a disjunction or a conjunction. Languages differ in the default and natural way to express this meaning: English on the one hand uses Neg...Disjunction, while Chinese and Japanese on the other hand uses Neg...Conjunction.

(13) Table 3: Truth table of the NSD and WSC

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

<sup>8</sup> As in the previous chart, here, ✓ stands for “allowed”, ✗ for “disallowed”, and ✓✓ for “default”.

0 | 0 | 1 | 1 | 1 | 1 | 1

Recall that Neg...Disjunction in both English and Chinese can be interpreted as “neither” (the NSD) or “not this or not that” (the WSD), but the pattern of speakers’ preference between the two interpretations of Neg...Disjunction differs in the two languages. I propose that this is related to the different choices these two languages make in how to naturally express a “neither” meaning. In English, as Neg...*or* is the default way to express a “neither” meaning, this form is somehow reserved for this meaning, and the alternative meaning (the WSD) is not as prominent. On the hand, Neg...*he* is the default form to use given a “neither” meaning, and Neg...*huozhe* is “marked” in expressing this meaning and associated with specific implications. As a result, Neg...*huozhe* is not by default to be perceived as entailing the “neither” meaning.

Given the interpretive contrasts of negated sentence involving disjunction and conjunction in different languages, in addition to learning what disjunction words and conjunction words mean semantically (i.e., map them to the respective logical concepts), children learning these languages have at least these tasks in this respect: one, they have to identify which option their local languages choose regarding the interpretation of Neg...Disjunction and Neg...Conjunction; second, they have to learn which form is the default way to express a certain meaning and what the conditions of using Neg...Disjunction and Neg...Conjunction with specific meaning; third, in case a string presented to them is potentially ambiguous, they have to decide what the speaker intends

to convey with the string in the specific context.

### **1.1.2 Linguistic assumptions**

The theoretical issues regarding how surface strings in the form of negated sentences involving coordinated NP object are mapped to the relevant semantic representations are complex. There are controversies regarding the syntax and semantics of logical connectives such as negation, disjunction and conjunction, as well as debates over how scope ambiguities arise. In this dissertation, I do not intend to defend any theoretical positions, and my experimental studies do not target at testing different theories. There must be some mechanisms that are responsible for the observed interpretive facts. For the present purpose of this dissertation, the mechanisms are less relevant; rather, we focus on the interactions of these logical expressions in terms of their meaning and use in individual languages; and based on these interpretive facts in adult language, we examine what are available in children's grammatical knowledge and pragmatic factors that contribute to children's behavior. For concreteness, I briefly lay out the main linguistic assumptions adopted in this dissertation in what follows and leave theoretical implications aside.

Following the Chomskyan tradition, I assume that there is a level of syntactic representation called *logical form* (LF) and that the output of the LF level after the application of syntactic operations determines the semantics of a sentence. Operations applying at this level are considered “covert”, because the output is not pronounced and

not visible from the surface form. Sometimes, when a string of words contains multiple operators (including quantifiers), it can have multiple structural representations at LF as the consequence of different ways syntactic operations apply targeting at these operators. In each of the structural representations, the c-commanding relation of the relevant operators determines their semantic scope, and each structural representation maps to one semantic representation. In this way, the resulting ambiguity associated with one string, characterized as semantic scope ambiguity, is reduced to structural terms.

I have shown that Neg...Disjunction and Neg...Conjunction in some languages exhibit scope ambiguity of negation and coordination in interpretation. This can possibly derive from different potential c-commanding relations negation and coordination hold at LF. As I alluded to when describing the interpretive facts, I assume logical words like disjunction, conjunction and negation that we deal with here have the basic semantic value of their Boolean counterparts in logic, which are connectives that apply to propositions. But, while the interpretation of the relevant sentences contains conjoined propositions, the surface form involves sentential negation and coordination (disjunction or conjunction) of two NPs in the object. If we assume only sentential constituents are propositional<sup>9</sup>, the immediate question then is how the coordinated NPs are mapped to conjoined propositions. In this dissertation, following Partee & Rooth's (1983) and Partee (1986), I consider coordinated NPs directly generated as such in the syntax and "expand"

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<sup>9</sup> If the VP-internal subject hypothesis is adopted, VP can also be considered 'sentential' and thus propositional (of type t).

to propositions through semantic mechanisms<sup>10</sup>.

Following Gazdar (1980), von Stechow (1974) and Keenan & Faltz (1978), Partee & Rooth (1983) considered all types of categories conjoinable except for categories of type *e*, which follows from recursive definition of conjoinable types, given in (14) (= (4) in Partee & Rooth 1983). Conjunction words like *and* and disjunction words like *or* correspond to generalized connectives  $\sqcap$  and  $\sqcup$  (“meet” and “join”), respectively. They are of basic type *t* and have other derived types for conjoinable types other than *t* (e.g., type  $\langle e, t \rangle$ , type  $\langle \langle e, t \rangle, t \rangle$ , etc.). In this way, conjunction and disjunction can also combine with categories in addition to sentences (of type *t*), while still maintain the core meaning of Boolean connectives, and the output interpretation corresponds to coordination of propositions.

(14) Definition: Conjoinable Type

- (i) *t* is a conjoinable type
- (ii) if *b* is a conjoinable type, then for all *a*,  $\langle a, b \rangle$  is a conjoinable type.

However, within this generalized conjunction framework, NPs intuitively of type *e* (e.g., *John, the book*) still cannot be conjoined as is. One solution is to consider no NPs as of type *e*, such as in Montague (1973), who treated all NPs as generalized quantifiers of type

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<sup>10</sup> Another conceivable way to approach this problem is to consider surface coordinated NPs as reduced from coordinated sentences (e.g., *John ate the apple or the orange* is a reduced form of *John ate the apple or John ate the orange*), while some part of the second “junct” (cover term for conjunct and disjunct) is deleted under identity with the first junct; so that disjunction and conjunction are actually connecting two sentential constituents in the syntax, and directly translated to Boolean connectives connecting two propositions in semantics.

$\langle\langle e,t\rangle, t\rangle$ . Another solution is to recognize type  $e$  as the basic type of some NPs (Heim 1982 and Kamp 1981) and allow type lifting to apply so that those NPs can have higher types when necessary. This flexible NP type view is advocated for example by Partee (1986). In this approach, NPs of basic type  $e$  can be type-lifted to generalized quantifiers of type  $\langle\langle e,t\rangle, t\rangle$ , which are then conjoinable. An example is given in (15), where  $P$  is a variable of type  $\langle e,t\rangle$ .

- (15) a.  $\llbracket \text{John} \rrbracket = j \rightarrow \lambda P[P(j)]$   
 b.  $\llbracket \text{Mary} \rrbracket = m \rightarrow \lambda P[P(m)]$   
 c.  $\llbracket \text{John or Mary} \rrbracket = \lambda P[P(j)] \sqcup \lambda P[P(m)] = \lambda P[P(j) \vee P(m)]$   
 d.  $\llbracket \text{John and Mary} \rrbracket = \lambda P[P(j)] \sqcap \lambda P[P(m)] = \lambda P[P(j) \wedge P(m)]$ <sup>11</sup>

In this framework, conjoined NPs as constituent can be treated uniformly as generalized quantifiers of type  $\langle\langle e,t\rangle, t\rangle$ , while the individual NPs themselves do not need to be of basic type  $\langle\langle e,t\rangle, t\rangle$  (e.g., like *every boy*). When conjoined NPs are in the object of a negative sentence (Neg...Disjunction or Neg...Conjunction), the potential scope ambiguity between negation and conjoined NPs can be attributed to a mechanism parallel to what accounts for the scope ambiguity of negative sentences involving quantified NP object such as *Bill didn't call more than 2 people*, for example, a Quantifier Raising (QR) approach (e.g., May 1977). Because the conjoined NP object of type  $\langle\langle e,t\rangle, t\rangle$  cannot combine directly with a transitive verb that demands an object of type  $e$  (i.e., a transitive

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<sup>11</sup> The equations in (c) and in (d) are given the facts presented in Partee & Rooth (1983):  $\lambda zX \sqcap \lambda zY = \lambda z(X \sqcap Y)$  and  $\lambda zX \sqcup \lambda zY = \lambda z(X \sqcup Y)$ . Because  $P(j)$  and  $P(m)$  are of type  $t$ , so Boolean connective symbols are used.

verb of type  $\langle e, \langle e, t \rangle \rangle$  due to a type mismatch, the NP object needs to move covertly at LF to a higher position and creates an abstraction over individuals<sup>12</sup>. When the landing site of the movement is in a position c-commanded by negation, disjunction/conjunction will have narrow scope with respect to negation in interpretation; otherwise, when the movement targets a position c-commanding negation, the respective wide scope disjunction/conjunction interpretation will be generated. Let me use a simple sentence as in (16) to demonstrate this point. The two ways of interpretation are illustrated in (17) and (18), respectively<sup>13</sup>.

(16) Bill didn't call John or Mary.

(17) Narrow scope disjunction interpretation

a. LF after QR: not  $[[\text{John or Mary}]_i \text{ Bill called } x_i]$

b. Semantic translation:  $\neg[(\lambda P[P(j) \vee P(m)])(\lambda x [\text{call}(b, x)])]$   
 $= \neg[\text{call}(b, j) \vee \text{call}(b, m)]$

c. Paraphrase: It is not the case that Bill called either John or Mary.

(18) Wide scope disjunction interpretation

a. LF after QR:  $[\text{John or Mary}]_i [\text{not Bill called } x_i]$

b. Semantic translation:  $\lambda P[P(j) \vee P(m)](\lambda x [\neg[\text{call}(b, x)]])$   
 $= \neg[\text{call}(b, j)] \vee \neg[\text{call}(b, m)]$

c. Paraphrase: Bill didn't call John or Bill didn't call Mary.

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<sup>12</sup> Alternatively, according to the type ambiguity approach to verbs in Partee & Rooth (1983), the verb can be promoted to a higher type to resolve the type mismatch with the conjoined NP object.

<sup>13</sup> The two LF forms here focus on the relative hierarchy of the relevant constituents and ignore the details of the syntactic structures.

This mechanism provides two ways of analyzing Neg...Disjunction and Neg...Conjunction sentences and in principle allows scope interaction of negation with disjunction and conjunction in the object position. Without other constraining factors, Neg...Disjunction and Neg...Conjunction can be compatible with two interpretations, as in languages like English. In languages where not both interpretations are allowed, there are presumably some factors specific to those languages that exclude one of the interpretations. For example, the obligatory wide scope disjunction interpretation of Neg...Disjunction (the WSD) in Japanese and the obligatory wide scope conjunction interpretation of Neg...Conjunction (the WSC) in Japanese and Chinese could be attributed to language-specific properties of the relevant lexical items that correspond to disjunction and conjunction<sup>14</sup>. Szabolcsi (2002) proposed that the disjunction word *vagy* in Hungarian, which does not invoke the “neither” interpretation (the NSD) when it conjoins two NPs in the object of a simple negated sentence (i.e., Neg...Disjunction), is a positive polarity item (PPI) like *some* in English and cannot be interpreted in the scope of local negation. Therefore, the WSD of Neg...Disjunction is forced in Hungarian. She speculated that the polarity sensitivity of disjunction words like *vagy* in Hungarian could possibly correlate with whether the lexical item can bear stress, specifically, if the lexical item cannot be stressed (like *vagy*), it cannot scope below negation<sup>15</sup>. Goro & Akiba

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<sup>14</sup> Another possibility is to relate the interpretive contrasts to the different behavior of negation in different languages. However, the facts in Chinese seem to refute this possibility. If the behavior of negation is responsible for the interpretive contrasts, we would expect Neg...Disjunction and Neg...Conjunction in all languages to show the same interpretive pattern. But Neg...Disjunction in Chinese allows both interpretations, while Neg...Conjunction only allows one.

<sup>15</sup> Szabolcsi also noted that this correlation might be weak to account for the cross-linguistic contrasts.

(2004a), Goro (2004), Goro (2007), extended Szabolcsi's PPI view to the behavior of disjunction word *ka* as well as conjunction word *mo...mo...* in Japanese<sup>1617</sup>. In this dissertation, I assume with them – ignoring the details of the PPI analysis – that the conjunction word *he* in Chinese is also a PPI and must be interpreted outside the scope of negation, so that the narrow scope conjunction interpretation of Neg...*he* (the NSC) is ruled out.

## 1.2 When logical expressions meet pragmatics

In natural settings, sentences in human languages are always used in communicative contexts. When speakers communicate, they presumably observe some basic principles and hold a series of common assumptions about how the communication should proceed (Grice 1967, 1975, 1989). Expressions involving logical expressions are also subject to this generalization. In this section, let us take a look at how pragmatic principles affect the overall meaning of logical expressions such as negation and disjunction and how the use of sentences containing these expressions is regulated by pragmatic considerations.

Grice (1975, 1989) named the general principle communication participants follow as *the Cooperative Principle*: “make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange

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<sup>16</sup> But, see Szabolcsi (2004) and Szabolcsi & Haddican (2004), who argued for different origins of the behavior of *es* (conjunction in Hungarian) vs. the behavior of *vagy* in negative context.

<sup>17</sup> These authors provided a syntactically driven movement analysis for the obligatory wide scope disjunction/conjunction interpretation of Neg...Disjunction and Neg...Conjunction. According to them, the lexical item *ka* and *mo...mo...* in Japanese have an uninterpretable feature [+PPI], so that they have to move into a functional projection higher than negation to have this feature checked.

in which you are engaged” (Grice 1989: 26). Grice then specified four categories of sub-principles, or, Maxims, that constitute the general principle, as stated below (Grice 1989: 26-27)

- (19) a. *The Maxims of Quantity*:
- i. Make your contribution as informative as is required (for the current purposes of exchange).
  - ii. Do not make your contribution more informative than is required.
- b. *The Maxims of Quality*: Try to make your contribution one that is true.
- i. Do not say what you believe to be false.
  - ii. Do not say that for which you lack adequate evidence.
- c. *Maxim of Relation*: Be relevant.
- d. *Maxims of Manner*: Be perspicuous.
- i. Avoid obscurity of expression.
  - ii. Avoid ambiguity.
  - iii. Be brief (avoid unnecessary prolixity). Be orderly.

These maxims and their interactions are meant to explain various pragmatic phenomena. Neo-Griceans (e.g., Horn 1972, 1984a, 1989; Gazdar 1979a; Levinson 2000a; among others) have made different attempts to improve the classical Gricean paradigm with different degrees of success. I sometimes will refer to some of those contributions, especially, by Horn. This dissertation works within the basic Gricean/Neo-Gricean framework and set the controversies aside.

### 1.2.1 Pragmatic use of disjunction

The operation of the conversational maxims determines what a speaker can appropriately utter depending on the discourse context and subscribes felicity conditions to certain expressions<sup>18</sup>. Let us first look at the case of disjunction to see how its felicitous use is regulated by these principles.

A simple affirmative sentence with a disjunct NP object can be uttered, such as the English sentence in (20), has a basic meaning of  $Pa$ , or  $Pb$  or  $Pa \wedge Pb$  (in this case: John ate the apple, or John ate the orange, or John ate both the apple and the orange). This meaning derives from the inclusive-*OR* property of the disjunction word *or*, namely,  $Pa \vee Pb$  is true when  $Pa$  is true, or when  $Pb$  is true, or when  $Pa \wedge Pb$  is true, as illustrated in the truth table in (21).

(20) John ate the apple or the orange.

(21) Table 4: Truth conditions of disjunction

$Pa$	$Pb$	$Pa \vee Pb$
1	1	1
1	0	1
0	1	1
0	0	0

However, if the speaker knows exactly what John ate and utters (20), her utterance would be infelicitous, though not truth-conditionally incompatible. Depending on the actual fact,

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<sup>18</sup> Originally, “felicity condition” is a term for speech acts, referring to conditions under which certain speech act can be felicitously performed (Austin, 1962). Our use of this term in this dissertation follows the tradition in related experimental research and differs from its standard use. It simply means the conditions of felicitous (appropriate) use.

she could have said one of the sentences in (22), each of which is more specific and informative than (20)<sup>19</sup>. By saying a less informative utterance, the speaker violates the first sub-maxim of the maxims of quantity, i.e., “make your contribution as informative as is required”. On the other hand, if the speaker has completely no idea what John ate, she cannot utter (15), because she does not have evidence that what John ate is something in the {the apple, the orange} set. This would violate the second sub-maxim of the maxims of quality, i.e., “do not say that for which you lack adequate evidence”.

- (22) a. John ate the apple.  
 b. John ate the orange.  
 c. John ate the orange and the apple.

Therefore, a simple disjunctive statement as a description of some past event can only be uttered when the speaker has some information about what happened, but lacks more specific knowledge about what exactly happened. In the above example, when the speaker knows that what John ate is in the {the apple, the orange} set, but she does not

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<sup>19</sup> An affirmative sentence involving a conjunction is more specific/stronger than that involving a disjunction because the former is true in a narrower range of circumstances, as shown in the truth table below. Horn (1972) made use of asymmetric entailment relation to determine the relative scale among related expressions. In this case, based on Horn’s scale, because  $Pa \wedge Pb$  entails  $Pa \vee Pb$ , conjunction is stronger than disjunction.

$Pa$	$Pb$	$Pa \wedge Pb$	$Pa \vee Pb$
1	1	1	1
1	0	0	1
0	1	0	1
0	0	0	0

have further information, her uttering any of the three sentences in (22) would violate the maxims of quality, because she does not have evidence for any of those more specific scenarios. In this case, a disjunctive statement like (20) would be not only felicitous but also mandatory.

Given the felicity condition of disjunction, when a speaker utters sentence (20), she not only conveys the message that she is sure that John ate something in the {the apple, the orange} set, but also implicates the information that she is not in the position to commit to what exactly John ate. Because the speaker does not say any of the sentences in (22), which are more specific alternatives to sentence (20), the hearer, assuming the same conversational principles as the speaker, can conclude that the speaker does not have evidence for which of the three scenarios (corresponding to the three sentences in (22)) is factual, and that a disjunctive statement like (20) is the most informative expression she can truthfully utter. This is an instance of *generalized conversational implicature*, more specifically, *scalar implicature* (Horn 1972, 1989; Gazdar 1979; Hirschberg 1991). The idea is that when a set of expressions form a scale in terms of their informational strength<sup>20</sup>, such as  $(Pa \vee Pb < Pa (Pb) < Pa \wedge Pb)$ , uttering an expression on the weaker end of the scale implicates that the speaker has no evidence that the stronger counterparts are true.

Although disjunction expressions are logically inclusive (“this, that, or both”), as

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<sup>20</sup> It has been debated on what the basis for the “scale” is, see Horn (2007) for a review. Horn (1972) proposed that that scale is based on entailment relation of the relevant expressions.

shown in the truth table in (21), it is observed that they are often associated with some exclusivity ('this or that, but not both'). In the previous example, the sentence in (20) is true if it turns out that John ate both the apple and the orange. However, without knowing this outcome, the hearer will be more inclined to think that the sentence implies that John only ate one of the two things. An example that can better illustrate the exclusivity expressed by a disjunction sentence is given in (23).

(23) Please eat the apple or the orange.

In this case, the sentence clearly implies that the speaker invites the hearer to eat one of the two things, but not both. For if the speaker intended to ask the hearer to eat both fruit, following the maxims of quantity, she would have said (24), which is more specific and stronger than the original sentence. This exclusivity is not logical inference, as it can be cancelled easily. For instance, after uttering sentence (23), the speaker can add sentence (25), explicitly canceling the "not both" exclusivity carried by the previous sentence. And the two sentences in that order express a coherent meaning. We could suppose that speaker says sentence (23) instead of the stronger (24), because she assumes the hearer may not have the appetite to eat both fruit at the time.

(24) Please eat the apple and the orange.

(25) ... and feel free to eat both if you have enough appetite

As early as Mill (1867), researchers have considered the exclusivity invoked by disjunction expressions in natural languages to be conversational in nature. After the development of “Horn’s Scale” (Horn 1972), it is generally attributed to scalar implicature: the exclusivity arises as the result of the speaker’s not uttering the stronger conjunction expression, suggesting that the speaker intends to express that  $Pa$  and  $Pb$  are not both true. So, the exclusivity implicature from disjunction expressions corresponds to the speaker’s knowledge on  $\neg(Pa \wedge Pb)$ . Note, this is different from the kind of implicature we discussed earlier, i.e., that the speaker does not have evidence (at that moment) that both disjuncts  $Pa$  and  $Pb$  are true, which corresponds to the speaker’s uncertainty or lack of knowledge on  $(Pa \wedge Pb)$ . This difference actually reflects some controversies on scalar implicature among pragmatists (See Y-S Lee 1995 and Horn 2007 for detailed discussions on this issue). What does a speaker implicate after all, when he opts for a relative weaker expression instead of a stronger one: her knowledge about the falseness of the stronger expression (e.g., Gazdar 1979), or her lack of knowledge about the truthfulness of the stronger expression (e.g., Soames 1982), or either of these two (e.g., Hirshberg 1991, Horn 1989)? Based on our discussions on disjunction case, it seems both kinds of implicature can emerge, and language users are able to compute both of them and target at the appropriate one depending on the context.

Sometimes, disjunction words are used in a very exclusive way, and the exclusivity seems not “cancelable”. Here is sample scenario.

(26) Context: Ryan participated in two contests of the school games this year: the jumping contest and the running contest. The rule of each contest was that the winner would get a golden star. At the end, Ryan got one golden star. Jenny, a friend of Ryan's, did not know what happened in the games, but she knew which contests Ryan was in and the rule of the contests. When she saw the one star Ryan got, she told her mom about what happened:

(27) Ryan got a golden star. He won the jumping contest or the running contest.

In this case, Jenny intended to say that Ryan won one of the contests and not both, but she was not sure which one he won. So, her use of disjunction here is meant to be exclusive. Based on the rule of the contests, one golden star can only mean winning one contest. It is hard to see how the exclusivity expressed by the disjunction sentence in (26) can be cancelled, since adding something like *and probably he won both* at the end of the above sentence would make the sentence sound illogical. However, in cases like this, the exclusivity still derives from scalar implicature, not because *or* is an exclusive-disjunction word. The disjunction sentence itself is compatible with the inclusive-*OR* meaning, it is the specific discourse context that makes the exclusive implicature actual and limits the interpretation to exclusive disjunction: the speaker's knowledge base assures her that a stronger expression is false.

We have presented how conversational principles operate in speakers' use and interpretation of disjunction expressions and how the overall meaning of disjunction expressions can be affected by pragmatic considerations. Compared to conjunction expressions, which normally assert a proposition with certainty and are the strongest on the relevant scale, disjunction expressions undoubtedly are associated with more complex

conditions of use. Minimally, when used in simple sentences, conjunction does not seem to invoke any necessary implicature, disjunction always does, one way or the other<sup>21</sup>

### 1.2.2 Pragmatic use of negation

Now let us switch to negation, and see how its use and interpretation are governed by pragmatic principles.

In propositional logic, negation is a one-place connective ( $\neg$ ), what it does is to reverse the proposition  $p$  it attaches to into the contrary  $\neg p$ , and  $\neg p$  is true iff  $p$  is not true. In natural languages, negative expressions are still truth-conditionally the opposite of their affirmative counterparts, but they are systematically “marked” in form as well as function (Greenberg 1966, Horn 1989), and their use is much more complex than the latter.

Normally, a negative expression is sound under the premise that its positive counterpart is considered or expected in the communicative background assumed by the conversational participants; while uttering an affirmative expression does not require the negative counterpart being considered in the discourse context. An affirmative statement can be used relatively freely to convey new information the hearer is ignorant of, while a negative statement often contradicts to the hearer’s original belief or expectation (Givón 1979). A concrete example will illustrate this point more clearly.

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<sup>21</sup> The exclusive implicature of disjunction expression can be suspended when disjunction is used as a prediction for instance. But by using a disjunction as prediction, it still implicates the speaker is not in ready to offer a stronger assertion.

(28) Context: Sally went to an Italian restaurant with Kim last night. This morning, Sally told Fred, a friend of both Sally and Kim, about it. And she started the conversation with *Kim and I went to a good Italian restaurant last night*.

At this point, she could utter sentence (29a), simply letting Fred know what Kim ordered, without assuming anything about Fred's belief on Kim's attitude toward tiramisu. Conversely, if she added sentence (29b) to the initial utterance, she was most likely assuming something like Fred knows that Kim likes tiramisu a lot and would probably order it at any Italian restaurant. Her utterance of (29b) is thus a contradiction to Fred's expectation that Kim would order Tiramisu last night.

- (29) a. Kim ordered tiramisu.  
b. Kim didn't order tiramisu.

Our real world is for the most part not dichotomous, so negative statements are prototypically less specific, less informative than positive ones (Horn 1989). For example, (29a) is generally more informative than (29b) given the communicative context, since (29a) specifies what was ordered, while (29b) only mentioned one thing among many others that were not ordered – assuming a good Italian restaurant has a reasonable variety of food selections. So, if there is no other factor, saying what Kim did not order is less informative than saying what she ordered, and thus would be violating the quantity maxims. However, if it was the case that Fred expected Kim to order tiramisu, Sally's

utterance about whether Kim ordered tiramisu would be directly addressing to Fred's expectation, in an effort to observe the maxim of relation. In this case, the set of alternatives Sally could say is {29a, 29b}; and bounded by the maxims of quality, Sally should say (29b). Here, the existence of hearer's positive expectation changes the alternatives the speaker can choose to utter. This may be related to why negative statements normally require some positive expectation.

In the above example, if Sally said (29b), knowing that Fred had no belief about Kim's love of Tiramisu and thus no expectation that Kim would order it last night, she might continue with something like (30), justifying her use of a negative statement as expressing a surprise. In this case, her negative statement directly addresses to her own expectation, thus satisfying the felicity condition of using such a statement.

(30) You know, Kim loves Tiramisu, I thought she would order it.

What if Sally didn't add such a justification? The utterance would sound odd at first, but it would be accommodated if Fred could recognize that Sally's intention with the negative statement is to convey more than just the fact that Kim did not order Tiramisu last night, but it also implicated that Sally expected Kim to order Tiramisu, deriving presumably from her knowledge that Kim loves Tiramisu. In this way, Fred interprets Sally's utterance as expressing a negative proposition plus an implicature of her opposite (positive) expectation.

(31) Fred's reasoning: Given that Sally was with Kim last night in the restaurant, she know what exactly Kim ordered. Sally is a rational person, and the conversation is goal-oriented, so her negative statement must be informative and relevant. The negative statement is relevant in case one of us expected Kim to order tiramisu. Since I (Fred) did not expect Sally to order tiramisu, then Sally must have expected so, and the reason why she had such expectation is probably that she knows Kim loves tiramisu. In this case, Sally's negative statement is informative.

In any case, a negative statement seems to have to satisfy the felicity condition in some way, and thus its positive counterpart always "exists" in some form in the discourse context. Negative expressions are not truth-conditionally harder than positive ones (Horn 1989), but they obviously are associated with more complex discourse conditions and involve more computation complexities.

### **1.2.3 Pragmatic use of Neg...Disjunction**

In the last two sections, we have seen that disjunction expressions and negation expressions both are pragmatically complex. Recall strings in the form of Neg...Disjunction we discussed in section 1.1, which contains both a disjunction word and a negation word, this kind of sentences are expected to be pragmatically complex as well. Note that such a string potentially allows two different scopal relations between disjunction and negation to derive two interpretations, which are subject to different levels of complexities in terms of pragmatic conditions. In what follows, I unpack this issue a little bit.

The truth table in (32) represents the truth conditions of Neg...Disjunction under the two interpretations. In this case, the string represent a case of *privative* ambiguity (Crain, Ni & Conway1994), in that the  $\neg(Pa \vee Pb)$  interpretation (the NSD, “neither”) entails  $\neg Pa \vee \neg Pb$  interpretation (the WSD, “not this or not that”) because the string under the NSD (i.e.,  $S_N$ ), is true in a narrow range of circumstances than when the string is under the WSD (i.e.,  $S_W$ ):  $S_N$  is true only when both disjuncts are false, while  $S_W$  is true when both disjuncts are false as well as when either of the disjuncts is false. This means,  $S_N$  is stronger and more specific than  $S_W$ .

(32) Table 5: Truth table of the two interpretations of Neg...Disjunction

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

$S_N$  is logically equivalent to conjunction of two negative propositions and describes a definite scenario. The use of  $S_N$  is bounded by the general conditions of using a negative statement, namely, when the two propositions  $Pa$  and  $Pb$  are somehow expected or considered, so that asserting the contrary is relevant for the communicative purpose. It can be used when what exactly failed to happen is clear to the speaker<sup>22</sup>, who asserts her

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<sup>22</sup> This is a necessity condition, not necessarily a sufficient one in all languages. Neg...Conjunction under the NSD in some languages can be associated with additional pragmatic requirements in its use, e.g., the use of Neg...*he* in Chinese mentioned in section 1. This issue will be addressed more in detail later.

certainty about a given scenario. On the other hand,  $S_W$  expresses inclusive disjunction of two negative propositions. In this case, as per the conditions of using a negation, the speaker should know exactly that something in the discourse-salient expectation failed to occur; while the conditions of using disjunction are satisfied only if the speaker is not sure what specifically happens. So, the discourse requirement from the negation side and that from the disjunction side are somewhat contradictory (Goro 2004, Goro 2007). Therefore,  $S_W$  can only be used when  $Pa$  and  $Pb$  are relevant, and the speaker has some evidence that  $Pa$  or  $Pb$  or both failed to happen, but lacks further evidence for the specifics. The rather complex pragmatic requirement for using an  $S_W$  appropriately means that the discourse context must be particularly suitable for uttering this kind of sentences. From a distributional perspective, presumably,  $S_W$  sentences are less common than  $S_N$  sentences. Moreover, in order for a Neg...Disjunction string to be interpreted the WSD way in a specific instance, the hearer must identify the context as appropriate for uttering a  $S_W$  from the speaker's perspective, which may not align with her own perspective. Compared to the NSD, the WSD is pragmatically more demanding. We will return to this point in chapter 2 when we address the issue of how contextual situations affect the interpretation of Neg...Disjunction.

### **1.3 When children face logical expressions**

Children's knowledge on logical expressions has been extensively studied. Considerable amount of studies have been focused on whether children's semantic knowledge of

disjunction words matches their logical content, i.e., inclusive disjunction. Some researchers (e.g., Braine and Romain 1981) claimed children do not access the full range of truth conditions of natural language disjunctions, rather, they consider disjunction words such as *or* to correspond to exclusive disjunction, which means  $Pa$  or  $Pb$  is true only when one but not both disjunct is true. However, this claim has been vigorously challenged (e.g., Chierchia, Crain, Guasti & Thornton 1998, Crain, Gualmini & Meroni 2000). According to researchers on this side, children's knowledge on the logical property of disjunction words is complete, they can access the full range of truth conditions of disjunction when pragmatic considerations do not restrict the use of disjunction to exclusive disjunction; for instance, when disjunction is used as predictions (e.g., *A or B will do x*) and when disjunction is embedded in conditional clauses (e.g., *if A or B, then C*) and in the nuclear scope of universal quantifiers (e.g., *every A or B did x*). There is also experimental evidence that children sometimes are "more logical" than adults in allowing the inclusive-*OR* meaning, such as, they prefer the inclusive meaning of disjunction in logical reasoning tasks (e.g., Evans & Newstead 1980), and they accept the use of disjunction in situations that is truth-conditionally compatible with disjunction but pragmatically demands a stronger connective (e.g., Gualmini, Meroni & Crain 2003). Based on previous studies on children's semantic knowledge on disjunction, we have reasons to believe that children have no problem computing the truth conditions of disjunction and that their apparent non-adult ways in approaching disjunction, if any, are more related to pragmatic factors.

These studies are more concerned with cases where a single meaning, i.e., inclusive disjunction, is truth conditionally compatible with a number of circumstances, but pragmatically less appropriate under some of the circumstances. The present study looks at children's knowledge of logical expressions from a different angle, namely, when a single string can potentially be associated with different meanings, which are subject to different degrees of pragmatic conditions.

As we described in section 1.1.1, Neg...Disjunction strings are ambiguous in some languages, e.g., English and Chinese, but unambiguous in other languages, e.g., Japanese. Children learning English and Chinese need to learn to assign two interpretations to the same string; while children learning Japanese need to learn to assign one specific interpretation to the target string. If we assume children of different language backgrounds start off with similar general strategies in approaching interacting logical expressions, the question is what children's early state of Neg...Disjunction interpretation is. Hypothetically, it could be one of the three cases in (28):

- (33) i. only the NSD (“neither”)
- ii. only the WSD (“not this or not that”)
- iii. both the NSD and the WSD

Because of the entailment relation the two interpretations of Neg...Disjunction exhibit, some researchers (Goro & Akiba 2004a, Jing, Crain & Hsu 2005) proposed that the initial state of children's grammar must be the first option, attributing to the Semantic Subset

Principle (SSP, Crain, Ni & Conway 1994, Crain & Thornton 1998), which dictates that children start with only the stronger “subset” option in interpreting a string. In the relevant experiments in Goro & Akiba (2004a) and in Jing, Crain & Hsu (2005), Japanese-speaking and Chinese-speaking children were found to reject Neg...Disjunction test sentences in scenarios which made the sentences true under the WSD, while adults accepted the sentences<sup>23</sup>. This was taken as evidence that children at age 4 systematically lack the WSD (the weaker interpretation compared to the NSD), which was argued to reflect the operation of SSP.

SSP was motivated to avoid potential learnability problems children might face when their options of interpretation are in asymmetrical entailment relation: If children start with the more general and weaker superset interpretation, a learnability problem is claimed to occur for children whose local language allows both interpretations, since they will never get linguistic evidence that the stronger subset interpretation is possible, as all the circumstances the string is used intending the stronger interpretation are also truth-conditionally compatible with the weaker interpretation, let us call this the *entailment problem*, following Gualmini & Schwarz (2007). And if children start with both the superset and the subset interpretation, a learnability problem is believed to challenge children whose local language only allows one interpretation (especially the subset interpretation), since they will not be able to purge the other interpretation in lack

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<sup>23</sup> Jing, Crain & Hsu (2005) considered Neg...Disjunction in Chinese unambiguous, allowing only the WSD, just like the Japanese case. However, this is not the right generalization about the facts in Chinese.

of negative evidence, let us call this the *purge problem*. However, as some researchers have argued, these learnability problems may be solved without necessarily invoking the SSP. For example, Gualmini & Schwarz (2007) argued that children facing the entailment problem could conceivably reply on pragmatic knowledge<sup>24</sup> or/and instances involving relevant forms embedded in downward entailing operator<sup>25</sup> to solve it. The purge problem might be solved with the aid of children's general probabilistic learning mechanism (e.g., a Bayesian approach, as in Regier & Gahl 2004; Tenenbaum & Griffiths 2001; etc), which assumes children are sensitive to both presence and absence of relevant data points as distributional evidence to confirm or dismiss their hypotheses (interpretations in this case)<sup>26</sup>, together with their pragmatic knowledge about the appropriate use of the form under the two interpretations – pragmatically speaking, the two interpretations are in complementary relation (Musolino & Lidz 2006). Moreover, the SSP was also challenged by Musolino (2006). According to him, the SSP predicts that children's initial interpretation of sentences that potentially allow two interpretations in

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<sup>24</sup> Pragmatically speaking, when a weaker expression is used, it implicates that the scenario does not correspond to a stronger expression. For instance, *not every horse jumped over the fence* is truth conditionally compatible with the scenario that no horse jumped over the fence, yet, when this sentence is used to describe some event, it implicates that some horses jumped over the fence (i.e., the stronger expression *no horse jumped over the fence* does not hold.; otherwise, the speaker should have used the stronger expression). An ambiguous sentence *every horse didn't jump over the fence* can be interpreted in two ways, parallel to the “not every” expression and the “no” expression, respectively. If children start with only the weaker, “not every”, way of interpreting this kind of sentences, as they master the pragmatic implicature of those sentences under the “not every” meaning, they can learn that the stronger, “no” way of interpreting those sentences are allowed, when they hear those sentences used to describe “no” scenarios.

<sup>25</sup> The entailment relation of the two interpretations of an ambiguous string is reversed when the string is embedded in the scope of a downward entailing (DE) operator. In this case, the original strong subset interpretation becomes the weaker super set option. When children experience the string embedded in a DE environment being used in a weaker way, they have positive truth-conditional evidence for the stronger interpretation of the original string.

<sup>26</sup> This contrasts with a learning mechanism assumed by those who argued for the SSP, which only recognizes presence of data points as evidence to confirm a hypothesis.

asymmetrical entailment relation should always be (only) the subset option, regardless of the syntactic relation of the relevant elements, but this was empirically proved to be not true<sup>27</sup>. Also, Musolino argued that sometimes language learners facing potential semantic subset-superset problems could plausibly arrive at the correct hypothesis about the interpretive option of their local language by relying on syntactic knowledge of the language<sup>28</sup>, so that the SSP is not necessary.

Some experimental findings about children's interpretation of negated sentences containing *every* (e.g., *every horse didn't jump over the fence*) and those containing *some* (e.g., *the detective didn't find some men*) were originally claimed to support the SSP: children at age 4 were found to reject these sentences, when the scenario made the weaker interpretation (i.e., "not every horse jumped over the fence"; "there were some men that the detective didn't find") true (Musolino 1998, Musolino, Crain & Thornton 2000). However, subsequent studies on children's interpretations of these kinds of sentences (e.g., Gualmini 2004; Musolino & Lidz 2006) revealed that children could

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<sup>27</sup> For example, according to Musolino, sentences that contain negation and existential quantifier in subject position such as *Some students can't afford a new car* could in theory be compatible with two interpretations: 1. 'not all', some students are such that they can't afford a new car; and 2. 'none', it is not the case that some students can afford a new car, i.e., no students can afford a new car. The SSP predicts children initially would interpret this sentence the second way, because 'none' entails 'not all'. However, experimental studies such as Musolino (1998, 2001) found out that children strongly preferred the 'not all' interpretation, i.e., the 'superset' option.

<sup>28</sup> Musolino used interpretive contrasts between English and Chinese regarding negated sentences involving universal quantified NP subject as example. While *every...not* sentences in English allow both the 'none' interpretation (*every > not*) and the 'not all' interpretation (*not > every*), the counterpart sentences in Chinese only allows the 'none' interpretation. Musolino argued that this derives from the assumption that subjects in Chinese are base generated in the Spec of IP instead of Spec of VP, thus a copy of the subject containing the universal quantifier in a position lower than negation is absent, so that an interpretation corresponding to negation having wider scope than universal quantifier ("not all") is unavailable. According to him, children learning Chinese can successfully dismiss the "not all" interpretation if they know this independently motivated syntactic property in Chinese, if their initially hypothesis includes both the "none" interpretation and the "not all" interpretation.

access the weaker interpretations, when the contexts set up in the experiments were made more felicitous for these interpretations. These series of studies suggest several things that are relevant to the present discussion: One, children do not necessarily start with just one interpretation of a potentially ambiguous string, and if their grammar allows both interpretations, children could have a preferred analysis. Two, pragmatic factors could affect children's interpretation of ambiguous sentences, and in some cases, the dispreferred interpretation is not observable; therefore, even if children rejected test sentences based on their access to one interpretation in some experiments, this should not be directly taken as evidence that the other interpretation that would make the sentences true is unavailable in their grammar.

Given the above discussions, in the case of Neg...Disjunction, there seems to be no *prima facie* reason to obligate the NSD as the only option at the early stage of acquisition. Because Neg...Disjunction is ambiguous in some languages, restricting the initial interpretation of Neg...Disjunction to the NSD by invoking the SSP does not help. Positive evidence about the WSD would help children learn this interpretation if they do not have it, but this evidence alone does not ban the NSD (e.g., considering English children and Chinese children), so Japanese children (and children of languages alike in this respect) have to learn to get rid of the NSD no matter whether their initial grammar contains the WSD or not. It is thus theoretically plausible that UG provides children with both ways of analyzing Neg...Disjunction sentences and thus the two interpretations, and for some reason, the NSD is uniformly preferred by children of different language

backgrounds. Because of the pragmatic complexities tied with the WSD, accessing this interpretation requires that children can effectively integrate discourse information; this capacity has been found to be not fully developed in children (Thornton & Wexler 1999; Trueswell, Sekerina, Hill, & Logrip, 1999; Chierchia, Crain, Guasti, Gualmini & Meroni 2001; Noveck 2001; Gualmini 2004; Musolino & Lidz 2006; Conroy 2008). So children may be stuck with the preferred and pragmatically “easier” interpretation, i.e., the NSD, when presented with a Neg...Disjunction sentence. Therefore, previous experiments might only reveal children’s strong preference toward the NSD rather than their lack of the WSD in general.

Our current experimental studies explore the possibility that children at age 4 have both interpretations of Neg...Disjunction available. In our experiments, we manipulated experimental factors to further facilitate the WSD and tried to reveal children’s knowledge of this interpretation. The facilitation attempts in our experiments aimed to aid children’s pragmatic computation involved in accessing and settling on the WSD. This was inspired by the findings of some studies I just mentioned on children’s interpretation of privative ambiguities involving negation and quantifiers (e.g., Gualmini 2004; Musolino & Lidz 2006), which proved that children are somewhat sensitive to pragmatic facilitations for certain hard to access interpretations. If children could access the WSD after all, this would empirically challenge a deficient grammar view on children’s interpretation of Neg...Disjunction. Furthermore, it would underscore the importance of pragmatic computation in language acquisition, specifically, children’s acquisition of the

full-fledged knowledge regarding the interpretation of interacting logical expressions is tied to the development of their capacity in performing pragmatic computations.

### **1.3 Organization**

This dissertation is organized as follows. Chapter 2 discusses the pragmatic properties of Neg...Disjunction in English and in Chinese under the two interpretations and previous experimental investigations on children's interpretation of Neg...Disjunction in various languages. Using concrete language examples, I specify the relatively complex conditions for the felicitous use of Neg...Disjunction under the WSD ("not this or not that") in general and identify the specific discourse condition associated with the NSD ("neither") of Neg...*huozhe* in Chinese. I try to demonstrate that the interpretation of Neg...Disjunction in a language is related to the interpretation of Neg...Conjunction in the language. Then, by reviewing previous studies on children's interpretation of Neg...Disjunction as well as other constructions involving interacting quantificational elements, I tie the observations in previous studies that children appear to lack the WSD of Neg...Disjunction to the pragmatic complexities associated with this interpretation, children's immature capacity in implementing pragmatic computations, and experimental factors that could contribute to children's behavior. I hypothesize that children's grammar can in principle generate the WSD, but this aspect of children's linguistic competence may be observable only in "ideal" discourse contexts where their pragmatic computations toward the WSD are highly facilitated. This motivates our current experimental

investigations, which focused on assessing children's interpretation of Neg...Disjunction in discourse contexts conducive for the WSD. The experiments are reported in chapter 3 and chapter 4. Chapter 3 first presents two parallel target experiments on children's and adults' interpretation of Neg...Disjunction in English and in Chinese, respectively. In these two experiments, extra attention was paid to accommodating the pragmatic complexities of the WSD, using novel manipulations of the task and conditions. The critical manipulation involved making the aspect of the contextual information that corresponded to the WSD ("not this or not that") directly relevant, so that children might be able to utilize this information in computing the pragmatic considerations associated with the WSD. The findings of our experiments showed that both Chinese children and English children are able to access the WSD, contrary to what previous studies concluded. The experimental results also demonstrate English-speaking adults' knowledge of WSD, empirically challenging the dominating view in the literature on the interpretive pattern of Neg...*or* in English, i.e., that the WSD is unavailable. This chapter also reports two parallel control experiments on children's interpretation of disjoined negative expressions (Neg...Disjunction...Neg) in the two languages. The results revealed children's non-adult behavior in this respect. In addition, one other control experiment is included in this chapter, which tested Chinese children's interpretation of Neg...*he* (conjunction) and observed adult-like pattern of children's responses. Chapter 4 documents two follow-up experiments on Chinese children's knowledge of the WSD of Neg...*huozhe* (disjunction). Both experiments had children experience some related forms before presenting them

with Neg...*huozhe* sentences and targeted at observing the potential priming effect prior experience with those specific forms could have on children's interpretation of Neg...*huozhe* sentences. In the first priming experiment, children first heard Neg...*huozhe* sentences with a disambiguating clause meaning "I don't know which he didn't do" added to the end used to describe "not this or not that" scenarios. We discovered that the explicit disambiguating clause, which directly revealed the speaker's intended meaning, helped children accept Neg...*huozhe* under the WSD more often. After this experience, children were found to access the WSD of plain Neg...*huozhe* sentences more often in contexts where normally no children access the WSD. This suggested that prior experience with disambiguated Neg...*huozhe* sentences under the WSD activated the linguistic representation corresponding to this interpretation and made children more sensitive to the "not this or not that" aspect of the contextual information, which primed children to compute the truth conditions and use conditions of later Neg...*huozhe* sentences under the WSD and consequently improved their access to the WSD. The second priming experiment first presented children with Neg...*he* (conjunction) sentences used in some contexts, which they uniformly interpreted as "neither"; then these children were given Neg...*huozhe* sentences to evaluate in similar contexts. The results of this experiment showed that prior experience with the form-meaning pairing between Neg...*he* as well as the appropriate use of Neg...*he* relaxed children's adherence to the NSD of Neg...*huozhe* (meaning "neither") and enhanced their access to the WSD of Neg...*huozhe*. This suggested that children are in principle able to compute the

relation of alternative forms, but they must be able to recognize the relevant alternatives first; experience with the alternative form right before encountering the target form facilitated children's computation of the relation of the two forms. Chapter 5 contains general discussions on the main issues relevant to the experimental investigations reported in this dissertation and concluding remarks.

## **Chapter 2: Neg...Disjunction from a pragmatic perspective**

Children as language learners sometimes show non-adult behaviors in producing and comprehending certain constructions in their language. Their non-adult behaviors could come from grammatical deficiency, parsing limitations, immature discourse abilities, etc., or a combination of multiple factors. When we observe that children behave differently from adults in some respect, we try to identify the major factor or separate different factors that influence the observed discrepancies. In terms of the interpretation of negated sentences with a disjunction object (Neg...Disjunction), the observation is that children of different languages all access the narrow scope disjunction interpretation (NSD), no matter whether this interpretation is licit in their respective languages, and that they seem to resist the wide scope disjunction interpretation (WSD) even if their adult cohorts accept it. Facing this kind non-adult behavior in children, we could argue that children in principle have a deficient grammar which limits their analysis of Neg...Disjunction to one single representation. But when we look at the interpretation children generally resist in experimental settings, i.e., the WSD, we can see that this interpretation is subject to much more complex discourse conditions than the NSD. This complicating factor has to be taken into consideration when we evaluate children's grammatical knowledge of Neg...Disjunction. This chapter tries to spell out the pragmatic factors that influence the interpretation of Neg...Disjunction in English and Chinese and also looks at experimental studies on children's interpretation of Neg...Disjunction from a pragmatic perspective.

## **2.1 Pragmatic factors involved in interpreting Neg...Disjunction**

In case a single string can be interpreted in different ways, which of the available interpretations is accessed and evaluated in a given context, can be dependent on different factors. Given that speakers tacitly assume the general communication principles (Grice 1989), they should strive to be reasonable and rational in a conversation, and they also presume their interlocutors to be the same. This means, generally and ideally, when we hear an ambiguous expression being uttered, we should resolve the ambiguity toward the interpretation that makes the speaker most reasonable given the context, which is often referred to as “principle of charity” (Wilson 1959, 1970; Quine 1969; Davidson 1984). Nonetheless, ambiguity resolution does not seem to be always straightforward. In some cases of ambiguity, the different interpretations are relatively equally accessible to speakers, and the context can by and large determine which interpretation is more likely to be targeted. In some other cases, certain ambiguous constructions have a default interpretation, due to language-specific idiosyncrasy or general processing constraints or pragmatic considerations (or whatever other reasons), then the strength of the contextual support is critical for speakers to opt out of the default and entertain other possibilities. And there are other factors in communication situations that could potentially interfere with the charity principle, misinterpretation is not uncommon. Different speakers may perceive a given context differently, thus have different assumptions about which interpretation of an ambiguous string is relevant or more likely. Moreover, when the

individual maxims and sub-maxims of conversations are concerned, they are sometimes in competition – in case of ambiguity, for instance, the “avoid ambiguity” sub-maxims and “be brief” sub-maxims are often in conflict, speaker’s adherence of the general cooperation principle involves complex interactions among the maxims. Because individual speakers may employ different strategies in making decisions to generally follow the conversation principles in specific context, this also leaves room for misalignment of interpretations among different conversation participants. Furthermore, sometimes speakers may use a form that is ambiguous in the language without recognizing its potential ambiguity at the time of utterance and does not take the perception of the hearer into consideration in planning her utterance (Albritton, McKoon & Ratcliff 1996). In this case, the hearer could misunderstand the speaker’s intended message, because she assumes the speaker to be an ideal interlocutor, while the speaker actually fails to be so.

Despite all these complications, it is important to acknowledge that the kind of context in which an ambiguous string is uttered plays a significant role in ambiguity resolution. As I introduced in chapter 1, Neg...Disjunction in English and Chinese are ambiguous. And I also mentioned in section 1.2.3 that the WSD is subject to more complex conditions of use than the NSD in general. In this section, let us look at the two interpretations of Neg...Disjunction in the two languages more closely and see how contextual differences affect the naturalness and accessibility of each interpretation. At the same time, because Neg...Disjunction and Neg...Conjunction are logically related

and are sometime synonymous, it is worth examining the interpretation and the use of the two forms side by side and see how speakers' interpretation of one form might affect their interpretation of the other.

### **2.1.1 Neg...*or* and Neg...*and* in English**

Neg...*or* in English is by default interpreted as having a “neither” meaning (the NSD), and this form is also the natural and standard way to express a “neither” meaning in English. The “not this or not that” reading (the WSD) of Neg...*or* is highly dispreferred and mostly only emerges when the contextual situation offers strong conducive clues for such meaning. The WSD is pragmatically more complex, and circumstances corresponding to such meaning are also rarer. The underlying reason why the WSD is pragmatically complex is because it corresponds to two disjoined negative propositions. And this is directly related to the fact that negative statements are general more complex than positive ones, and disjunctions are pragmatically more demanding than conjunctions. While sentence (34) (due to Wason 1972) and (35) have the same truth condition, the negative sentence in (34) feels harder to evaluate than the affirmative sentence in (35). In a situation where the department hired a syntactician and a phonologist, both (36) and (37) are truthful descriptions, but the disjunction sentence (36) does not feel appropriate in this context.

(34) 5 is not an even number.

(35) 5 is an odd number.

(36) The department hired a syntactician or a phonologist.

(37) The department hired a syntactician and a phonologist.

It is obvious that conversations demand more than just being truthful. A Neg...Disjunction sentence under the WSD,  $S_w$ , normal needs to satisfy at least the following conditions of use:

(38) a. *Uncertainty*

The speaker does not know which disjunct is (or both are) false.

b. *Evidence*

The speaker has evidence that (at least) one of the disjuncts is false.

c. *Relevance*

Among the alternatives, disjoined negation is most relevant to the current communicative purpose.

These conditions of using an  $S_w$  felicitously are specifically tied to the conversation maxims that underlie successful communications among reasonable speakers. The “uncertainty condition” is traced back to the maxim of quantity, which dictates the speaker to use a form alternative to  $S_w$  which expresses a more specific message (and hence being more informative), if she is certain about which disjunct is false or knows that both disjuncts are false. The “evidence condition” derives from the maxim of quality, which obligates the speaker to use  $S_w$  only when it can reasonably be truthful given the information provided by the context. The “relevance condition” pertains to the maxim of relation, which requires that the speaker uses  $S_w$  under the circumstance that the

proposition it denotes is conceivably more relevant to the direct communicative goal than other propositions she could have conveyed<sup>29</sup>. Because these conditions do not involve any language-specific requirement, they apply to Neg...Disjunction under the WSD cross-linguistically. In what follows, let us first look at how satisfying vs. not satisfying these conditions can affect how Neg...Disjunction is interpreted by speakers with concrete examples in English.

As the truth table of the WSD of Neg...Disjunction shows, it corresponds to inclusive disjunction of two negated propositions. This means, truth-conditionally, an  $S_W$  can describe some situation where at least one of the disjuncts is false. The sentence in (40) represents a case where an  $S_W$  can be used this way.

(39) Table 6: Truth table of the WSD

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

(40) It's so cold here. I guess they didn't close the window or the door.

Here, the sentence is compatible with the WSD, which means, the speaker speculates that the reason why it is cold there is because some people didn't close the window or didn't

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<sup>29</sup> For instance, a  $\neg Pa \vee \neg Pb$  scenario sometimes is also a  $Pa \vee Pb$  scenario – when exactly one of the two disjuncts is true and the other one is false; in this case, an affirmative disjunction sentence is an alternative to  $S_W$ .

close the door or didn't close either. In this case, the speaker is offering a speculation (with the explicit use of *I guess*), this satisfies the uncertainty condition of using an  $S_W$ . Based on our real-world knowledge, not closing just one of the two things (the window and the door) in a cold winter day is normally sufficient to cause chilliness in the room. The speaker presumably uses this piece of real-world knowledge as basis of her speculation, which satisfies the evidence condition of using an  $S_W$ . In this scenario, when chilliness is concerned, the cause for this outcome is "didn't close something", so not closing the window and not closing the door are more relevant than closing the window and closing the door; and because the speaker presumably does not have direct evidence that neither is closed, she expresses a relatively weaker speculation, namely, at least one thing was not closed, but she does not exclude the possibility that both the window and door were left open. Here, the relevance condition of using an  $S_W$  is also satisfied. Theoretically, the WSD of this sentence is naturally appropriate in this context. On the other hand, the above context is also compatible with the NSD, with which the speaker offers a strong speculation: because it's very cold here, both the door and the window must have been left open. In this case, the speaker might perceive an extreme degree of chilliness, which she believes demands for a stronger cause. Presented with such a sentence, different speakers may end up choosing different interpretations. As Neg...*or* has the default NSD interpretation, some speakers can choose to stick to this interpretation and interpret the sentence as a strong speculation. Other speakers, recognizing that the context is clear enough to pragmatically "license" the WSD, can

choose to interpret the sentence as a weaker speculation.

However, if the same Neg...Disjunction sentence is used not as a speculation, rather as an explanation of why it is cold there, as in (41), the WSD is no longer an appropriate interpretation, and a reasonably speaker uttering this sentence should intend with the  $S_N$ . Here, the use of an expression like *no wonder* signals the speaker's certainty about the cause of the chilliness and is in the position to offer an explanation. This undermines the possibility of uncertainty. As the speaker is certain about what happened, assuming she follows the maxim of quantity, she should not use the weaker  $S_W$ , because the  $S_N$  is more specific. In this context, the conditions for using an  $S_W$  are not met, so the Neg...Disjunction sentence conveys a definite description of some (negative) event.

(41) No wonder it's so cold here. They didn't close the window or the door!

As illustrated in the truth table below, the NSD (i.e.,  $\neg(Pa \vee Pb)$ ) and the WSD (i.e.,  $\neg Pa \vee \neg Pb$ ) of a Neg...Disjunction sentence are in asymmetrical entailing relation, namely, every circumstance where the NSD is true, the WSD is also true, but not vice versa. In order to clearly demonstrate the contrast between the two interpretations, it is more convenient to use contexts where one interpretation is true and the other is false, namely, when only one disjunct is false. In this case, the NSD is false, while the WSD is true; and the  $S_W$  is used in an "exclusive" way, delivering a "not this or not that, but not both" meaning.

(42) Table 7: Truth table of the NSD and the WSD

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

It is worth noting here that the exclusive way of using  $S_W$  should not be confused with the disjunction word being exclusive-*OR*. An  $S_W$  always corresponds to inclusive disjunction underlyingly, but it can be used in exclusive contexts. Let us look at a case of this kind.

(43) Context: John is a freshman. He registered for several courses last semester. Among these courses, he found physics and chemistry very challenging. After the semester ended, John's friend Peter accidentally heard that that John got an F last semester. He said to himself:

(44) John got an F last semester. He didn't pass physics or chemistry.

In this scenario, the Neg...Disjunction sentence in (44) must be interpreted as "not this or not that, but not both" in order to be coherent with the context – got an F. The context satisfies the various conditions for using an  $S_W$ : Peter does not know which disjunction is false, because he only heard John got an F, but not specifically which course John failed, hence the uncertainty condition is met. And Peter has some evidence that one of the disjunct is false, because John only seemed to have trouble with these two courses and one F means failing one course, but not both. Furthermore, talking about not passing one

of the two courses is also relevant in the present context, too: the context makes it salient that physics and chemistry are the two courses that are relevant; the fact that the two courses are challenging to John can be associated with the possibility of not passing; and got an F means not passing one course, presumably one of the courses John had trouble with. In this case, the WSD of the Neg...Disjunction sentence is in accord with the context, while the NSD of Neg...Disjunction is incompatible with the fact. By the principle of charity, if we assume Peter is a rational person, his use of Neg...Disjunction should intend the WSD rather than the NSD.

Interestingly, a small change in the context can turn the same Neg...Disjunction sentence anomalous.

(45) Context: John is a freshman. He registered for several courses last semester. Among these courses, he found physics and chemistry very easy. After the semester ended, John's friend Peter accidentally heard that that John got an F last semester. He said to himself:

(46) John got an F last semester. He didn't pass physics or chemistry.

In this scenario, the NSD of the Neg...Disjunction sentence, 'John passed neither course', does not match the fact that he got just one F. Assuming Peter has the normal competence in logical reasoning, if the NSD is what Peter intended, he would violate the maxim of quality, because he is say something he would not believe to be true. The WSD, i.e., "John didn't pass one of the two courses", could in theory be truth-conditionally compatible with the outcome in the context, because it is indeed the case the John didn't

pass one course. And it could be the case Peter is uncertain, and his use of disjoined negation per se could be relevant. However, the context does not provide any reasonable indication that John would fail one of these two courses among the courses he took; rather, the contrary expectation was introduced: John might fail other courses, but he would easily pass these two. Therefore, the evidence condition of using the  $S_W$  in this context is not met. If the WSD is what Peter intended, his conjecture about John's not passing one of those two courses would also violate the maxim of quality, because he does not have any evidence (or clue) for saying so.

Sometimes, although the WSD makes a Neg...Disjunction sentence true given what happened, the use of a Neg...Disjunction sentence feels unjustified. This is also related to the conditions of using an  $S_W$ . Consider a context I mentioned in chapter 1.

(47) Context: Ryan participated in two contests of the school games this year: the jumping contest and the running contest. The rule of each contest was that the winner would get a golden star. At the end, Ryan got one golden star. Jenny, a friend of Ryan's, did not know what happened in the games, but she knew which contests Ryan was in and the rule of the contests. When she saw the one star Ryan got, she told her mom about what happened:

(48) Ryan got a golden star. He didn't win the jumping contest or the running contest.

Here, Ryan was in two contests and would get one golden star for winning one contest. Nothing about Ryan's competitiveness in the contests was explicitly introduced in the context (e.g., he was expected to win both contests), so a normal situation would be assumed, i.e., Ryan tried to win each contest. The outcome is that John got one golden

star, which is evidence that he won one of the two contests, but did not win the other. This satisfies the evidence condition of using the  $S_W$ . Because Jenny does not know what happened exactly in the games, and the outcome does not suggest a definite situation, Jenny is in deed uncertain about what happened. Truth-conditionally speaking, the sentence is true under the WSD. However, in this context, the relevance condition of using the  $S_W$  is not well satisfied. The problem lies in the “polarity” set up in the discourse: Before uttering the Neg...Disjunction sentence, Jenny referred to the golden star Ryan got; normally getting a reward is considered to be positive rather than negative, so it is easily associated with existence of some positive event. Given this, the discourse context is biased toward some “positiveness”, and what is immediately relevant is Ryan’s winning a contest, rather than his losing one. Therefore, a truthful alternative to the  $S_W$ , such as sentence (49), is more relevant. We would expect Jenny to say something like this to inform her mother about what happened.

(49) Ryan got a golden star. He won the jumping contest or the running contest.

In this example, the “positiveness” of the discourse context makes a negative expression sound peculiar. It is presumably not the case that we cannot compute the truth conditions of the  $S_W$ . What is in question here is the appropriateness of using the  $S_W$ . One complicating factor here is that the Neg...*or* sentence is ambiguous, and its default interpretation, the NSD, contradicts to the inferred fact from the outcome. And if the

addressee of the sentence knows nothing about which contests Ryan participated in, the  $S_N$  would be not informative enough, because it doesn't explain why Ryan got a golden star after all. In any case, the Neg...*or* sentence in (48) violates some pragmatic conditions one way or the other and thus feels inappropriate.

The “polarity” of the above discourse context can be altered, which will then make the WSD of the Neg...Disjunction sentence relevant and thus easier to access. For instance, in exact the same context, Jenny can say this:

(50) Ryan got only one golden star. He didn't win the jumping contest or the running contest.

Jenny's use of *only* here is crucial in pragmatically facilitating the WSD. *Only* identifies the focus of the lead-in sentence, which is *one*, and invokes a contrast set (i.e., “two” here). So, the *only* sentence not only says Ryan got one star, it also asserts that Ryan didn't get two stars. This makes Jenny's expectation that Ryan would be likely to win both contests apparent and expresses some degree of disappointment. Because Jenny's disappointment is caused by Ryan's losing one contest, some “negativeness” is introduced into the discourse context. In this case, Ryan's not winning one of the two contests can be immediately relevant, which satisfied the relevance condition of using the  $S_W$ . Although the Neg...*or* sentence remains the same in (49) and in (50), because it is used felicitously under the WSD in (50), but not in (49), the WSD is easier to access in (50).

Because of the ambiguity of Neg...*or* in English, the dispreferred reading of such a sentence, the WSD (“not this or not that”), is often expressed with unambiguous alternatives, i.e., sentences with disjunction overtly joining two negated IPs or negated VPs (Neg...Disjunction...Neg)<sup>30</sup>, as exemplified in (51a) and (51b), respectively. This can be seen as the speaker’s effort in following the sub-maxim of the maxim of manner, i.e., “avoid ambiguity”.

- (51) a. Ryan didn’t win the jumping contest, or he didn’t win the running contest.  
b. Ryan didn’t win the jumping contest or didn’t win the running contest.

In context (47) for example, Jenny can say (52) with Neg...*or*...Neg, which has exactly the same meanings as (48) when Neg...*or* is interpreted as the WSD. The utterance in (52) still feels somewhat awkward, but it is relatively easier to reconcile the mismatch between the polarity of the discourse context and the polarity of negative sentence. Because the hearer is forced to access the “not this or not that” meaning of the sentence, she may be able to accommodate the infelicity of using such a sentence by assuming Jenny’s utterance as implicating that she expected Ryan to win both contests.

- (52) Ryan got a golden star. He didn’t win the jumping contest or didn’t win the running contest.

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<sup>30</sup> Or, both cases involve coordination of two negated IPs, while in the latter case the second disjunct contains an unpronounced subject. For simplicity and clarity, I will keep calling sentences like (51b) “disjunction of negated VPs”, “coordination of disjoined negated VPs”, etc.

As we can see, these unambiguous alternatives are not as brief as a Neg...*or* sentence in form, and thus to some extent violate another sub-maxim of the maxim of manner, i.e., “be brief”. In this case, there exists some tension between following these two sub-maxims at the same time. When the speaker chooses which form to use in a “not this or not that” situation, he has to evaluate which sub-maxim should take precedence in the specific context. If the context is such that the hearer is very likely to be confused by the ambiguous Neg...*or* sentence (as in the “got a golden star” case), the speaker will use an unambiguous but more prolix form; and if the context is clearly conducive for the WSD (as in the “got an F” case), the speaker will tend to use a more concise form.

In English, a Neg...*or* sentence can be disambiguated with an added *I don't know (I don't remember / I am not sure / I can't recall, etc.)* which clause at the end, which explicitly identifies the WSD as the intended meaning. In the example below, speaker A asks whether speaker B knows which kind of food Kate can't eat, speaker B uses a Neg...*or* sentence, but he is not certain which of the two kinds food Kate can't eat. In order to make this point clear and avoid potential confusions, he adds the *I don't know which one exactly* clause at the end. Because his utterance with Neg...*or* addresses to A's “do you know...” question, it is prone to be interpreted as a piece of definite epistemic knowledge, i.e., the “neither” reading. Since this is not what speaker B intends, he clarifies the potential confusion by adding a disambiguating clause at the end, explicitly expressing his uncertainty about which one exactly Kate can't eat, although he has evidence to believe it is one of the two he mentions.

- (53) A: Kate is allergic to one kind of food. Do you know what she can't eat?  
B: She can't eat nuts or dairy products, but I don't know which one exactly.

Adding a disambiguating clause at the end of an ambiguous sentence can be seen as the speaker's attempt in compensating for his initial violation of the "avoid ambiguity" maxim. In this case, "I don't know which" not only forces the WSD reading of the preceding clause, it also confirms the exclusive implicature of the disjunction clause, i.e., "not this or not that, but not both". With the presence of this kind of disambiguating clause, the WSD of Neg...*or* is easier to access (Han & Romero 2004).

Having discussed the interpretation and the use of Neg...*or*, let us now shift to Neg...*and*. The default interpretation of Neg...*and* in English is believed to be the narrow scope conjunction interpretation (NSC), which expresses a "not both" meaning. Logically speaking, this interpretation is equivalent to the wide scope disjunction interpretation of Neg...*or* (the WSD). But when pragmatic use is concerned, it appears that the contexts where the Neg...*and* under the NSC is felicitously used does not overlap exactly with where Neg...*or* under the WSD is pragmatically licensed. As I just discussed, using Neg...*or* under the WSD must satisfy the condition of uncertainty. If it is already known which one of the two respective positive disjuncts is false, Neg...*or* under the WSD cannot be used felicitously, because that would violate the maxim of quantify in using weaker form. On the other hand, while Neg...*and* under the NSC can be used in uncertain situations, this form does not seem to be constrained by the uncertainty

condition. To illustrate this point clearer, consider such a scenario.

(54) Context: The linguistics department offers an undergraduate syntax seminar course each semester. The prerequisite for this course is that a student must have taken syntax I and semantics I by the time of registration. Aaron wanted to register for this course this semester, but he got to know that he didn't meet the prerequisite, because he has taken syntax I, but hasn't taken semantics I yet. He told John about this. Mary thought Aaron would register for the seminar but heard that he didn't register at the end. She was curious and asked whether John knows why.

(55) Mary: Do you know why Aaron didn't register for the syntax seminar?

John: Because he hasn't taken syntax I and semantics I.

In this context, John knows exactly that Aaron hasn't taken semantic I. But in answering Mary's question about why Aaron didn't register for the syntax seminar, he chose to use a Neg...*and* sentence. This is in order in this context, because what John is conveying is that Aaron didn't meet the full prerequisite for the seminar, and that is why he couldn't and didn't register for the course. Although John knows which course Aaron hasn't taken exactly, if he says *he didn't take semantics I*, he would not be able to inform Mary about the full prerequisite<sup>31</sup>. His use of Neg...*and* sentence makes it clear that Aaron needed to have taken the two specific courses in order to be able to register for the seminar, and it was simply not the case that he met the requirement, while how exactly he failed to meet the requirement is less relevant. In this context, as the uncertainty condition is not met, a Neg...*or* sentence under the WSD is not appropriate, neither is its unambiguous

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<sup>31</sup> In fact, John could say *he didn't take semantics I* in this context. This would implicate that having taken semantics I is at least part of the prerequisite.

counterpart such as (56). John's answer in (56) is only appropriate if he doesn't know which course Aaron hasn't taken. In a scenario where John indeed doesn't know what Aaron hasn't taken, his answer in (21) with Neg...*and* under the NSD is also valid, as an inferred speculation.

(56) Mary: Do you know why Aaron didn't register for the syntax seminar?  
John: Because he hasn't taken syntax I or hasn't taken semantics I.

From this example, we can conclude that the Neg...*and* under the NSC is subject to less strict conditions of use than Neg...*or* under the WSD, although they mutually entail each other based on their logical relation. This pragmatic difference between the two expressions, together with the default status of the NSC of Neg...*and* in English, presumably restricts the use of Neg...*or* under the WSD and limits the accessibility of this interpretation. In a "not both" situation, the speaker will prefer using a Neg...*and* sentence over a Neg...*or* sentence, because Neg...*or* is ambiguous and has a default interpretation "neither", which is not the intended one, while "not both" is the default interpretation of Neg...*and*, which is as brief as Neg...*or* in form. Therefore, Neg...*and* is generally a better candidate in such a situation<sup>32</sup>. This minimizes potential confusions to the addressee and can be seen as an effort to follow the "avoid ambiguity" and "be brief" sub-maxims. Following this logic, when a Neg...*or* string is presented without

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<sup>32</sup> In a situation where the speaker wants to highlight her uncertainty about which disjunct is false, Neg...*or* under the WSD might be a better candidate than Neg...*and* under the NSC.

clear context, the WSD of *Neg...or* is further inhibited when the hearer compute the relation of the WSD and the NSC: even if the hearer does not immediately assign the NSD to *Neg...or*, she would probably reason that the speaker could have used the better candidate *Neg...and* if she intended a “not both” meaning, so her use of *Neg...or* is more likely to intend a “neither” meaning. Therefore, contextual properties are crucial in licensing the WSD of *Neg...or* in English: roughly speaking, only when the context is clear and “ideal”, this interpretation will emerge.

*Neg...and* under the wide scope conjunction interpretation (WSC) has the “neither” meaning, but it is not the default way to express this meaning in English. Compared to *Neg...or* under the NSD, which also has the “neither” meaning, the use of *Neg...and* under the WSC is relatively limited. For instance, it is often used in an exclusive list situation, as in (57), due to Szabolcsi & Haddican (2004)<sup>33</sup>. In this case, the sentence means Mary took neither hockey nor algebra.

(57) Of the courses on the list, Mary didn't take hockey and algebra.

So far, we have seen that truth-conditionally equivalent logical expressions in English are not necessarily used in the same contexts. Different forms are subject to different discourse conditions, which are caused by general pragmatic factors and/or language-specific choices. In addition, the accessibility of a particular interpretation of

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<sup>33</sup> But Szabolcsi and Haddican (2004) have a different view on the “neither” interpretation of *Neg...and*, specifically, according to them, *and* is not used in a Boolean way in this kind of cases.

one ambiguous string is influenced not only by the discourse conditions that interpretation is subject to, but also by its relation to the alternative interpretation and other alternative expressions. These generalizations also hold in the case of Neg...Disjunction and Neg...Conjunction in Chinese, which I turn to next.

### **2.1.2 Neg...*huozhe* and Neg...*he* in Chinese**

Like Neg...*or* in English, Neg...*huozhe* in Chinese is also ambiguous. But unlike Neg...*or*, neither interpretation of Neg...*huozhe* is treated as the default. Both interpretations are subject to a set of discourse conditions, and speakers rely on the context they perceive or construct to determine which interpretation is more plausible. As I mentioned in chapter 1, I propose that this difference between Chinese and English is related to the idiosyncratic choice the two languages make in naturally expressing a “neither” meaning.

While a “neither” meaning is expressed with Neg...*or* by default in English, the same meaning is naturally conveyed using Neg...*he* (conjunction) in Chinese; and Neg...*he* sentences in Chinese only allow this way of interpretation (i.e., “neither”, the WSC). In a context, such as in (58), where someone simply want to convey that what happened is a “neither” situation, this same proposition (59) is expressed in the two languages with different logical connectives, as shown in (60) and (61), respectively. In this context, John’s buying a list of things is expected, so it is felicitous to use negation to talk about things he forgot to buy.

(58) Context: John was supposed to buy a lot of supplies for the party. At the end, he found out that he forgot at least two things, napkins and cokes.

(59) **JOHN DIDN'T BUY NAPKINS AND JOHN DIDN'T BUY COKES.**

(60) John didn't buy napkins or cokes.

(61) Yuehan meiyou mai zhijin he kele.  
John not-PERF buy napkin and coke

In Chinese, Neg...*huozhe* under the NSD is associated with specific condition of use, given in (62). If this condition is not satisfied, a “neither” situation should be described with the default expression Neg...*he*. Given this, when Neg...*huozhe* is used to express a “neither” meaning instead of Neg...*he*, it implicates that  $Pa \vee Pb$  is specifically expected (or relevant). At the same time, in a context where this condition is satisfied, the speaker can still use Neg...*he*, which means he does not think that the “disjunctiveness” of the two positive propositions in the expectation matters to the current purpose.

(62)  $Pa \vee Pb$  is (or can reasonably be) expected (or relevant) in the discourse context.

When it is salient that  $Pa \vee Pb$  would result in some outcome, while the present outcome is the contrary and should be caused by  $\neg(Pa \vee Pb)$ , a Neg...*huozhe* sentence can be used to describe that “neither” situation. For instance, the context in (63) makes it clear that get a raise or get a bonus (i.e.,  $Pa \vee Pb$ ) is the premise for the outcome of John's buying a computer. The present outcome is that John didn't buy a computer, so what happened

should presumably be the premise not being satisfied (i.e.,  $\neg(Pa \vee Pb)$ ). In this context, sentence (64) with Neg...*huozhe* can be used to describe the “neither” situation under the NSD, meaning it is not the case that John got a raise or a bonus. In this scenario, the WSD is truth-conditionally compatible, but because it is clear in the context that John’s not buying a new computer means he got no raise and no bonus, the WSD is less specific than required, so it cannot be what the speaker intends to convey, otherwise she would violate the maxim of quantity.

(63) Context: John would definitely buy a new computer if he got a raise or a bonus. At the end, he didn’t buy a new computer.

(64) Yuehan meiyou nadao jiaxin huozhe jiangjin  
 John not-PERF get raise or bonus  
 “John didn’t get a raise or a bonus.”

Sometimes, when the context is not fully specified, a Neg...*huozhe* sentence can be compatible both the NSD and the WSD, as long as the conditions of use associated with the two interpretations can be reasonably satisfied. Here is an example.

(65) Yuehan meiyou mai diannaoh, shuoming ta meiyou nadao jiaxin huozhe jiangjin  
 John not-PERF buy computer mean he not-PERF get raise or bonus  
 “John didn’t buy a computer, this means he didn’t get a raise or a bonus.”

In this example, the outcome is that John didn’t buy a computer, and the Neg...*huozhe* sentence is trying to give a plausible explanation for this outcome, but it is not exactly

clear what the premise for John's buying a computer is. Given what is said, the premise can reasonably be either of these two: 1. get a raise or get a bonus ( $Pa \vee Pb$ ); 2. get a raise and get a bonus ( $Pa \wedge Pb$ ). These two options make this single sentence compatible with both the NSD and the WSD. If the first case is what the speaker knows, i.e.,  $Pa \vee Pb$  is relevant, then the speaker is certain that the present outcome is caused by  $\neg(Pa \vee Pb)$ , so the Neg...*huozhe* sentence in (65) describes a "neither" situation and implicates that "get a raise or get a bonus" is the premise for John's buying a computer. On the other hand, if the second case is what the speaker knows, then given the outcome, the speaker is uncertain about what exactly happened, but because she knows the causal relation between "get a raise and a bonus" and "buy a computer", she has evidence to infer from the present outcome that what happened is  $\neg Pa \vee \neg Pb$  (equivalent to  $\neg(Pa \wedge Pb)$ ). Because the outcome is "didn't buy a computer", which is negative and caused by some premise not being satisfied, so using negative expression is appropriate here; specifically, given the causal relation, the best guess from "didn't buy a computer" is inclusive disjunction of negative propositions (i.e.,  $\neg Pa \vee \neg Pb$ ). Therefore, the conditions of using Neg...*huozhe* under the WSD are satisfied, so the sentence conveys the "not this or not that" meaning and implicates that the premise for John's buying a computer is "get a raise and get a bonus". In cases like this, the two interpretations are equally available to Chinese speakers, while the English counterpart of this sentence has a preferred reading, which is that John got neither a raise nor a bonus. Because there is no clear evidence for "not this or not that" in this situation, English speakers normally just stick to the default

interpretation of Neg...or.

In the next example given in (66), the actual outcome is that Xiaowang can't see far away. It is reasonable to think that Xiaowang has to wear glasses or contact lenses ( $Pa \vee Pb$ ) in order to see clearly, which conforms to our real world knowledge. This makes the sentence felicitous under NSD. The speaker should intend to convey the “neither” meaning. If the WSD were intended, the sentence would implicate that Xiaowang needs to wear both glasses and contact lenses in order to see far away. But given our real world knowledge, a near-sighted person normally wears glasses or contact lenses, but not both at the same time. So, the speaker is not likely to intend the WSD.

(66) Xiaowang kan bu qing yuanchu, ta meiyou dai yanjing huozhe yinxingyanjing.  
Xiaowang see not clear far away he not-PERF wear glasses or contact lenses  
“Xiaowang can't see far away, he didn't wear glasses or contact lenses.”

When the context satisfies the conditions of use associated with the WSD, a Neg...*huozhe* sentence in Chinese is easily interpreted this way. Here are two sentences translated from the examples I used in discussing the WSD of Neg...or in English, they both are interpreted as “not this or not that”.

(67) Yuehan shang xueqi de-le yi-ge bujige, ta meiyou kaoguo wuli huozhe huaxue  
John last semester get-PERF a-CL fail he not-PERF pass physics or chemistry  
“John got an F last semester. He didn't pass physics or chemistry.”

(68) zheli zhen leng. wo cai tamen meiyou guan men huozhe chuang

here so cold I guess they not-PERF close door or window  
“It’s so cold here. I guess they didn’t close the window or the door”

Because the NSD of Neg...*he* (“not both”) is unavailable in Chinese, there is no equally brief form in Chinese that bears the same logical meaning as the WSD of Neg...*huozhe*. This presumably makes the WSD easier to access in Chinese than in English. And because the NSD of Neg...*huozhe* is not preferred and subject to specific condition of use in Chinese, Chinese speakers are expected to be more willing to access the WSD than the NSD when the discourse context is favorable toward the WSD. This seems to be attested in speakers. For example, sentence (68) in Chinese could in theory also be compatible with the NSD, but then the sentence in Chinese would implicate “close the window or close the door” ( $Pa \vee Pb$ ) is the premise for “not cold”. But given our world knowledge, normally both the window and the door need to be closed in order to assure a “not cold” situation in a cold winter day. Therefore, the context is in favor of a “not closing one” situation, and Chinese speakers clearly prefer the WSD of the sentence.

Like in English, a disambiguating clause<sup>34</sup> can also be added to the end of a

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<sup>34</sup> The disambiguating clause does not have exactly the same form as what is normally used in English (i.e., *but I don’t know which*). This is because Chinese does not seem to have the same sluicing phenomenon as English, especially when the WH element is an argument (as opposed to an adjunct). In Chinese, standard sluicing is not allowed and incurs ungrammaticality, as exemplified in (i). The grammatical counterparts involve “sluicing” with WH element in focus, as in (ii), or full clause without sluicing, as in (iii).

- i. \*Mali jian-le yi-ge ren, dan wo bu zhidao shei  
Mary meet-PERF one-CL man but I not know who  
Lit. “Mary met with someone, but I don’t know who.”
- ii. Mali jian-le yi-ge ren, dan wo bu zhidao shi shei  
Mary meet-PERF one-CL man but I not know be who  
“Mary met with someone, but I don’t know who it was.”

Neg...*huozhe* clause in Chinese to identify that the WSD is intended.

- (69) Xiaoli bu neng chi jianguo huozhe nai zhipin, dan wo bu zhidao shi na yi-ge  
Xiaoli not can eat nuts or milk product but I not know be which one-CL  
“Xiaoli can’t eat nuts or dairy products, but I don’t know which one it is.”

There are also cases where neither interpretations of a Neg...*huozhe* sentence seem to be immediately compatible with the context. For instance, given the context in (70), sentence (71) is peculiar.

- (70) Context: John was supposed to buy a lot of supplies for the party.

- (71) Yuehan meiyou mai zhijin huozhe kele.  
John not-PERF buy napkin or coke  
“John didn’t buy napkins or cokes.”

Here, there is no salient premise-outcome relation in this context, it is not immediately clear how “buy napkins or buy cokes” ( $Pa \vee Pb$ ) is expected or relevant. In this case, if the speaker intends to convey a “neither” meaning, he should use the neutral expression Neg...*he*, which can unambiguously express such a meaning and is equally brief in form. And the WSD is also not immediately felicitous, because it is unclear in the context how the speaker can be uncertain about what John didn’t buy but has evidence that he didn’t

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iii. Mali jian-le yi-ge ren, dan wo bu zhidao ta jian-le shei  
Mary meet-PERF one-CL man but I not know she meet-PERF who  
‘Mary met with someone, but I don’t know who she met with.’

buy at least one thing. In cases like this, if Chinese speakers are forced to assign an interpretation, they are equivocal, depending on what hypothetical situations they can construct, they may choose to favor either interpretation. This contrasts with what English speakers perceive: the English counterpart sentence is natural for English speakers and means “neither”, ordinary speakers would not even think there is another possibility given the context.

As we have seen, both interpretations of Neg...*huozhe* in Chinese are subject to certain pragmatic conditions of use, and neither interpretation has the default status. However, it is worth pointing out that the discourse conditions associated with the WSD in Chinese are “universal”, and this interpretation in different languages is subject to the same conditions. On the other hand, the conditions of use associated with the NSD in Chinese are more “local”, caused by the idiosyncratic property of Chinese that Neg...*he* is the default way to express a “neither” meaning. The situation in English is different. Neg...*or* is the default and natural way to express a “neither” meaning. This makes the NSD of Neg...*or* relatively free of special discourse conditions, while the WSD of Neg...*or* is subject to a universal set of conditions of use. Consequently, if no clear context conducive to the WSD is present, a Neg...*or* sentence is by default interpreted as “neither”. Because of the different status of the NSD in Chinese vs. in English, we expect to observe a difference in the accessibility of the WSD to Chinese speakers vs. to English speakers. This expectation is empirically supported in our experiments, which will be reported in next chapter.

Because the specific discourse condition associated with the “neither” interpretation of Neg...*huozhe* is local to Chinese, children learning Chinese need to specifically learn it. This condition can only be learned when children know to pay attention to the relevant alternatives (Neg...*huozhe* under the NSD vs. Neg...*he*) and notice the differences in their uses in adult language. This means, in the early stage of language acquisition, Chinese children’s knowledge on the NSD of Neg...*huozhe* may not include a clear definition of the specific condition of use. Then, at that stage, Neg...*huozhe* under the NSD and Neg...*he* (under the WSC) can be generally interchangeable for Chinese children, specifically so in comprehension (they may prefer to use Neg...*he* in production for independent reasons); and the NSD of Neg...*huozhe* is pragmatically less constrained for children than for adults. This means, the way Chinese children interpret Neg...*huozhe* can differ from adults. What we are interested in finding out is to what extent children are different from adults, and how we can make them more like adults.

### **2.1.3 Pragmatic computation**

With the discussion of the interpretation and the use of Neg...Disjunction and Neg...Conjunction in English and in Chinese, it is clear that interpreting expressions involving interacting logical words is often influenced by pragmatic factors. In this section, I want to summarize and highlight the pragmatic computations involved in accessing (or inhibiting) the WSD of Neg...Disjunction. Basically, two kinds of pragmatic computation are relevant here; let me present them one by one.

The first kind of pragmatic computation is based on the perception and evaluation of the contextual information, we can call it *local computation*. Because the WSD is subject to a specific set of pragmatic conditions, a Neg...Disjunction sentence under the WSD is felicitously used only when the conditions of use are satisfied. Therefore, in order to disambiguate a Neg...Disjunction sentence toward the WSD, the hearer need to integrate the information she gathers from the context and make sure that the context is pragmatically compatible with the WSD. This requires the hearer to be sensitive to the critical pieces of information in the context and be able to evaluate the context against the discourse conditions associated with the WSD. When the context is impoverished in providing clear clue, the hearer must be able to construct plausible hypothetical situations that fit the WSD in order to opt for this interpretation.

The other kind of pragmatic computation relies on the comparison of relevant alternatives in terms of their appropriate use, let us call it *global computation*. The comparison includes comparing the relation of the two interpretations of Neg...Disjunction as well as comparing the interpretations of Neg...Disjunction with the interpretation(s) of Neg...Conjunction. For English speakers, when a Neg...*or* sentence is presented without a clear context, the NSD will normally be accessed immediately, because it is the default interpretation, and compared to the WSD, the NSD is subject to less complex pragmatic conditions. By assigning the NSD to Neg...*or*, their pragmatic computation is performed at a minimal level, and they do not need to exhaust all possibilities in the context or construct hypothetical situations to make the context

compatible with the interpretation, which would be necessary if they were to assign the WSD to Neg...*or*. And given that there is a better candidate in English to express the “not this or not that” meaning, i.e., Neg...*and*, in a not very clear context, the likelihood of English speakers perceiving Neg...*or* with such a meaning is further reduced. But the situation is different for Chinese speakers. Because neither the NSD nor the WSD is the default interpretation of Neg...*huozhe*, and both are subject to some conditions of use, when Neg...*huozhe* is presented without clear disambiguating context, Chinese speakers will have to accommodate the insufficient felicity in the context this way or the other, if they are to assign a meaning to Neg...*huozhe*. Without the influence from other factors, they are not biased toward either interpretation in this case. So, compared to English speakers, the chance that Chinese speakers can access the WSD is higher, due to lack of the bias toward the NSD. At the same time, because Neg...*he* is Chinese can unambiguously express a “neither” meaning and is also the standard and unmarked way to express such a meaning, if a “neither” meaning is intended, Neg...*he* is generally a better candidate than Neg...*huozhe*. When this piece of pragmatic information is taken into consideration, Chinese speakers are even more likely to access the WSD when they are presented with Neg...*huozhe* and the context does not clearly satisfy the pragmatic condition associated with the NSD. Performing this kind of global computation generally demands the hearer to be able to recognize relevant alternatives and be sensitive to their uses.

While the local computation and the global computation interact with each other in

influencing speakers' interpretation of Neg...Disjunction, ultimately, the local computation needs to be successfully performed for speakers to access the WSD. For Chinese speakers, the global computation of the interactions of the WSD of Neg...*huozhe*, the NSD of Neg...*huozhe* and the WSC of Neg...*he* can be helpful in stimulating the local computation toward the WSD. It is true that the WSD is associated with more complex discourse conditions, which make this interpretation not easy to access; but we have to also emphasize that the difficulty in accessing this interpretation is directly linked to the ambiguity of Neg...Disjunction, so that the local computation is necessary to disambiguate a Neg...Disjunction sentence toward the WSD. If no ambiguity is involved in a sentence, although the felicitous use of such a sentence might be subject to some discourse conditions, accessing its interpretation is less contingent on successful computation of the contextual information with respect to the felicity condition. This is evident in the case of sentences containing disjunction of two negated IPs (i.e., Neg...Disjunction...Neg, such as *Ryan didn't win the running contest or Ryan didn't win the jumping contest*). This kind of sentences have the same meaning as Neg...Disjunction sentences under the WSD and are subject to the same set of discourse conditions. However, even without any context given, competent speakers will not have any problem assigning the "not this or not that" meaning to a Neg...Disjunction...Neg sentence.

Given the pragmatic complexities involved in the interpretation of Neg...Disjunction, as well as children's immature capacity in integrating information from the discourse context (e.g., Chierchia et al. 2001; Noveck 2001; Musolino & Lidz 2002,

2006; Gualmini 2004; Conroy 2008), when we investigate children's knowledge of Neg...Disjunction, we must take children's pragmatic capacity properly into consideration. The questions we can ask include: Do children possess the grammatical knowledge of both interpretations? Do they know the use conditions, if relevant, associated with the two interpretations in their local language? Can children reliably compute the pragmatic information necessary to access the 'harder' interpretation? What could possibly aid children in performing pragmatic computations? Etc. Children's knowledge of Neg...Disjunction can differ from that of adults of their local language, but the difference may demand a grammatical explanation or pragmatic explanation or both<sup>35</sup>, and our task is to identify the right direction in explaining the difference.

## **2.2 Children's knowledge of Neg...Disjunction in previous studies**

A growing body of experimental studies on children's interpretation of Neg...Disjunction have been done in recent years (e.g., Crain, Gardner, Gualmini & Rabbin 2002; Gualmini & Crain 2005; Goro & Akiba 2004a; Jing, Crain & Hsu 2005; Verbuk 2006). It has been shown through previous studies that children of different languages systematically access the NSD of Neg...Disjunction rather than the WSD when they are 4 years old. This means children at age 4 all allow the NSD, despite the fact that this interpretation is unavailable in some languages (such as Japanese). Based on these findings, as I

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<sup>35</sup> These two aspects are most relevant for the purpose of this dissertation. By mentioning them here, I do not limit the possible causes of the differences to only these two. For example, it is conceivable that processing factors may play some role, too.

mentioned in section 1.3, some researchers (Goro & Akiba 2004a, Goro 2004, Jing, Crain & Hsu 2005) proposed that that children's knowledge of disjunction words with respect to negation is parameterized, specifically, the default setting of the relevant parameter is the English way and only allows the NSD. This proposed setting of the relevant parameter is claimed to be constrained by the Semantic Subset Principle (SSP), which forces the initial choice among two options of interpretation to be the one that make the same string true in a subset of circumstances (i.e., only the "stronger" interpretation at the beginning) and allows for revision of the choice based on positive evidence. Whether there is enough valid reason to motivate such a general principle is another issue (but see some arguments against the SSP I mentioned in section 1.3 and the works cited there), but just in case of the ways in analyzing Neg...Disjunction sentences, it seems the SSP is not applicable. As I have presented, Neg...Disjunction in English and Chinese is compatible with both the NSD and the WSD. This means, getting positive evidence that the WSD is possible in a language does not automatically eliminate the NSD. Then the original motivation for restricting children's initial hypothesis to the NSD no longer sustains. In terms of the interpretive options Neg...Disjunction allows, Japanese is a more restrictive case, compared to English and Chinese. And if the relevant parameter is set to the English way as default – thus allowing the NSD way of interpreting Neg....Disjunction, the WSD should be available as well. If the mechanism responsible for the two possible interpretations of Neg...Disjunction (be it QR or conjunction reduction or another kind) is general and provided by UG, then the default interpretation

of Neg...Disjunction just happens to be the English way. Given this reasoning, the two interpretations of Neg...Disjunction should in principle be available to children, unless they have learned language-specific constraints (e.g., the PPI property of certain disjunction words in some languages) that block one of the interpretations.

In any case, it may be too hasty to draw the conclusion from previous studies that children simply lack the WSD in their grammar around age 4. It is possible that their grammar can generate both interpretations at that age, but they strongly prefer the NSD; and because of the pragmatic complexities involved in the use of Neg...Disjunction under the WSD and children's immature capacity in performing the relevant pragmatic computations, this interpretation is often "suspended" and hard to observe in children. Our goal is to exploit manipulations in experimental conditions to explore whether the "absent" interpretation can emerge; and if so, in what kind of circumstances. In this section, I discuss some aspects of the basic experimental framework adopted in the present studies and review some previous studies on children's interpretation of Neg...Disjunction.

### **2.2.1 Some basics about truth value judgment task**

A lot of the experimental studies that investigate children's interpretation of certain constructions are done with the truth value judgment task (TVJT, Crain & McKee, 1985; Crain and Thornton, 1998). Unlike act-out task (Goodluck 1996) or picture selection task (Gerken & Shady. 1996), in a TVJT trial, one specific sentence is presented in a given

context. This allows researchers to manipulate the context into different circumstances across different trials while keeping the test sentence constant. In addition, the test sentence is always uttered by a puppet manipulated by one of the experimenters, children's task is to evaluate whether the puppet says "the right thing", which translates to whether the sentence truthfully describes the relevant circumstances. In this kind of setting, children are less taxed, as they feel they are judging someone else instead of being tested. Based on children's acceptance or rejection of the target sentence in different circumstances, researchers can observe what circumstances are consistent with children's interpretation of the target sentence and derive the range of interpretations children can assign to the target sentence. In case children accept the target sentence in certain circumstance, it is apparent which interpretation children can assign to the target sentence; in case they reject the target sentence in certain circumstance, because the interpretation children assigned to the target sentence by rejecting it is contrary to the present circumstance, so it is still clear which interpretation children can assign to the target sentence. Therefore, the TVJT is useful in showing children's specific interpretation of a target form. For instance, if we want to see whether children interpret sentence (72a) as meaning (72b), we can present the sentence in a scenario where all horses jumped over the fence. If children accept it, this means their interpretation is compatible with a circumstance corresponding to (72b). Alternatively, we can present the sentence in a scenario where most horses jumped over the fence, but there is one horse that didn't jump over the fence, thus, a scenario where it is not the case that every horse

jumped over the fence. If children reject the sentence in this scenario, it also suggests that they assign the interpretation of (72b) to the sentence (72a), because (72b) is the contrary to the present circumstance.

- (72) a. Every horse jumped over the fence.  
b. For all x, such that x is a horse, x jumped over the fence.

However, complications arise when the test sentence involves privative ambiguity. Consider the sentence in (73), which is ambiguous in English and have the two meanings given in (74a) and (74b). The ambiguity is caused by the different scopal relations between the universal quantifier and the negation. In (74a), because the semantic scope relation, i.e., *every > not*, is isomorphic to the surface syntactic relation, i.e., universal quantifier c-commands negation, this interpretation is often referred to as the *isomorphic* interpretation. On the other hand, (74b) involves a semantic scope relation (*every > not*) that is not isomorphic to the surface syntactic relation, and this kind of interpretation is dubbed as *non-isomorphic* or *inverse scope* interpretation.

(73) Every horse didn't jump over the fence.

- (74) a. For all x, such that x is a horse, it didn't jump over the fence.  
b. It is not the case that for all x, such that x is a horse, x jumped over the fence.

The ambiguity exhibited by the sentence in (73) is privative because the two interpretations are in asymmetrical entailment relation: the interpretation in (74a) entails

the interpretation in (74b), but not vice versa, which means in every circumstance where (74a) is true, (74b) is true. Therefore, no matter which interpretation children assign to sentence (73), if the sentence is presented in a circumstance corresponding to (74a), children are expected to accept it, but the acceptance does not show which interpretation they assign to the sentence. Therefore, the only way to possibly determine whether children can assign interpretation (74a) to sentence (73) in a TVJT is to present the sentence in a scenario where (74a) is false while (74b) is true, i.e., some horses jumped over the fence, and some didn't. If children reject (73) in that circumstance, this is evidence that they can assign interpretation (74a) to sentence (73). This is exactly what Musolino et al (2000) showed: children in their experiment consistently rejected sentence (73) in a scenario where not every horses jumped over the fence. Children's rejection of sentence (73) in such a scenario was interpreted by these researchers not only as their access to the isomorphic interpretation, but also as their lack of the non-isomorphic interpretation. Their argument relied heavily on the principle of charity, which is claimed to obligate children to make every effort possible to accept the puppet's utterance (i.e., the test sentence) in a given context, as long as their grammar permits the respective interpretation. Given this assumption, because children in the experiment did not accept sentence (73) in a circumstance where the non-isomorphic interpretation (74b) was true, they should not have this interpretation in their grammar.

It is reasonable to assume the charity principle is generally operating in normal conversation situations, where we assume our interlocutors to be rational and competent

speakers. However, it should also be noted that a TVJT is not a normal conversation situation. Crucially, in a TVJT experiment, in order to make the child subject's rejection of the puppet's utterances possible, the puppet is introduced to the child in a way that it sometimes makes mistakes. In this way, when the child hears an utterance the puppet says, she has the option to think that the puppet said something silly or illogical and reject its utterance. Given this, when a potentially ambiguous utterance is presented to the child, with one interpretation making the utterance true and the other making the utterance false, the judgment the child makes is not necessarily strictly bound by the charity principle. This does not mean they intentionally violate the principle, but, they are not forced to exploit the situational information in the context and entertain all the options of interpretations in making the puppet's utterance true. Sometimes, even if a child's grammar allows more than one representations for a single string, it is possible that she has a preferred way of analysis. In this case, if the context is not conducive enough for the dispreferred interpretation, the child could stick to her preferred way of interpretation and make the judgment accordingly. All these being said, we have to also acknowledge, when both interpretations are more or less equally accessible to children in the TVJT, they indeed tend to give the puppet credit for "saying something right".

Musolino et al.'s (2000) conclusion that children systematically lack the non-isomorphic interpretation of sentences involving negation and quantifiers like (73) has been undermined by experimental findings in subsequent studies on children's interpretation of this kind of sentences (Lidz & Musolino 2002; Gualmini 2004;

Musolino & Lidz 2006; among others). In these studies, children were found to be able to access the non-isomorphic interpretation (e.g., 74b) when contextual properties were manipulated. In one of the manipulation cases (i.e., Musolino & Lidz 2006), the context set up in the test story contained some contrast, e.g., every horse jumped over the log, while not every horse jumped over the fence; and the test sentence in (73) was presented to children with a positive lead-in sentence, as in (75)<sup>36</sup>. The motivation behind this manipulation is that sentential negation is found to be easier to process when a related positive contrast is present, for example, the negative sentence in (76) is easier to evaluate in this context than when it is uttered alone.

(75) Every horse jumped over the log, but/and every horse didn't jump over the fence.

(76) 4 is an even number, and 5 is not an even number.

In this specific experimental scenario, the relevant contrast can be roughly stated as the following: talking about every horse jumping over things, it is the case that each jumped over the log, but it is not the case that each jumped over the fence. Because of the existence of the positive contrast, sentential negation becomes more felicitous and directly relevant, so that the non-isomorphic interpretation, which involves negation having widest scope, is easier to access for children. If we assume pragmatic principles do not add meaning to unambiguous structures (Crain, Gualmini, Meroni 2000), the

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<sup>36</sup> Musolino & Lidz's study (2006) controlled for the factor of using *but* vs. *and* to connect the lead-in sentence and the target sentence and found no difference in children's responses when the two sentences were joined with *but* vs. when they were joined with *and*.

results of these studies mean that children's grammar must be able to generate the non-isomorphic interpretation.

Although experiments employing the TVJT task do not always show the full picture of children's grammatical knowledge, the TVJT is nonetheless a useful tool in investigating children's knowledge about meaning. It gives us the power of manipulating the context, not only truth-condition-wise, but also in terms of pragmatic facilitations. In studying children's interpretation of ambiguous constructions, we can take advantage of pragmatic facilitations to possibly bring out children's dispreferred interpretation. The experiments in the represent studies were all conducted using the TVJT paradigm.

### **2.2.2 Prediction mode**

As discussed earlier, a Neg...Disjunction sentence under the WSD ( $S_w$ ) has to satisfy a set of discourse conditions to be used felicitously. One of the conditions is *uncertainty*, which is directly tied to the felicity condition of using a disjunction expression, as dictated by the maxim of quantity. There are various ways one could be uncertain in this case: for instance, her knowledge about what happened is inferred rather than through direct experience, and the strongest inference she can draw involves disjunction; or she predicts some outcome based on her perception of the relevant circumstance, and she does not have enough evidence to make a stronger prediction than one with disjunction. Therefore, when we want to test speakers' knowledge of the WSD, theoretically, we can present Neg...Disjunction sentences either in an inference situation or a prediction

situation. The TVJT welcomed an addition with the ‘Prediction Mode’ first used by Chierchia, Crain, Guasti & Thornton (1998). These researchers targeted at assessing children’s knowledge of the inclusive-*OR* semantics of disjunction. While disjunction expressions often carry exclusive implicature (i.e., “this or that, but not both”), a prediction situation is one of the environments where the exclusive implicature of disjunction expressions does not arise, so that disjunction is pragmatically compatible with its full range of truth conditions (i.e., inclusive-*OR* as in standard logic). For example, if someone says “I predict A or B”, his prediction is accurate when the actual outcome is A, or B or A and B. These researchers found out that children accepted disjunction sentences as predictions about what would happen when the actual outcome was a “both” scenario, which undermined the conclusions drawn from previous studies that children’s semantic knowledge of the disjunction word *or* in English corresponded to exclusive-*OR* rather than inclusive-*OR* (Beilin & Lust 1975; Braine & Romain 1981, 1983). Although prediction mode seems to be a suitable technique to employ in assessing speakers’ knowledge of the WSD, as I discuss next, it does not serve our current purpose better than description mode incorporating inference situation.

The prediction mode works nicely in studying the inclusive-*OR* interpretation of simple affirmative sentences containing disjunction. Disjunction is linguistically unambiguous, and the “alternative interpretation” (exclusive-*OR*) derives from conversational implicatures, which is suspended in the prediction mode. When a prediction is made with a disjunction expression, the full range of truth conditions of *or* is

preserved, and there is this single set of truth conditions available; and when the outcome is revealed, the subject's task is to evaluate the outcome against the range of truth conditions of *or*. However, in the case of Neg...Disjunction, there are two potential interpretations that derive from linguistic ambiguity<sup>37</sup>. Although a prediction satisfies the uncertainty condition for using negated disjunction sentences under the WSD, it is also compatible with the NSD as a certain predicative assertion. So, when the prediction is made with a Neg...Disjunction sentence, unlike in an affirmation disjunction sentence case, there are two sets of truth conditions potentially available. However, at the time when a prediction is made, the hearer would immediately assign an interpretation to the Neg... Disjunction sentence with the respective set of truth conditions, because she would not assume that the predictor intends more than one meaning with the prediction sentence. In this case, if the WSD is not the preferred interpretation for the hearer, and the context does not clearly satisfies the discourse conditions of the WSD, the hearer has no reason to interpret the Neg...Disjunction sentence as the WSD. When the outcome is revealed, the hearer's task is to compare the outcome against the interpretation she has assigned to the prediction sentence when it was uttered, because that is what she believes the predictor is predicting based on the context at the time of prediction. It is not implausible that she goes back to revise her initial interpretation of the prediction sentence and extend charity to the predictor, but this is not certain. The prediction mode

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<sup>37</sup> The WSD, meaning “not this or not that”, has an independent “alternative interpretation” from conversational implicature, which says “not this or not that, but not neither”. In our experiments, in order to truth-conditionally contrast the WSD and the NSD, we were actually using  $S_w$  in this ‘exclusive’ way.

presumably asks subjects to interpret the ambiguous test sentence twice in two different contexts and assumes that they will adjust the interpretation according to the outcome. But in fact subjects may have settled on one interpretation the first time they hear the test sentence (i.e., at the time of the prediction). Therefore, the prediction mode can add complications to how subjects' responses to the test sentences should be interpreted. Moreover, although prediction mode by default satisfies the uncertainty condition for the WSD of Neg...Disjunction, the context by the prediction time still has to satisfy other conditions of use associated with the WSD in order for a prediction sentence under this interpretation to be felicitous. However, in order to make the Neg...Disjunction sentence compatible with both ways of interpretation at the time of prediction – so that the subject can proceed further, no matter which interpretation she can assign to Neg...Disjunction, the evidence for providing the prediction should be relatively vague in the context. This puts the WSD in a disadvantageous position, because this interpretation needs clearer contextual support. Consider all these factors discussed, prediction mode is not specifically suitable for our current purpose.

There are some studies that use TVJT in prediction mode to test children's interpretation of Neg...*or* in English, which all showed that children can access the “neither” interpretation. Let me review two of them and clarify why the conditions of use associated with the WSD are not satisfied at the time of the prediction in these experiments. In those cases, we would not expect children to access the “not this or not that” interpretation.

Crain, Gualmini & Meroni (2000) used prediction mode to test children's interpretation of Neg...*or*. Their goal was to find out whether children consider *or* as inclusive disjunction or exclusive disjunction. One of their conditions (not the critical condition in their experiment) is relevant to the present discussion. They described a typical trial in their experiment this way:

(77) Experimenter: "This is a story about a gorilla. Kermit, here we have a big gorilla who is very hungry and is looking for food. Here is the food that he can have. We have an onion ring, a strawberry, a potato chip and some fish. I am gonna put the food behind the curtain and I would like you to guess what the gorilla is gonna choose".

Kermit: "Let me see...I don't really know what gorillas like, but I know what they do not like. I think the gorilla will not choose the onion ring or the potato chip".

The experimenter opens the curtain so the child can see what is on the stage.

Kermit: "Was I right?"

(From Crain, Gualmini & Meroni 2000)

In one of the conditions, the child subject was asked to judge whether the prediction *gorilla will not choose the onion ring or the potato chip* was right given the outcome that gorilla chose one thing but not the other. Given what happened, it was the case that gorilla didn't choose one thing, so the prediction was true under the WSD. However, children consistently rejected the puppet's prediction, meaning that they based their judgment on the NSD, rather than the WSD. This is not surprising when we look more carefully at the context set up in the story. Before the prediction was made, the puppet said *I don't really know what gorillas like, but I know what they do not like*. This

confirmed the puppet's knowledge about what exactly gorilla doesn't like. Given this, his prediction about what gorilla would not choose was more likely to be perceived as a stronger, certain assertion, e.g., "gorilla won't choose either, because I know he doesn't like them". At the time of the prediction, the context was salient that the puppet was more likely predict a "neither" situation than a "not this or not that" situation. In this case, the subject would not consider the WSD because the discourse conditions for this interpretation were not clearly met. When the result was revealed, the context at the time of the prediction did not change, i.e., "the discourse conditions for the WSD were not clearly met", so the subject should not be expected to revise the initial interpretation, which could be reasonably evaluated given the outcome, i.e., it was false.

In Crain, Gardner, Gualmini & Rabbin's (2002) study on children's interpretation of Neg...*or*, prediction mode was also used in TVTJ. The goal of their study was to reveal that children's interpretation of sentences containing negation and disjunction is structure-dependent. Let us look at one of their test stories.

(78) "On this trial, children were told a story about two girls who had both lost a tooth. The girls knew that the Tooth Fairy would come during the night and would give them a reward in exchange for their lost tooth. One girl decided to go to bed right away, while the other girl decided to stay up late to see what the Tooth Fairy looked like. Then, the Tooth Fairy arrived, with two jewels and two dimes." (Crain et al. 2002)

At this point, the puppet made a prediction about what would happen using one of the two sentences:

(79) a. The girl who stayed up late will not get a dime or a jewel

b. The girl who didn't go to sleep will get a dime or a jewel.

(80) “As events ensued, the Tooth Fairy gave a dime and a jewel to the girl who was sleeping. The Tooth Fairy was disappointed to see that the other girl was still awake, however. The little girl explained that she had decided to stay up to see what the Tooth Fairy looked like. At the end, the Tooth Fairy decided to give a jewel, but no dime, to the girl who had stayed up late.” (Crain et al. 2002)

The story was designed in this way primarily to make the disjunction sentence (79b) felicitous, but what is relevant to the discussion here is sentence (79a), which is a Neg...*or* sentence. When we look at the details of the story, it is not clear the context set up by time the prediction is made satisfies the conditions of using a  $S_w$  (Neg...*or* sentence under the WSD). This is so exactly because of the reason I mentioned earlier: the contextual evidence for the prediction needs to be vague to some extent, so that both ways of interpreting the prediction are plausible. In the first half of the story, the two girls' expectation was that Tooth Fairy would give each of them a reward. When Tooth Fairy (TF) came with jewels and dimes, since there was no (explicit) expectation that each girls would get more than one thing as reward, the natural inference a story-hearer could draw at this point was that TF would give each girl a dime or a jewel as reward. Given this, the puppet's prediction about the girl who stayed up late with sentence (79a) should be a rejection to “get a dime or a jewel”, which is abstractly  $\neg(Pa \vee Pb)$ , i.e., the NSD of Neg...*or*. The alternative interpretation, the WSD, would be felicitous only if the TF was supposed to give the girls two things as reward and might give partial reward, which was absent in the first part of the story. Given the absence of clear satisfaction of

the discourse conditions for the WSD, upon hearing the puppet's prediction, the child subject would immediately assign the default "neither" interpretation to the *Neg...or* sentence and wait for the outcome of the story to evaluate whether the puppet's prediction was right. In the second half of the story, TF gave the girl who was sleeping two things as reward and partial reward to the girl who stayed up late, which contradicted the story-hearers' original expectation about what TF would give to the girls. However, this already passed the time when the puppet made the prediction and the child subject assigned an appropriate interpretation. Although the puppet repeated his prediction before the child subject made the judgment, the child would not be forced to revise her original interpretation of the puppet's prediction sentence, which was already an appropriate interpretation of *Neg...or*. The problems I addressed here do not intend at opposing Crain et al.'s (2002) finding about children's knowledge of the NSD. But just because children accessed the NSD of *Neg...or* in this kind of scenarios does not entail that they lacked the alternative interpretation in their grammar.

The prediction mode in a TVJT is specifically suitable in revealing children's knowledge of certain expressions that normally carry conversational implicatures. Its applicability to genuine ambiguity cases is limited, especially when the two interpretations are associated with different degrees of felicity requirement.

### **2.2.3 Experiments focusing more on the WSD**

Since the WSD of *Neg...or* in English is not recognized by all linguists and not a

preferred interpretation anyway, researchers investigating children's knowledge of Neg...*or* focused on the NSD and did not expect children to access the WSD. In the relevant experiments, such as the two I just reviewed, the felicity condition of using Neg...*or* under the WSD was actually not satisfied. Therefore, it was not surprising that English speaking children did not access the WSD in those experiments, considering that children are generally believed to be not as good at accommodating infelicity as adults do when dealing with ambiguous forms (e.g., Gualmini 2004; Musolino & Lidz 2006). Unlike the English case, the WSD of Neg...Disjunction is clearly available in a number of other languages, and in some languages, it is the only interpretation. Researchers working on children's interpretation of Neg...Disjunction in those languages have focused more on the WSD and tried different ways to make this interpretation felicitous in the context of the experiments. In this section, I review three studies that investigated children's knowledge on the interpretation of Neg...Disjunction in Japanese, Chinese and Russian, respectively. These studies found similar pattern in children's interpretation of Neg...Disjunction, i.e., they all accessed the NSD instead of the WSD, despite the fact that adult speakers all accessed the WSD and adult Japanese and adult Russian do not allow the NSD. However, when we look at the details of these experiments, we also find interfering factors that could prevent them from showing children's knowledge of the WSD. In light of these experiments, we can explore possibilities in further manipulating the experimental settings to facilitate children's access to the WSD.

The most prominent experimental study in this respect was carried out by Goro &

Akiba (2004a). In their experiment, in order to make the “not this or not that” interpretation of Neg...*ka* (disjunction in Japanese) felicitous, these researchers implemented an ingenious experimental design. Each experiment session contained two subparts. In the first subpart, an “eating contest” was acted out with paper-crafted props. There were 12 animals in the contest, each of which had three pieces of food to choose from, a cake, a carrot and a pepper. While everyone liked the cake, not everyone liked vegetables. So the rule of the contest was set up this way: an animal would be rewarded if he ate some vegetables, a gold medal for eating both vegetables and a blue medal for eating only one; and animals who did not eat either vegetable would get a black cross. The story proceeded as each individual animal made their choice and was labeled with the corresponding reward. After all animals were done with the contest, the experiment moved on to the second subpart, i.e., the testing phase, where the puppet and the child went back to each animal and checked how well they did in the contest. The puppet would provide a guess about what happened to each animal. Crucially, the area where the three pieces of food used to be was covered, even if no food was left there. In this case, as it is impossible for the puppet to remember what choice each individual animal made, the puppet had to infer what the animal ate and didn’t eat based on the kind of reward (gold medal, blue medal or black cross) he got. This naturally satisfied the uncertainty condition and evidence condition associated with the WSD. The critical relevant condition was when the animal got a blue medal, which meant he only ate one of the vegetables (and did not eat the other). In this situation, the puppet would say a sentence

like (81). Then, the ‘food area’ was uncovered, and the animal’s choice became clear; the child would judge whether the puppet was right. While Japanese adults consistently accepted the test sentence in this scenario 100% of the time, Japanese children only accepted it 25% of the time. This means Japanese children judged the test sentences based on the NSD of Neg...*ka* most of the time.

(81) Butasan-wa aoi medaru-wo motteru-yo. To-iu koto-wa...

“The pig has a blue medal, which means...”

Butwasan-wa keki-wo tabeta kedo, ninjin *ka* piman-wo tabe-nakat-ta  
pig-TOP cake-ACC eat-PAST but carrot or pepper-ACC eat-NEG-PAST

Lit. “the pig ate the cake, but didn’t eat the carrot or the pepper”

In this kind of design, the puppet’s guess about what happened is based on his inference from the reward the animal got, let us call this kind of design the *inference mode*. The puppet’s inference could be either right or wrong, since he is likely to make silly mistakes. This is different from the prediction mode, where the prediction utterance is often based on something rather vague. In this experiment, after the puppet uttered his guess but before the actual fact (what was left uneaten, if any) was revealed, the child presumably would also evaluate the situation base on the reward the animal got, assign an interpretation to the puppet’s utterance and have some judgment about his guess. But the child’s task in the experiment was assumed to be comparing the puppet’s inference against the actual fact and determine whether they were compatible. This design somehow resembled the prediction mode in that a test sentence could be interpreted in

two different situations (once in an inference situation, and the other in the factual situation). This was a potential complicating factor. In the inference situation, the reliable evidence was a blue medal as reward, which ultimately meant the pig ate one of the two things, but not both. But a blue medal in this contest was a second level reward, depending on which contrast alternative it was compared with, it could carry either a positive or a negative signification: compared the black cross, a blue medal was positive, as it meant the pig did some thing good (contrasting with did nothing good); while compared to the gold medal, a blue medal was negative, as it meant the pig didn't do the best thing (contrasting with did the best thing). However, as we discussed earlier, getting a reward is normally considered as something positive, and in this story, a reward was directly related to some positive event, i.e., eating some vegetable. In this case, we can assume the direct inference from a blue medal was "eat the carrot or the pepper", and "not eat the carrot or not eat the pepper" was the indirect inference. Therefore, the test sentence under the NSD was a rejection to the direct inference from the evidence (the reward), while the test sentence under the WSD was an assertion of the indirect inference. It is conceivable that children can utilize direct resources in the discourse context (e.g., the direct inference from the evidence in this case) better than indirect resources. If this is true, at this point, the child might tend to assign the NSD to Neg...*ka*, which could be reasonably evaluated. The factual situation revealed should confirm and strengthen the inferences from the reward: whatever left in the food area was what the pig didn't eat. This "did not eat one" situation actually might facilitate a "not this or not that"

interpretation of Neg...*ka*. However, at this point, the child might have already accessed the NSD and evaluated the test sentence based on this interpretation, and she was somehow immune to revision of the initial interpretation.

Another point worth some discussion is that the negative test sentence was introduced by a positive contrast lead-in clause. This was intended as an effort to satisfy the felicity condition of using negative expressions and could also be considered as pertaining to the relevance condition of the WSD (e.g., negative proposition is relevant as it is contrastive to some positive proposition). As I mentioned in section 2.2.1, a positive lead-in clause (and the positive contrast set up in the test story) facilitated children's access to the non-isomorphic interpretation of *every...not* sentences (Musolino & Lidz 2006), i.e., the interpretation with negation taking sentential scope. This means that a positive lead-in clause tends to be contrastive to a clause with negation taking widest scope. But in Neg...Disjunction case, when negation takes widest scope, the sentence has the "neither" meaning, i.e., the NSD. Therefore, in the experiment at discussion, a positive lead-in clause seemed to facilitate the NSD rather than WSD by introducing such a contrast: talking about the pig eating things, it was the case that the pig ate the cake, but it was not the case that the pig ate the carrot or the pepper. Therefore, the positive contrast lead-in clause might also be an interfering factor in this experiment.

Goro & Akiba's (2004a) study revealed an important aspect of Japanese children's knowledge regarding the interpretation of Neg...*ka*, namely, they allow the interpretation Japanese adults do not allow. However, just based on the results of this experiment, we

are not convinced by the other side of these authors' conclusion, i.e., Japanese children do not allow the interpretation Japanese adults allow. Because of the interfering factors in this experiment that might make children's access to the NSD easier, it could be the case that this experiment did not reveal children's knowledge of the WSD.

The next study I review also contained complicating factors that might contribute to children's access to the NSD rather than the WSD. One experiment in Jing, Crain & Hsu (2005) tested Chinese children's interpretation of Neg...*huozhe* (disjunction in Chinese). They described a sample test trail as given below.

(82) "This story is about a contest to see who can lift heavy things. Three guys think that they can lift heavy things: Mickey Mouse, Donald Duck and the Smurf. Elmo is going to judge, and he will award prizes to anyone who can lift heavy things. Each guy will try to lift a TV and a desk. If someone can lift both objects, Elmo will give him a gold medal; if someone can lift one object, but not the other, Elmo will give him a silver medal; and if someone can't lift either object, he gets nothing. Mickey Mouse easily lifted both objects and got a gold medal; Donald Duck is a little bit sick today and lifted up the desk but could not lift the TV, and he got a silver medal; Smurf was too old to lift any of the two objects and got nothing at the end. When the game ended, the three participants stood there with a medal on his neck if he got one, and the desk and the TV were in the background."

"At this point, Kermit interrupted the story to say: 'I wasn't paying attention just now and I can't remember exactly who lifted up what, but, I can guess from the kind of medals each of them has: ...'"

After this, the puppet produced a series of sentences guessing how well each contestant did by referring to the kind of reward they got. One of the test sentence involved Neg...*huozhe*, as in (83). The sentence was true under the WSD and false under the NSD.

20 out of the 21 Chinese children in the experiment consistently rejected the test sentence, while Chinese adults consistently accepted the test sentence. Like Japanese children, Chinese children also based their judgment of a Neg...Disjunction sentence on the NSD.

(83) Tangtaoya    meiyou    ju-qi    zhuozi    huozhe    dianshiji  
Donald Duck not-PERF    lift-up table    or    TV  
Lit. 'Donald Duck didn't lift up the table or the TV'

The problem in this experiment was that the child had access to what exactly Donald Duck lifted up and didn't lift up. Although the puppet said he didn't pay attention and couldn't remember who lifted up what, from the child's perspective, the situation was relatively clear. Therefore, the uncertain condition and evidence condition for using Neg...*huozhe* under the "not this or not that" meaning were satisfied only from the puppet's perspective. The child had to think and judge from the puppet's perspective to consider the WSD as felicitous, which was potentially complex – as shown in some knowledge access tasks (e.g., Wellman & Liu 2004), judgment based on other people's knowledge is not fully developed until children are 5 years old. Moreover, this experiment design also involved a second level reward, which, as I already discussed, could invoke either a positive or a negative association. Since reward in this story is directly related to some positive event, i.e., lifting up heavy objects, the direct inference from a second level reward was presumably 'lifted up the table or the TV'; and 'didn't lift up the table or didn't lift up the TV' is a derived inference. In this case, even if the child

could think and judge from the puppet's perspective, she might be stuck with the direct inference from the reward and thus rejected the sentence based on the NSD.

In these two studies I just reviewed, Japanese and Chinese children were presented with one scenario (i.e., “not this or not that”) and asked to judge a Neg...Disjunction sentence that could potentially be compatible with two interpretations against the one scenario. Their rejections to the test sentence provide strong evidence that the “neither” reading of Neg...Disjunction is prominent in their grammar. However, we also see experimental factors that might contribute to the kind of behavior observed in children.

The last experiment I briefly review is Verbuk (2006), which tested Russian children's interpretation of Neg...*ili*. The disjunction word *ili* in Russian behaves like *ka* in Japanese and cannot be interpreted within the scope of clausemate negation. Therefore, Neg...*ili* in Russian is unambiguous for adult speakers and means “not this or not that” (the WSD). In her experiment, Verbuk used the picture selection task (Gerken & Shady 1996) and presented children with two scenarios that corresponded to the two interpretations of Neg...*ili*. What Verbuk found was that 16 out of 21 children consistently chose the pictures that matched the “neither” meaning of Neg...*ili*. She described the story used in one of the conditions in her experiment this way:

(84) “Lion hid a key and a mirror in two identical boxes and promised to give a basket with strawberries to animals who found both the key and mirror. Subsequently, different animals took turns looking for the boxes. In the “or” condition, the child was shown a picture where an animal found one box and a picture where an animal found nothing.”

In one case, the two pictures showed Cat with a box and Cat without any box, respectively. At this time, the target sentence was uttered and the experimenter requested the child subject to select one picture:

(85) “Lion did not give Cat a basket with strawberries because Cat did not find the key or the mirror.”

“Experimenter: show me a picture where this is shown.”

In this test story, the requirement for an animal to get a basket with strawberries was that they found both the key and the mirror. So, if they failed to find one of the two, they would not get a basket; and if they failed to find two, they also would not get a basket. Therefore, not getting a basket was compatible with both “Cat finding neither item” and “Cat not finding one item”. In the picture showing Cat found one box, the actual item was not revealed; it could be the key or the mirror, so that using disjunction was felicitous. However, this picture was biased toward a positive direct inference, because Cat with a box meant Cat found one thing. Given this, “Cat found the key or found the mirror” is more directly relevant in this picture. A disjoined negation would be relevant only when “lack of the basket with strawberries” piece of the story was integrated, but this required further computation. On the other hand, the picture showing Cat had no box was directly associated with “Cat found neither items”, no other information needed to be computed for this inference – although integrating more information was possible. Therefore, the

two pictures were not parallel in their correspondence to the two respective interpretations of Neg...*ili*, one correspondence (i.e., the “neither” case) was more direct and thus easier to recognize than the other one. In this kind of task scenario, children were free to choose an “easier” option and to not even consider other alternatives. The results in this experiment showed that Russian children allowed non-adult interpretation of Neg...*ili*, i.e., the NSD, but they did not show they lack the WSD. In fact, Verbuk also speculated that Russian children go through an “English stage” and may have both interpretations available.

The three experiments I reviewed in this section provide solid evidence that children learning languages where the WSD is obligatory (i.e., Japanese & Russian) or not generally dispreferred (i.e., Chinese) all can systematically access the NSD. However, we also see complicating factors in these experiments that could make children more likely to base their judgment on this interpretation, even if they allow both interpretations. This motivated the current series experimental investigations we conducted, which I will report and discuss in the rest of this dissertation. In those studies, further manipulations in the experimental context were performed, all targeting at facilitating children’s access to the WSD. The general findings in those experiments are that children are in principle able to access the WSD, which empirically undermine the claim that children’s grammar cannot generate this interpretation.

### **Chapter 3: Access to the WSD in different contextual settings**

Although previous experimental studies observed that 4 year old children across different languages access the narrow scope disjunction interpretation of Neg...Disjunction sentences (the NSD, “neither”), we are not convinced by the conclusions drawn from some of those studies (e.g., Goro & Akiba 2004a, Jing, Crain & Hsu 2005) that children systematically lack the wide scope disjunction interpretation (the WSD, “not this or not that”) in their grammar at this stage of language acquisition. Because of the pragmatic complexities associated with the WSD, even if children’s grammar can generate this interpretation, it is conceivable that this interpretation remains dispreferred in general and only surfaces when the context presents an “ideal” situation. As I discussed in section 2.2 and 2.3, there were different kinds of complicating factors in previous studies that could lead to the observed facts about children’s interpretation of Neg...Disjunction in those experiments. We conducted a series of new studies that targeted at promoting the accessibility of the WSD to children. If children’s grammar allows the WSD, and our facilitation efforts are in the right direction, we expect to see children access the WSD in contexts that are highly conducive toward this interpretation. This chapter reports two target experiments we carried out with Chinese-speaking and English-speaking children and adults, respectively. The findings confirmed our hypothesis that children around age 4 do not simply lack the WSD and that their access to this interpretation can be boosted when the relevant pragmatic computation is facilitated. Three experiments intended as

control experiments are also included in this chapter, in two of which we observed unexpected patterns in children's behavior.

### 3.1 Target experiment in Chinese

The first in the series of experiments we conducted investigated Chinese children's knowledge of the WSD of Neg...*huozhe*. In order to make the WSD of Neg...*huozhe* easier to access, we first need to make the context satisfy the minimal discourse conditions associated with this interpretation. Recall that I proposed this set of conditions of using a Neg...Disjunction sentence under the WSD in section 2.1.1, repeated here as (86) (=38):

(86) a. *Uncertainty*

The speaker does not know which disjunct is (or both are) false.

b. *Evidence*

The speaker has evidence that (at least) one of the disjuncts is false.

c. *Relevance*

Among the alternatives, disjoined negation is most relevant to the current communicative purpose.

The first two conditions can be satisfied using an "inference mode" design, i.e., what the speaker knows is inferred based on some cause-outcome relation. But our critical manipulation of the context in this experiment pertained to the relevance condition. In previous studies involving inference mode (Goro & Akiba 2004a, Jing, Crain & Hsu 2005), the cause-outcome relation was always that completion of some positive task

(eating vegetables, lifting heavy objects, etc.) would result in some reward, so that the direct inference from a reward was always some positive event. In this case, if the outcome was some second level reward, disjoined negation was only relevant as an indirect inference. However, as I discussed in section 2.1.1, in contexts where the WSD is more natural and easy to access, the outcome is often directly associated with some negative event. For instance, in the example below (= (44)), the outcome is “got an F”; because an F is caused by and hence directly related to “not passing a course”, the direct inference from “got an F” in this case is didn’t pass one of the two relevant courses, which makes disjoined negation ( $\neg Pa \vee \neg Pb$ ) directly relevant.

(87) John got an F last semester. He didn’t pass physics or chemistry.

If direct inference vs. indirect inference and the consequent direct relevance vs. indirect relevance of the WSD does play a role in the degree of accessibility of the WSD, we could take advantage of this distinction in our experiment design. We devised two conditions in our experiment: the “positive goal” condition vs. the “negative goal” condition. In a positive goal condition story, like those in previous studies, labels or rewards were assigned when the featured figure in the story finished some tasks toward a positive goal, like fixing objects, water plants, etc.; so that labels and rewards in the outcome were directly inferred as existence of some positive events. In a negative goal condition, on the other hand, rewards were associated with successfully avoiding some

mistakes toward a negative goal, such as, not hitting obstacles, not dropping objects, etc.; then rewards in the outcome were directly inferred as corresponding to some negative events. Given this kind of contrast, in the negative goal condition, when the featured character in a test story got one reward, the direct inference would be “didn’t do one thing”, so that “not this or not that” (i.e., the WSD) was directly relevant; but in the positive goal condition, the direct inference from one label or reward would be “did one thing”, which made a “not this or not that” less directly relevant.

Our hypothesis has two parts: 1. children do not simply lack the WSD of Neg...Disjunction; 2. the context where “not this or not that” corresponds to the direct inference from observable evidence makes the WSD more directly relevant and is more conducive to the WSD, which can aid children in performing the relevant pragmatic computation in order to access this interpretation. The prediction was that children could access the WSD more easily in a direct inference situation, i.e., the negative goal condition, if their grammar could generate both the NSD and the WSD of Neg...*huozhe*. If children’s grammar only allowed the NSD, or whether the WSD was directly relevant in the context did not make a difference for children, then we would not expect children to behave differently in the positive goal condition vs. in the negative goal condition, i.e., they were most likely to only access the NSD in both conditions. With respect to Chinese adults, because the NSD is not the default interpretation and is associated with specific discourse conditions, they should not favor the NSD in the test situations; and because adults should be able to compute both the direct and the indirect inference from the

evidence in the test stories relatively easily, they were expected to access the WSD in both the positive goal condition and the negative goal condition with no problem<sup>38</sup>.

Because a  $S_W$  (Neg...*huozhe* under the WSD, meaning “not this or not that or neither”) is true in a wider range of circumstances than a  $S_N$  (Neg...*huozhe* under the NSD, meaning “neither”), the meanings of a Neg...*huozhe* string make it impossible to set the truth conditions up in a test story such that the WSD is false while the NSD is true and expect children to reject the test sentence based on the WSD. Therefore, our test stories all involved scenarios where the WSD is true and the NSD is false. We asked children to justify their answer in each trial, no matter whether they accepted the test sentence or rejected it. If they accepted the test sentence and gave reasonable justification, we took the acceptance as their access to the WSD of Neg...*huozhe*.

### **3.1.1 Method**

#### **3.1.1.1 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 Kindergarten Affiliated with Nanjing Forestry University in Nanjing, China. In addition to children, a control group of twelve Chinese-speaking adults were also tested.

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<sup>38</sup> This means, although the context in the positive goal condition was not as ideal as that in negative condition for the WSD, Chinese adults, without a bias toward the NSD, should be able to accommodate the less ideal context in the positive goal condition to access the WSD.

### **3.1.1.2 Procedure**

In this experiment, we used TVJT, an experimental methodology I already discussed in chapter 2 (for detailed description, see Crain & Thornton, 1998). One experimenter acted out the test stories by manipulating toy figures and props, and another experimenter manipulated the puppet, Kermit the frog. Given the concerns 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 important story scene and the story-hearers, 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 what happened exactly from their own experience and had to infer from the outcome. At the same time, this also set up the test stories in an "inference mode", thus satisfying the uncertainty and evidence condition associated with the WSD.

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; and in the other story, Kermit said something false about what happened. With this contrast, we showed children that Kermit could be wrong in making an inference about what exactly happened due to lack of enough attention or intelligence. Only if a child could make the relevant inference from the outcome of the two stories, correctly judge the sentences and justify his answer

appropriately, we would move on to the test phase with this child. Children who had difficulty responding cooperatively would be eliminated from the test phase. After passing the screening session, each child would be tested in two separate sessions (normally at least one night apart), testing their interpretation of Neg...*huozhe* in 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.

### **3.1.1.3 Material**

#### **3.1.1.3.1 Positive goal condition**

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 (88) represents a typical trail story in the positive goal condition:

(88) 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 workers to fix my bike and my skate board? They are broken.*

The boss said: *Sure. But we only have one worker on duty today, so he must fix them one by one. It may take longer. And when he is working, the garage door must remain closed for safety reasons. 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 then 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)

Mickey Mouse talked to the boss: *Do you think the worker has fixed my stuff?*

The boss said: *Oh, you came back already! I think the worker hasn't fixed anything yet. But let's go and check.*

The two walked to the front of the garage door and see one flag on the door.

The boss said: *Oh, well, it seemed that 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, the experimenter acting out the story asked Kermit his opinion about what happened in the story using sentence (89):

(89) ni juede gushi li fasheng-le shenme ne?  
you think story in happen-PERF what Q  
“What do you think happened in the story?”

Kermit said sentence (90) first, signally that he was trying to compute the situation. After a little pause, he said the target test sentence as in (91).

(90) gongren gua-le yi-ge qizi zai men-shang, en..., wo xiang  
worker hang-PERF one-CL flag at door-on umm I think

‘The worker hung one flag on the door, umm, I think...’

- (91) 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 (91) is a negated sentence with a disjunct object (Neg...*huozhe*). 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. The sentence under the WSD ( $\neg Pa \vee \neg Pb$ ) means the worker didn’t fix the bike or didn’t fix the skateboard and is true, because it was the case that the worker fixed one thing and didn’t fix one thing. On the other hand, the sentence under the NSD ( $\neg(Pa \vee Pb)$ ) means the worker fixed neither the bike nor the skateboard and is false, because it must be case that the worker fixed one of the two things. This contrast is presented in the table below:

(92) Table 8: Truth values of the two interpretations

	WSD $\neg Pa \vee \neg Pb$	NSD $\neg(Pa \vee Pb)$
Neg... <i>huozhe</i> ...	True	False

In this case, if subjects accessed the WSD and judged the test sentence based on this interpretation, we would expect them to accept the test sentence; and if subjects based their judgment of the test sentence on NSD, we would expect them to reject the test sentence.

Now let us look at the detail of the story described in (88) and see how different

experiment goals are satisfied.

In the beginning of the story, Mickey Mouse and Donald Duck had some discussion about 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 the story-hearers familiar with these two objects and remember what they were. The setting with the two objects remaining in the garage at the end of the story made sure that the puppet (and the subject) had no evidence on which of the two objects exactly was fixed, so that using a disjunction expression was felicitous (i.e., satisfying the uncertainty condition).

At the garage, the boss said the fixing might take longer because of one single worker on duty. This made the boss's later guess at Mickey's return that the worker had not fixed anything yet reasonable. The boss also explicitly explained the rules, namely, one flag on the door meant the worker finished fixing one thing, and two flags meant both were fixed. This set up the basis for the inference about what happened to be drawn from the number of labels (flags in this story), which was necessary, as demanded by the evidence condition of the WSD. Note, the goal for the worker in this story was to fix objects, which was positive. Therefore, 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 critical part of story (the garage) and the story-hearers, Kermit and the subject. This ensured that what would happen next behind the curtain was unclear to both Kermit and the subject. As I mentioned earlier, this modification of the TVJT served two purposes: one, make 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. The experimenter acting out the story would then manipulate the story setting behind the curtain so that there was one flag on the garage door before the curtain was removed. After Donald left, Mickey went back to the garage. The boss did not expect Mickey to come back so quickly 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 of the test sentence in the context set up by the story, the boss's guess here satisfied the plausible dissent condition (Crain & Thornton 1998), because the situation that would make the alternative interpretation  $\neg(Pa \vee Pb)$  true<sup>39</sup> was considered in the story.

The actual outcome was revealed when the boss and Mickey discovered 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 *zhi* "only" implicitly asserts that there was

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<sup>39</sup> In privative ambiguity cases like this, it is impossible to satisfy the plausible dissent condition with a situation that falsifies the weaker interpretation ( $\neg Pa \vee \neg Pb$ ) and attests the stronger interpretation ( $\neg(Pa \vee Pb)$ ), because whenever the sentence is true under the stronger interpretation, it is also true under the weaker interpretation. Therefore, we take consideration of the situation that makes the weaker interpretation true as satisfying the plausible dissent condition, when the stronger interpretation is targeted.

something still unfixed. Because what was actually fixed would not be revealed in the story, the subject had to judge the test sentence based on the inference drawn from the label. The boss's explanation here was to make sure that children were aware of cause-outcome relation.

Lastly, before Kermit uttered the target test sentence, he made it 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. However, whether Kermit could make the right inference was undetermined before he uttered the test sentence. We assumed that subjects knew this, because in the warm-up session we showed that Kermit could be right and could be wrong in making inferences. An utterance with the  $\neg Pa \vee \neg Pb$  meaning (or the  $Pa \vee Pb$  meaning) would mean Kermit made the right inference; while an utterance with the  $\neg(Pa \vee Pb)$  meaning would mean he made the wrong inference. In this experiment, the subject's task was to judge whether Kermit's utterance was true, which in turn was equal to judge whether Kermit made the right inference. In the test story, which of the two things the worker fixed was not revealed when the subject judged the test sentence, because we wanted to assure that the subject only interpreted the test sentence in one context, i.e., based on her own inference about what happened. What happened could be inferred as a  $Pa \vee Pb$  scenario and further as a  $\neg Pa \vee \neg Pb$  scenario. If the subject compared the WSD of Kermit's utterance with this scenario, she would accept his

utterance; if the subject compared the NSD of Kermit's utterance, i.e.,  $\neg(Pa \vee Pb)$ , with the inferred fact, she would think Kermit made a wrong "guess" and reject his utterance. Subjects were asked to justify their judgment in a friendly way. If they said Kermit was wrong, we would ask them to teach Kermit about what was happened; and if they said Kermit was right, we would ask them to praise Kermit and reinforce Kermit's knowledge about what happened.

Literal English translations of the test sentences used in the positive goal condition stories are given in (93). Filler sentences used in this experiment were unambiguous negated sentences without disjunction, as listed in (94). 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 could 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.

- (93) 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.

- (94) 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.

### 3.1.1.3.2 *Negative goal condition*

Contrasting with the positive goal condition, in a negative goal condition story, rewards were associated with successfully avoiding mistakes toward a negative goal, like not hitting obstacles, not dropping objects, etc. The story in (95) represents in a typical trial story in such condition:

(95) 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 said: *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, the experimenter acting out the story asked Kermit to guess what

happened in the story using sentence (96)

(96) ni shuo-shuo gushi li fasheng-le shenme ne?  
you say-say story in happen-PERF what Q  
“What would you say happened in the story?”

Kermit first said sentence (97), indicating his attempt to calculate the scenario. He then said the target test sentence as in (98).

(97) xiong-gege na-dao yi-ge beike, en..., wo cai  
bear-brother get-PERF one-CL shell umm I guess  
“Bear brother got one shell, umm... I guess...”

(98) 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 in (98) has exactly the same form as those in the positive goal condition. It is also a negated sentence with a disjunct object (Neg...*huozhe*) and is ambiguous for adult speakers. Based on the context set up in the story, the sentence is true under the WSD ( $\neg Pa \vee \neg Pb$ ), because it was indeed true that bear brother didn’t hit the barrel or didn’t hit the rock; and the sentence is false under the NSD ( $\neg(Pa \vee Pb)$ ), given it was not true that bear brother hit neither objects. This relation of the truth values of the test sentence to its interpretations in this condition is the same as in the positive goal condition, illustrated in (92), repeated here as (99). Again, subjects were expected to accept the test sentence upon judging the sentence, if they accessed the WSD of the

sentence in the given context; on the other hand, we expected subjects to reject the test sentence, if they based their judgment on the NSD of the sentence.

(99) Table 9: Truth values of the two interpretations

	WSD $\neg Pa \vee \neg Pb$	NSD $\neg(Pa \vee Pb)$
Neg... <i>huozhe</i> ...	True	False

If we expected subjects to access the “not this or not that” interpretation in the context given in this story, the situation corresponding to the alternative “neither” interpretation must be plausible in the story. The pre-game part was designed 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 possible for bear brother to make mistakes.

The rules for assigning rewards were explained by the judge, so that the story-hearers (Kermit and the subject) could infer from the reward at the end about what happened even they would not be able to see the process. This was to satisfy the evidence condition associated with the WSD. 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. Therefore, the direct inference from one reward would be that bear brother didn't hit one thing (abstractly, equivalent to  $\neg Pa \vee \neg Pb$ ), and the indirect inference would be that there was one obstacle that bear brother hit (abstractly, equivalent to  $Pa \vee Pb$ ). This contrasts with the situation in the positive goal case and is the critical difference in the two conditions.

How bear brother actually pushed the cart through the obstacle course in the real game was blocked by the curtain. As in the positive goal condition, this targeted at satisfying the uncertainty condition associated with the WSD and aligning the subject's perspective with the puppet's perspective. 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 all other stories as well) was intentionally chosen, it does not correspond 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. Using verbs like *zhuang* "hit" in the test stories guaranteed that the story-hearers did not know which object was acted upon even when they saw the objects at the end, which made what happened an "uncertain" situation.

After the curtain was removed, it became visible that bear brother got one shell as reward, but it was not obvious which obstacle got hit. Bear brother's explanation about

the outcome, that he got one reward because he only didn't hit one thing, reinforced the association of the number of rewards with the number of obstacles avoided. The use of *zhi* 'only' in his explanation implied that something was hit. This, again, was designed to remind children about the relation between the outcome and the cause. 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 condition, Kermit's utterance (an indication of the inference he made) could be right and could also be wrong. Based on the judgment subjects made on Kermit's utterance (i.e., inference), we could see what interpretation of Neg...*huozhe* they accessed upon judging the test sentence.

The sentences in (100) are literal English translations of the test sentences used in the negative goal condition. Filler sentences are given in (101).

- (100) 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. Little deer didn't step on the mud or the branch.

- (101) a. Mom didn't finish the dinner.  
b. The gorilla didn't push the train.  
c. The little boy didn't lift the chair.

### 3.1.2 Results

In the analyses of the results following, the dependent variable is the proportion of "yes" (*dui* in Chinese) responses to the test sentences (Kermit's utterances in the stories). In the positive goal condition, we found 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>40</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,  $t(11) = -3.57$ ,  $p < .005$ ). No effect of the order of conditions presented to children is observed.

(102) Table 10: Mean proportion of subjects' "yes" responses

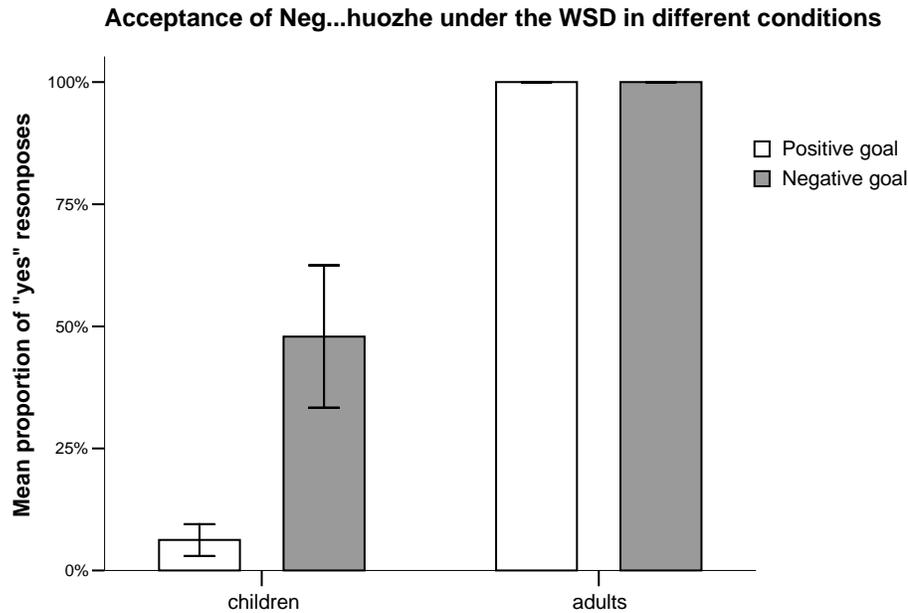
	Children	Adults
Positive goal condition	6%	100%
Negative goal condition	48%	100%

The proportions 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 also had two levels (positive goal vs. negative goal). 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 reliable interaction between age and goal ( $F(1, 22) = 8.59$ ,  $p < .01$ ). See the graph in (103).

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<sup>40</sup> Among the twelve child 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.

(103) Figure 1: Acceptance of Neg...*huozhe* under the WSD in different conditions



While children’s responses in the positive goal condition were uniform, their responses in the negative goal condition showed a bimodal distribution. The table in (104) illustrates the distribution of the individual responses in the two conditions; the numbers in the table represent numbers of subjects in each condition according to their acceptance rates (proportion of “yes” responses). A Chi Square analysis also revealed a significant difference of children’s responses in the two conditions ( $\chi^2 = 8, p < .005$ )<sup>41</sup>.

<sup>41</sup> The Chi Square analysis was performed based on the contingency table below. We considered acceptance rate over 50% as (consistent) acceptance, and the numbers in the table are number of subjects in the relevant categories.

	Acceptance	Non-acceptance
Positive goal	0	12
Negative goal	6	6

(104) Table 11: Distribution of children's responses

% of "yes" responses	0%	25%	50%	75%	100%
Positive goal	9	3	0	0	0
Negative goal	6	0	0	1	5

Children's responses were not random guesses. No matter what their judgment was in any single trial, they gave reasonable justification. In the positive goal condition, almost all children rejected the test sentences (94% of the time) and justified their rejections by saying something like 'the worker fixed one thing' or 'there is one flag on the door'. In the negative goal condition, half of the children accepted the test sentences and typically said 'there was one shell which 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.

In addition, children's responses did not seem to have an observable correlation with their respective age: younger children and older children seemed to be equally likely to accept Neg...*huozhe* under the WSD, as shown in the table in (105).

(105) Table 12: Proportion of "yes" responses from individual children

Subject	Age	Positive Goal	Negative Goal
1	3;10	0%	100%
2	3;10	0%	0%
3	4;0	25%	100%
4	4;2	25%	0%
5	4;2	0%	75%
6	4;2	0%	0%

7	4;3	0%	0%
8	4;6	0%	100%
9	4;7	25%	100%
10	4;7	0%	0%
11	4;8	0%	100%
12	4;9	0%	0%

### 3.1.3 Discussion

#### 3.1.3.1 *The effect of different contextual settings*

The results in this experiment showed that Chinese children’s responses to simple negated sentences with a disjunct object (Neg...*huozhe*) were significantly different from those of Chinese 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,  $p < .005$ ). In this experiment, Chinese adults easily accessed the “not this or not that” interpretation of Neg...*huozhe* (the WSD) in the contexts set up in the test stories of both conditions and made judgment based on this interpretation of the test sentences. This is consistent with our expectation: because Chinese adults have no reason to favor the NSD of the test sentence in the first place, once the context satisfies the discourse conditions associated with the WSD – even if indirectly, they should be willing to accept the test sentences under this interpretation.

Although children’s behavior in this experiment was not adult-like, their different

response patterns in the two conditions provided valuable evidence that it cannot be the case that children simply lack the WSD in their grammar. While children's responses to test sentences in the positive goal condition echoed findings in previous studies, their significantly higher acceptance of the test sentences under the WSD in the negative goal condition challenged the claim on the general unavailability of the WSD in children's grammar. Our prediction that children would be able to access the WSD of Neg...*huozhe* sentences more easily in the negative goal conditions than in the positive goal condition was also borne out.

The results from this experiment showed that Chinese children indeed have a strong preference toward the NSD of Neg...*huozhe*, which is not observed in Chinese adults (at least in terms of comprehension). Intuitively, this preference could make children stuck with the NSD and hard to recover in some cases. In this experiment, the same children who accessed the WSD and accepted the test sentences in the negative goal condition rejected the test sentences in the positive goal condition. As I discussed in section 2.1.3, accessing the WSD of a Neg...Disjunction string, which is ambiguous, involves relatively complex pragmatic computation of the contextual information. The context in a negative goal condition story contained inherent negativity ("not doing something") and thus directly connected the observable evidence in the outcome to a  $\neg Pa \vee \neg Pb$  situation, i.e., corresponding to the WSD. This could direct children's attention to the critical information in the context and make the WSD immediately available to them, so that they were able to make use of this option. In this case, children's pragmatic computation

toward the WSD was facilitated, and this released their adherence to the NSD and resulted in their acceptance of the Neg...*huozhe* test sentences. On the other hand, in positive goal condition, due to lack of enough facilitation toward the harder interpretation (i.e., the WSD), children's pragmatic computation was performed at a minimal level, so that their "charity" desire (i.e., to make Kermit a truth-teller) surrendered to their strong preference toward the NSD. Here, we do not intend to argue against the principle of charity; on the contrary, we think it is reasonable to assume that children follow this principle whenever they can. However, we also want to argue that the operation of this principle has limit and is conditioned on children's ability to evaluate multiple representations. In some contexts, following this principle is too resource consuming for children, namely, the option that makes children charitable is not equally available to them as the option that makes them give an "easier" answer.

Given children's different responses in the two conditions of this experiment, we can confidently conclude that different contextual settings can affect children's pragmatic computation differently, which translates to different degrees of accessibility of the pragmatically more complex interpretation of an ambiguous string. Overall, children did not seem to have problem computing the truth conditions of Neg...*huozhe* sentences under either interpretation or understanding the scenarios in the stories. Their difficulties are related to mapping the Neg...*huozhe* string to the relevant interpretation by effectively integrating all the information in the context. This is presumably bound by children's immature pragmatic capacity.

### **3.1.3.2 Some notes on ambiguity resolution and the default interpretation**

Although this experiment studied children's interpretation of potentially ambiguous sentences, it did not provide conclusive evidence on the nature of children's ambiguity resolution mechanism. It could be the case that children's parser generated the two representations of Neg...*huozhe* simultaneously and they chose one representation based on their perception of the context and other factors such as their default interpretation. In this case, their lower acceptance of Neg...*huozhe* under the WSD in the positive goal condition could be caused by a different choice strategy children employed than adults. For instance, they could perceive the outcome in a story in the positive goal condition more of a "this or that" scenario than a "not this or not that" one, and choose the more relevant interpretation of the Neg...*huozhe* test sentence (i.e., the NSD, the "neither" interpretation) instead of the one that made the test sentence true (i.e., the WSD) – this kind of choice was made possible in a TVJT setting, because the puppet who uttered the test sentence could be saying something wrong. This view assumes that children either do not always extensively exploit the context in making their choice of interpretation or are not fully competent in comparing the two interpretations given the context, so that the effect of the principle of charity sometimes does not show up.

Alternatively, it could also be possible that children's parser first generated only one representation, depending on the context or/and the default interpretation they assign to Neg...*huozhe*; and if the perception of the context changes, the parser can generate the

other alternative if necessary. So, in case both representations are generated, they are generated serially. In this case, when the context was not directly favorable toward the WSD (such as in the positive goal condition stories), the parser was more likely to generate the default and “more relevant” representation first. Based on the interpretation corresponding to this representation (i.e., the NSD), children could have already completed their judgment in a TVJT (i.e., rejecting the test sentence), so that the parser could stop further generation. On the other hand, when the context was more directly related to a “not this or not that” situation (i.e., in the negative goal condition stories), the parser was ‘primed’ to generate the WSD of Neg...*huozhe* first, based on which children made the relevant judgment. This view assumes that children often work with the immediately available interpretation rather than exhausting all the possibilities to follow the principle of charity.

The results in our experiments appeared to be compatible with both hypotheses. In order to test these two hypotheses, we presumably need to rely on other experimental techniques that look into children’s online sentence processing procedure in approaching Neg...Disjunction sentences. However, it is not immediately apparent to us how to properly design such an experiment, because the two interpretations of Neg...Disjunction are appropriate in different contexts, specifically, the WSD demands an uncertain situation, while the NSD is compatible only with a definite scenario. Neg...Disjunction sentences may not be particularly suitable to test these hypotheses.

No matter which mechanism is responsible for children’s ambiguity resolution, we

find that the dispreferred and pragmatically more complex interpretation of an ambiguous string is generally in a disadvantageous position. This predicts that whenever we want to discover children's knowledge of the disadvantageous interpretation, we have to make the context in the experiment very conducive toward that interpretation. This is consistent with findings in previous investigations on children's knowledge on non-isomorphic interpretation involving negation and quantifiers (e.g., Gualmini 2004; Musolino & Lidz 2006).

We have been saying that the results of our current experiment and previous experiments revealed children's general preference toward the NSD (rather than the absence of the WSD in their grammar). One might wonder what the origin of this preference could be and how the NSD becomes the default interpretation of Neg...Disjunction for children. One possibility is that the default status of the NSD is a property of the grammar, related to the surface structural relation of the two quantificational elements. As spelled out in section 1.1.2, I assume in this dissertation that the potential scopal ambiguity exhibited by Neg...Disjunction sentences is the consequence of the two possible c-commanding relations between negation and disjunction at LF. In this case, the NSD, where negation has wider scope than disjunction in interpretation, corresponds isomorphically to the structural of negation and disjunction in the surface syntactic form (i.e., negation c-commands disjunction); while the WSD involves non-isomorphic mapping between the surface syntactic relation and the semantic scopal relation of the two elements. For some reason, isomorphic mapping is generally

preferred in the grammar than non-isomorphic mapping, unless other factors override this preference. If this is true, and if children's grammar can generate both interpretations of Neg...Disjunction, they will have the NSD as the default interpretation of a Neg...Disjunction string until they have mastered language-specific factors (if any) that call for another pattern (e.g., the NSD is not the default interpretation, as in Chinese; or, the NSD is not allowed, as in Japanese). Alternatively, it is also possible that the reason why children prefer the NSD over the WSD comes from some property of the parser. For example, parsing a Neg...Disjunction string into the structural relation that corresponds directly to the surface syntactic relation may consume less processing resources than one that does not. Consequently, assuming children are constrained by limited processing resources (e.g., working memory), they will prefer the syntactic representation that maps to the NSD. No matter whether children's preference toward the NSD has a grammatical origin or a processing origin, this preference is translated into children's preference toward the isomorphic interpretation, which is consistent with findings in previous studies on children's interpretation of interacting quantificational elements (e.g., Musolino 1998; Musolino, Crain & Thornton 2000; Gualmini 2004; Musolino & Lidz 2006; and most interestingly, Lidz & Musolino 2002<sup>42</sup>). Yet another possibility is that the preference is related to pragmatic considerations. Because the WSD is associated with more complex discourse conditions than the NSD in general, fewer computations are

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<sup>42</sup> These authors investigated children's interpretation of sentences like *the detective didn't find two guys*, where the two possible interpretations do not have an entailment relation (unlike the other experiments mentioned here). Children were found to prefer the isomorphic interpretation of this kind of sentences, too – 'it is not the case that the detective found two guys (e.g., he only found one guy)'.

needed to get to the NSD than to the WSD. In this case, the NSD can be preferred to save pragmatic computation effort. Having presented these possibilities, we think it is also likely that the default status of the NSD for children originates from multiple sources. While a definite answer to the kind of origin for children's preference toward the NSD requires further investigations, it is evident through the current experiment that pragmatic facilitations could help children overcome the adherence to the preferred interpretation.

### **3.1.3.3 *Impoverished input***

While Chinese adults in the current experiment had no problem accessing the WSD of Neg...*huozhe*, it does not mean they use Neg...*huozhe* sentences under the WSD frequently. On the one hand, because of the complex discourse conditions associated with the WSD, circumstances corresponding to this interpretation are rarer. On the other hand, even if the circumstance is a “not this or not that” situation and the context satisfies the conditions of use associated with this interpretation, speakers often use the unambiguous form Neg...*huozhe*...Neg to express this meaning. Consequently, Neg...*huozhe* sentences under the WSD are expected to occur sparsely. At the same time, because the NSD of Neg...*huozhe* in Chinese is subject to specific condition of use – the two corresponding positive propositions are expected to have a disjunctive relation (i.e.,  $Pa \vee Pb$  is specifically expected or relevant), while Neg...*he* is the natural and standard way to express a “neither” meaning, Neg...*huozhe* sentences under the NSD are not expected to occur very often, either. The results of preliminary corpus search support these intuitions.

We ran some searches in online corpus of the Penn Chinese Treebank project (e.g., Xue, Xia, Chiou & Palmer 2005) provided by the Linguistic Data Consortium ([www ldc.upenn.edu](http://www ldc.upenn.edu)). Using the same search and selection criteria to search for *meiyou...huozhe* (Neg...Disjunction) and *meiyou...he* (Neg...Conjunction)<sup>43 44</sup>, the searches returned about 60 relevant distinct hits for *meiyou...huozhe* and over 1500 relevant distinct hits for *meiyou...he*<sup>45</sup>, and no hits of *meiyou...huozhe* could be reasonably interpreted as the WSD. Given this kind of search results, it is logical to assume that Chinese children receive rather impoverished input regarding the WSD. Nonetheless, our current experiment showed that Chinese children’s grammar should in principle be able to generate this interpretation when they are 4 years old. A natural explanation for this kind of discrepancy between the input and children’s grammatical knowledge is that this way of interpretation (or, the general mechanism responsible for this way of interpretation) is “given” to children by UG, so that children do not need to learn this interpretation by attending to the direct positive evidence in the input. If this line of reasoning is on the right track, the prediction is that children across different languages should all have the WSD in their grammar at some point. This prediction was

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<sup>43</sup> The string *meiyou* in Chinese has two “homophones/homographs” that are tightly related: in one case, *meiyou* is a negation word meaning ‘not’, normally used in perfective aspect, and it has a short form *mei*, which is used overwhelmingly in informal speech; in the other case, *meiyou* is actually *mei- you*, formed by *mei* (the short form of *meiyou* as in the first case) plus *you* (“have”), meaning “do not have”, “did not have”, “have not had”, etc.. Our search results counted both cases of *meiyou* in.

<sup>44</sup> We searched for sentences containing *meiyou* and *huozhe/he* in this order with 1 to 5 characters in between. The string between *meiyou* and *huozhe/he* is supposed to be V NP or NP. Because the regular length of a Chinese word is between 1 to 3 characters, we think that this search criterion is reasonable in catching typical cases of Neg...Disjunction and Neg...Conjunction in Chinese.

<sup>45</sup> “Relevant distinct hits” means that only strings containing *meiyou* and *huozhe/he* that were clear cases of simple negative sentences containing coordinated NPs in the object were counted and that repeated occurrences of the same strings were only counted once.

attested in English children, who behaved similarly to Chinese children in an experiment parallel to the current experiment. The next section reports the experiment conducted with English children (and English adults).

### **3.2 Target experiment in English**

This experiment in English is for the most part replicating the target experiment in Chinese. Our goal is to further test our hypothesis that children do not simply lack the WSD of Neg...Disjunction in general and would be able to access the WSD in a more favorable context. Our prediction was that English children would also be able to access the WSD to some extent, specifically in the negative goal condition. In addition, this experiment also investigated English adult speakers' interpretation of Neg...*or*. While the availability of the WSD of Neg...*or* is often denied by researchers, I have shown in section 2.1.1 that this interpretation is possible when more data are taken into consideration with appropriate context. I also proposed that the reason why this interpretation is not well recognized is related to the complex discourse conditions it is subject to as well as its dispreferred status relative to the NSD of Neg...*or* (i.e., the NSD is the default interpretation of Neg...*or*) and the NSC of Neg...*and* (i.e., Neg...*and* is normally a better candidate in a “not this or not that” scenario). We expected English adults to accept the test sentences under the WSD to some extent and were also prepared to find individual variations.

### **3.2.1 Method**

#### **3.2.1.1 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 unambiguous), 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.

#### **3.2.1.2 Procedure**

This experiment adopted the same procedure as the Chinese experiment described in 3.1.1 in testing child subjects. 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.

#### **3.2.1.3 Materials**

The test stories and test sentences in this experiment were almost identical to those in the

Chinese experiment, except that the stories and test sentences were presented in English.

The complete sets of test sentences used in the positive goal condition and the negative goal condition of this experiment are listed in (106) and (107), respectively.

- (106) 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.

- (107) 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. Little deer didn't step on the mud or the branch.

Unlike in the original Chinese experiment, where simple negative sentences without disjunction were used as filler sentences, this experiment had simple affirmative sentences with a disjunct object as filler sentences, which are interpreted unambiguously as  $Pa \vee Pb$ . 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 to make the truth value of most filler sentences opposite to the truth value of most test sentences judged by individual subjects<sup>46</sup>. The fillers sentences used in the

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<sup>46</sup> In the videotaped versions of the experiment, we could not predict adults' response for each test sentence. We made 2 filler sentences true and 1 false in the positive goal condition, and 1 true 2 false in the negative goal condition. When introducing adult subjects to the experiment, we explicitly told them that the distribution of the "yes"/"no" answers in the whole experiment was not necessarily balanced.

positive goal condition and the negative goal condition are listed in (108) and (109), respectively.

- (108) 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.

- (109) 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.

### 3.2.2 Results

The dependent variable in the analysis below is the proportion of “yes” responses to the test sentences. 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 ( $t(11) = -0.14, p > .5$ ).

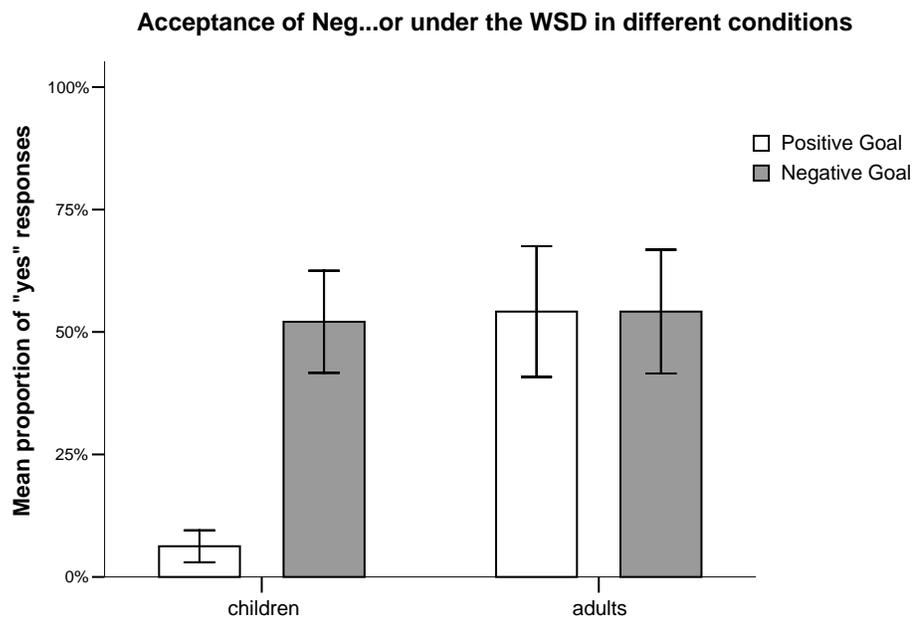
(110) Table 13: Mean proportion of subjects’ “yes” responses

	Children	Adults
Positive goal condition	6%	54%
Negative goal condition	52%	54%

The proportions of “yes” responses to the test sentences were entered into a 2 (children vs.

adults)  $\times$  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 ( $F(1,22) = 20.48, p < .0001$ ). See the graph in (111).

(111) Figure 2: Acceptance of Neg...or under the WSD in different conditions



We found great individual variations of responses among children in the negative goal condition and among adults in both conditions. In each of these three cases, the distribution was bimodal, as shown in the table in (27). The results of Chi Square analyses showed that children's responses differed significantly in the two conditions ( $\chi^2 = 9.89, p < .002$ ).

(112) Table 14: Distribution of subjects' responses

% of "yes" responses		0%	25%	50%	75%	100%
Children	Positive goal	9	3	0	0	0
	Negative goal	3	1	1	6	1
Adults	Positive goal	4	1	1	1	5
	Negative goal	4	0	2	2	4

No matter whether children accepted the test sentences or rejected the test sentences, they normally justified their responses appropriately. Some children sometimes responded to the test sentences with a question: *Which one?* And they eventually accepted the test sentences. And sometimes children justified their acceptance of the test sentence by explicitly using the target form *Neg...or*.

English children's responses in this experiment seemed to suggest a tendency that younger children accepted the test sentences more often than older children, while this trend was not observed in Chinese children in the Chinese target experiment. Given the limited subject size, it is unclear whether the tendency observed here is representative for the correlation of children's responses with their age or caused by coincidence. The details of children's responses with their age are given in the table in (113).

(113) Table 15: Proportion of "yes" responses from individual children

Subject	Age	Positive Goal	Negative Goal
1	4;4	25%	75%
2	4;4	0%	75%
3	4;5	25%	100%

4	4;6	0%	50%
5	4;6	0%	75%
6	4;8	0%	75%
7	4;8	25%	75%
8	4;8	0%	25%
9	4;10	0%	0%
10	5;0	0%	75%
11	5;0	0%	0%
12	5;3	0%	0%

English children’s responses to filler sentences (simple affirmative disjunction sentences) were perfectly adult-like: they accepted the sentences when the outcome was a  $Pa \vee Pb$  scenario and rejected them when the outcome was a “neither” scenario.

### 3.2.3 Discussion

#### 3.2.3.1 On children’s responses

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 uniformly accessed the NSD of Neg...or, while half of the adults based their judgment on the WSD. In the negative goal condition, children’s acceptance greatly improved to 52% of the time (which was caused by half of the children consistently accepting the test sentences), identical to adults’ acceptance rate in this condition. It is evident that the negative goal in the test stories that related the direct inference from a reward to the  $\neg Pa \vee \neg Pb$  situation helped half of the children judge the test sentences based on the WSD,

who rejected the test sentences based on the NSD in the positive goal condition. This means, when the contextual settings made the situation corresponding to the pragmatically more demanding interpretation (the WSD) more directly observable (as in the negative goal condition), so that  $\neg Pa \vee \neg Pb$  was more directly relevant, children were more likely to be able to integrate this discourse information in performing the pragmatic computation to access the WSD. Children's behavior in this experiment further proved our hypothesis that children's grammar is not simply deficient regarding the WSD of Neg...Disjunction and that this interpretation is accessible to children when strong contextual support is available.

When reporting the results of the experiment in the last section, I mentioned two special cases where children provided unusual responses or justifications to their responses. Now let me talk a bit more about these two cases. One case was that some children sometimes asked the question *which one?* after hearing the test sentence<sup>47</sup>. In this case, 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 children accepted the test sentences and said: *You are right*. When asked why Kermit was right, these children reasonably justified

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<sup>47</sup> This kind response raises an interesting possibility regarding children's rejection to Neg...Disjunction sentences under the WSD. Valentine Hacquard (p.c.) speculated that children in this experiment as well as in the Chinese experiment might have generally misunderstood Kermit's task as have to give an answer depicting a definite scenario: while Neg...Disjunction under the NSD ( $S_N$ ) was such an answer – although it was false given the outcome in the test stories, Neg...Disjunction under the WSD ( $S_W$ ) described an uncertain situation and was thus dispreferred. However, general misunderstanding of the task cannot account for different behaviors in the two conditions. In addition, children's adult-like responses to the filler sentences in this experiment seemed to refute this possibility as well. Specifically, children accepted simple affirmative disjunction sentences given "this or that" scenarios, suggesting that they had no problem accepting an uncertain answer from Kermit.

their judgment with something like *because bear brother didn't hit one thing*. The question children asked showed that they somehow misunderstood Kermit's task and thought he needed to also guess which object exactly. At the same time, this question did show that they accessed the WSD ( $\neg Pa \vee \neg Pb$ ) interpretation of Neg...*or*. Otherwise, with the "neither" interpretation (i.e., the NSD) of Neg...*or*, there would be no issue of "which one", they would simply reject Kermit's guess. Hence, the question was consistent with their later acceptance of the test sentences, where they based their judgment on the "not this or not that, I don't know which" meaning of Neg...*or*.

The other case was that children sometimes explicitly used the target form Neg...*or* in their justifications. 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 then asked him why bear brother had one shell, the child said, while pointing to the relevant obstacles: *because he didn't hit one thing...he didn't hit this or this!* This piece of children's production data using Neg...*or* intending a "not this or not that" meaning directly revealed their knowledge of this interpretation of Neg...*or*. Some researchers suggested that children could integrate linguistic and contextual information better in production than in comprehension (e.g., Hurewitz, Brown-Schmidt, Gleitman, & Trueswell 2000). This seems to be relevant here, too. We have some reason to believe that children's production of Neg...*or* under the WSD might be better than their comprehension of Neg...*or* intending the WSD, if their grammar allows this interpretation. When a child utters something in a given context, he has already

determined what he thinks the relevant information in the context is. If he perceives the context as a case of the  $\neg Pa \vee \neg Pb$  scenario, he could use any appropriate form in his language to express the “not this or not that” meaning, and Neg...*or* is one of the simplest forms. So, when he uses Neg...*or* intending the WSD, he knows what he wants to express, there is no ambiguity problem for him. But when he interprets Neg...*or*, the sentence becomes potentially ambiguous; he has to get what another person is intending with the sentence (and the other person could potentially also make wrong “guess”, as in the case of Kermit in our experiments) in the specific context, and he has the option of assuming the default interpretation of Neg...*or*. In this case, his knowledge of the WSD may be masked by his difficulty in making use of the contextual information.

When we compare the results in the original Chinese experiment with those in this experiment, we can see that Chinese children and English children behaved very similarly in their interpretation of Neg...Disjunction, although Chinese adults and English adults behaved differently – recall that in these two experiments, while Chinese adults accessed the WSD and thus accepted the test sentences uniformly, only half of the English adults accepted the test sentences under the WSD (i.e., about 54% of acceptance in both conditions). Children in the two languages all preferred the NSD in general but could access the WSD in special context, and, some children were better than others in accessing this generally dispreferred interpretation. Given the cross-linguistic differences in the interpretation of Neg...Disjunction for adult speakers, and the relatively rare occurrence of the WSD, the cross-linguistic similarities these children exhibited

regarding the interpretation of Neg...Disjunction in our two experiments suggested that children across different language backgrounds have the same initial grammatical knowledge of Neg...Disjunction that possibly includes also the WSD and that children are subject to similar pragmatic and cognitive constraints that shape their behavior in interpreting Neg...Disjunction. If UG does provide the WSD to language learners, without other interfering factors, children of other languages such as Japanese are expected to behave similarly as Chinese children and English children when they are tested in this kind of experiment. This will need to be tested in future empirical studies.

### ***3.2.3.2 On adults' responses***

English adults' responses in this experiment empirically challenge the claim that the WSD is generally unavailable to English speakers. We observed that half of the adults consistently accepted the test sentences under the WSD in both test conditions. This means that the relevant contextual difference in the two conditions did not affect adult subjects' interpretation of Neg...*or*; and both kinds of contextual setting were conducive enough for half of them to access the dispreferred interpretation, i.e., the WSD. The individual variations observed among English adults in this experiment are potentially compatible with two explanations. One explanation says this bimodal distribution pattern truly reflects speakers' variations in terms of their linguistic knowledge on Neg...*or*. As the WSD of Neg...*or* is not uniformly recognized by linguists, it is possible that the WSD is indeed unavailable in some English speaker's grammar. Alternatively, the reason why

some of the adult subjects resisted the WSD in the experiment may be related to the dispreferred status of the WSD in English, the characteristic of the TVJT and possibly also prosodic factors. Let me elaborate the latter possibility more in detail and see why those factors may be relevant.

For English adults, the “neither” interpretation (the NSD) of *Neg...or* is the default interpretation, which means adults in general prefer this interpretation of *Neg...or* over the alternative interpretation (the WSD). Even if adults allow both interpretations in principle, the degree to which they are willing to give up the preferred NSD for the dispreferred WSD may vary across contexts and also across speakers. In the specific test situation in our experiment (TVJT), unlike in a normal conversation situation, the puppet who uttered the target sentences was likely to say something wrong (i.e., make wrong inferences). And the scenario set up in a TVJT story made both interpretations of the *Neg...or* relevant to the same context, with one interpretation making the test sentence true and the other interpretation falsifying it. Given this, subjects’ interpretation of the test sentence was not necessarily based on the presumption that the sentence was a truthful description (inference) about what happened, so that they were not required to exploit the context and could stick to an interpretation of the test sentence they generally prefer that falsified the sentence in the context given. Adult subjects who were more ready to step away from their general preference in interpreting *Neg...or* as specific context was given, would be more willing to accept the test sentences as a truthful description based on the WSD. And subjects who strongly preferred the “neither” interpretation might resist

revising their initial commitment based on their preference.

Another interfering factor may come from the specific prosodic properties associated with Neg...*or* under the WSD. It has been observed that prosodic differences sometimes play a critical role in disambiguating an ambiguous sentence. This is for instance evident in English with certain kind of sentences involving the focus marker *only*. As discussed in Gualmini, Maciukaite & Crain (2003), the written sentence in (115a) is potentially ambiguous depending on how it is uttered and has opposite truth values given the scenario in (114): (115b) shows the neutral intonation with stress on *Piglet*, which identifies *Piglet* as the focus. The sentence with this focus pattern means Piglet was the only one who Tiger threw a chair to and is false in a scenario described in (114), since Tiger also threw a chair to Winnie. (115c) shows the intonation with stress shifted to *chair*, which makes *chair* the focus. In this case, the sentence means a chair was the only thing Tiger threw to piglet and is true in the same scenario. Adult speakers are found sensitive to the stress pattern differences in determining the meaning and truth conditions of the sentence.

(114) Scenario: Tiger threw a chair and a table to Winnie, and a chair to Piglet.

- (115) a. Tiger only threw a chair to Piglet.  
b. Tiger only threw a chair to PIGLET.  
c. Tiger only threw a CHAIR to Piglet.

Also, while the utterer of a potentially ambiguous sentence does not necessarily

recognize the ambiguity or does not plan the way of uttering the ambiguous sentence taking the hearer's needs into consideration (e.g., Kraljic & Brennan. 2005), it has been suggested that the hearer nonetheless pays attention to prosodic prominences of utterances in making interpretive choices (e.g., Dahan, Tanenhaus & Chambers 2002). According to Han & Romero (2004), while Neg...*or* sentences under the NSD have neutral intonation on the disjunct NP object, Neg...*or* sentences under the WSD are often uttered with special focus intonation, in that each of the two object NPs receives focus stress. In our experiment, all the test sentences were uttered with neutral intonation to ensure that both interpretations could be potentially compatible with the sentences. In this case, although we did not intend to give subjects prosodic cues to bias their interpretation of Neg...*or*, for subjects who relied heavily on prosodic cues to disambiguate Neg...*or* sentences, the test sentences were already disambiguated toward the "neither" interpretation just given the intonation pattern. In fact, one of the adult subjects who rejected the test sentences asked us after the experiment session whether intonation of the sentences were supposed to be taken into consideration and said that he would have answered differently if it were not. Although this did not give us conclusive evidence that the neutral intonation of the test sentences played a decisive role in the response pattern observed in English adult subjects, it suggested that some subjects might indeed have relied on intonation information to disambiguate the test sentences toward the NSD. We might be able to find more English adults willing to accept the test sentences under the WSD if the test sentences were uttered with focus stress on both disjuncts of the object.

If the prosodic factor really affected adults' interpretation of Neg...*or* in our experiment, one might wonder whether a prosodic account along this line could be extended to explain some children's adherence to the NSD of the test sentences in both conditions of this experiment. Generally speaking, we do not believe so. It has been shown (e.g., Halbert, Crain, Shankweiler & Woodams 1995; Gualmini, Maciukaite & Crain 2003) that children do not rely much on focus intonation information in analyzing potentially ambiguous sentences. We think that the likelihood of children using intonation information to disambiguate Neg...*or* sentences in the current experiment is rather low.

In parallel experimental conditions, English adults' responses to Neg...*or* sentences in this experiment differed from Chinese adults' responses to Neg...*huozhe* sentences in the Chinese target experiment. This was not unexpected, given the different interpretive patterns of Neg...Disjunction and Neg...Conjunction in the two languages. Specifically, the default status of the NSD and the existence of Neg...*and* to express the "not this or not that" meaning in English presumably could bias English speakers to commit to the NSD in this experiment, while Chinese speakers are not subject to this kind of bias.

### **3.3 Two control experiments in Chinese and English**

As we discussed in section 2.1.1 and 2.1.2, English speakers as well as Chinese speakers often use unambiguous alternatives to Neg...Disjunction to express a "not this or not that" meaning, as they try to follow the "avoid ambiguity" sub-maxim. One of the

alternatives they use is sentences involving two disjoined negated VPs<sup>48</sup> (Neg...Disjunction...Neg), such as the English sentence given in (116). In both English and Chinese, this kind of sentences only allow one way of interpretation and should map directly to the abstract logical form of  $\neg Pa \vee \neg Pb$ .

(116) Ryan didn't win the jumping contest or didn't win the running contest.

Although Neg...Disjunction...Neg is subject to the same discourse conditions governing its felicitous use as Neg...Disjunction under the WSD, because it is unambiguous, the  $\neg Pa \vee \neg Pb$  interpretation is forced even when such a sentence is uttered out of context. From a grammatical perspective, sentences of this kind seem transparent in terms of the mapping between the surface form and the logical form. Not considering other factors, children are expected to be relatively successful in interpreting this kind of sentences. We conducted two parallel experiments in Chinese and in English, respectively, targeting at examining children's interpretation of Neg...Disjunction...Neg. These two experiments were meant to be control experiments for the target experiments in the two languages I just reported and were minimally different from those two experiments. However, the results in the two experiments were somewhat surprising – children were not uniformly adult-like in interpreting this kind of sentences.

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<sup>48</sup> Or two disjoined IPs with an unpronounced subject in the second disjunct.

### **3.3.1 Method**

#### **3.3.1.1 Subjects**

In the Chinese control experiment, we interviewed twelve monolingual Chinese speaking children (seven boys and five girls). 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” to test sentences in the test session but could not justify any of her judgments.

In the English control experiment, 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 at 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. We also tested twelve English-speaking adults.

#### **3.3.1.2 Procedure**

The two control experiments followed exactly the same procedure as the two target experiments.

#### **3.3.1.3 Material**

All the stories in these two experiments were exactly the same as in the two target

experiments. As discussed in section 3.1.1.3, the pragmatic conditions associated with the ‘not (doing) this or not (doing) that’ interpretation were met in these test stories, so the Neg...Disjunction...Neg test sentences were used felicitously in these two current experiments. In addition, while Neg...Disjunction...Neg sentences in both English and Chinese are only compatible with the  $\neg Pa \vee \neg Pb$  interpretation (the same as the WSD), we think one conceivable “alternative” (mis)interpretation could be  $\neg(Pa \vee Pb)$  (the same as the NSD); because the test stories made both  $\neg Pa \vee \neg Pb$  and  $\neg(Pa \vee Pb)$  plausible in the process (see discussion in section 3.1.1.3), the plausible dissent condition in the current two experiments could be considered as being satisfied.

In the Chinese control experiment, the test sentences involved two negated disjunct VPs. Given the scenarios in the test stories, we expected subjects to accept the test sentences if they accessed the  $\neg Pa \vee \neg Pb$  interpretation. If they somehow assigned the  $\neg(Pa \vee Pb)$  interpretation to the test sentences, they would reject them. One sample test sentence in the positive goal condition is given in (117), and one in the negative goal condition is given in (118).

(117) 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.”

(118) 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 condition and negative goal condition are presented in their literal translations in English in (119) and (120), respectively. These two lists of sentences were used as test sentences in the English control experiment, in the positive goal condition and the negative goal condition, respectively.

- (119) 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.

- (120) 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. Little deer didn't step on the mud or didn't step on the branch.

The filler sentences in the Chinese control experiment were exactly the same as in the Chinese target experiment, which were simple negated sentences without disjunction in the object). In the English control experiment, the filler sentences were positive sentences involving VP disjunct, listed in (121) and (122). Like in the two target experiments, we made the filler stories such that the truth values of the filler sentences alternated with subjects' judgments of the test sentences.

- (121) 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.

- (122) 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.

### 3.3.2 Results

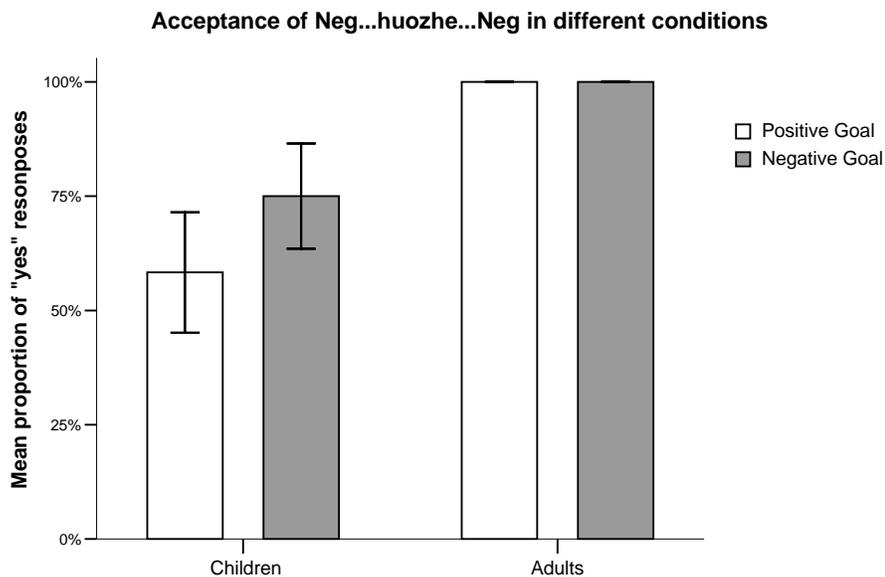
As in the two target experiments, the dependent variable in the analyses of the results in these two control experiments is the proportion of subjects' "yes" responses to the test sentences. In both the Chinese experiment and the English experiment, adults consistently accepted the test sentences in both conditions, while children's responses were significantly different from adults'. In the Chinese experiment, children accepted the test sentences only 58% of the time in the positive goal conditions (compared to adults at 100%,  $t(11) = -3.16, p < .01$ ) and slightly but not significantly more in the negative goal conditions at 75% of the time (compared with 58% of the time in the positive goal condition,  $t(11) = -1.68, p > .1$ ; compared to adults at 100%,  $t(11) = -2.17, p = .05$ ). In the English experiment, children's acceptance rate in the positive goal condition was only 48% (compared to adults at 100%,  $t(11) = -4.3, p = .001$ ); similarly, in the negative goal condition, while adults accepted the test sentences 96% of the time, children only accepted them 48% of the time ( $t(11) = -3.96, p = .002$ ).

(123) Table 16: Mean proportion of subjects' "yes" responses

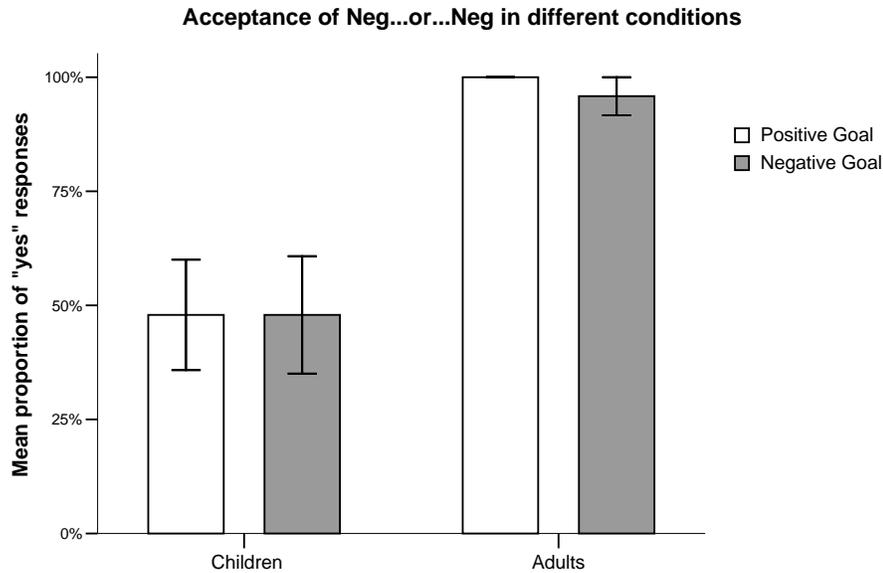
	Chinese		English	
	Children	Adults	Children	Adults
Positive goal condition	58%	100%	48%	100%
Negative goal condition	75%	100%	48%	96%

An ANOVA analysis with a between subject factor of age (children vs. adults) a within subject factor of goal (positive goal vs. negative goal) was performed for the results in each experiment. In the Chinese experiment, 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 ( $F(1,22) = 2.84, p > .1$ ). Similarly, in the English experiment, a significant main effect of age was also observed ( $F(1,22) = 23.62, p < .0001$ ), while no significant effect of goal ( $F(1,22) = .074, p > .5$ ) or reliable interaction of age and goal ( $F(1,22) = .074, p > .5$ ) were evident. The graphs in (124) and (125) illustrate the results in the Chinese experiment and those in the English experiment, respectively.

(124) Figure 3: Acceptance of Neg...*huozhe*....Neg in different conditions



(125) Figure 4: Acceptance of Neg...or...Neg in different conditions



In both the Chinese experiment and the English experiment, children's responses showed bimodal distribution, as illustrated in the table in (126). The correlation between children's responses and their age was not parallel in the two experiments. As shown in the tables in (127) and in (128), especially in the negative goal condition, while older children in the Chinese experiment seemed to accept the test sentences more often than younger children, English children exhibited the opposite pattern.

(126) Table 17: Distribution of children's responses

	% of "yes" responses	0%	25%	50%	75%	100%
Chinese	Positive goal	3	2	1	0	6
	Negative goal	2	0	2	0	8
English	Positive goal	4	1	2	2	3
	Negative goal	4	2	1	1	4

(127) Table 18: Proportion of “yes” responses from individual Chinese children

<b>Subject</b>	<b>Age</b>	<b>Positive Goal</b>	<b>Negative Goal</b>
1	3;11	100%	100%
2	4;0	100%	100%
3	4;1	0%	0%
4	4;2	0%	0%
5	4;2	50%	50%
6	4;3	25%	50%
7	4;4	100%	100%
8	4;4	100%	100%
9	4;7	0%	100%
10	4;7	100%	100%
11	4;8	25%	100%
12	4;8	100%	100%

(128) Table 19: Proportion of “yes” responses from individual English children

<b>Subject</b>	<b>Age</b>	<b>Positive Goal</b>	<b>Negative Goal</b>
1	4;5	100%	100%
2	4;6	100%	75%
3	4;6	50%	100%
4	4;7	50%	100%
5	4;8	0%	100%
6	4;9	75%	25%
7	4;11	75%	50%
8	5;1	0%	0%
9	5;1	100%	0%
10	5;2	0%	0%
11	5;4	0%	0%
12	5;5	25%	25%

### 3.3.3 Discussion

A simple sentence with two negated VP disjuncts (Neg...Disjunction....Neg) in both

Chinese and English can only be interpreted as  $\neg Pa \vee \neg Pb$ , and what could be inferred from the outcome of the stories (i.e., “didn’t do one of the two things”) in this experiment matched this interpretation. Therefore, as expected, adults of the two languages consistently accepted the test sentences in these two experiments. On the other hand, children of both languages rejected the test sentences unexpectedly often and justified their rejection by contrasting what could be inferred with a “neither” interpretation of Neg...Disjunction...Neg. The original goal of these two experiments was to show that children should have little problem handling a “not this or not that” situation when the test sentences did not involve ambiguity and forced a  $\neg Pa \vee \neg Pb$  interpretation – compared to when the test sentences involved ambiguity, as in the two target experiments. This goal was partially reached, as evidence from children’s responses to the test sentences in the positive goal condition, where half of the children in both languages accepted the test sentences, meaning that they correctly interpreted the sentences as  $\neg Pa \vee \neg Pb$  and successfully computed the pragmatic factors in the context. This contrasted with children’s responses to the ambiguous Neg...Disjunction sentences in the same condition of the target experiments, where almost no children accepted the sentences under the  $\neg Pa \vee \neg Pb$  interpretation. However, still half of the children in these two experiments rejected the test sentences based on a “neither” interpretation in at least one of the two conditions<sup>49</sup>. How those children assigned a “neither” interpretation to

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<sup>49</sup> Valentine Hacquard (p.c.) suggested that this might also be caused by children’s misunderstanding of the task, i.e., they wanted Kermit to provide an answer describing a definite scenario. However, as I mentioned in footnote 47, it is not very likely that children in these experiment generally misunderstood the task.

Neg...Disjunction...Neg is a mystery to us. We thought the mapping from the surface form of this kind of sentences to the relevant logical form should be straightforward, even for children. But children's behavior in these two experiments suggested that either the mapping is not as straightforward for children as we thought or children somehow misparsed Neg...Disjunction...Neg as something else, such as Neg...Disjunction.

Children's non-adult way of analyzing relatively complex sentences has been reported in the literature. For example, in some experimental studies, children were found to associate *every* quantifying over the subject (e.g., *every boy is riding an elephant*) with events or other constituents in the sentence (e.g., Philip 1995, Drozd 2003, Roeper & de Villiers 1993). And some studies showed that children had the tendency to associate *only* with specific constituent irrespective of the position of *only* (e.g., Crain et al. 1992; Crain, Ni & Conway; Philip & Lynch 1999; Drozd 2005). In our current two experiments, some children's rejection to test sentences like (129a) could also be caused by their misanalyzing the sentence. The origin of the misanalysis is unclear. These children might somehow extract the negation in both clauses to quantify over the whole sentence and derive a logical form as in (129b); consequently, they would map a "neither" interpretation to the test sentence. Or, they might fail in paying attention to the negation in the second clause as they started processing the string *the worker didn't fix the bike or...*, so that the test sentence was parsed as (129c); and because of their preference toward the NSD of Neg...Disjunction sentences, some children would assign a "neither" interpretation to the misparsed test sentence.

- (129) a. The worker didn't fix the bike or didn't fix the skateboard.  
b. Not (the worker fixed the bike or fix the skateboard).  
c. The worker didn't fix the bike or fix the skateboard.

Just based on the results of these two experiments, we do not have conclusive explanations about the mechanism involved in some children's unexpected way of interpreting Neg...Disjunction...Neg sentences. And children's behavior in this experiment suggested that "not this or not that" situations may contain general complexities for children.

### **3.4 One more Chinese control experiment**

Simple negated sentences with a conjunct object in Chinese (Neg...*he*) are unambiguously interpreted as  $\neg Pa \wedge \neg Pb$  ("neither", the WSC) for Chinese adults. This interpretation of Neg...*he* in Chinese is both obligatory and natural, and it is not associated with special discourse conditions, as the "neither" interpretation of Neg...*huozhe* (the NSD) in Chinese is. Neg...*he* is also the default and standard way in Chinese to express a "neither" interpretation. Therefore, children presumably have abundant positive evidence regarding Neg...*he* in the input, at least compared to Neg...*huozhe* – as suggested by the results of our preliminary adult corpus searches mentioned in section 3.1.1.3. We expect them to know that Neg...*he* means "neither" in Chinese. The current experiment tested children's interpretation of Neg...*he* and was

designed as a control experiment for the Chinese target experiment I reported in section 3.1.

### **3.4.1 Method**

#### **3.4.1.1 Subjects**

Twelve monolingual Chinese speaking (seven boys and five girls) children participated in this experiment. Their main age was 4;3 (from 3;8 to 4;8). One other child was initially tested, but he refused to give any answer, therefore, we had to eliminate him from the test session. We also interviewed twelve Chinese speaking adults.

#### **3.4.1.2 Procedure and material**

This experiment followed exactly the same procedure as the Chinese target experiment and the other control experiment. All the test stories, filler stories and filler sentences in this experiment were the same as in the other two experiments. The test sentences in this experiment were simple negated sentence with a conjunct object (Neg...*he*). One sample test sentence in the positive goal condition is given in (130) and one in the negative goal condition is given in (131).

(130) 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.”

(131) 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.”

As I discussed in section 3.1.1 on the Chinese target experiment, the way the test stories were designed made both the “not this or not that” situation (corresponding to  $\neg Pa \vee \neg Pb$ , equivalent to  $\neg(Pa \wedge Pb)$ ) and the “neither” situation (corresponding to  $\neg(Pa \vee Pb)$ , equivalent to  $\neg Pa \wedge \neg Pb$ ) plausible in the process. Therefore, the test stories in the target experiment could be used in this control experiment with Neg...*he* test sentences under the  $\neg Pa \wedge \neg Pb$  interpretation (i.e., the WSC) and also satisfied the plausible dissent condition, assuming that the potentially alternative interpretation of Neg...*he* was  $\neg Pa \vee \neg Pb$  (i.e., the NSC). The actual outcome in each test story was a “not this or not that” situation (and, a “not both” situation), and thus would falsify a Neg...*he* sentence under the WSC (“neither”). In this experiment, we expected subjects to reject the test sentence if they interpreted Neg...*he* as meaning “neither”. And if they somehow assigned the “not both” meaning to Neg...*he* (i.e., the NSC), they would accept the test sentences.

The complete set of test sentences used in the positive goal and in the negative goal condition are listed in their literal English translation in (132) and (133), respectively.

- (132) 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.
- (133) 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. Little deer didn't step on the mud and the branch.

### 3.4.2 Results and Discussion

As expected, all the children and adults in this experiment consistently rejected the test sentences (100% of the time), showing that they all accessed the  $\neg Pa \wedge \neg Pb$  interpretation of Neg...*he* (i.e., the WSC). No further statistical analysis was performed with the results.

Chinese children's responses in this experiment showed that they had no problem with the wide scope conjunction interpretation (the WSC) of Neg...*he*. If the mechanism of the mapping from a Neg...*he* string to the WSC is parallel to that of the mapping from a Neg...*huozhe* string to the wide scope disjunction interpretation (the WSD), Chinese children's difficulties in accessing the WSD in normal context cannot be attributed to their general problem in interpreting coordination outside the scope of negation. Meanwhile, children's different behaviors in the target experiment and in this control experiment, specifically in the negative goal condition, proved that the two logical words, *huozhe* and *he*, do not bear identical meaning for Chinese children.

Although both the narrow scope disjunction interpretation (the NSD) of Neg...*huozhe* and the WSC of Neg...*he* correspond to the "neither" meaning, some special discourse condition is associated with the NSD for Chinese adult speakers, namely, the two corresponding positive propositions are not only relevant, but are also expected to have a disjunctive relation (i.e.,  $Pa \vee Pb$  is specifically expected). This

property of the NSD in Chinese prevents it from being generally preferred by adult speakers, who rely more on the context to disambiguate Neg...*huozhe* sentences. The results of our Chinese target experiment showed that Chinese children preferred the NSD, which suggested that they have not yet formed a reliable understanding of the special condition of using an  $S_N$  (Neg...*huozhe* under the NSD) felicitously. This means, for Chinese children,  $S_N$  and Neg...*he* are more or less interchangeable, so that we could observe children's parallel responses to Neg...*huozhe* and Neg...*he* in normal context (e.g., in the positive goal condition). However, Neg...*huozhe* and Neg...*he* are not completely identical for Chinese children. In contexts that are especially conducive to the WSD (and hence also to the narrow scope conjunction interpretation, i.e., the NSC) e.g., in the negative goal condition, children could somehow get away from their preference toward the NSD and assign the “not this or not that” meaning (the WSD) to Neg...*huozhe* presented to them; but in the same contexts, they adhere to the “neither” meaning (the WSC) of Neg...*he*.

Our two target experiments in Chinese and in English showed that children at age 4 had both interpretations of Neg...Disjunction available in their grammar. In section 3.1.3.3 and 3.2.3.1, I entertained the possibility that the WSD is provided to children by UG. Extending similar logic to the case of Neg...Conjunction, it is theoretically possible that children are also provided with both interpretations of Neg...Conjunction at the initial stage of language acquisition. Given the test scenarios of this control experiment, the test sentences were true if Neg...*he* was interpreted as “not both” (the NSC).

Although this is not the adult way of interpretation, in theory, children might allow this interpretation – considering that Japanese children allow the NSD of Neg...*ka*, while Japanese adults do not. However, in this experiment, no children accepted the test sentence, meaning that they did not base their judgment on the NSC of Neg...*he*. If the NSC is provided by the UG, children’s uniform rejection to Neg...*he* test sentences in both conditions of this experiment could mean that Chinese children at age 4 have already learned that Neg...*he* in simple negated sentences does not allow the NSC. The question then is how they could have purged the impossible interpretation. One possibility is that children utilize a Bayesian learning mechanism (Regier & Gahl 2004, Tenenbaum & Griffiths 2001) and take both the presence of the WSC and absence of the NSC into consideration to determine the correct interpretive option of Neg...*he*. This first requires that ample data points regarding Neg...*he* exist in children’s input, which is presumably true, considering our preliminary adult corpus search results. Then, it also requires that children can identify occurrences of Neg...*he* as not involving the NSC. Because Neg...*he* under the NSC (not allowed in adult Chinese) would be true in a wider range of circumstances than Neg...*he* under the WSC, whenever Neg...*he* is used by adult speakers, the circumstance will be truth-conditionally compatible with both the WSC and the NSC. So children must be able to tell that the WSC is always the intended meaning. This seems to presume that children can take pragmatic use of Neg...*he* under the two potential interpretations into consideration, namely, Neg...*he* under the NSC would not be appropriate to use when the circumstance is a definite “neither” scenario.

One might wonder whether children can do this, given the findings in some experimental studies that children sometimes accept a “weaker” expression to be used in a “stronger” circumstance (e.g., in Chierchia et al. 2001, English children were found to accept *or* describing “and” scenarios). We must note that these two cases are not actually parallel. When children were found to accept a weaker form in a stronger situation (e.g., Chierchia et al. 2001), the computation involved two distinct forms (e.g., *or* and *and*), accepting the weaker form suggested that they focused on the truth-conditional aspect of the weaker form and did not take its appropriate use into consideration in the experimental tasks. On the other hand, in the current Neg...*he* case, a single form potentially compatible with two interpretations is always used in a stronger situation; here, children can well assign the stronger interpretation to Neg...*he*, without even worrying about whether the weaker interpretation is appropriate in this situation. In addition, what we observed in children’s interpretation of Neg...*huozhe* was that they did not access the weaker interpretation (the WSD) even in a matching weaker situation (“not this or not that”), if the context did not well satisfy the felicity condition. It is conceivable that children will not tend to assign the weaker interpretation (the NSC, “not both”, equivalent to “not this or not that”) to Neg...*he* given a stronger situation (“neither”), as the felicity condition associated with the NSC is not satisfied. We admit that further careful investigations in this respect are needed to evaluate this possibility.

Children’s rejection to Neg...*he* sentences in this experiment could also be argued to show their strong preference toward the WSC and that Chinese children at age 4 in fact

allow the NSC, but accessing this interpretation is somehow even more resource consuming for them than accessing the WSD of Neg...*huozhe*, so that their knowledge of the NSC was not revealed in the current experiment. If this is true, we wonder how it is possible to reveal children's knowledge of the NSC of Neg...*he* after all. And if children of other languages that allow the NSC (such as English) can access the NSC in experimental conditions like the negative goal condition of the current experiment, this would argue against the hypothesis that Chinese children did not access the NSC in the current experiment because accessing this interpretation is not facilitated enough for children in this kind of experimental settings.

In fact, the results of the current experiment do not provide empirical support for the hypothesis that both the NSC and the WSC are available to children at the early stage of language acquisition. It is also possible that the initial option children have to analyze Neg...Conjunction is only the WSC, and if their language allow the NSC, they learn this interpretation through exposure to positive evidence in the input. If this is the case, we would wonder why the WSC is the initial option. Because the WSC involves a semantic scopal relation of negation and conjunction that does not match transparently to the surface c-commanding relation of the two elements, from a grammatical perspective, it is not easy to see why this "inverse" mapping becomes the initial option. Goro (2004) provided an account for this initial option that made reference to the Semantic Subset Principle (SSP). According to him, because the WSC ("neither") entails the NSC ("not both"), children must start off with only the WSC, i.e., the stronger option, as required by

the SSP. However, as I have discussed earlier, the general applicability of the SSP in regulating the design of the language faculty is under debate, and the SSP also does not seem to be relevant in the Neg...Disjunction case; therefore, appealing to the SSP in the case of Neg...Conjunction is not justified.

Despite the unsettled issues discussed above, from this experiment, we can conclude that Chinese children at age 4 can reliably assign the “neither” interpretation to Neg...*he*. This observation set up the basis for one of our follow up experiments, which is reported in section 4.2 of next chapter.

## Chapter 4: Access to the WSD in priming contexts

As presented in chapter 3, our two target experiments in Chinese and English revealed very similar pattern of children's behavior regarding the interpretation of Neg...Disjunction sentences in these two languages, although adult speakers of the two languages behave differently. What we concluded in chapter 3 from the experimental results was that children's grammatical knowledge on the interpretation of Neg...Disjunction is more complex than what had been thought before, but children are constrained by their limited capacity in pragmatic computation in exhibiting this knowledge. In this chapter, we report two more experiments conducted with Chinese-speaking children, which targeted at revealing their knowledge of the WSD of Neg...*huozhe* with other kinds of facilitations.

In both of the two experiments, before children were presented with Neg...*huozhe* sentences to judge, we had them experience some related forms. In one experiment, we first asked children to judge Neg...*huozhe* sentences with an extra disambiguating clause toward the WSD added at the end. For children who could consistently access the WSD of disambiguated Neg...*huozhe* sentences, presumably, this representation of Neg...*huozhe* would be more activated than its normal state, and these children would be more sensitive to the “not this or not that” aspect of the contextual information. These might improve children's access to the WSD of later plain Neg...*huozhe* sentences without a disambiguating clause. In the other experiment, we first presented children with

Neg...*he* sentences to evaluate. After children experienced Neg...*he* used meaning “neither”, their might be more likely to consider Neg...*he* as the form to use to express a “neither” meaning, which could help them loosen their adherence to the “neither” interpretation of Neg...*huozhe* and improve their access to the WSD. If children indeed could access the WSD of Neg...*huozhe* more easily in these priming contexts, we would get further empirical evidence that children’s grammatical knowledge of Neg...*huozhe* contains the WSD; and we could conclude that children can better integrate discourse information and perform pragmatic computations in interpreting ambiguous sentences when the targeted representation is more activated or/and the necessary ingredients for the computations (e.g., critical contextual information, relevant alternatives, etc.) are more directly accessible. From a learning perspective, if children’s access to the WSD of Neg...*huozhe* could be affected by their experience with other forms (especially, Neg...*he*), we could project that their ultimate mastery of this interpretation in an adult way may be dependent on their experience with these related forms and their ability to compute the relations.

## **4.1 Neg...*huozhe* with disambiguating clause and its priming effect**

### **4.1.1 Logic of the experiment**

I discussed in section 2.1.1 that Neg...*or* is disambiguated toward the WSD if a clause such as *I don’t know which* is added to the end, in which case the WSD is easier for English adults to access (Han & Romero 2004). Each of the sentences in (134) without

the *I don't know which* (or *I'm not sure which*) clause is most likely to be interpreted by English speakers as expressing the “neither” meaning (i.e., the NSD). But the added disambiguating clause changes how the Neg...*or* clause should be interpreted. This clause directly reveals that the speaker’s intended meaning with the Neg...*or* clause is the WSD and reflects her efforts in clarifying potential misunderstanding and confusions caused by the ambiguous Neg...*or* clause – specifically because the intended meaning is not the default interpretation. With the assumption that the speaker is reasonable, the hearer of these sentences should be able to recognize the speaker’s intended meaning and is forced to revise her initial hypothesis about the interpretation of the Neg...*or* clause in this case, if it is not the WSD<sup>50</sup>. This assumes that both the speaker and the hearer are cooperative and following the conversational maxims: the speaker tries to be as clear as possible in addressing her intended message – following the maxim of manner; and the hearer considers the speaker as being truthful and relevant by following the maxim of quality and the maxim relation, so that the two clauses together should convey a coherent message.

- (134) a. This bus doesn't stop at the courthouse or the library, but I don't remember which one it doesn't stop at.  
b. David hasn't been to Paris or London, but I am not sure which city he hasn't been to.  
c. The tenant didn't pay the utility bill or phone bill, but I don't know which bill he didn't pay.

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<sup>50</sup> There might be English speakers who do not allow the WSD of Neg...*or* no matter what. If so, for these speakers, the sentences presented here are simply bad, because the two clauses express incoherent information.

This kind of explicit disambiguating attempt also occurs with lexical ambiguity, as illustrated in (135). There, the speaker is concerned that the addressee might misunderstand what she meant with the word *bank* as referring to some financial institution, so she adds an explicit explanation about what she really means, i.e., “the river bank”.

(135) We’re gonna meet at the bank – I mean, the river bank.

It is evident in these examples that the circumstances when the speaker uses an explicit disambiguating explanation always involve the intended meaning which is the dispreferred or less commonly occurring option of an ambiguous form. This is consistent with the cooperation principle. When the speaker chooses to use a form to deliver some meaning, the form is never ambiguous for her, in that she intends exactly one meaning to be associated with the form. However, the form could have multiple meanings in the language, which means that the hearer could perceive the form in more than one way. In case the speaker intends to express the meaning that is the default one or the one that is very salient and clear given the specific context, she normally does not need further explanation – and most of the time she might not even realize the potential ambiguity, since the hearer should get the speaker’s intended message right away. In this case, any further disambiguation would be redundant and violates the ‘be brief sub-maxim of the

maxim of manner. On the other hand, when the speaker's intended message is the dispreferred option or unclear in the context, potential misinterpretation by the hearer may occur. If the speaker realizes that she is using a potentially ambiguous form with an uncommon or less salient meaning intended, which could cause misunderstanding and confusions, she is somewhat obligated to clarify the ambiguity, in order to follow the "avoid ambiguity" sub-maxim of manner.

Unlike Neg...*or* in English, which has the NSD as the default interpretation, Neg...*huozhe* in Chinese does not have a common 'default' interpretation shared by most speakers. In this case, if it is not clear from the context which interpretation the speaker intends with a Neg...*huozhe* sentence, the speaker can add an extra explanation clause right after it, directly resolving the ambiguity. Based on which interpretation the speaker intends, the disambiguating clause she adds is either one that favors the NSD of the Neg...*huozhe* clause (as exemplified in (136)), or one that calls for the WSD (such as in (137)). Upon hearing the disambiguating clause, the hearer will either confirm or revise her initial interpretation, depending on whether it conforms to what the speaker intends to convey. Given this, the WSD of Neg...*huozhe* is also easier for Chinese speakers to access, when a disambiguating clause meaning "I don't know which he didn't do" is added to the end.

(136) zhe-lu che bu ting fayuan huozhe tushuguan,  
his-rout bus not stop courthouse or library  
ruguo ni yao qu zhe liang-ge difang, yao huan yi-lu che

if you want go these two-CL place need change one-route bus  
'This bus doesn't stop at the court house or the library. If you want to go to (either of) these two places, you need to change to another bus.'

- (137) zhe-lu che bu ting fayuan huozhe tushuguan  
his-rout bus not stop courthouse or library  
dan wo bu jide ta bu ting na zhan le  
but I not remember it not stop which stop LE  
'This bus doesn't stop at the courthouse or the library, but I don't remember which one it doesn't stop at.'

Although we have already established that children are not fully competent in pragmatic computation as adults, we also showed that certain pragmatic facilitations could to some extent help children perform the relevant computation and access the generally dispreferred WSD of Neg...Disjunction in Chinese and in English. Given that an added disambiguating clause helps adults access the WSD, it is conceivable that this might also help children, if their grammar allows this way of interpretation. Although children overwhelmingly prefer the NSD, a disambiguating clause favoring the WSD would give them a potential chance to reconsider the context and make corresponding (re)analysis of the Neg...Disjunction sentence. In light of this, the first goal of the current experiment was to test whether children were sensitive to the effect of the added disambiguating clause and able to access the WSD more easily. Because our previous two target experiments revealed similar behavior of Chinese children and English children in interpreting Neg...Disjunction, and both languages use similar kinds of explanation clauses to explicitly disambiguate Neg...Disjunction toward the WSD, we tested Chinese children only in the current experiment and assumed that their responses would be

representative for children in general. We hypothesized that Chinese children at age 4 had the WSD interpretation of Neg...*huozhe* in their grammar and could make use of the disambiguating clause to some extent. The prediction was that children in the experiment could somehow overcome the preference toward the NSD and accept Neg...*huozhe* sentences under WSD more often when the sentences had a disambiguating clause at the end. Since we observed a difference in children's performance with the WSD of Neg...*huozhe* sentences as a function of different contextual settings (positive goal vs. negative goal) in our previous experiments, we should look at the effect of the disambiguating clause on children's access to the WSD in different contextual settings separately.

One interfering factor was that children might rely solely on the "I don't know which" clause to make judgment about the test sentence. To control for this factor, we also tested whether Chinese children would interpret Neg...*he* as "not both" (i.e., the NSC, truth conditionally equivalent to "not this or not that") when an "I don't know which" clause was added to the end. In one of our previous control experiments (reported in section 3.4), we showed that Chinese children uniformly interpreted Neg...*he* as "neither" (the WSC), even in contexts where they could assign the "not this or not that" (the WSD) meaning to Neg...*huozhe*. Given this, if children relied on the "I don't know which" clause to judge the test sentence, they would interpret Neg...*he* with such a clause added to the end as "not this or not that". Therefore, if it turned out that they still interpreted Neg...*he* as "neither" with the presence of an "I don't know which" clause,

this would mean that they did not use the disambiguating clause as the source to judge the test sentence.

Another goal of this experiment was to test whether the effect of having accessed the WSD of disambiguated Neg...*huozhe* sentences might somehow aid children in accessing the WSD of plain Neg...*huozhe* sentences without a disambiguating clause. Our hypothesis was that prior access to the WSD of disambiguated Neg...*huozhe* would “activate” this interpretation of Neg...*huozhe* more and also make children more experienced with the “not this or not that” aspect of context, which might bias children’s analysis of later plain Neg...*huozhe* sentences toward the WSD and their attention to the crucial piece of information relevant to this interpretation. This predicted that children would accept plain Neg...*huozhe* sentences under WSD more often when they accepted disambiguated Neg...*huozhe* sentences under the WSD more often.

In evaluating whether Chinese children could access the WSD more easily in various conditions of this experiment, we used Chinese children’s performances in our original Chinese target experiment reported in 3.1 as baseline, given comparable experimental designs and similar demographics of the subjects in the two experiments.

#### **4.1.2 Method**

##### **4.1.2.1 Subjects**

Forty-eight monolingual Chinese-speaking children (24 boys and 24 girls) were tested in this experiment, their age ranged from 3;10 to 5;8 (mean age 4;8). One other child was

eliminated from the test phase because she didn't pass the screening. All child subjects were from the Kindergarten Affiliated with Nanjing Forestry University in Nanjing, China.

#### **4.1.2.2 Procedure**

This experiment also used the TVJT paradigm, as in our other experiments reported in chapter 3. But unlike those experiments, which used toy figures and props to act out the stories, in this experiment, computer generated cartoon stories were presented to children on a computer screen in full-screen mode. This method was intended to speed up the test process and accommodate the amount of materials to be tested on each subject, by eliminating the time spent on setting up the story scenes and cleaning up after each story. Computer generated stories were used in other experiments using TVJT and proved to be as effective as acted-out stories (e.g., Goro, Minai & Crain 2005).

Children were all tested individually in a quiet room. A test session for each child was composed of three successive phases: the warm up phase, the test phase and the follow up phase. Although each phase was designed to serve its own purpose in the experiment, in the testing process, no noticeable divisions between these phases were intended, so that the whole test session would be one big coherent 'game' for the children. In the warm up phase, children were told two relatively simple stories with the "curtain trick" as described in chapter 3. At the end of each story, the puppet, Kermit the frog, would "guess" what happened using a simple positive sentence involving a disjunct NP

object<sup>51</sup>. Children were asked to judge whether Kermit was right or wrong. Those who couldn't perform the task or couldn't concentrate would be eliminated from the test phase. In the test phase, each child was tested in two consecutive blocks: in the first block, the *priming block*, children were tested with Neg...*huozhe* sentences that had a disambiguating clause meaning "I don't know which one he didn't do" at the end ('disambiguated Neg...*huozhe* sentences'); in the second block, the *target block* children were tested with plain Neg...*huozhe* sentences. In each block of the test phase, 3 test stories were presented. In the whole test phase, a total of 3 filler stories were told, similar to the test stories, and the filler sentences were simple positive sentences involving a disjunct NP object like the warm up sentences<sup>52</sup>. The stories in the test phase all used the "curtain trick". The two block design of the experiment served the two goals of the experiment I mentioned earlier: the first block tested whether children could access the WSD of disambiguated Neg...*huozhe* sentences easier; the second block immediately following the first block tested whether there was a priming effect of prior access to the WSD on plain Neg...*huozhe* sentences.

The critical part of the experiment was a 2×2 between subject design: one of the two factors was the type of goal the test stories had (positive goal vs. negative goal) in the first block of the test phase; the other factor was the type of goal the test stories had in the

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<sup>51</sup> One of the sentences also contained an explanation clause meaning "I don't know which one he did" at the end.

<sup>52</sup> One of the 3 filler sentences in the test phase also contained the "I don't know which" clause at the end and was presented in the first block; the other 2 filler sentences were presented in the second block. It should be noted, from the perspective of the whole test session, warm up stories and sentences were also considered as fillers.

second block (positive goal vs. negative goal). The 48 children were divided into 4 groups; each group received a different combination of the types of test stories in the two blocks, as shown in the table in (138). This kind of design aimed at observing children’s interpretation of Neg...*huozhe* sentences in different contextual settings in the context of other manipulations. Our baseline experiment showed that children’s interpretation of Neg...*huozhe* differed in positive goal condition vs. in negative goal condition; we also expected to see this difference in this experiment. We predicted that children in group 3 and group 4, who heard disambiguated Neg...*huozhe* sentences in negative goal stories, would access the WSD of Neg...*huozhe* in the priming block more often than children in group 1 and group 2, and that consequently, the priming effect of prior access to the WSD on analysis of later Neg...*huozhe* would be more observable in these two groups of children.

(138) Table 20: Sub-grouping of the subjects

1st block \ 2nd block	Positive goal	Negative goal
Positive goal	group 1 (P-P)	group 2 (P-N)
Negative goal	group 3 (N-P)	group 4 (N-N)

In addition, the experiment had a follow up phase, where children were told one story like the ones in the test phase but were then given a Neg...*he* sentence (meaning “neither” for Chinese adults) to judge, which also had a clause meaning “but I don’t

know which one he didn't do" added to the end. The goal of this phase was to control for the factor that children might base their judgment of a test sentence simply on the added "but I don't know which one he didn't do" clause. If so, children's responses in the follow up phase would resemble their responses in the test phase.

#### **4.1.2.3 Materials**

All the test stories had similar plot structures as those in our original baseline experiment, regardless of the block where they were told. Some of the stories in this experiment were borrowed from that experiment and adapted into cartoon stories with some modifications. There are 12 total test stories designed for this experiment, 6 positive goal stories and 6 negative goal stories. Each test session would use 6 stories, and the specific combination of the stories depended on which group the child subject belonged to.

A sample positive goal story is given in (139); and a sample negative goal story is given in (140).

(139) Mickey Mouse had a bike and a skateboard. But they were broken. Mickey looked at the bike and the skateboard carefully and decided that he couldn't fix them on his own. So he sent the bike and the skateboard to the garage.

Mickey said to the boss: *Hi boss, can you ask your workers to fix my bike and my skate board? They are broken.*

The boss said: *Sure. But we only have one worker on duty today, so he must fix them one by one. It may take longer. And when he is working, the garage door must remain closed for safety reasons. 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 then 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 played outside and felt bored after a while. He decided to go back to the garage.

(Curtain removed)

Mickey Mouse talked to the boss: *Do you think the worker has fixed my stuff?*

The boss said: *Oh, you came back already! I think the worker hasn't fixed anything yet. But let's go and check.*

The two walked to the front of the garage door and see one flag on the door.

The boss said: *Oh, well, it seemed that 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!*

(140) Donkey and Rhino 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 chair in the middle. You are supposed to push the cart through this obstacle course. If you don't hit the chair, you can play the real game.*

Rhino was very clumsy and hit the chair. Donkey made it to the end without hitting the chair, 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 suitcase. It seems that Donkey is very good in pushing cart. Rhino, 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 suitcase, 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)

(The puppet, Kermit, said: *I am wondering how well Donkey does in the real game.*)

(After some time, curtain removed)

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

As in our baseline experiment, after each story was over, the puppet would first say something about his observation, such as “the worker hanged one flag on the door, I guess...” After a short pause signaling thinking, the puppet would utter the test sentence with the “I don’t know which” disambiguating clause. One sample positive goal test sentence and one sample negative goal test sentence used in the first block are given in (141) and (142), respectively. (143) and (144) exemplify the test sentences used in the second block, in positive goal stories and in negative goal stories, respectively. In any one block, each child only heard one of the two types of stories (all positive goal stories or all negative goal stories); while two of the four groups of children (group 2 and group 3) heard different types of stories in the two blocks. The outcomes of the test stories always made the test sentences true under the WSD.

(141) 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,  
 danshi wo bu zhidao ta meiyou xiu-hao na yi-ge  
 but I not know he not-PERF fix-ready which one-CL  
 but I don’t know which one he didn’t fix”

(142) lüzi meiyou zhuang-dao datong huozhe xiangzi  
 donkey not-PERF hit-at barrel or suitcase  
 Lit. “Donkey didn’t hit the barrel or the suitcase,  
 danshi wo bu zhidao ta meiyou zhuang-dao na yi-ge  
 but I not know he not-PERF hit-at which one-CL  
 but I don’t know which one he didn’t hit”

(143) yisheng meiyou jiancha-hao xiao-mao huozhe xiao-gou  
 doctor not-PERF examine-ready little-cat or little-dog  
 Lit. “The vet didn’t examine the cat or the dog.”

(144) xiao-lu meiyou cai-dao niba huozhe shuzhi  
 little-deer not-PERF step-on mud or branch  
 Lit. “Little deer didn’t step on the mud or the branch.”

The table in (145) illustrates the complete sets of test sentences presented to the four groups of children in their English literal translations, together with the filler sentences used in the test phase. The outcomes of the test stories made the test sentences true under the WSD and false under the NSD; and the filler stories were designed such that the first two filler sentences were false and the last one was true.

(145) Table 21: Test sentences and filler sentences

Group	Block / Goal	Test sentences and filler sentences
Group 1	Priming block (Positive goal)	<ul style="list-style-type: none"> <li>The worker didn’t fix the bike or the skateboard, but I don’t know which one he didn’t fix.</li> <li>Rabbit didn’t water the rose or the sunflower, but I don’t know which one he didn’t water.</li> <li>The alien didn’t jump over the TV or the radio, but I don’t know which one he didn’t jump over.</li> </ul>
	Target block (Positive goal)	<ul style="list-style-type: none"> <li>The vet didn’t examine the cat or the dog.</li> <li>Mouse didn’t feed the horse or the cow.</li> <li>Big sister didn’t lift up the chair or the stool.</li> </ul>
Group 2	Priming block (Positive goal)	<ul style="list-style-type: none"> <li>The worker didn’t fix the bike or the skateboard, but I don’t know which one he didn’t fix.</li> <li>Rabbit didn’t water the rose or the sunflower, but I don’t know which one he didn’t water.</li> <li>The alien didn’t jump over the TV or the radio, but I don’t know which one he didn’t jump over.</li> </ul>
	Target block (Negative goal)	<ul style="list-style-type: none"> <li>Little dear didn’t step on the log or the rock.</li> <li>The girl didn’t drop the shell or the diamond.</li> </ul>

		<ul style="list-style-type: none"> <li>• Square robot didn't hop on the brush or the broom.</li> </ul>
Group 3	Priming block (Negative goal)	<ul style="list-style-type: none"> <li>• Donkey didn't hit the barrel or the suitcase,, but I don't know which one he didn't hit.</li> <li>• The girl didn't slip on bucket or the cup, but I don't know which one she didn't slip on.</li> <li>• Kangaroo didn't fall off the rack or the balance beam, but I don't know which one he didn't fall off.</li> </ul>
	Target block (Positive goal)	<ul style="list-style-type: none"> <li>• The vet didn't examine the cat or the dog.</li> <li>• Mouse didn't feed the horse or the cow.</li> <li>• Big sister didn't lift up the chair or the stool.</li> </ul>
Group 4	Priming block (Negative goal)	<ul style="list-style-type: none"> <li>• Donkey didn't hit the barrel or the suitcase, but I don't know which one he didn't hit.</li> <li>• The girl didn't slip on bucket or the cup, but I don't know which one she didn't slip on.</li> <li>• Kangaroo didn't fall off the rack or the balance beam, but I don't know which one he didn't fall off.</li> </ul>
	Target block (Negative goal)	<ul style="list-style-type: none"> <li>• Little deer didn't step on the log or the rock.</li> <li>• The girl didn't drop the shell or the diamond.</li> <li>• Square robot didn't hop on the brush or the broom.</li> </ul>
All	Filler (Positive goal)	<ul style="list-style-type: none"> <li>• This girl played with the basketball or volleyball, but I don't know which one she played with.</li> <li>• The karate student reached the lamp or the mobile.</li> <li>• Winnie the Pooh caught the chicken or the squirrel.</li> </ul>

The two warm up stories had similar set up as the test stories. The two warm up sentences, given in (146aa) and (146b), were simple positive sentences involving a disjunct NP object, and one of them also contained a “I don't know which” clause at the end. The first sentence was true given the story, while the second sentence was false.

- (146) a. daxingxing tui-dong-le      qiche huozhe huochē,  
gorilla    push-move-PERF bus    or    train  
“Gorilla moved the bus or the train,  
danshi wo bu zhidao ta tui-dong-le      na      yi-ge  
but    I    not know he push-move-PERF which one-CL

but I don't know which one he moved"

- b. xiao-gege            za-dao-le        songshu huozhe xianrenzhang  
little-older-brother throw-at-PERF pine        or        cactus  
"The boy threw (the ball) at the pine or the cactus."

The test story in the follow-up phase was a positive goal story similar to other positive goal test stories. The test sentence was a Neg...*he* clause (meaning "neither" for Chinese adults) followed by an "I don't know which" clause, as in (147). The story was about Donald Duck visiting Daisy Duck. Daisy told Donald to play outside while she was preparing a soup and a vegetable dish. She would put one bowl on the table after she finished cooking one thing. When the story ended, the outcome was that Donald saw one bowl on the table. This made the Neg...*he* clause under the "neither" meaning false, but it was compatible with the added "I don't know which" clause.

- (147) tanglaoya-xiaojie    meiyou    zuo-hao    tang he    cai  
Daisy-miss            not-PERF cook-ready soup and    vegetable  
Lit. "Daisy didn't finish cooking the soup and the vegetable,  
danshi wo bu    zhidao ta    meiyou    zuo-dao    na    yi-ge  
but    I    not know    she not-PERF    cook-ready    which one-CL  
but I don't know which one she didn't finish cooking"

### 4.1.3 Results

In the analyses of the results, the dependant variable is for the most part the proportion of children's "yes" responses to the test sentences (Kermit's utterances at the end of the stories); in a few cases, number of subjects is the dependent variable, when distribution

patterns of responses were compared.

In the first block (the priming block), where test sentences were Neg...*huozhe* sentences containing a disambiguating clause (DAC), two groups of children (group 1 and group 2) heard positive goal stories, and the other two groups of children (group 3 and group 4) heard negative goal stories. The responses of group 1 and group 2 children were combined here in the analysis, so were the responses of group 3 and group 4 children. Overall, children accepted the test sentences in negative goal condition significantly more than in positive goal condition (79% vs. 46%,  $F(1, 46) = 6.949$ ,  $p = .01$ ), and the presence of negative goal in the test stories made a significant difference in the distribution of children's responses to Neg...*huozhe* sentences ( $\chi^2 = 6$ ,  $p < .002$ ). This echoed the pattern of children's responses revealed in the baseline experiment. Meanwhile, we observed a significant increase in children's acceptance rate in both conditions, compared to the respective rate in the baseline experiment: in the positive goal condition, children accepted the test sentences with a DAC significantly more than their baseline rate (46% vs. 6%,  $F(1,34) = 7.845$ ,  $p < .01$ ), and the distribution of children's responses in this experiment also differed significantly from the baseline distribution pattern ( $\chi^2 = 9$ ,  $p < .005$ ); in the negative goal condition, children's acceptance rate was also significantly higher than the baseline (79% vs. 48%,  $F(1,34) = 4.314$ ,  $p < .05$ ), and distribution wise, children's responses were significantly different than the baseline ( $\chi^2 = 4.43$ ,  $p < .05$ ). This means a disambiguating clause has significant effect on facilitating children's access to the WSD of Neg...*huozhe*, regardless of

contextual conditions. Children’s mean acceptance rates and the distribution of their responses are given in table (148) and (149), respectively. As is evident in table (149), children’s responses to disambiguated Neg...*huozhe* showed bimodal distribution in both conditions. Children’s “yes” responses were then entered into an ANOVA with two factors, each of which had two levels: the type of goal in the test stories (positive goal vs. negative goal), and presence vs. absence of the disambiguating clause. The results revealed a significant main effect of the type of goal ( $F(1, 68) = 11.333, p = .001$ ) and a significant main effect of the disambiguating clause ( $F(1, 68) = 11.866, p = .001$ ); no reliable interaction of the two factors was evident ( $F(1, 68) = .233, p > .5$ ). See the graph in (150).

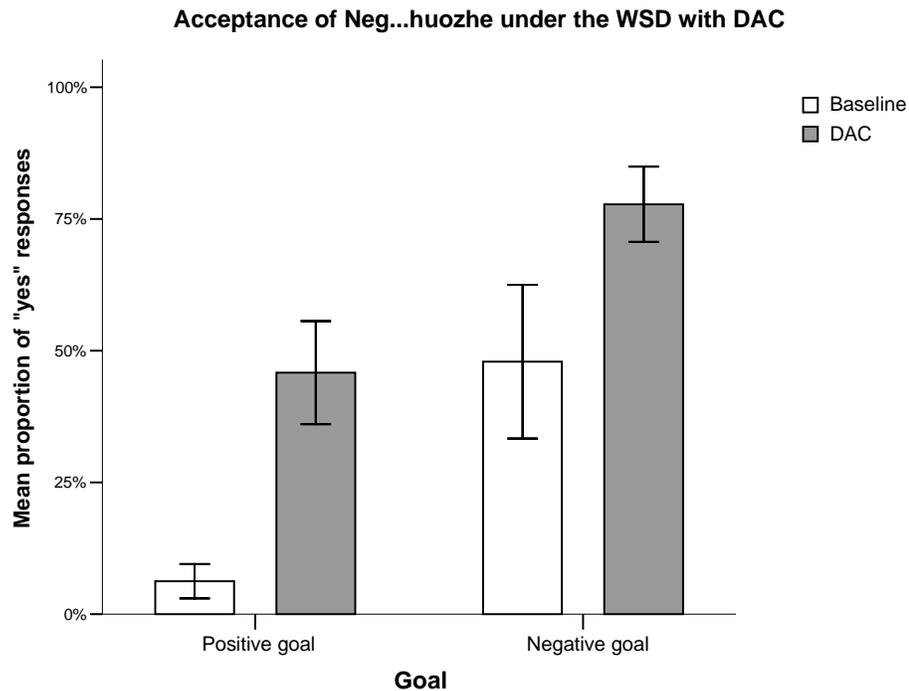
(148) Table 22: Mean proportion of children’s “yes” responses compared to the baseline

	Positive goal	Negative goal
Neg... <i>huozhe</i> with DAC	46%	79%
Neg... <i>huozhe</i> baseline	6%	48%

(149) Table 23: Distribution of responses to Neg...*huozhe* with DAC in the priming block

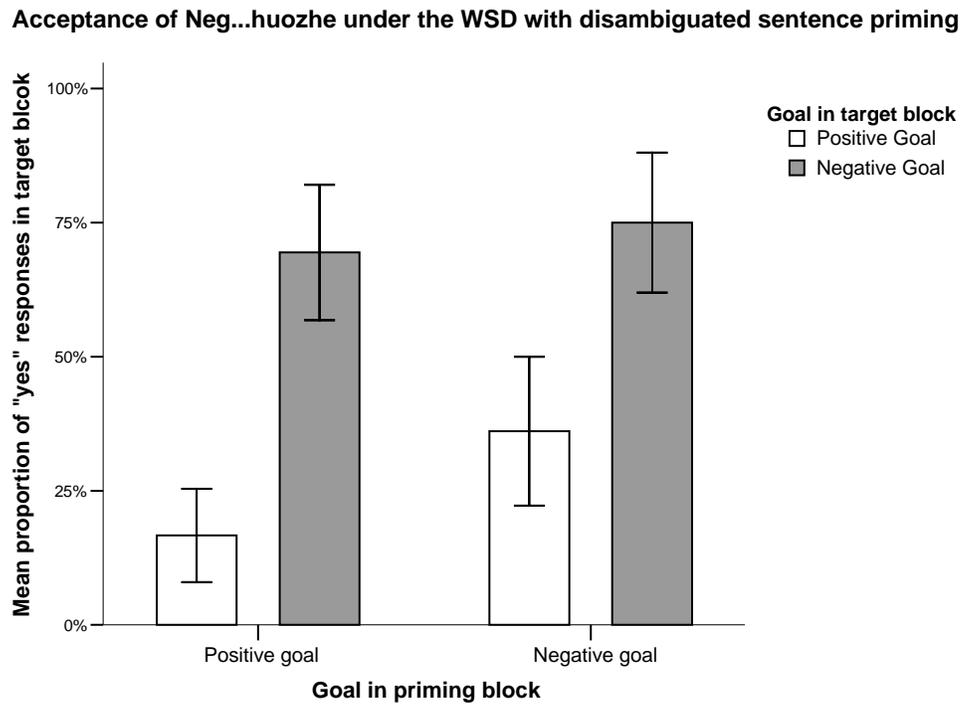
% of “yes” responses		0%	33%	67%	100%
Positive goal	Group 1 (P-P)	6	0	2	4
	Group 2 (P-N)	6	0	1	5
	Combined	12	0	3	9
Negative goal	Group 3 (N-P)	2	0	3	7
	Group 4 (N-N)	1	1	2	8
	Combined	3	1	5	15

(150) Figure 5: Acceptance of Neg...*huozhe* under the WSD with DAC



In the second block (the target block), children's acceptance rate of plain Neg...*huozhe* sentences varied across different groups, which had different combinations of the types of stories presented to them in the whole test phase (i.e., the type of the goal in the test stories in the target block and the type of the goal in the test stories in the priming block). The proportions of "yes" responses to the test sentences in the target block were entered into an ANOVA with two factors, the goal of the priming block stories and the goal of the target block stories, each with two levels (positive goal vs. negative goal). The analysis revealed a significant main effect of the goal of the target block stories ( $F(1, 44) = 14.043$ ,  $p = .001$ ), a non-significant main effect of the goal of priming block stories ( $F(1, 44) = 1.045$ ,  $p > .1$ ), and a non-significant interaction between the goal in the target block stories and the goal in the priming block stories ( $F(1, 44) = .322$ ,  $p > .5$ ).

(151) Figure 6: Acceptance of Neg...*huozhe* under the WSD with disambiguated sentence priming



In the target block, for children who heard positive goal stories in the priming block (group 1 and group 2), those who heard negative goal stories in the target block accepted the test sentences 69% of the time, significantly higher than those who heard positive goal stories (i.e., 17%,  $F(1,22) = 11.854$ ,  $p = .002$ ). But for children who heard negative goal stories in the priming block (group 3 and group 4), the acceptance rate difference between those who heard negative goal stories and those who heard positive goal stories was at most marginal (i.e., 75% vs. 36%,  $F(1,22) = 3.283$ ,  $p = .082$ ). These results suggested that children generally accessed the WSD easier in negative goal stories than in positive goal stories, but the gap became closer when they had accessed the WSD of

disambiguated Neg...*huozhe* sentences in negative goal stories before<sup>53</sup>.

(152) Table 24: Mean proportion of children’s “yes” responses in the target block

1st block \ 2nd block	Positive goal	Negative goal
Positive goal	17% (group 1)	69% (group 2)
Negative goal	36% (group 3)	75% (group 4)

From the result of the ANOVA, it is not evident that the type of goal in the priming block stories made a statistically significant difference on children’s access to the WSD of plain Neg...*huozhe* in the target block. Simple mean comparisons revealed similar findings: comparing group 1 and group 3 children, who all heard positive goal stories in the target block, those who judged disambiguated Neg...*huozhe* sentences in negative goal stories in the priming block (i.e., group 3) accepted plain Neg...*huozhe* sentence under the WSD not significantly more than those who judged disambiguated Neg...*huozhe* sentences in positive goal stories in the priming block (i.e., group 1) (36% vs. 17%,  $F(1,22) = 1.407$ ,  $p > .1$ ); the difference between group 2 and group 4 children (who all heard negative goal stories in the target block) in terms of their acceptance rate of plain Neg...*huozhe* sentences under the WSD was also non-significant (69% vs. 75%,  $F(1,22) = 0.94$ ,  $p > .5$ ).

However, when each group of children’s mean acceptance rate of Neg...*huozhe*

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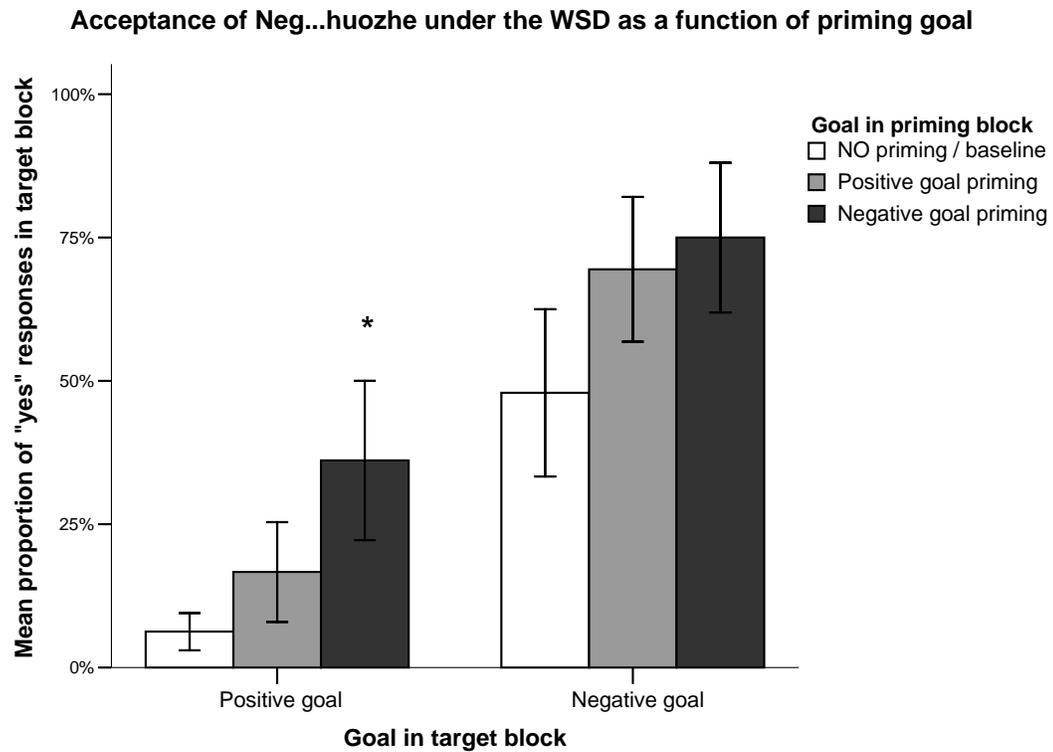
<sup>53</sup> Chi Square analysis comparing the distribution of children’s responses had a slightly different result: both group 1 vs. group 2 children and group 3 vs. group 4 differed significantly. But the statistics of this analysis seemed to suggest a similar tendency as mean acceptance rate comparison analysis: the difference between group 1 and group 2 children ( $\chi^2 = 6$ ,  $p = .0143$ ) is greater than the difference between group 3 and group 4 ( $\chi^2 = 4.196$ ,  $p = .0405$ ).

sentences in the target block was compared against the respective baseline acceptance rate, the results showed that children accepted the test sentences in positive goal stories in the target block significantly more than the baseline when they judged disambiguated Neg...*huozhe* sentences in negative goal stories in the priming block (i.e., group 3, 36% vs. 6%,  $F(1,22) = 4.318, p < .05$ ); while children's acceptance rates in the other three conditions did not differ significantly from the corresponding baseline rates, although the figures were higher. See the table in (153) and the graph in (154). This means that having heard negative goal stories in the priming block and accessed the WSD of Neg...*huozhe* with a disambiguating clause had an observable effect on facilitating children's access to the WSD of plain Neg...*huozhe* in positive goal stories.

(153) Table 25: Acceptance rate of each group in the two blocks compared to the baseline

	Priming block	Target block	Baseline
Group 1 (P-P)	44%	17%	6%
Group 2 (P-N)	47%	69%	48%
Group 3 (N-P)	75%	36%	6%
Group 4 (N-N)	81%	75%	48%

(154) Figure 7: Acceptance of Neg...*huozhe* under the WSD as a function of priming goal



Individual data showed bimodal distribution of children's responses in the target block, as illustrated in the tables in (155).

(155) Table 26: Distribution of responses to Neg...*huozhe* in the target block

% of "yes" responses		0%	33%	67%	100%
Positive goal	Group 1 (P-P)	9	0	3	0
	Group 3 (N-P)	7	1	0	4
Negative goal	Group 2 (P-N)	3	0	2	7
	Group 4 (N-N)	3	0	0	9

Overall, the differences in children's responses in both block of this experiment did not

seem to correlate to their age differences, as shown in the table in (22)<sup>54</sup>.

(156) Table 27: Proportion of “yes” responses from individual children

Subject	Group	Age	Neg... <i>huozhe</i> (with DAC)	Neg... <i>huozhe</i>
1	1	3;10	0%	0%
2	1	3;11	100%	0%
3	1	3;11	0%	0%
4	1	3;11	67%	67%
5	1	4;5	0%	0%
6	1	4;7	67%	0%
7	1	4;7	0%	0%
8	1	4;10	100%	67%
9	1	5;6	100%	67%
10	1	5;7	0%	0%
11	1	5;7	0%	0%
12	1	5;8	100%	0%
13	2	3;10	0%	67%
14	2	3;11	0%	0%
15	2	4;4	0%	100%
16	2	4;4	100%	67%
17	2	4;6	67%	100%
18	2	4;7	0%	100%
19	2	4;10	100%	100%
20	2	4;10	0%	0%
21	2	4;11	100%	100%
22	2	5;2	0%	0%
23	2	5;5	100%	100%
24	2	5;5	100%	100%
25	3	4;0	100%	0%
26	3	4;1	100%	0%
27	3	4;5	100%	0%
28	3	4;6	0%	0%
29	3	4;6	67%	0%

<sup>54</sup> The responses of group 4 children in the target block might arguably show a slight tendency of age factor, namely, the only two children (subject 37 and 40) who consistently accepted disambiguated Neg...*huozhe* under the WSD but not plain Neg...*huozhe* under the WSD happened to be among the youngest.

30	3	4;10	100%	100%
31	3	4;11	100%	100%
32	3	5;3	0%	33%
33	3	5;3	100%	100%
34	3	5;3	100%	100%
35	3	5;6	67%	0%
36	3	5;7	67%	0%
37	4	3;11	100%	0%
38	4	4;0	100%	100%
39	4	4;0	0%	0%
40	4	4;0	67%	0%
41	4	4;6	100%	100%
42	4	5;0	33%	100%
43	4	5;2	100%	100%
44	4	5;4	100%	100%
45	4	5;4	67%	100%
46	4	5;6	100%	100%
47	4	5;6	100%	100%
48	4	5;7	100%	100%

Children’s responses to filler sentences in this experiment, which were simple affirmative disjunction sentences, were adult-like. In particular, they accepted this kind of sentences given “this or that” scenarios, meaning that they did not consider *huozhe* as conjunction and had no problem with Kermit giving an uncertain answer about what happened.

In the follow-up phase of the experiment, no children accepted the test sentence, which had a Neg...*he* clause followed by an “I don’t know which” clause, which contrasted with children’s acceptance of Neg...*huozhe* sentences in the priming block. This meant that children did not base their judgment of the test sentence on the NSC of Neg...*he*, which would be compatible with the outcome in the story. In addition, children’s responses to this sentence showed that they did not just judge the “I don’t

know which” clause; rather, they did analyze the main test sentence.

#### **4.1.4 Discussion**

##### **4.1.4.1 *The effect of the disambiguating clause***

The first goal of this experiment was fulfilled: children’s responses in the priming block clearly showed that they accessed the WSD of Neg...*huozhe* sentences more easily in both positive goal stories and negative goal stories, when a disambiguating clause toward this interpretation was added to the end. This provided further evidence for our hypothesis that children do not simply lack the WSD of Neg...*huozhe* in their grammar. Given children’s uniform rejection to the Neg...*he* test sentence involving the same “disambiguating clause” in the follow up phase, their higher acceptance of the Neg...*huozhe* sentences in the priming block must not be the result of focusing solely on the “I don’t know which” clause and ignoring the Neg...*huozhe* clause. On the contrary, children seemed to take the “I don’t know which” clause into consideration only when it was consistent with some interpretation they could assign to the main test sentence (i.e., the WSD of Neg...*huozhe*); they did not base their judgment of the puppet’s utterance on this clause when they did not find it compatible with the interpretation they assigned to the Neg...*huozhe* test sentence.

Children’s behavior in the priming block can be viewed from two aspects. One is that they accepted Neg...*huozhe* under the WSD in negative goal condition more often than in positive goal condition. This was consistent with the findings from our original

Chinese baseline experiment and further confirmed our hypothesis that making a “not this or not that” scenario as the direct inference from the outcome of the test story would promote the relevance of disjoined negation and greatly enhance the accessibility of the WSD of Neg...*huozhe*. Children’s different performances in the positive goal condition vs. in the negative goal condition provided evidence that the WSD of Neg...*huozhe* is pragmatically more demanding for children than the NSD and that children’s knowledge of this interpretation would be more easily observable when the context was made highly conducive toward this interpretation. In the negative goal condition, the critical contextual information children needed to integrate to compute the pragmatic considerations associated with the WSD were more directly available to them, i.e., disjoined negation was the direct inference from the observable evidence and thus directly relevant.

Another aspect of children’s behavior in the priming block of this experiment is that children could make use of an added disambiguating clause to access the normally dispreferred interpretation of Neg...*huozhe*. This was especially evident in the positive goal condition of this experiment, where half of the children accessed the WSD of Neg...*huozhe*, while in the same condition of the baseline experiment children almost never based their judgment of the Neg...*huozhe* test sentence on the WSD. Meanwhile, in this experiment, most children accessed the WSD in the negative goal conditions (i.e., 79% acceptance of the test sentences. This strongly argued against a deficient grammar hypothesis about children’s knowledge on the interpretation of Neg...*huozhe*. Children’s

weakness in this respect was more likely to be related to their limited capacity in utilizing available discourse resources to carry out pragmatic computations. It seemed that they were not fully competent in forming a comprehensive picture of the context or using different pieces of the contextual information flexibly. An explicit disambiguating clause could potential direct children's attention of the context toward the "not this or not that" aspect. Children also appeared less experienced in identifying the speaker's intention or accommodating the speaker's utterance based on the context. This does not claim that children did not know the conversational principles, but they could have difficulties in implementing them in an adult way. A disambiguating clause could presumably reflect the speaker's intended meaning directly, so that the burden of pragmatic computation involved in identifying the speaker's intention was greatly reduced for children. Our present experiment did not answer the question about the exact parsing mechanism in children's analysis of Neg...*huozhe* sentences. Rather, the results of our experiment here revealed that children's grammar should in principle contain the WSD of Neg...*huozhe*; although their grammatical knowledge of this interpretation was not easy to observe in normal circumstances; when an explicit disambiguating clause favoring this interpretation was present, they could take advantage of this facilitation to access the WSD. At the time the disambiguating clause was uttered, children should not have completely finished analyzing the Neg...*huozhe* clause and evaluating the context. The "I don't know which" clause added an important piece of information in the discourse that made the WSD of the Neg...*huozhe* clause more relevant. So, the presence of this clause

‘activates’ the WSD to a level that was easier to access. Children seemed to be somewhat sensitive to this piece of discourse information in interpreting Neg...*huozhe* sentences.

In this part of the experiment, however, we also observed limitations of the facilitation toward the WSD with the disambiguating clause – it was not uniformly effective in all children and in all conditions. In the negative goal condition, most children were able to access the WSD, but in the positive goal condition only half of the children were. In our baseline experiment, we also found that contextual facilitation toward the WSD in the negative goal condition did not succeed in all children. These findings suggested that children’s sensitivity to pragmatic facilitations toward the WSD varied individually, and the trend was that the more ‘ideal’ the discourse context was, the higher the proportion of children who could access the WSD was. At the same time, given children’s different acceptance patterns in the positive goal condition vs. in the negative goal condition, it was not likely that they just paid attention to the “I don’t know which” clause in making judgment of the test sentences. Otherwise, children could have simply applied the same strategy in both conditions and behaved more similarly in the two conditions. This position was further supported by children’s uniform rejection to the Neg...*he* sentence involving the “I don’t know which” clause in the follow up phase. The test story in the follow up phase presented a “this or that” / “not this or not that” (also, “not both”) scenario, which made Neg...*he* false under the “neither” interpretation (i.e., the WSC), but was compatible with the “I don’t know which” clause. If children only paid attention to the “I don’t know which” clause and ever ignored the test sentence, we

would expect that at least some children might accept the test sentence. However, none of the 48 children in our experiment accepted the test sentence, suggesting that they did not base their judgment of the test sentence on the “I don’t know which” clause. Therefore, it is safe to conclude that the “I don’t know which” clause did not determine children’s responses, but aided children in retrieving the interpretation of the test sentence consistent with it. Notice, children’s rejection to Neg...*he* sentences in the follow up phase also showed that they did not base their judgment on the “not both” interpretation of Neg...*he* (i.e., the NSC, which is not allowed in adult Chinese), because the story in deed involved a “not both” scenario and made Neg...*he* true if it was interpreted the NSC way. As I discussed in section 3.4.2, children’s uniform rejection to Neg...*he* sentences could in principle mean that they did not allow this interpretation or that we did not show that their grammar contained this way of interpreting Neg...*he*. However, the findings in this phase of the experiment made us lean further toward the former alternative. While the “I don’t know which” clause was proved to be effective in significantly boosting children’s access to the “not this or not that” interpretation of Neg...*huozhe* in positive goal condition (which originally was not very conducive toward this interpretation for children, as evident in the baseline experiment), it did not make any one single child assign the “not both” (equivalent to “not this or not that”) interpretation to Neg...*he*. This could be naturally explained if children do not allow this interpretation.

One concern that might arise is whether the “I don’t know which” clause would confuse children in case they did not assign the “not this or not that” interpretation to the

test sentences, as the “neither” interpretation of the test sentences and the “this or that”/ “not this or not that” implication of the “I don’t know which” clause were contradictory. In our experiment, children did not seem to be puzzled by the “I don’t know which” clause when they interpreted the test sentences as “neither” (in both the priming block and the follow up phase); rather, they confidently rejected what the puppet said and justified their rejection by pointing out that the featured character in the story did one thing (and thus not “neither”). In this case, children behaved as if the “I don’t know which” clause was ignored. An alternative perspective to view this issue, and probably children’s general response patterns in a TVJT, could be that children are “captious” and would accept the puppet’s utterance only when the whole utterance is consistent with the scenario in the story from their understanding. This hypothesis has two advantages. First, it does not need to assume that children know to identify the key piece in the puppet’s utterance researchers expect them to judge in a TVJT setting. Given an “ignorance” account, if children could ignore the “I don’t know which” clause in our experiment, it would be reasonable to expect them to ignore the main test sentence at least occasionally as well. But what this was not what we found in the follow up phase – they always “ignored” the “I don’t know which” clause. Then, it must be assumed that children knew what they were supposed to pay attention to and judge. This assumption is hard to justify. On the other hand, the ‘captiousness’ account allows children to take every piece in the puppet’s utterance more or less equally into consideration, while it does not exclude the possibility that children sometimes might miss some pieces of the utterance. This seems

to be more reasonable. Second, related to the first point, this hypothesis also does not need to assume that children know to separate the lead in sentence from the test sentence they are supposed to judge. In the present experiment and our baseline experiment (as in most experiment using the TVTJ methodology), the puppet said something before uttering the test sentence, such as “the worker hanged one flag on the door, I guess...” Given the scenario in the stories, this part of the puppet’s utterance was true. However, it did not seem that children ever base their judgment of the puppet’s utterance solely on this. Given this, we either have to assume that children could tell the test sentence from the lead in sentence; or we adopt the “captiousness” account, so that it did not matter for the children which part of the utterance was the lead in sentence and which part was the test sentence, they simply processed every piece of the utterance, and checked whether each part was consistent with the scenario in the story, based on the interpretation they assigned to each part of the utterance. Here, the latter option seems to be more plausible.

Although there are still outstanding issues demanding further investigations, the results from this part of our current experiment clearly demonstrated children’s knowledge of the WSD of Neg...*huozhe* sentences and their ability to take advantage of more readily available contextual resources to perform pragmatic computations in accessing a harder interpretation.

#### **4.1.4.2 Priming effect of prior experience with disambiguated Neg...*huozhe***

The second goal of the current experiment was to test whether children could carry over

the WSD way of analyzing Neg...*huozhe* containing a disambiguating clause and the experience with the “not this or not that” aspect of the context in the priming block to approaching plain Neg...*huozhe* sentences in the target block. We predicted that we would observe such a priming effect, especially in the groups of children who accessed the WSD of disambiguated Neg...*huozhe* sentences more often, i.e., those who heard negative goal stories in the priming block. Children’s responses in the target block partially proved our prediction: children’s acceptance of Neg...*huozhe* under the WSD in the target block was significantly higher than the respective baseline rate, when they judged disambiguated Neg...*huozhe* sentences in negative goal stories in the priming block and plain Neg...*huozhe* sentence in positive goal stories in the target block (group 3); in each of the other conditions, their acceptance rate was not statistically different than the baseline. This kind of results illustrated that prior access to the WSD of disambiguated Neg...*huozhe* could potentially have a priming effect on the interpretation of later plain Neg...*huozhe* sentences, but the degree of the effect could vary depending on other factors.

In most experiments investigating priming effect, the priming stimuli are unambiguous and do not invoke individual response variations. In that case, the “priming material” can be assumed to be uniform in all subjects. However, the ‘priming stimuli’ in our current experiment involved complications. The sentences used in the priming block were ambiguous, and responses to those sentences varied among children subjects. Specifically, the distribution of children’s responses was bimodal, so the interpretation

that was relevant to the priming effect, i.e., the WSD, was not accessed by all subjects in the priming block. Because priming effect is individual-bound, in this experiment, only children who accessed the WSD in the priming block were candidates to ‘carry over’ this interpretation to the target block. This means that the actual number of subjects who got the relevant “priming material” was smaller than the whole group, so we basically relied on a subset of the subjects to observe the potential priming effect, let us call this the “subset subject problem”. This problem was more prominent with the groups of children who heard positive goal stories in the priming block (i.e., group 1 and group 2), because only half of them accessed the WSD of disambiguated Neg...*huozhe* sentences. Due to limitation of the number of subjects tested in this experiment, it is not surprising that the priming effect overall was not obvious. Nonetheless, we still observed a statistically significant raise of children’s acceptance rate of plain Neg...*huozhe* sentences over the baseline in one condition, namely, when these sentences were uttered in positive goal stories after children judged disambiguated Neg...*huozhe* sentences in negative goal stories in the priming block (i.e., group 3). When we take a closer look at this condition, it is understandable why this condition was where the priming effect was most observable: First, most children consistently accessed the WSD and accepted the test sentences in the priming block in this condition<sup>55</sup> (i.e., 10 out of the 12 children, specifically, 9 children accepted the test sentences 100% of the time and 1 other child 75% of the time), so that the “subset subject problem” was alleviated. Second, the target test sentences were

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<sup>55</sup> As before, we considered acceptance rate higher than 50% as consistent acceptance.

uttered in positive goal stories in this condition, and the baseline acceptance rate of Neg...*huozhe* under the WSD in positive goal condition was very low (i.e., 6%, significantly lower than that in the negative goal condition at 48%,  $t(11) = -2.93$ ,  $P < .05$ ) and did not involve much variation among subjects, so the potential for an observable raise was bigger. When the distribution of individual acceptance is concerned, in this condition of the experiment (i.e., group 3), among the 10 children who consistently accessed the WSD of disambiguated Neg...*huozhe* and thus could potentially exhibit the priming effect, 4 of them consistently accepted plain Neg...*huozhe* under the WSD in positive goal stories; while in the baseline experiment, none of the 12 children consistently accepted Neg...*huozhe* under the WSD in positive goal stories. Chi Square analysis also revealed significant difference between the two groups ( $\chi^2 = 5.87$ ,  $p < .02$ ). What we can say at this point given the results of our experiment is that the priming effect of prior access to the WSD of disambiguated Neg...*huozhe* on interpretation of later plain Neg...*huozhe* was somewhat verified and observable in some condition. It is possible that the effect could be statistically more obvious in some of the other conditions when more children are tested.

The priming effect under discussion here could come from two sources. One is that prior access to the WSD of disambiguated Neg...*huozhe* activated this kind of syntactic/semantic representation of Neg...*huozhe* to a higher level than its normal state, so that children could be primed to analyze later Neg...*huozhe* sentences in the same way. The other is that prior experience in recognizing the relevance of the “not this or not that”

aspect of the contextual information made children more sensitive to discourse features, so that they were more likely to pay attention to and integrate this aspect of contextual information in order to access the WSD. It seems that these two sources cannot be easily teased apart. In this experiment, the priming effect was observable in the groups of children who heard negative goal stories in the priming block and positive goal stories in the target block. For these children, although they accumulated experience with the “not this or not that” aspect of the context in the priming block, the activation of the respective linguistic representation corresponding to the WSD could aid children to effectively use that experience in the target block, because the contextual settings in the two blocks were different. The finding that children’s access to the WSD of Neg...*huozhe* could be facilitated by prior successful experience with disambiguated Neg...*huozhe* did not undermine the conclusion we made earlier that children’s access to the WSD was constrained by pragmatic factors. Rather, the observed priming effect suggested that the activation of the dispreferred and pragmatically harder interpretation of an ambiguous string, together with children’s increased sensitivity to discourse features, could to some extent help children overcome the difficulty posed by pragmatic factors in accessing certain interpretation.

One side note I want to bring up is that the priming effect discussed here might not be a long-lasting one. In this experiment, children who accessed the WSD in negative goal stories in the priming block were found to be more likely to carry this interpretation over to analyzing Neg...*huozhe* presented in positive goal stories in the target block. This

reminds us of our baseline experiment, where the same children heard both positive goal stories and negative goal stories and half of them heard negative goal stories first. We did not find differences of children's responses to Neg...*huozhe* sentences as a function of the order of the type of stories they heard. There did not seem to be a priming effect of prior access to the WSD in negative goal stories on interpreting later Neg...*huozhe* sentences in positive goal stories toward the WSD in that experiment. We could offer two possible explanations for this: One, children in the baseline experiment heard the two types of stories in two separate sessions with at least one night in between, the potential effect of their prior access to the WSD in negative goal stories had faded off when they heard Neg...*huozhe* sentences in positive goal stories. Two, only half of the children heard negative goal stories first in the baseline experiment, and children's acceptance rate there was lower – only half of the children accessed the WSD in negative goal condition, this meant the 'subset subject problem' was acute there, so that a 'priming effect' was hardly possible to observe. Having said that the relevant priming effect per se might be temporary, we should not underestimate the significance of children's successful experiences with the WSD in natural learning environment, through which children can accumulate positive evidence to confirm the legitimacy of the WSD in their language.

This part of the experiment offered us the opportunity to observe potential priming effect of prior access to the WSD of disambiguated Neg...*huozhe* sentences on the interpretation of later plain Neg...*huozhe* sentences. The results also strengthened our conclusion that children's grammar has the WSD of Neg...*huozhe* available and they are

constrained by immature pragmatic capacity to access this interpretation in normal circumstances.

## **4.2 Priming with Neg...*he***

### **4.2.1 Logic of the experiment**

As presented in earlier chapters, Neg...Disjunction in natural languages could in principle be ambiguous between the narrow scope disjunction interpretation (the NSD, “neither”) and the wide scope disjunction interpretation (the WSD, “not this or not that”), but some languages (e.g., Japanese) disallow one of the interpretations due to language specific constraints. In languages where both interpretations are available, the default interpretation is often the NSD, and the WSD is marked, such as the case in English. However, for Chinese-speaking adults, while Neg...Disjunction (Neg...*huozhe*) is also ambiguous between the NSD and WSD, the NSD of Neg...*huozhe* is not the default interpretation – without context given, they do not readily assign this interpretation to Neg...*huozhe*. Neg...*huozhe* sentences under the NSD in Chinese are used only in specific circumstances, i.e., when  $Pa \vee Pb$  is specifically expected (or relevant) in the context and the outcome is a “neither” scenario (i.e.,  $\neg(Pa \vee Pb)$ ). Therefore, a Neg...*huozhe* sentence is not by default interpreted as “neither” (the NSD); rather, the hearer needs to evaluate whether the context in which the sentence is uttered satisfies (or could reasonably satisfy) the specific discourse condition associated with this interpretation and determine whether she should assign the NSD to the Neg...*huozhe*

sentence in the given context. In chapter 1 and chapter 2, I proposed that this behavior of the NSD of Neg...Disjunction (Neg...*huozhe*) in Chinese is tightly related to the behavior of Neg...Conjunction (Neg...*he*) in Chinese. Unlike Neg...*and* in English, which allows both a “not both” interpretation (the narrow scope conjunction interpretation, the NSC), and a “neither” interpretation (the wide scope conjunction interpretation, the WSC), Neg...*he* in Chinese only allows the WSC and is obligatorily interpreted as “neither”. In addition, Neg...*he* is the default and natural form to use to express a “neither” meaning in Chinese – this contrasts with English, which uses Neg...*or*. Therefore, given a “neither” scenario, although Neg...*he* under the WSC and Neg...*huozhe* under the NSD are synonymous and both can express a “neither” meaning, Neg...*he* is normally a better candidate than Neg...*huozhe* in describing the scenario in Chinese for two reasons: one, Neg...*he* is relatively neutral on expectation and implicature in expressing the “neither” meaning, compared to Neg...*huozhe* under the NSD; the other, while Neg...*he* and Neg...*huozhe* are comparable in the complexity of the form, Neg...*he* is unambiguous and will not cause confusions, but Neg...*huozhe* could cause confusions due to its ambiguity. This means, the speaker will not use Neg...*huozhe* to express a “neither” meaning unless it is relevant or necessary to implicate that  $Pa \vee Pb$  is expected; and the hearer also holds this assumption about the speaker. Because of the restricted behavior of the NSD of Neg...*huozhe* in Chinese, the alternative interpretation of Neg...*huozhe*, the WSD, presumably gains a more prominent status in the computation of Neg...*huozhe*, compare to the same interpretation in other

languages where the NSD is the default interpretation (e.g., English). This predicts Chinese adult speakers can access the WSD easier than English adult speakers, which is empirically supported with the results of our two parallel target experiments in Chinese and in English reported in chapter 3. Nonetheless, due to the general pragmatic complexities associated with the WSD, a Neg...*huozhe* sentence in Chinese, which is potentially ambiguous, is not readily interpreted as the WSD. The hearer also needs to evaluate the context and determine whether it is more likely that the speaker intends the WSD rather than the NSD. After we are clear about the pragmatic conditions associated with both of the two interpretations of Neg...*huozhe*, it is not hard to understand why the Neg...*huozhe* form is generally marked in Chinese if used out of context and why the WSD of Neg...Disjunction is less difficulty to access for Chinese speakers than for English speakers.

The comprehensive knowledge about the interpretation of Neg...*huozhe* involves complex pragmatic computations in evaluating the context (“local computation”, as I discussed in section 2.1.3.), comparing the two interpretations of Neg...*huozhe* as well as comparing the NSD of Neg...*huozhe* with the WSC of Neg...*he* (“global computation”). The key components of the computation include these pieces: 1) adequate understanding of the complete picture of the context where a Neg...*huozhe* is uttered; 2) recognition of the fact that Neg...*huozhe* and Neg...*he* are logically and formally related so that they are comparable candidates, and that Neg...*huozhe* under the NSD (“neither”) is reserved for special use, while Neg...*he* bearing the same semantic content (“neither”) is used in

general and normal cases; 3) reliable reasoning about the speaker's intention, e.g., when the context does not clearly satisfy the condition of using Neg...*huozhe* under the NSD, Neg...*he* will be used if a "neither" meaning is intended, and if Neg...*huozhe* is used, the WSD is more likely to be intended. Not all pieces are necessarily actively computed in any given circumstance, but Chinese adult speakers can process and integrate all these pieces almost instantaneously if necessary. However, Chinese children's performance in our Chinese target experiment reported in 3.1 demonstrated their deficiency with this kind of pragmatic computation. Chinese children's non-adult behavior in this respect is presumably caused by their limited capacity in paying attention to the full picture of the context, especially, the less direct piece of information which was specifically relevant, compounded with their (mis)understanding about the NSD being the default interpretation of Neg...*huozhe* and their incomplete knowledge about the pragmatic conditions associated with the "neither" interpretation of Neg...*huozhe*. In the Chinese target experiment reported in section 3.1, we showed that making the contextual setting in the experiment favorable toward children's dispreferred interpretation (the WSD) helped children access that interpretation. The manipulation in the negative goal condition of that experiment made the "not this or not that" piece of contextual information more direct and salient, so that children were more likely to be able to integrate this information in the pragmatic computation of interpreting Neg...*huozhe* and overcome their adherence to the default NSD. In the first priming experiment reported in this chapter, it was clear that adding a disambiguating clause meaning "I don't know which he didn't do" further

boosted children's access to the WSD. The disambiguating clause favoring the "not this or not that" interpretation added explicit piece of discourse information directly tied to the WSD, which reminded children to pay attention to relevant critical information in the context. The first priming experiment also showed that children's prior successful experience with "not this or not that" scenarios could help improve children's access to the WSD. These experimental results suggested that the pragmatic computation involved in disambiguating Neg...*huozhe* toward the WSD could be carried out by children to some extent, when they were facilitated to pay attention to the critically relevant contextual information. As evident from the behavior of Chinese children, English children as well as English adults, compared with that of Chinese adults, in our previous experiments, the fact that the NSD is taken as the default interpretation of Neg...Disjunction is an important factor in making the WSD harder to access. With this interpretation bearing the default status, subjects in a TVJT could reduce the pragmatic computation to a minimal level and resort to this readily available interpretation to complete the experiment task. For Chinese children to acquire the complete knowledge on the interpretation of Neg...*huozhe*, they have to learn that Neg...*huozhe* is only used to express a "neither" meaning in a limited set of "neither" circumstances and the NSD is not the default interpretation of Neg...*huozhe*. We suppose children can learn this characteristic of the NSD in Chinese if they are exposed to overwhelming evidence that Neg...*he* is used by default and more generally in "neither" circumstances and at the same time can utilize this information effectively to understand the use of Neg...*huozhe*

under the NSD. There are presumably abundant occurrences of Neg...*he* in Chinese children's input, based on which they have learned that Neg...*he* can mean "neither" and probably can only mean "neither". One of our previous control experiments, reported in section 3.4, as well as the follow up phase of the first priming experiment reported in section 4.1, demonstrated that Chinese children correctly rejected Neg...*he* sentences in "this or that" / "not this or not that" scenarios, which showed that they indeed knew Neg...*he* in Chinese means "neither". What Chinese children at age 4 have not yet mastered may be to reliably relate the behavior of Neg...*he* to that of Neg...*huozhe*.

Children's deficiency in the pragmatic computation involved in interpreting Neg...*huozhe* could be attributed to their immature capacity to exploit the available resources (such as different aspects of the contextual information). In the Chinese target experiment reported in 3.1 and the first priming experiment reported in 4.1, we have shown that Chinese children behaved more adult-like regarding the WSD of Neg...*huozhe* when we manipulated pragmatic factors in the experiment to make the relevant resource (i.e., the critical contextual information) more directly available to children. As I just discussed, being able to relate the use of Neg...*huozhe* to the use of Neg...*he* would be important for children to acquire the adult way of interpreting Neg...*huozhe*. We hypothesize that children at this age are capable of computing some relations between Neg...*huozhe* and Neg...*he* to certain degree, but they normally do not carry out this computation when presented with a Neg...*huozhe* sentence, because they do not consider Neg...*he* as the alternative form at that time. This predicts that they are

more likely to perform the computation if they are somehow “primed” to consider these two forms as related, because the resources (i.e., that the two forms are potential alternatives) they can make use of to compute the pragmatic considerations are more directly available to them in this case. Our current experiment targeted at testing this possibility, specifically, whether children could access the WSD more easily right after they experienced Neg...*he* being used in similar context to convey the “neither” meaning. The logic was this: after children heard Neg...*he* being used in some context to express a “neither” meaning and accessed this interpretation (the WSC) of Neg...*he*, they built up some idea that Neg...*he* was the form to use to express a “neither” meaning in this kind of context. After this, when Neg...*huozhe* was used in a similar context (the outcome could be a different scenario), children might be able to consider Neg...*he* as the alternative when analyzing Neg...*huozhe* and thus loosen their adherence to the NSD bearing the same meaning (i.e., “neither”). Note that our experiment did not target at making children aware of the pragmatic condition of using Neg...*huozhe* under the NSD – although this awareness in natural learning environment would be useful for Chinese children; rather, we simply tried to make children more likely to consider Neg...*he* as the alternative form when presented with Neg...*huozhe*.

As in our first priming experiment reported in 4.1, we used Chinese children’s performances in the original Chinese target experiment reported in 3.1 as baseline to evaluate whether children could access the WSD more easily in different conditions.

## **4.2.2 Method**

### **4.2.2.1 Subjects**

48 monolingual Chinese-speaking children (25 boys and 23 girls) aged from 3;9 to 5;7 (mean age 4;8) participated in this experiment. One other child was interviewed first but then eliminated from the test phase because she couldn't understand the task in the warm up phase. These children attended the same Kindergarten as children in our other experiments.

### **4.2.2.2 Procedure**

This experiment also employed TVJT with computer generated cartoon stories, and all the stories involved the “curtain trick”. A test session contained a warm up phase and a test phase, which were not separated. The warm up phase contained two warm up stories with two warm up sentences, which were also designed as fillers for the whole test session. The warm up sentences were simple positive sentences involving a disjunct NP object, one of which was true and the other was false. Children who could not perform well in the warm up phase would be eliminated from the test phase. There were two consecutive blocks in the test phase for each child. In the priming block, depending on which specific condition was assigned to a child, the outcome of each story presented to the child was either a “neither” scenario or a “not this or not that” scenario; because the test sentences were Neg...*he* (meaning “neither” in Chinese) across different conditions, the outcome of the test stories made the test sentences true for some children and false for

others, assuming they assigned “neither” to Neg...*he*. In the target block, the stories all had a “not this or not that” scenario outcome, and the test sentences were Neg...*huozhe* sentences, so the test sentences were true under WSD and false under NSD. Although the outcome of the stories in the priming block and that of the stories in the target block were not necessarily the same, the stories throughout the test phase for any single child subject were minimally different, so that the kind of context where Neg...*he* was used and the kind of context where Neg...*huozhe* was used were kept similar in the experiment. 3 test stories were presented with 3 test sentences in each block, and 3 filler stories were told in the whole test phase. Filler stories had similar design as the test stories, and filler sentences were simple positive sentences containing a disjunct NP object. This kind of two-block design allowed children to experience the use of Neg...*he* and Neg...*huozhe* back-to-back in similar context with possibly different outcomes, so that they might be primed to compute the relation of these two forms and access the WSD of Neg...*huozhe* more easily.

In this experiment, a 2×2 between subject design was used. One factor was the truth value of test sentences in the priming block with two levels (whether Neg...*he* was truthful description or false description of the scenario in the test stories); and the other factor was the type of goal involved in the test stories (we kept the type of goal consistent in the stories across the two blocks in this experiment, so that the context of using Neg...*he* and that of using Neg...*huozhe* were similar), which also had two levels (positive goal and negative goal). The 48 children were divided into 4 groups, each of

which heard a different combination of test stories, as illustrated in the table in (157). In natural and normal language acquisition environment, the input Chinese children receive regarding Neg...*he* most likely involve cases when Neg...*he* is used to truthfully describe a “neither” situation, rather than cases when the speaker misunderstands a “not this or not that” scenario as a “neither” situation. But access the “neither” interpretation and compute the truth conditions of Neg...*he* is not dependent on whether the scenario matches this interpretation, given that Neg...*he* in Chinese is unambiguous. In the priming block of this experiment, we had half of the children experience the normal way of using Neg...*he*, i.e., truthfully describing a “neither” scenario, and the other half the unusual way, i.e., expressing a “neither” meaning by misunderstanding the contextual scenario. The goal was to determine whether simply accessing the “neither” interpretation of Neg...*he* could evoke a priming effect on the computation of later Neg...*huozhe* toward the WSD, or whether a matching scenario present in the context was necessary for such an effect. The positive goal vs. negative goal design allows us to observe children’s interpretation of Neg...*huozhe* in different contextual settings and compare the results with those in other experiments.

(157) Table 28: Sub-grouping of the subjects

1st block \ 2nd block	Positive goal	Negative goal
Truthful description	group 1 (T-P)	group 2 (T-N)
False description	group 3 (F-P)	group 4 (F-N)

### 4.2.2.3 Materials

The test stories as well as the test sentences in the target block of this experiment were exactly the same as those presented in the target block of the first priming experiment reported in 4.1. The test stories either involved positive goal or negative goal, depending on the group of children they were told to, and each child subject heard stories involving the same kind of goal. The test sentences were simple negated sentences containing a disjunct NP object (Neg...*huozhe*). One sample test sentence in positive goal stories is given in (158), and one in negative goal stories is given in (159).

(158) yisheng meiyou jiancha-hao xiao-mao huozhe xiao-gou  
doctor not-PERF examine-ready little-cat or little-dog  
Lit. “The vet didn’t examine the cat or the dog.”

(159) xiao-lu meiyou cai-dao niba huozhe shuzhi  
little-deer not-PERF step-on mud or branch  
Lit. “Little deer didn’t step on the mud or the branch.”

In the priming block, the test sentences were simple negated sentences with a conjunct NP object (Neg...*he*). The four lists of test stories told in the priming block to the four groups of child subjects were based on the two lists of test stories in the first priming experiment reported in section 4.1 (where one list contained positive goal stories, and the other contained negative goal stories): For group 3 and group 4 children, where the outcome in each test story corresponded to a “this or that” / “not this or not that” scenario, which made Neg...*he* false (and Neg...*huozhe* under the NSD false but Neg...*huozhe*

under the WSD true), the two lists of test stories in the priming block of the first priming experiment were directly borrowed and told to the respective groups of children. For group 1 and group 2 children, each of the two lists of test stories were adjusted to have “neither” scenario outcomes and thus make the Neg...*he* test sentences true. In addition, each of those stories was also modified a little bit to accommodate the plausible dissent requirement – the scenario corresponding to the potentially alternative interpretation of Neg...*he*, i.e., “not both”, was made plausible at some point in the story.

A sample positive goal test story told to group 1 children in the priming block is given in (160) in its English translation. Places different from the counterpart story in the first priming experiment are underlined.

(160) Mickey Mouse had a bike and a skateboard. But they were broken. Mickey looked at the bike and the skateboard carefully and decided that he couldn't fix them on his own. So he sent the bike and the skateboard to the garage.

Mickey said to the boss: *Hi boss, can you ask your workers to fix my bike and my skate board? They are broken.*

The boss said: *Sure. But we only have one worker on duty today, so he must fix them one by one. It may take longer. And when he is working, the garage door must remain closed for safety reasons. 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 then 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 played outside and felt bored after a while. He decided to go back to the garage.

(Curtain removed)

Mickey Mouse talked to the boss: *Do you think the worker has fixed my stuff?*

The boss said: *Oh, you came back already! I think the worker may have only finished fixing one thing. But let's go and check.*

The two walked to the front of the garage door and see no flag on the door.

The boss said: *Oh, well, it seems I was not right. You have to wait much longer.*

Mickey said: *Ok, see you later!*

After the story was over, the experimenter telling the story asked the puppet, Kermit, what he thought happened with sentence (161)

(161) ni juede gushi li fasheng-le shenme ne?  
you think story in happen-PERF what Q  
“What do you think happened in the story?”

Kermit first said sentence (162) with a little pause at the end, then uttered the target test sentence as in (163).

(162) gongren meiyou gua qizi zai men-shang, en..., wo xiang  
worker not-PERF hang flag at door-on umm I think  
“The worker didn't hang any flag on the door, umm, I think...”

(163) 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.”  
‘The worker fixed neither the bike nor the skateboard.’

For group 2 children, test stories in the priming block (and in the target goal as well) involved negative goals. A sample story is translated into English and given in (164).

(164) 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 chair in the middle. You are supposed to push the cart through this obstacle course. If you don't hit the chair, you can play the real game.*

Rhino was very clumsy and hit the chair. Donkey made it to the end without hitting the chair, 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 Donkey is very good in pushing cart. Donkey, 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. But it's very easy to hit one thing in this game, try harder this time!*

(Curtain put down)

(The puppet, Kermit, said: *I am wondering how well Donkey does in the real game.*)

(After some time, curtain removed)

Donkey had two shells. He said: *The real game was really harder. But I tried my best and didn't hit anything. That's why I got two shells.*

At this point, the experimenter telling the story asked Kermit whether he could tell what happened in the story, as in (165).

(165) ni shuo-shuo gushi li fasheng-le shenme ne?  
you say-say story in happen-PERF what Q  
“What would you say happened in the story?”

Kermit uttered sentence (166), followed by the target test sentence in (167).

(166) xiong-gege na-dao liang-ge beike, en..., wo cai  
bear-broth get-PERF two-CL shell umm I guess  
“Bear brother got two shells, umm... I guess...”

(167) lüzi meiyou zhuang-dao datong he xiangzi

donkey not-PERF hit-at barrel and suitcase  
 Lit: “Donkey didn’t hit the barrel and the suitcase.”  
 “Donkey hit neither the barrel nor the suitcase.”

The complete sets of test sentences presented to the four groups of children are given in the table below in (168). Group 1 and group 2 children were tested with exactly the same set of test sentences, but the test stories accompanied the test sentences in the priming block had different outcomes for the two groups of children, so that the priming test sentences had different truth values in the two cases. The same held for group 3 and group 4 children.

(168) Table 29: Test sentences

<b>Group</b>	<b>Block / Truth value / Goal</b>	<b>Test sentences</b>
Group 1	Priming block (True)	<ul style="list-style-type: none"> <li>• The worker didn’t fix the bike and the skateboard.</li> <li>• Rabbit didn’t water the rose and the sunflower.</li> <li>• The alien didn’t jump over the TV and the radio.</li> </ul>
	Target block (Positive goal)	<ul style="list-style-type: none"> <li>• The vet didn’t examine the cat or the dog.</li> <li>• Mouse didn’t feed the horse or the cow.</li> <li>• Big sister didn’t lift up the chair or the stool.</li> </ul>
Group 2	Priming block (True)	<ul style="list-style-type: none"> <li>• Donkey didn’t hit the barrel and the suitcase.</li> <li>• The girl didn’t slip on bucket and the cup.</li> <li>• Kangaroo didn’t fall off the rack and the balance beam.</li> </ul>
	Target block (Negative goal)	<ul style="list-style-type: none"> <li>• Little deer didn’t step on the log and the rock.</li> <li>• The girl didn’t drop the shell and the diamond.</li> <li>• Square robot didn’t hop on the brush and the broom.</li> </ul>
Group 3	Priming block (False)	<ul style="list-style-type: none"> <li>• The worker didn’t fix the bike and the skateboard.</li> <li>• Rabbit didn’t water the rose and the sunflower.</li> <li>• The alien didn’t jump over the TV and the radio.</li> </ul>
	Target block (Positive goal)	<ul style="list-style-type: none"> <li>• The vet didn’t examine the cat or the dog.</li> <li>• Mouse didn’t feed the horse or the cow.</li> </ul>

		<ul style="list-style-type: none"> <li>• Big sister didn't lift up the chair or the stool.</li> </ul>
Group 4	Priming block (False)	<ul style="list-style-type: none"> <li>• Donkey didn't hit the barrel and the suitcase.</li> <li>• The girl didn't slip on bucket and the cup.</li> <li>• Kangaroo didn't fall off the rack and the balance beam.</li> </ul>
	Target block (Negative goal)	<ul style="list-style-type: none"> <li>• Little deer didn't step on the log and the rock.</li> <li>• The girl didn't drop the shell and the diamond.</li> <li>• Square robot didn't hop on the brush and the broom.</li> </ul>

Both the warm up stories and the filler stories in the test phase had similar design as the test stories. The English literal translation of the two warm up sentences are given in (169a) and (169b). Given the outcomes of the warm up stories, the first warm up sentence was true, while the second was false. The three filler sentences in the test phase were listed in their English literal translation in (170a-c). The first two filler sentences were true, and the last one was false.

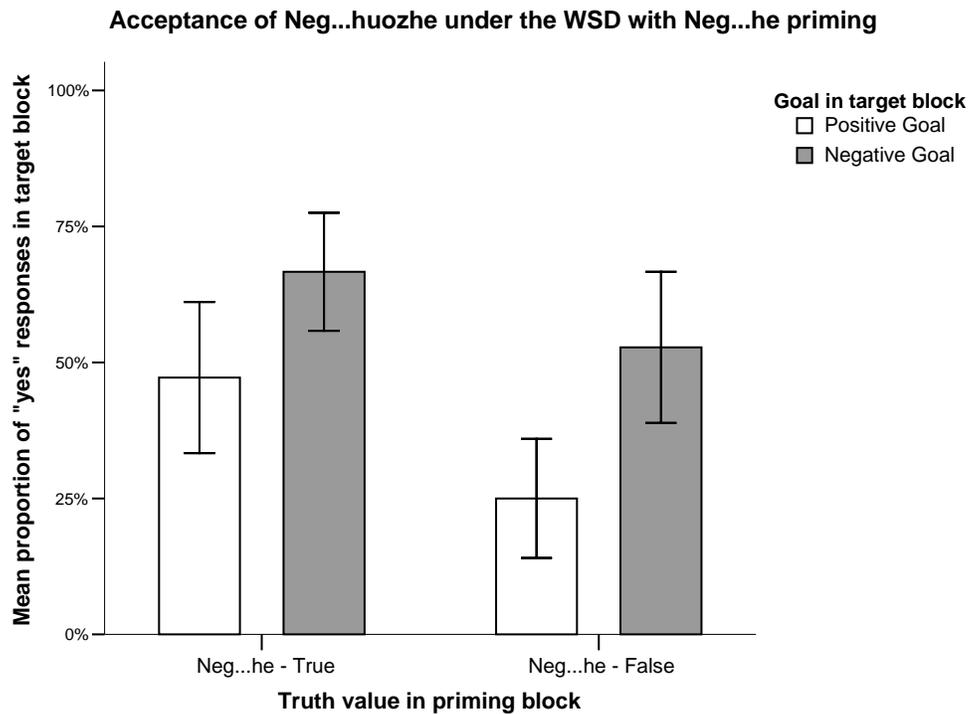
- (169) a. Gorilla moved the bus or the train.  
b. The boy threw (the ball) at the pine or the cactus.
- (170) a. This girl played with the basketball or volleyball.  
b. The karate student reached the lamp or the mobile.  
c. Winnie the Pooh caught the chicken or the squirrel.

#### 4.2.3 Results

Children in this experiment correctly judged the truth value of the test sentences (Neg...*he*) in the priming block 100% of the time, meaning that their interpretation of Neg...*he* was consistently restricted to “neither”. In the analyses that follow, the

dependant variable is proportion of children’s “yes” responses to test sentences in the target block. The proportions of “yes” responses were entered into an analysis of ANOVA with the two factors, i.e., truth value of the test sentences in the priming block and the type of goal in the test sentences. The analysis suggested a marginal main effect of the type of goal in the test stories ( $F(1,44) = 3.576, p = .065$ ) and a non-significant effect of the truth value of the test sentences in the priming block ( $F(1,44) = 2.091, p > .1$ ). No significant interaction between the two factors was found ( $F(1,44) = .111, p > .5$ ).

(171) Figure 8: Acceptance of Neg...*huozhe* under the WSD with Neg...*he* priming



The result of the ANOVA analysis suggested the effect of the type of goal of the test stories on children’s interpretation of Neg...*huozhe* was diminished in this experiment.

Results of relevant mean comparisons made this point clearer: For children who heard truthful Neg...*he* sentences in the priming block, those who heard positive goal stories (group 1) and those who heard negative goal stories (group 2) did not show a significant difference in their acceptance rate of Neg...*huozhe* in the target block (i.e., 47% vs. 67%,  $F(1,22) = 1.127$ ,  $p > .2$ ); and for children who heard false Neg...*he* sentences in the priming block, those who heard negative goal stories (group 4) accepted Neg...*huozhe* under the WSD in the target block 53% of the time, not significantly different with those who heard positive goal stories (i.e., 25%,  $F(1,22) = 2.466$ ,  $p > .1$ ). Chi Square analyses comparing the distribution of children's responses in different groups revealed similar patterns: for children who heard truthful Neg...*he* priming sentences, those who judged Neg...*huozhe* in negative goal stories did not differ from those who judged Neg...*huozhe* in positive goal stories ( $\chi^2 = 2.743$ ,  $P = .1$ ); and for children who heard false Neg...*he* sentences in the priming block, those who judged Neg...*huozhe* in negative goal stories also did not differ from those who judged Neg...*huozhe* in positive goal stories ( $\chi^2 = 1.6$ ,  $P = .2$ ). Given the baseline observation that children's acceptance of Neg...*huozhe* differed significantly in negative goal stories vs. in positive goal stories, the reduced gap between the patterns of children's response to Neg...*huozhe* in these two kinds of stories here suggested that a priming effect of prior experience with Neg...*he* sentences on the interpretation of later Neg...*huozhe* might be observable in some of the conditions.

At the same time, the result of the ANOVA analysis showed that the truth value of the Neg...*he* sentences in the priming block did not make a statistically significant

difference on children's access to the WSD of Neg...*huozhe* sentences in the target block. This is also reflected in the results of simple mean comparisons. Among children who heard positive goal test stories, those who judged Neg...*he* sentences as truthful descriptions of the scenarios in the priming block accepted Neg...*huozhe* sentences under the WSD in the target block 47% of the time, not significantly more than those who heard Neg...*he* sentences falsely described the scenarios in the priming block (i.e., 25%,  $F(1,22) = 1.578$ ,  $p > .1$ ). Similarly, among children who heard negative goal test stories, the acceptance rates of the Neg...*huozhe* sentences in the target block did not differ significantly between those who received true Neg...*he* sentence priming and those who received false Neg...*he* sentence priming (i.e., 67% vs. 53%,  $F(1,22) = .621$ ,  $p > .1$ )<sup>56</sup>.

Nonetheless, when children's acceptance rate of the Neg...*huozhe* sentences in each group were compared with the respective baseline acceptance rate, it was evident that children accepted Neg...*huozhe* sentences in positive goal stories significantly more than the baseline when they heard truthful Neg...*he* sentence in the priming block (i.e., group 1 children, 47% vs. 6%,  $F(1,22) = 8.247$ ,  $p < .01$ )<sup>57</sup>. Children's acceptance rates in the other three conditions were not significantly higher than the baseline rates. This kind of result showed that having heard Neg...*he* sentences used to truthfully describe "neither"

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<sup>56</sup> These observations are consistent with the results of Chi Square analyses comparing the distribution of children's responses in different conditions: children who judged truthful Neg...*he* sentences and those who judged false Neg...*he* sentences did not behave differently in judging Neg...*huozhe* sentences in positive goal stories ( $\chi^2 = 0.75$ ,  $p > .2$ ); and same held in case when children judged Neg...*huozhe* sentences in negative goal stories ( $\chi^2 = 1.6$ ,  $p > .2$ ).

<sup>57</sup> Comparison of the distribution of children's responses in this condition and those the baseline condition revealed the same pattern: having heard and judged truthful Neg...*he* sentences differentiating the two groups of children significantly with respect to their responses to Neg...*huozhe* sentences in positive goal stories ( $\chi^2 = 6.316$ ,  $p < .02$ ).

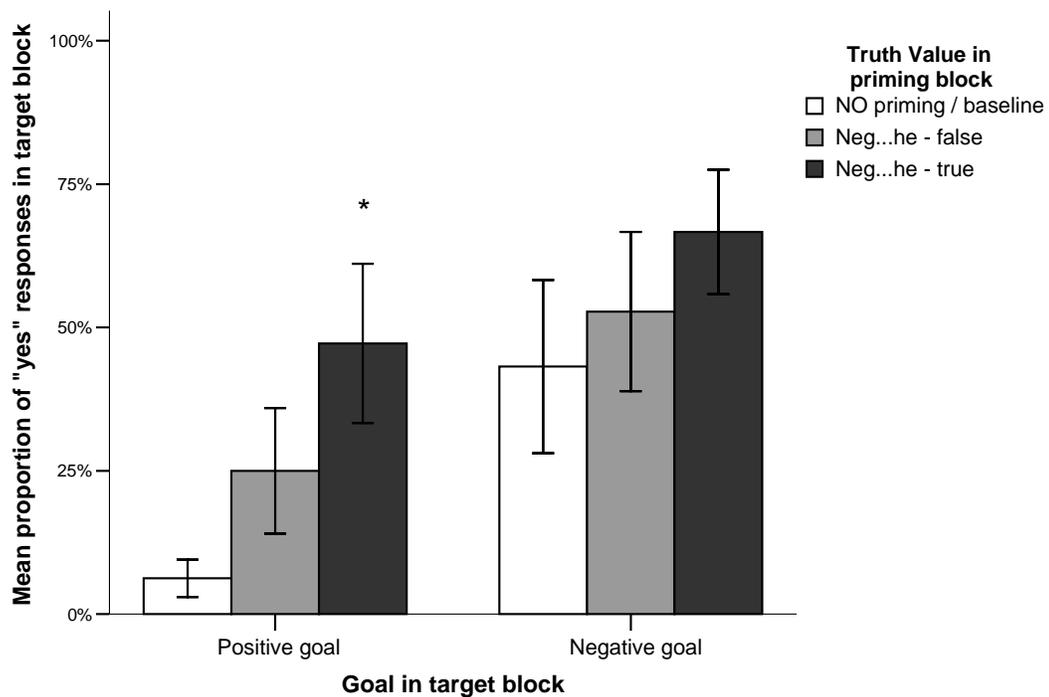
scenarios boosted children’s pragmatic computation involved in accessing the WSD of Neg...*huozhe* sentences in positive goal stories to an observable level.

(172) Table 30: Mean proportion of children’s “yes” responses compared to the baseline

1st block \ 2nd block	Positive goal	Negative goal
Truthful description	47%	67%
False description	25%	53%
Baseline	6%	48%

(173) Figure 9: Acceptance of Neg...*houzhe* under the WSD as a function of priming truth value

**Acceptance of Neg...*huozhe* under the WSD as a function of priming truth value**



Children’s individual responses in all four conditions of this experiment displayed

bimodal distribution, as illustrated in the table in (174). This kind of individual variations regarding children’s interpretation of Neg...*huozhe* resembled findings in our Chinese target experiment and the first priming experiment. In those two experiments, there was no clear evidence that the variations had a correlation with children’s age. And it was also the case in the current experiment, as shown in the table in (175) with children’s individual proportions of “yes” responses to Neg...*huozhe* sentences and their respective age at testing.

(174) Table 31: Distribution of responses to Neg...*huozhe* in the target block

% of “yes” responses		0%	33%	67%	100%
Positive goal	Group 1 (T-P)	5	2	0	5
	Group 3 (F-P)	6	3	1	2
Negative goal	Group 2 (T-N)	2	1	4	5
	Group 4 (F-N)	6	0	1	5

(175) Table 32: Proportion of “yes” responses from individual children

Subject	Group	Age	Neg... <i>he</i>	Neg... <i>huozhe</i>
1	1	4;1	100%	100%
2	1	4;4	100%	0%
3	1	4;5	100%	0%
4	1	4;5	100%	0%
5	1	4;6	100%	100%
6	1	4;6	100%	100%
7	1	4;8	100%	0%
8	1	4;10	100%	100%
9	1	4;10	100%	100%
10	1	5;0	100%	0%
11	1	5;5	100%	33%
12	1	5;6	100%	33%

13	2	4;0	100%	100%
14	2	4;2	100%	100%
15	2	4;5	100%	100%
16	2	4;6	100%	67%
17	2	4;6	100%	100%
18	2	4;9	100%	67%
19	2	4;9	100%	100%
20	2	4;10	100%	67%
21	2	4;10	100%	33%
22	2	5;1	100%	0%
23	2	5;2	100%	67%
24	2	5;7	100%	0%
25	3	3;10	0%	100%
26	3	4;1	0%	33%
27	3	4;4	0%	67%
28	3	4;5	0%	100%
29	3	4;6	0%	0%
30	3	4;6	0%	0%
31	3	4;6	0%	0%
32	3	4;11	0%	0%
33	3	4;11	0%	33%
34	3	5;0	0%	0%
35	3	5;1	0%	0%
36	3	5;3	0%	33%
37	4	3;9	0%	0%
38	4	4;3	0%	100%
39	4	4;4	0%	67%
40	4	4;6	0%	0%
41	4	4;6	0%	0%
42	4	4;7	0%	100%
43	4	4;11	0%	0%
44	4	4;11	0%	0%
45	4	5;0	0%	0%
46	4	5;1	0%	100%
47	4	5;2	0%	100%
48	4	5;7	0%	100%

#### 4.2.4 Discussion

Generally speaking, the results of this experiment once again supported our hypothesis that children at age 4 do not simply lack the WSD of Neg...*huozhe* in their grammar and argued against a deficient grammar view on children's knowledge of this interpretation. Although children's behavior did not exhibit a fully adult pattern, this could conceivably be consequence of factors other than grammar. I have proposed that that the way Chinese children differ from Chinese adults regarding the interpretation of Neg...*huozhe* is that they consider the NSD as the default interpretation and can assign this interpretation to Neg...*huozhe* without considering the context. Their adherence to the NSD sometimes prevents them from performing the relevant pragmatic computation involved in accessing the WSD. At the same time, because children's ability to effectively integrate discourse information and compare alternatives is not mature (Chierchia et al. 2001; Noveck 2001; Gualmini 2004; Musolino & Lidz 2006), they can process more directly available information better and are prone to have difficulties utilizing relatively remote discourse resources. The design of this experiment targeted at making the relatedness of Neg...*he* and Neg...*huozhe* more obviously so that children might be able to use this information to perform the relevant pragmatic computation. Statistical analyses of the experimental results revealed that prior experience with truthful Neg...*he* sentences caused a significant raise of children's access to the WSD in positive goal condition from the baseline. This meant that a priming effect of Neg...*he* on children's access to the WSD of Neg...*huozhe* was in principle possible, although it was not observable in all conditions

and did not show up in all children.

Unlike in the first priming experiment presented in 4.1, the priming stimuli in this experiment were supposed to be unambiguous, and children's responses were uniform in the priming block. Therefore, this experiment did not have the 'subset subject problem' as the first priming experiment, and all subjects were potential candidates to exhibit a priming effect. One way the priming effect observed in this experiment could be explained is the following: Children who heard truthful Neg...*he* sentences built up some implicit knowledge about the appropriate use of this form in some contexts with a "neither" outcome. Then, when they were presented with Neg...*huozhe* sentences in similar contexts with a "this or that"/ "not this or not that" outcome, some children among those who initially assigned the "neither" interpretation to Neg...*huozhe* would be primed to consider Neg...*he* and Neg...*huozhe* as alternatives and perform some pragmatic computation like this: the puppet used Neg...*huozhe*, I could assign a "neither" interpretation to it; but he would have used Neg...*he* if he intended such a meaning, as he did earlier; the reason the puppet used Neg...*huozhe* instead of Neg...*he* might be that he intended a different meaning. This kind of computation somehow inhibited the "neither" interpretation (the NSD) of Neg...*huozhe* and prepared children to be more likely to pay attention to the "not this or not that" aspect of the contextual information and access the WSD of Neg...*huozhe*. In this experiment, children who heard positive goal stories, but not those who heard negative goal stories, were found to exhibit significant priming effect of having experienced truthful Neg...*he* sentences on their access to the WSD of

Neg...*huozhe*. This could be related to the fact that children’s baseline acceptance rate of the WSD in positive goal stories was extremely low (i.e., 6%) and their responses did not show bimodal distribution, so that a significant raise from the baseline was easier to observe.

Alternatively, the priming effect might be related to the dynamic change in the probability of using certain form to express certain meaning. After children experienced Neg...*he* sentences used to express a “neither” meaning, they were prone to bind Neg...*he* and a “neither” meaning together: they would be more likely to use Neg...*he* given a “neither” meaning; and if another form instead of Neg...*he* was used by others, they would be less likely to associate a “neither” meaning with the other form. In this model, the increased probability of the form-meaning binding between Neg...*he* and “neither” caused by experience with this pair decreased the probability of the binding between Neg...*huozhe* and “neither” and consequently boosted the association between Neg...*huozhe* and “not this or not that”. But a mechanism based solely on probability change of the form-meaning relation might be too weak. A pure probability change model does not care about context, as long as certain meaning is accessed given some form, the probability of this form-meaning relation increases. This predicts whether the context provides a matching scenario for the meaning and even whether the form is used given any context will not make a difference. But the observation in the current experiment seemed to be that a matching scenario did make a difference, because false Neg...*he* sentences did not quite serve as a prime for the WSD of Neg...*huozhe*, only truthful

Neg...*he* sentences did. Presumably, a matching “neither” scenario in the context was useful for children (especially at this age) in paying attention to the use of Neg...*he* in the context and carry this information to the target block in interpretation Neg...*huozhe*.

In fact, the two models mentioned above are not necessarily contradictory. In natural language acquisition, it is likely that both a pragmatic computation mechanism (which focuses on the some “qualitative” properties of the relevant forms) and a probabilistic algorithm (which deals with their quantitative properties) are relevant for children’s successful learning of Neg...*huozhe*. Assuming normal conversational situations are based on truthful statements rather than false ones – given the maxim of quality (Grice 1989), experiencing Neg...*he* sentences truthfully describing “neither” scenarios in this experiment resembled the majority of cases of input. From a pragmatic learning perspective, the contexts that matches the “neither” meaning provide children with valuable information about the appropriate use of Neg...*he*, against which they can compare the appropriate use of Neg...*huozhe* under the “neither” interpretation. Children need to become more adept in recognizing alternatives and computing the relations between the alternatives in terms of their appropriate use. And this cannot be done without accumulating enough experience with the relevant alternatives used appropriately in respective contexts. From a probabilistic learning point of view, over a period of time, accumulated experience with Neg...*he* used to express the “neither” meaning – contrasted with relatively rarer experience with Neg...*huozhe* under the “neither” meaning, increases the probability of the consistent binding between this form (Neg...*he*)

and the meaning (“neither”), and impacts the likelihood of the alternative form (Neg...*huozhe*) for the same meaning. However, the impact requires that children can identify relevant alternatives<sup>58</sup> without having them presented side-by-side, which is tied back to their pragmatic capacity. In addition, children must also learn to appropriately use Neg...*huozhe* under the “neither” interpretation, which also demands more than just a pure probabilistic algorithm.

What the results of this experiment showed was that children’s prior experience with Neg...*he* could have an effect on their interpretation of Neg...*huozhe*. We project that children’s global computation of the relation between Neg...*huozhe* and Neg...*he* contributes to their successful learning of Neg...*huozhe*. In actual learning circumstances, children receive input of both Neg...*he* and Neg...*huozhe* under the NSD (meaning “neither”), and the latter form is used in a restricted set of circumstances. Neg...*huozhe* under the NSD can only be used in a “neither” scenario when the specific discourse condition (i.e.,  $Pa \vee Pb$  is specifically expected or relevant) is satisfied; but when this condition is satisfied in the context, Neg...*he* can also be used to describe the “neither” scenario, without addressing to the specific expectation; and if Neg...*huozhe* is used, it obligatorily carries the implicature about the ‘disjunctiveness’ of some positive propositions (i.e.,  $Pa \vee Pb$  is expected or relevant). Children eventually have to learn the use of these two forms, when they can reliably relate these two forms together and pay

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<sup>58</sup> For instance, Neg...*he* and Neg...*huozhe* are the relevant alternatives in this case; but other forms that also mean “neither” do not count, e.g., Neg...*ye* (‘also’) Neg.

attention to the kind of context each form is used. In one condition of our current experiment, Neg...*he* was used where the discourse condition of using Neg...*huozhe* under the NSD ( $S_N$ ) was satisfied – in order to satisfy the plausible dissent condition of the TVJT; but this alone would not expose children to the appropriate use of  $S_N$ , so, it is rather irrelevant to the goal of the current experiment. In the priming block, for children presented with truthful Neg...*he* sentences, the discourse context set up in the each test story made a “not both” scenario plausible (to satisfy the plausible dissent requirement), which actually made using Neg...*huozhe* under the NSD to describe the “neither” outcome also felicitous. For example, in the ‘fixing’ story, before the outcome was examined, the garage boss told Mickey Mouse that he thought the worker might have only fixed one thing (and didn’t fix one thing). This built up some expectation in the context about  $Pa \vee Pb$  (fixed the bike or fixed the skateboard) in the discourse context and thus satisfied the discourse condition of using Neg...*huozhe* under the NSD in case the outcome was a “neither” scenario (fixed neither things). Given the actual “neither” scenario outcome, if a Neg...*huozhe* sentence under the NSD were used, it would implicate that the two corresponding positive propositions (fixing the bike and fixing the skateboard) was expected to be specifically disjunctive, making the utterance directly relate back to the speculation expressed by the garage boss. Using a Neg...*he* sentence did not address to this specific speculation and simply expressed that the two corresponding positive propositions (fixing the bike and fixing the skateboard) salient in the context both failed to happen. As I said earlier, using Neg...*he* sentences in this kind

of contexts was not meant to be relevant to the goal of the current experiment. Nonetheless, these circumstances represent cases in children's actual learning environment, which, together with other case where Neg...*he* are used and cases where Neg...*huozhe* are used, provide evidence that Neg...*he* is used more generally than Neg...*huozhe*.

Based on the results of the current experiment, as well as those of our other experiments I reported earlier, we can conclude that children's knowledge on the interpretation of Neg...*huozhe* can be divided into two parts, the grammatical aspect and the pragmatic aspect; and that children's grammar in this respect is not deficient, while their pragmatic capacity is still developing. Children have the potential to analyze a Neg...*huozhe* string in both the NSD way and the WSD way, and they can compute the truth conditions of Neg...*huozhe* under either interpretation. Yet, some of this grammatical knowledge is often concealed due to their immature capacity in dealing with the pragmatically more demanding interpretation, i.e., the WSD. Meanwhile, children are not simply incompetent in performing pragmatic computations; rather, they need to rely on more readily available resources in the discourse. It is unfair to judge children's grammar regarding the interpretation of Neg...*huozhe* as incomplete without taking pragmatic factors into consideration. Chinese children still have things to learn in order to become mature speakers, but those are pragmatic rather than grammatical aspect. Presumably, the learning is two-fold. On the one hand, as children's ability to flexibly use discourse resources grows, they learn to pay attention to the critical piece of information

in the context relevant to the dispreferred WSD, whether it is directly evident or less so. The success of this learning makes children able to implement the local computation related to the WSD more effectively and access this interpretation more easily when it is intended. On the other hand, with the increase of children's ability to relate alternatives, as they accumulate experience with Neg...*he* and Neg...*huozhe* under the NSD ( $S_N$ ), from a quantitative perspective, the form-meaning pairing between Neg...*he* and “neither” is reinforced with higher probability than the pairing between  $S_N$  and “neither”, because Neg...*he* is the default and natural way to express a “neither” meaning in adult Chinese and occurs much more frequently than  $S_N$ ; at the same time, from a qualitative perspective, children also learn to extract the use condition of  $S_N$ , based on the distribution of Neg...*he* and  $S_N$  in terms of kind of contexts they are used. This learning pertains to the global computation related to the WSD of Neg...*huozhe*. It leads to children's understanding that Neg...*he* is generally the best candidate given a “neither” meaning (both quantitatively and the qualitatively) and that the NSD is only appropriate when specific condition is met, which eliminates children's original bias toward the NSD of Neg...*huozhe* and makes the WSD at least equally accessible as the NSD.

## **Chapter 5: General discussions**

In the previous several chapters, I first presented cross-linguistic variations regarding the interpretation of negated sentences containing disjunction and conjunction in the object (Neg...Disjunction and Neg...Conjunction, respectively) and previous experimental findings that children in different languages (English, Japanese and Chinese) behaved similarly in interpreting Neg...Disjunction, specifically, they all seemed to systematically lack the wide scope disjunction interpretation (the WSD) of Neg...Disjunction, which is licit in their respective adult language. Then, I discussed pragmatic factors involved in the interpretation of Neg...Disjunction and the pragmatic complexities associated with the WSD. I also talked about methodological issues in previous experimental studies that might contribute to the observed lack of the WSD in children. Based on these discussions, I proposed that children's apparent lack of the WSD could be caused by their immature capacity in implementing pragmatic computations rather than deficient of their grammar regarding this interpretation. This predicted that children could access the WSD if the relevant pragmatic computation was facilitated, e.g., when the resources needed to perform the pragmatic computation were more directly available to children in the context where Neg...Disjunction is used. Generally speaking, the four target experiments reported in chapter 3 and chapter 4 all aimed at testing this prediction and the pragmatic account for children's incomplete knowledge regarding the interpretation of Neg...Disjunction. The results of those experiments confirmed the pragmatic account

from different perspectives. The current empirical studies demonstrate a case in language acquisition that being able to reliably carry out relevant pragmatic computations sometimes perfects the knowledge of certain interpretations and is crucial for speakers to exhibit their full grammatical capacity. This chapter contains general discussions on some central issues in the studies and the concluding remarks.

### **5.1 Children's pragmatic knowledge and pragmatic computation**

Natural language communications are governed by the general cooperative principle, which is specified with a set of conversational maxims (Grice 1975, 1989). This pragmatic knowledge is shared by mature speakers and influences how each individual speaker uses her language and understands the use of the language by other speakers. One could argue about the precise nature of those Grice's maxims: they could be specifically about language, or more broadly about communication, or about rational interaction generally. We could also ask about the origin of this pragmatic knowledge in speakers: it might be part of the innate knowledge children are born with, or, it might be acquired as children are exposed to how language is used. The answers to these theoretical questions are important, yet, we are not ready to answer them. What we could offer are empirical observations about children's command of pragmatic knowledge and its interaction with their grammatical knowledge. Generally speaking, the current set of experimental investigations join a lot of previous studies in showing that children's capacity in computing pragmatic considerations is immature and that this sometimes

masks certain aspect of their linguistic knowledge. However, this does not necessarily mean that children do not know the general pragmatic principle or the conversational maxims. The operation of the conversational maxims depends not only on the availability of these maxims to the conversation participants, but also on the participants' ability in terms of proper perception of the context and adequate consideration of alternatives. Therefore, even if children have these maxims in their toolbox early on, they might not be able to use them proficiently until later. In this dissertation, I have been assuming that children know the cooperative principle and the conversational maxims, but their capacity in performing pragmatic computations is still in the process of maturation.

Children's difficulties with tasks involving pragmatic computations have been documented in the literature (Thornton & Wexler 1999; Trueswell et al 1999; Noveck 2001; Chierchia et al. 2001; Gualmini, A., S. Crain, L. Meroni, G. Chierchia & M. T. Guasti, M. T. 2001; Musolino & Lidz 2002, 2006; Papafragou & Musolino 2003; Gualmini 2004; among others). In this respect, a lot of experimental studies looked at children's ability to derive scalar implicature. Scalar implicature arises when the speaker uses a weaker expression instead of a stronger alternative, by the maxim of quantity (i.e., be as informative as possible), she implicates the stronger expression does not hold<sup>59</sup>. This translates into the felicity conditions of using the weaker expression on a certain scale, i.e., only use the weaker expression when the stronger expression does not hold (unless it is in an uncertain scenario, such as in prediction). The ability to compute scalar

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<sup>59</sup> This is the stronger view on scalar implicature (e.g., Gazdar 1979).

implicature depends on knowledge of the conversational maxims as well as ability to implement the knowledge, including constructing the alternatives in online computation. Noveck (2001) looked at children's knowledge of modals like *might* using reasoning tasks. While *might* is semantically compatible with a "must" scenario, because it is weaker than *must*, *must* should be used given a "must" scenario, so that *might* implicates "not must" and is pragmatically not appropriate in a "must" scenario. Children were found to accept *might* in "must" scenarios, which suggested that they were not sensitive to the scalar implicature associated with *might*. Chierchia et al.'s (2001) study found out that some children accepted *or* in contexts that were compatible with *and*, which showed that these children did not derive the scale implicature associated with *or* (i.e., "not and"). In one experiment of Papafragou & Musolino's (2003) study, Greek speaking children all accepted the weaker expressions ("some", "two", and "start") when they were used to describe some scenarios compatible with the respective stronger alternatives ("all", "three", "finish"), which again revealed that children did not compute the relevant scalar implicatures. These experimental studies seemed to reveal children's inability to compute scalar implicature and insensitivity to the felicity conditions. However, the findings could also be explained with children's less developed capacity to construct alternatives (Gualmini et al. 2001) or/and their perception of the experimental goal as judging truth instead of felicity (Papagragou & Musolino 2003). These alternative accounts have some empirical support. In Chierchia et al.'s (2001) study, when presented with both *or* and *and* in an "and" scenario, children were found to choose *and* over *or*, showing that

children could compute scalar implicature when the alternatives were directly available to them. In another experiment of Papagragou & Musolino's (2003) study, children became sensitive to the scalar implicature, after they were trained to judge the appropriateness of expressions. From these experimental investigations, we learned two things: one is that children indeed have difficulties with pragmatically more demanding tasks; the other is that the difficulties do not necessarily arise due to their ignorance of the conversational maxims or inability to implement pragmatic computations.

Another line of experimental studies related to children's pragmatic capacity targeted at revealing children's knowledge of the dispreferred interpretation of certain ambiguous forms by making the context conducive toward that interpretation. Experimental findings in Musolino (1998) and Musolino et al (2000) led these researchers to conclude that children's grammar could only generate the isomorphic interpretation of negated sentences containing a universally quantified subject (*every N didn't V*) or an object quantified by an existential quantifier (*NP didn't V some N*), i.e., the "none" interpretation in both cases, because children were found to reject these sentences given "not every"/ "some not" scenarios. However, this conclusion has been undermined by findings in later experiments with enhanced pragmatic features. And the results of the earlier experiments should be viewed more appropriately as revealing children's preference toward the isomorphic interpretation. In Musolino & Lidz's (2006) study and Gualmini's (2004) study, where the felicity conditions associated with the dispreferred interpretations were better satisfied (by introducing explicit positive contrast

or/and clear positive expectation in the discourse context), children's access to those interpretations were greatly improved. These experiments showed two aspects of children's pragmatic capacity: one is that children are aware of the felicity conditions associated with the dispreferred interpretations; the other is that children are not very adept at accommodating infelicity and less ideal context, especially when the relevant interpretation is the dispreferred interpretation of an ambiguous string.

The findings of the experiments reported in this dissertation were consistent with the conclusions from the above studies. In these experiments, children were found to be able to carry out certain pragmatic computations necessary to access the dispreferred WSD of ambiguous Neg...Disjunction strings, when the contextual setting better satisfied the felicity condition associated with this interpretation, when explicit disambiguating information was present in the discourse, after they were trained to be more sensitive to the critical aspect of the contextual information, and after they immediately experienced the use of the alternative form to express the "neither" meaning (corresponding to the NSD). All these support the conclusion that children are in principle able to implement pragmatic computations and should possess the relevant pragmatic knowledge in the first place to back up the computations.

I discussed in detail in chapter 2 that the wide scope disjunction interpretation of Neg...Disjunction (the WSD) is associated with complex pragmatic conditions. A Neg...Disjunction sentence under the WSD is used felicitously when the speaker does not know which disjunct is false (i.e., the "uncertainty condition") but has evidence to

believe that at least one of the two disjuncts is false, (i.e., the “evidence condition”) and at the same time, disjoined negation is most relevant to the current communicative purpose among the alternatives (i.e., the “relevance condition”). As I discussed in section 2.1.2, these conditions are directly tied to the requirement from the conversational maxims imposing on disjoined negation (i.e., the WSD), assuming that children know the maxims, they should have some knowledge about these conditions. The difficulty for children seems to be to identify whether the context where a Neg...Disjunction sentence is uttered satisfies these conditions so that they assign the WSD to the Neg...Disjunction sentence. They must be able to pay attention to the critical piece of contextual information and process the speaker’s knowledge and intention. What our experiments illustrated is that children’s ability in performing this kind of pragmatic computation is restricted and can be boosted when the computation is facilitated, namely, when resources (e.g., critical contextual information, the relevant alternative) they can make use of to implement the computation are more evident in the discourse context and thus more directly accessible to them. The particular difficulty of the WSD of Neg...Disjunction for children is linked to its being an interpretation of a potentially ambiguous string, and the other interpretation, the NSD, is considered as the default interpretation of Neg...Disjunction and pragmatically less demanding in general. The presence of an “easier” interpretation can prevent children from searching for critically relevant contextual information to perform the pragmatic computation in accessing the “harder” interpretation. In a TVJT experiment, where it is not guaranteed that the speaker (i.e., the

puppet) is a truth-teller, children can resort to the easier interpretation (the NSD) and reject the puppet's Neg...Disjunction utterances under that interpretation, instead of exhausting the discourse resources to follow the "principle of charity".

In our experiments reported in this dissertation, we tried four different ways to facilitate children's pragmatic computation in accessing the WSD. In the two parallel target experiments conducted with Chinese children and English children, presented in section 3.1 and section 3.2, respectively, we made the contextual settings in one of the conditions (i.e., the negative goal condition) favorable toward the WSD, in that a "not this or not that" scenario could be directly inferred from the observable evidence in the outcome. In this condition, it was easier for children to recognize that a disjointed negative expression is directly relevant in the context, and both Chinese children and English children were found to be able to access the WSD significantly more often than when such facilitation was absent (i.e., in the positive goal condition). The first priming experiment conducted with Chinese children, which was reported in section 4.1, incorporated two kinds of facilitation manipulation, besides the positive goal vs. the negative goal distinction. In the priming block, the Neg...*huozhe* (disjunction in Chinese) test sentences contained a disambiguating clause meaning "I don't know which he didn't do" at the end. Compared to the baseline experiment (i.e., the Chinese target experiment reported in section 3.1), the contextual settings remained the same in the positive goal test stories and in the negative goal test stories, but the disambiguating clause in this experiment added a piece of information in the discourse that could possibly direct

children’s attention to the “not this or not that” aspect of the contextual information (rather than just focusing on the “this or that” aspect) and help them loosen their adherence to the “neither” interpretation of Neg...*huozhe*. The results showed that children were generally sensitive to this kind of facilitation and assigned the WSD to Neg...*huozhe* more often in both the positive goal stories and negative stories than the baseline rates. In this experiment, children’s experience with the WSD of disambiguated Neg...*huozhe* sentences in the priming block also served as a potential facilitation factor for their interpretation of plain Neg...*huozhe* in the immediately following target block. The higher activation level of syntactic/semantic representation corresponding to the WSD in the priming block as well as prior direct experience with “not this or not that” scenarios might lead children to parse plain Neg...*huozhe* in the target block in a way more favorable toward the WSD and become more sensitive to the “not this or not that” aspect of the context. It was observed that children who accessed the WSD of disambiguated Neg...*huozhe* more often (i.e., those who heard negative goal stories) in the priming block accepted plain Neg...*huozhe* sentences under the WSD in positive goal stories significantly more often than the baseline rate, which suggested that prior experience with the WSD of disambiguated Neg...*huozhe* and “not this or not that” scenarios could in principle affect the interpretation of later plain Neg...*huozhe*. Lastly, the second priming experiment conducted with Chinese children, detailed in section 4.2, demonstrated yet another facilitation attempt. Before children heard Neg...*huozhe* sentences, we presented them with Neg...*he* (conjunction in Chinese) sentences meaning

“neither” in the priming block, so that when they heard Neg...*huozhe* sentences in the target block, they might be primed to consider Neg...*he* as alternative to Neg...*huozhe* under the NSD and not stick to the “neither” meaning of Neg...*huozhe* (i.e., the NSD). Specifically, experience with Neg...*he* meaning “neither” could reinforce this form-meaning pair binding and thus decrease the probability of the form-meaning pairing between Neg...*huozhe* and “neither”; and experience with Neg...*he* used to truthfully describe “neither” scenarios might make children more sensitive to the appropriate use of this form in some contexts and drive children to consider the puppet’s use of Neg...*huozhe* later in similar contexts with a different outcome to bear a different meaning (i.e., “not this or not that”). In this experiment, children who heard positive goal stories accepted Neg...*huozhe* sentences under the WSD in the target block significantly more than the baseline rate, when they heard truthful Neg...*he* sentences in the priming block. This finding supported the hypothesis that prior experience with Neg...*he* sentences can in principle affect the interpretation of later Neg...*huozhe* sentences.

When pragmatic capacity is concerned, both pragmatic knowledge and pragmatic computations in implementing the knowledge are relevant. Our current experiment study supported the view that children’s immature pragmatic capacity is more related to their immaturity in performing pragmatic computations. In this respect, compared to adults, children need more direct discourse resources and are less flexible in accommodating less ideal contexts. The fact that children are sensitive to facilitations in performing pragmatic computations proves their possession of the basic pragmatic knowledge.

## 5.2 Pragmatic account and learnability

Throughout this dissertation, I have been advocating a pragmatic account for children's apparent lack of WSD of Neg...Disjunction observed in previous experiments. This contrasted with the grammatical account proposed by Goro & Akiba (2004a), Goro (2004, 2007) and Jing, Crain & Hsu (2005). The basis for their account is the assumption that Neg...Disjunction in any language has only one interpretation, either the NSD or the WSD, which is determined by the parameterized property of the disjunction word in the respective language, i.e., whether the disjunction word is a positive polarity item or not (specifically, whether it has the +PPI feature or the -PPI feature). According to these authors, if the disjunction word is a PPI, it must not be interpreted within the scope of negation, and Neg...Disjunction obligatorily has the WSD; and if the disjunction word is not a PPI, it is allowed to and thus must be interpreted within the scope of negation, and Neg...Disjunction has the NSD. Given this, children's universal default knowledge about Neg...Disjunction should only contain the interpretation that corresponds to the default setting of polarity parameter of disjunction. These authors proposed that the default setting of the polarity parameter of disjunction must be [-PPI], or the English case, and children universally start off with only the NSD of Neg...Disjunction. However, the "unitary interpretation" assumption is challenged when a broader range of cases in various languages are considered. As I discussed extensively in chapter 2, Neg...*huozhe* in Chinese can be interpreted both as NSD and as WSD, and which interpretation is

assigned depends on the context where Neg...*huozhe* is used; even in English, where the NSD of Neg...*or* is overwhelmingly preferred, the WSD is also possible. This means, even if cross-linguistic contrasts in the interpretation of Neg...Disjunction is the consequence of parameterized property of disjunction words, given the facts in these languages at discussion, no matter what the setting of the polarity parameter of disjunction words in a language is, the WSD is general possible. Therefore, if children are assumed to start with a universal default setting of the polarity parameter that allows the NSD, i.e., the English way, their grammar should not exclude the WSD. When UG provides the general mechanism for deriving the two interpretations of Neg...Disjunction to language learners, their initial way of analyzing Neg...Disjunction is expected to allow both interpretations. We hypothesized that children around age 4 are in a stage where they allow both the NSD and the WSD of Neg...Disjunction and consider the NSD as the default interpretation and that their access to the dispreferred and pragmatically more complex WSD is only observable in “ideal” contexts. The experimental findings were generally consistent with this hypothesis and supported the pragmatic account advocated in this dissertation.

One observation in most conditions of our experiments was that children’s responses exhibited bimodal distribution. This meant that responses from individual children to Neg...Disjunction in a single condition were relatively consistent. Children did not arbitrarily assign an interpretation to Neg...Disjunction, rather, they applied similar strategy in similar context. Meanwhile, the bimodal distribution pattern also

revealed that some children were more sensitive than other children to facilitations toward the dispreferred WSD. Children's variant responses might be related to variations in children's preference (or ability) to use linguistic or pragmatic information in making interpretive decisions and different computation strategies they employed in approaching the experimental tasks in TVJT. As I discussed in section 2.2.1, TVJT paradigm is on the one hand useful in setting up the context such that the felicity condition of using some pragmatically complex form is met; on the other hand, it makes both interpretations of an ambiguous string potential plausible in a single context and allows the utterer of the test sentences (the puppet) to make mistakes in describing what happened. Given this kind of circumstance, children could complete the task based on the generally preferred interpretation (the NSD), if they weigh linguistic information (e.g., the NSD is compatible with the form and the unmarked way of analyzing the form) over pragmatic information (e.g., the WSD is more plausible in the context) and choose to save computation cost; or, they could devote more computation efforts to complete the task in a "charitable" way (making the puppet a truth-teller), if they give pragmatic information higher priority which can overrides the default linguistic commitment. Also, individual variations observed in these experiments might also be caused by differences in children's ability to revise their initial hypothesis based on available information from different sources. In our experiments, the highest acceptance rate of the WSD (i.e., 79%) was observed when children judged Neg...*huozhe* sentences that contained a disambiguating clause at the end in negative goal stories, where still not all children

assigned the WSD to Neg...*huozhe*. For children who would not accept the WSD even in this kind of context, it might be impossible to find them access this interpretation using a TVJT. It would be nice if there are other methods to test whether this way of analyzing Neg...Disjunction could ever be allowed by these children, but at this point we are not aware of a better method<sup>60</sup>.

Given the pragmatic account, children's mastery of the WSD of Neg...Disjunction progresses as their overall pragmatic capacity grows. When children can reliably make use of discourse resources, direct or indirect, and better understand the speaker's perspective and intention, their access to the WSD will not be restricted to ideal conditions. This generalization holds for children cross-linguistically, because the pragmatic complexities of the WSD is universal. In addition, children's knowledge of the Neg...Disjunction is also subject to potential language-specific tunings, depending on the interpretive pattern in their respective language. For English-speaking children, tuning is less relevant, because their current state basically resembles the adult way, i.e., Neg...*or* has the NSD as the default interpretation and allows the WSD when the context satisfies the conditions of use. For Chinese-speaking children, tuning is necessary. In adult Chinese, Neg...*he* (conjunction word in Chinese) is the natural and default way to

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<sup>60</sup> One potential method is to use elicitation task. I mentioned some speculations in 3.2 that children might be better at using Neg...*huozhe* under the WSD than accessing the WSD when others use Neg...*huozhe*, as when they use it, they know what they want to express and there is no ambiguity problem for them. However, such task is not easy to design, since it is very hard to control how children perceive a scenario which we consider as "not this or not that" and what children might say in such a scenario. For instance, a "not this or not that" scenario can at the same time be perceived as a 'not one of the two' scenario, a "this or that" scenario, a 'one of the two' scenario, etc. Depending on which aspect strikes children as most relevant – different children can have different views, they can say any one of the following: *didn't do this or that*, *didn't do one*, *did this or that*, *did one*, etc.

express a “neither” meaning, while Neg...*huozhe* under the NSD is used in a subset of “neither” circumstances (i.e., when the two corresponding positive propositions are specifically expected to have a disjunctive relation). Therefore, unlike Neg...*or* in English, Neg...*huozhe* in Chinese does not have the NSD as the default interpretation. Chinese children need to learn the special pragmatic condition associated with the NSD of Neg...*huozhe* and expel this interpretation from occupying the default status. They have to adjust the prominence of the WSD in the interpretation of Neg...*huozhe* and be more ready to assign the WSD to Neg...*huozhe*. This is achieved as children become aware of the relatedness of Neg...*huozhe* under the NSD ( $S_N$ ) and Neg...*he* and able to process the differences of the contexts where they are used. On the one hand, children store the relative probabilities of the form-meaning pairing between Neg...*he* and “neither” vs.  $S_N$  and “neither” and conclude that Neg...*he* is quantitative-wise the better candidate given a “neither” meaning in general. On the other hand, children identify the kind of contexts Neg...*he* vs.  $S_N$  is appropriately used and stop assigning the “neither” interpretation to Neg...*huozhe* without considering contextual information.

Japanese-speaking children’s task is yet different, they need to eliminate the NSD from the interpretive inventory of Neg...*ka* and take the WSD as the sole interpretation allowed for Neg...*ka*. Theoretically, they have to rely on distributional evidence in their input to achieve this learning goal, i.e., every time Neg...*ka* is used, the WSD is intended, while the NSD never occurs. However, there are two potential problems involved here. First, children need to correctly assign the WSD to Neg...*ka* every time they hear it being

used in order to make use of the distributional evidence, otherwise, if they misunderstand that the speaker intends the NSD with Neg...*ka*, they will mischaracterize the distribution pattern. But the meaning the speaker intends with a potentially ambiguous form is often not transparent (Goro 2007) and children are found to overwhelmingly misunderstand Neg...*ka* as intending the NSD meaning in experimental settings (Goro & Akiba 2004a). Therefore, a paradox seems to exist here: children need to learn that only the WSD is available in Japanese given that they only assign the WSD to Neg...*ka*. Second, a probabilistic learning algorithm requires ample data points of the target option (in this case, the WSD) to statistically separate it from noise and confirm this option. However, the result of the corpus search in Goro (2007) revealed an extremely low frequency of the occurrence of Neg...*ka* in Japanese<sup>61</sup>, which poses a serious problem for a probabilistic learner to learn the right interpretive option of Neg...*ka* (see Goro 2007 for more discussions on Japanese children's learning of Neg...*ka*). Regarding this learnability issue, we can only offer some preliminary thoughts here. First, although sometimes speaker's intended meaning with an ambiguous string is not transparent, ambiguity resolution in communication contexts should be considered as generally successful. As the current studies and many other experimental investigations have concluded, the difficulties children face in ambiguity resolution is most often caused by their immature pragmatic capacity in integrating discourse information, accommodating less ideal

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<sup>61</sup> In particular, no adult utterance of Neg...*ka* was found in the CHILDES database; and only two instances of Neg...*ka* were found among 100,000 randomly collected sentences, and in both cases, Neg...*ka* is embedded in conditionals and believed .

contextual situation and comparing alternatives. This means children's ability to identify speaker's intended meaning will grow as they become more experienced with pragmatic computations. A coherence discourse context often provides the hearer with explicit or implicit cues for the intended meaning; and the common real world knowledge shared by the speaker and the hearer also makes certain meaning more plausible compared to the alternative. Therefore, we need not to be too pessimistic about children's growing potential in catching the occurrences of the WSD. With respect to the problem regarding sparse positive evidence for WSD, we have nothing more to say than some speculations. One conjecture is that the Japanese children's learning of the correct interpretive option of Neg...*ka* spans over a longer period of time, during which they accumulate positive evidence for the WSD and do not receive any reinforcement of the NSD. In addition, children might need to rely on a broader range of data than simple negated sentences containing a disjunct object to gather evidence showing that disjunction lower than negation in the surface form can scope over negation – unfortunately, we are not sure at this point what kind of data would be relevant. We have to leave the learnability issue regarding Japanese children's learning of Neg...*ka* open for further investigations.

### **5.3 Two more issues**

#### **5.3.1 On Neg...Conjunction**

While this dissertation focused on children's interpretation of Neg...Disjunction, our experiments did investigate a little bit on Chinese children's interpretation of

Neg...Conjunction (Neg...*he*). While Neg...*and* in English allows both the narrow scope conjunction interpretation (i.e., the NSC, “not both”) and the wide scope conjunction interpretation (i.e., the WSC, “neither”), Neg...*he* in Chinese only allows the WSC. The control experiment reported in section 3.4 and the priming block of the second priming experiment reported in section 4.2 showed that Chinese children uniformly accepted Neg...*he* sentences in “neither” scenarios and rejected them in “not both” (equivalent to “this or that” / “not this or not that”) scenarios, meaning that they systematically interpreted Neg...*he* as “neither”. Children’s uniform rejection to Neg...*he* in “not this or not that” scenarios contrasted with their varied acceptance of Neg...*huozhe* in the same scenarios, which suggested that Chinese children at age 4 probably do not allow the NSC of simple Neg...*he* sentences. This conclusion is strengthened by children’s contrastive responses to Neg...*huozhe* sentences and to Neg...*he* sentences, when the sentences contain the “I don’t know which he didn’t do” clause at the end. In the priming block of the first priming experiment, given the presence of the disambiguating clause, children accepted Neg...*huozhe* sentences under the WSD significantly more often than the baseline. This means that the “I don’t know which he didn’t do” clause is conducive to accessing the “not this or not that” meaning. But in the follow-up phase of the same experiment, while the “I don’t know which he didn’t do” clause was also present, no single child accepted Neg...*he* sentences under the NSC. The findings about Chinese children’s interpretation of Neg...*he* in the present study resemble what was reported in Goro & Akiba (2004a) and Goro (2004, 2007) about Japanese children’s interpretation of

Neg...*mo...mo*, i.e., they uniformly interpreted Neg...*mo...mo* as “neither”, just like Japanese adults. According to these authors, the obligatory wide scope conjunction interpretation of Neg...Conjunction in Japanese (and presumably also in Chinese) is tied to the positive polarity property of the conjunction words. Given this treatment of Neg...Conjunction, the lack of the NSC found in Chinese children and Japanese children could potentially be explained in two ways. One way, as proposed by Goro & Akiba (2004a) and Goro (2004, 2007), is that the default setting of a parameter regarding the polarity of conjunction words (i.e., the PPI parameter) is [+PPI], i.e., the Japanese/Chinese way, so that Japanese and Chinese children start out with the adult way of interpreting Neg...Conjunction and will never consider the NSC, while English children learn to switch the parameter setting for *and* given the experience with Neg...*and* meaning “not both”. One problem with this account concerns the motivation for this kind of parameter setting proposal. Considering children’s interpretation of Neg...Disjunction cross-linguistically, a parameterized account must consider [-PPI] as the default setting for disjunction words – in order to include the NSD in children’s initial grammar in this respect, then it is unclear why disjunction words and conjunction words have different default polarity settings, unless we assume the setting in each case is arbitrary<sup>62</sup>. The other way is that the default setting of the PPI parameter for conjunction

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<sup>62</sup> In Goro & Akiba’s (2004a) original proposal, the different default PPI parameter settings for disjunction and conjunction is driven by the Semantic Subset Principle (SSP). They assume that Neg...Disjunction and Neg...Conjunction in any language can each only have one interpretation, because [-PPI] for disjunction corresponds to the subset case, and [+PPI] for conjunction corresponds to subset case, this kind of setting is dictated by the SSP. However, as I pointed out, in languages like English and Chinese where disjunction is not a PPI, both the NSD and the WSD are allowed, so that the SSP does not apply in the first place.

words aligns with that for disjunction words, i.e., [-PPI], so that children start out with both the NSC and the WSC of Neg...Conjunction, but Chinese children and Japanese children have learned to expunge the NSC of Neg...Conjunction by age 4. The motivation for proposing this kind of setting could be that UG provides the general mechanism responsible for both ways of interpreting conjunction in negative context – the same as the disjunction case. One problem with this account is this: if Japanese children have learned to expunge the NSC of Neg...*mo...mo*, why is it the case that they have not learned to eliminate the NSD of Neg...*ka*, given that both NSC and NSD are absent in their input? A potential solution to this problem is hinged to the quantity of positive evidence for the other interpretation in each case (i.e., WSC vs. WSD): Neg...*mo...mo* under the WSC is the default and natural way to express a “neither” meaning, so Japanese children presumably receive abundant evidence for the WSC of Neg...*mo...mo*; on the other hand, as the corpus search results in Goro (2007) show, Neg...*ka* occurs extremely rarely in general (see footnote 61), so that the positive evidence for WSD is not strong enough to categorically differentiate it from the NSD, and accumulation of more evidence for the WSD is needed to purge the NSD.

As I discussed in section 3.1.3.3 and 3.3.3, the results of the preliminary corpus search of the Chinese data revealed a sharp distinction between Neg...*he* and Neg...*huozhe* in terms of their occurrence: given the same search and selection criteria, Neg...*he* occurs over 20 times more often than Neg...*huozhe*. In a sense, Chinese and Japanese are very similar in that Neg...Conjunction occurs much more often than

Neg...Disjunction, this presumably is the consequence of Neg...Conjunction being unambiguous and the default way of expressing a “neither” meaning in both languages. This should also be the distributional evidence for children of these two languages to learn the correct interpretive option of Neg...Conjunction – especially if it is the case that they are to purge the NSC. The reason why Neg...*huozhe* occurs relatively rarely can be traced back to the fact that both interpretations of Neg...*huozhe* are associated with special discourse conditions, and consequently, contexts that satisfy the felicity condition for either interpretation do not occur often. Nonetheless, we must also note that Neg...*huozhe* in Chinese is categorically different from Neg...*ka* in Japanese: while Neg...*ka* in Japanese is in general incompatible with the NSD, Neg...*huozhe* can be used productively to express a “neither” meaning, as long as the felicity condition for the NSD is satisfied (i.e.,  $Pa \vee Pb$  is expected or relevant). The comparison of the corpus search results in Goro (2007) with those reported in section 3.1.3.3 of this dissertation reflects this difference: while the NSD of Neg...*ka* almost never occurs in Japanese, the NSD of Neg...*huozhe* does occur naturally in Chinese occasionally<sup>63</sup>. This distributional difference between the NSD of Neg...*ka* vs. the NSD of Neg...*huozhe* will lead Japanese children and Chinese children to develop different grammars regarding disjunction words in terms of their behavior in negative context.

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<sup>63</sup> The main purpose of the corpus search I conducted is to illustrate the contrastive frequency of Neg...*he* vs. Neg...*huozhe*. For this purpose, it suffices to focus on one negation form in Chinese, namely, *meiyou*. But since one other negation form is used regularly in Chinese, i.e., *bu*, the search results presumably somewhat underestimate the actual occurrences of Neg...*huozhe* (as well as those of Neg...*he*) and thus the frequency of the NSD of Neg...*huozhe*.

The above discussions on children's interpretation of Neg...Conjunction and Neg...Disjunction presume that conjunction words like *he* in Chinese and *mo...mo* in Japanese and disjunction words like *huozhe* in Chinese and *ka* in Japanese correspond to Boolean connectives, and that the “neither” interpretation of Neg...Conjunction and the “not this or not that” interpretation of Neg...Disjunction derive from the conjunction/disjunction word scoping over c-commanding negation. However, the observation that Chinese children consider Neg...*huozhe* as ambiguous but Neg...*he* as unambiguous is also compatible with another possibility, namely, that disjunction words and conjunction words have different underlying semantics; in particular, while disjunction words map to Boolean disjunction operator, conjunction words like *he* and *mo...mo* are non-Boolean<sup>64</sup>, as proposed by Szabolcsi & Haddican (2004). According to these authors, the “neither” interpretation of Neg...Conjunction cross-linguistically is more likely to be linked to the parallelism between definite conjunctions and definite plurals, i.e., “due to pluralities undergoing homogeneous distributive predication within the scope of negation” (Szabolcsi & Haddican 2004, p225). For conjunction words that allow both the “not both” interpretation and the “neither” interpretation in negative context, such as *and* in English, these authors proposed that the two interpretations derive from using the conjunction words in a Boolean way vs. in a non-Boolean way, respectively<sup>65</sup>. If the “homogeneity” account for the “neither” interpretation of

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<sup>64</sup> At least, when these conjunction words conjoin simple NPs, rather than quantified NPs (see Szabolcsi & Haddican 2004 for discussion).

<sup>65</sup> Szabolcsi & Haddican (2004) considered stress as a decisive factor in determining whether *and* is

Neg...Conjunction is adopted, what Chinese children and Japanese children have learned is that the conjunction words in their respective language are non-Boolean, rather than the right choice between the potentially possible scopal relations between negation and “Boolean” conjunctions.

We admit that our current experiments did not explicitly show that *he* is a Boolean connective for Chinese children (or for Chinese adults). However, Goro, Minai & Crain (2004) and Minai, Goro & Crain (2006) demonstrated that Japanese children consider *mo...mo* as Boolean conjunction; nonetheless, they still interpret Neg...*mo...mo* uniformly as “neither” (Goro & Akiba 2004a; Goro 2004, 2007). In one of the experiments reported in Goro, Minai & Crain (2004) and Minai, Goro & Crain (2006), Japanese children were tested with sentences that contain *daka* “only” and *mo...mo* “and”, such as (176).

(176) *Pikachu-dake-ga aoi hako mo kuroi hako mo aketa*  
Pikachu-only-NOM blue box also black box also opened  
“Only Pikachu opened the blue box and the black box”

The meaning of this sentence is composed of two parts, one is that Pikachu opened the blue box and the black box (the “presupposition”), and the other is that everyone else did not open the blue box and the black box (the “assertion”). If *mo...mo* is Boolean conjunction, the assertion part conveys that everyone else did not open both the blue box and the black box (e.g., someone could have opened one of the two boxes, but not both)<sup>66</sup>;

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Boolean or non-Boolean, specifically, *and* is non-Boolean unless it is stressed.

<sup>66</sup> The negation in this sentence is considered “covert” by these authors (because the sentence itself does

on the other hand, if *mo...mo* is non-Boolean, the assertion part says that everyone else opened neither boxes<sup>67</sup>. In conditions where Pikachu did open both boxes, children were found to accept the test sentence given a scenario where another character (Hitokage) opened the blue box but not the black box (95% acceptance) and reject it when Hitokage opened both boxes (90% rejection). This means that Japanese children consider *mo...mo* as Boolean conjunction. Given this, what underlies Japanese children's interpreting Neg...*mo...mo* as “neither” is more likely to be attributed their mastery of the scopal restriction regarding interacting negation and *mo...mo*, rather than their (mis)understanding of *mo...mo* being non-Boolean.

Although the results of our current experiments are compatible with an explanation which resorts to a non-Boolean treatment of *he*, we are somewhat skeptical about this line of approach, given the parallel behavior of *he* and *mo...mo* and the findings of the Japanese experiments just mentioned. Experimental investigations on Chinese children's understanding of *he* independent of overt clausemate negation will be helpful to determine the nature of their interpreting Neg...*he* as “neither”.

### 5.3.2 On Neg...*he* priming

In earlier chapters, I proposed that the interpretive pattern of Neg...*huozhe*, in particular, that the NSD is not the default interpretation and that the WSD is easier to access for

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not contain negation in its overt or covert syntax) and does not behavior the same way as overt negation, which requires *mo...mo* to have wide scope.

<sup>67</sup> If *mo...mo* is non-Boolean, the conjoined NPs in the object would be equivalent to definite plurals, and the test sentence would mean the same as “only Pikachu opened the boxes”.

Chinese adult speakers compared to English speakers, is related to the fact that Neg...*he* is unambiguous and the default way to express a “neither” meaning (equivalent to the NSD) in Chinese. In addition, I attributed Chinese children’s preference toward the NSD of Neg...*huozhe* to their inexperience in recognizing Neg...*he* as the alternative form and better candidate given a “neither” meaning and hypothesized that they can better compute the relation between Neg...*huozhe* and Neg...*he* when the two forms are used back-to-back. This hypothesis is supported by the results of the Neg...*he* priming experiment reported in section 4.2, specifically, Chinese children were found to be able to depart from the adherence to the NSD and access the WSD of Neg...*huozhe* significantly more often, immediately after they experienced truthful Neg...*he* sentences used appropriately. I have offered two explanations for the priming effect observed in this experiment: one is that immediate experience with the appropriate use of Neg...*he* is more likely to make children consider this form as a better alternative to Neg...*huozhe* under the NSD and entertain the possibility that the speaker may intend another meaning than “neither” with Neg...*huozhe*, i.e., the WSD; the other is that prior experience with Neg...*he* meaning “neither” increases the probability of this form-meaning pair and thus decreases the probability of the form-meaning pairing between Neg...*huozhe* and “neither”, consequently, the probability of the form-meaning pairing between Neg...*huozhe* and “not this or not that” is boosted, and the WSD is easier to access. If these explanations are on the right track, the fact that children’s experience with certain form can affect their interpretation of some related form may have more general

implications, as the mechanisms responsible for this effect (i.e., computation of the relations between alternative forms and the dynamic change of the probability of form-meaning pairing) should be general. Recall that English children have been shown to prefer the “none” interpretation of *every...not* over the “not every” interpretation and the “none” interpretation of *not...some* over the “some not” interpretation (Musolino 1998, Musolino et al. 2000); and they are able to access the dispreferred interpretations more easily when the discourse contexts are more conducive toward those interpretations (Musolino & Lidz 2006, Gualmini 2004). Given the nature of the priming effect under discussion here, we would predict that children’s access to the dispreferred interpretation of *every...not* and *not...some* can improve after they experience the use of certain alternative forms expressing the meaning corresponding to the preferred interpretation (i.e., “none” in both cases). For example, in a TVJT experiment, we can have children experience unambiguous sentences in the form of *no N VP* (e.g., *no horse jumped over the fence*)<sup>68</sup> used to describe “none” scenarios before presenting them with the target *every...not* sentences (e.g., *every horse jumped over the fence*) to describe “not every” scenarios, children are predicted to accept *every...not* sentences more often. Applying the same logic, children are expected to accept *not...some* sentences (e.g., *the detective didn’t find some guys*) under the “some not” interpretation more often if they have been exposed to truthful *not...any* sentences (e.g., *the detective didn’t find any guys*).

In fact, one experiment in Viau, Lidz & Musolino (2006, 2008) did investigate

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<sup>68</sup> Or some other form that is the critical alternative to *every...not* under the “none” interpretation.

English children's access to the "not every" interpretation of *every...not* sentences given prior experience with some related form. However, the primes used in their experiment are sentences that contain *not every* in the subject (e.g., *not every horse jumped over the pig*) and unambiguously mean "not every" – the same meaning as children's dispreferred interpretation of *every...not*. Children in this experiment were found to accept *every...not* sentences under the "not every" interpretation significantly more often than the baseline after they experienced *not every* sentences used to convey the same meaning. Viau, Lidz & Musolino (2008) attributed the priming effect observed in their experiment to the elevated probability of the "not every" interpretation through children's prior experience with an unambiguous form expressing this meaning. The priming pattern in this experiment appear to be different from that in our Neg...*he* priming experiment: this experiment shows that prior experience with the dispreferred interpretation of *every...not* conveyed by another form (i.e., *not every*) can improve children's access to this meaning of *every...not*; what our Neg...*he* priming experiment discovers is that prior experience with the preferred interpretation of Neg...*huozhe* conveyed by another form (i.e., Neg...*he*) can improve children's access to the dispreferred interpretation of Neg...*huozhe*. The findings in these two experiments combined suggest that children's access to the dispreferred interpretation of a scopally ambiguous string can possibly be primed both with some unambiguous forms expressing the same meaning and with certain unambiguous forms expressing the meaning corresponding to the preferred interpretation of the ambiguous string. In addition, a "from acceptance to acceptance"

pattern seems to be critical in the priming cases: both instances involve prior experience with truthful unambiguous sentences (corresponding to acceptance of the sentences) having a positive impact on the acceptance of subsequent ambiguous sentences under the dispreferred interpretation. Crucially, in our Neg...*he* priming experiment, false Neg...*he* sentences (corresponding to rejections of the sentences) did not improve children's acceptance of Neg...*huozhe* under the WSD; and in Viau, Lidz & Musolino's experiment, truthful *not every* sentences did not bias children to reject *every...not* sentences under the "none" interpretation as one might expect<sup>69</sup>. More empirical studies are necessary to determine whether it is indeed the case that access to certain interpretation of an ambiguous string can be primed with both experience with the same interpretation and experience with the alternative interpretation. For instances, we can test whether children's access to the WSD of Neg...Disjunction improves after they have experienced unambiguous forms used to truthfully describe "not this or not that" scenarios, such as Neg...Disjunction...Neg<sup>70</sup>; and as I mentioned earlier, we can test whether children accept *every...not* sentences given "not every" scenarios more often after they have had experience with truthful *no* N VP sentences (or sentences of another form that bear the

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<sup>69</sup> According to the probabilistic model I described earlier in this section and in section 4.2 for the priming effect observed in our Neg...*he* priming experiment, prior experience with the use of *not every* sentences would probably decrease the likelihood of using *every...not* to convey the "not every" meaning and thus further boost the "none" interpretation of *every...not* (instead of the "not every" interpretation) and lead children to overwhelmingly reject the test sentences given "not every" scenarios. This is proved to be not true given the results of Viau, Lidz & Musolino's study. But as I have also discussed, a pure probabilistic account does not suffice anyway.

<sup>70</sup> Our two experiments on children's interpretation of Neg...Disjunction...Neg in Chinese and in English reported in section 3.3 revealed that not all children are adult-like in this respect. A priming experiment using this kind of sentences as primes would be more effective if subjects are pre-selected so that all of them can handle Neg...Disjunction...Neg sentences in the adult way.

“none” meaning). If the answers to these questions are “yes”, we need to identify why the priming cases always involve a “from acceptance to acceptance” pattern, for which we do not have a good explanation yet.

Another possibility that can potentially unify the findings in the two priming experiments is that both cases may involve some kind of “scope relation priming”: On the one side, both *not every* sentences and *every...not* sentences under the “not every” interpretation have negation scoping over the universal quantifier, so that experience with such scope relation in unambiguous sentences can improve children’s access to the same scope relation in ambiguous sentences. On the other side, Neg...*he* is interpreted with the conjunction word scoping over negation, so that experience with Neg...*he* sentences meaning “neither” also means experience with the wide scope coordination interpretation with respect to negation, which can prime children’s access to the parallel scope relation between disjunction and negation in Neg...*huozhe* sentences (i.e., the WSD)<sup>71</sup>. In order to evaluate this scope relation priming approach, further investigations are needed. If parallel scope relation is the sole source of the priming effect observed in the two experiments, we probably would not expect any priming effect from *no N VP* on the “not every” interpretation of *every...not* or from Neg...Disjunction...Neg on the WSD of Neg...Disjunction<sup>72</sup>.

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<sup>71</sup> This line of reasoning relies on the assumption that *huozhe* and *he* are parallel Boolean connectives. This issue was discussed in section 5.3.1.

<sup>72</sup> In Neg...Disjunction...Neg sentences, the scope relation is between one disjunction and two negations, specifically, disjunction is not in the scope of either negation. Given the linguistic assumptions about the syntax of Neg...Disjunction sentences under the WSD, the scope relation involved is between one disjunction and one negation, with the former having wider scope than the latter. It is unclear how the two

Despite the unsolved puzzles regarding the priming from Neg...*he* on the WSD of Neg...*huozhe*, the Neg...*he* priming experiment clearly demonstrates that children's interpretation of Neg...*he* can affect how they interpret Neg...*huozhe*. This has important implications for the learning of Neg...*huozhe*: while English and Chinese share the same grammar regarding Neg...Disjunction, adult speakers of the two languages have different preference patterns, which is presumably tied to how Neg...Conjunction is interpreted in the respective language; Chinese children learn the adult way of approaching Neg...*huozhe* as they can reliably and effectively utilize Neg...*he* as relevant resources.

#### **5.4 Concluding remarks**

The main goal of this dissertation was to identify pragmatic factors that contribute to children's apparent lack of certain grammar and underline the significance of children's successful pragmatic computation in exhibiting their full grammatical knowledge. I reported a series of experimental investigations dedicated to this goal. These experiments focused on children's knowledge of the wide scope disjunction interpretation of negated sentences containing disjunction in the object (i.e., the WSD of Neg...Disjunction, "not this or not that"), which involves a non-isomorphic mapping from the surface c-commanding relation of negation and disjunction to the semantic scopal relation of the two elements and is pragmatically more complex than the alternative narrow scope disjunction interpretation (i.e., the NSD, "neither"). Previous studies (Goro & Akiba

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cases can be parallel.

2004a; Jing, Crain & Hsu 2005) observed that children consistently accessed the NSD instead of the WSD given “not this or not that” scenarios and concluded that children’s grammar cannot generate the WSD. The findings in the current experiments undermined this conclusion and provided some insights into the conditions under which children’s linguistic knowledge of the WSD could be more observable.

Researcher in the language development field have recognized that children’s immature pragmatic capacity often results in their non-adult behaviors in language comprehension tasks (e.g., Trueswell et al 1999; Noveck 2001; Chierchia et al. 2001; Papafragou & Musolino 2003; Gualmini 2004; Musolino & Lidz 2006). Sometimes, given the same task, children were found to prefer linguistic information over pragmatic cues in making interpretive decisions, while adults put more weight on pragmatic considerations; this is most evident in tasks demanding computation of scalar implicature (e.g., Noveck 2001; Papafragou & Musolino 2003). On the other hand, children were also found to resist certain interpretation in contexts where the pragmatic conditions of its appropriate use was not well satisfied; this is often relevant in tasks involving ambiguity resolution toward a dispreferred interpretation (e.g., Gualmini 2004; Musolino & Lidz 2006). The particular deficiency children have in terms of their pragmatic capacity seems to be more related to their limited ability to integrate discourse information and recognize alternatives online than their incomplete knowledge of the general pragmatic principles and maxims. This was further attested in our current experiments.

In the original two target experiments conducted with Chinese children and English

children, we observed significant improvement of children's access to the WSD when the "not this or not that" aspect of the contextual information was made more directly relevant, namely, when the observable evidence in the outcome of the test stories was directly inferred as corresponding to a "not this or not that" scenario (i.e., in the negative goal condition). This demonstrated that children could integrate more directly accessible contextual information better in implementing pragmatic computations. The first priming experiment showed that children were generally sensitive to explicit disambiguating information and that prior experience with disambiguated Neg...*huozhe* under the WSD improved children's access to the WSD of plain Neg...*huozhe* sentences. The findings again proved that children could better make use of more directly evident information in the discourse. At the same time, children's sensitivity to priming from disambiguated Neg...*huozhe* sentences suggested that successful experience with the relevant linguistic representation (*huozhe* > Neg) as well as the critical aspect of the contextual information ("not this or not that") prepared children to better integrate linguistic information and discourse information when encountering plain Neg...*huozhe* sentences. The second priming experiment illustrated that prior experience with truthful Neg...*he* sentences had a positive impact on children's access to the WSD of Neg...*huozhe*, which meant increased probability of the form-meaning pairing between Neg...*huozhe* and "neither" and accumulated evidence for the appropriate use of Neg...*he* helped children reduce their bias toward the "neither" meaning of Neg...*huozhe* and access the "not this or not that" meaning of Neg...*huozhe* more easily. This is evidence that children can in

principle compute the relation between relevant alternatives (in this case, Neg...*he* and Neg...*huozhe* under the NSD, which are synonymous but used differently), but they sometimes can only recognize alternatives when they explicitly experience both forms back-to-back (see Chierchia et al. 2001 and Gualmini et al 2001 for more discussion on this point).

The findings in the current studies remind us again that children's grammatical knowledge of certain meaning is sometimes masked by their immature capacity in performing pragmatic computations and can emerge when pragmatic computations are facilitated. It must be recognized that pragmatic computation plays an important role in language acquisition. With the development of children's pragmatic capacity, they can not only better demonstrate the linguistic knowledge they possess, but also better process the input they receive about meanings to build an adult grammar. When we investigate children's grammatically knowledge that involves pragmatically complex aspects, we must not overlook or underestimate pragmatic factors. An adequate language acquisition theory must be based on a clear separation of different factors that contribute to children's observed behaviors.

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