

The Acquisition of Constraints in Child Mandarin

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A thesis submitted in fulfillment of the requirements for the degree of:

DOCTOR OF PHILOSOPHY

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Declaration

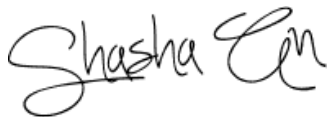
The research presented in this thesis is my original work and it has not been submitted for a higher degree in any other institution. In addition, I certify that all information sources and literatures used are indicated in the thesis. The research presented in this thesis received ethics approval from Macquarie University (Ref No. 5201200772).

Some of the material in this thesis has already been submitted or in preparation for submission to journals. Chapter 2 is based on the paper as in (1). Chapter 3 is based on the paper as in (2).

(1) An, S., Thornton, R., Zhou, P., Crain, S. (in preparation). The interpretation of disjunction in Verb Phrase Ellipsis in Mandarin Chinese.

(2) An, S., Thornton, R., Crain, S., Zhou, P. (in preparation). The interpretation of disjunction in the scope of *dou* in child Mandarin.

I designed the experimental stimuli and conducted the experiments as presented in each chapter. I wrote the first draft of each of the chapters, and the supervisors assisted with editing.



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December 2014

Thesis Abstract

Since Aristotle, language has been conceived of as a mapping between sentences and their meanings. Assuming that children come biologically equipped with a ‘Universal Grammar,’ the task of the language learner is to figure out the mapping relations between sentence structures derived within the computational system and their potential meanings. Within the Generative tradition, this mapping relation is seen to be constrained by core principles of Universal Grammar. These core principles limit children’s initial hypotheses, either about possible structures or about possible meanings in human languages. By limiting children’s hypotheses on both form and meaning, the core principles of Universal Grammar enable children to avoid many potential errors that they might otherwise commit. Therefore, children are expected to rapidly converge on the adult grammar, by only adopting linguistic hypotheses that are licensed by Universal Grammar. It is of considerable interest to investigate children’s knowledge of the linguistic constraints proposed by the theory of Universal Grammar. For one thing, such investigations hold the potential to provide findings that will distinguish the theory of Universal Grammar from alternative approaches to language acquisition, which view language acquisition as largely based on experience, and using general purpose learning mechanisms, rather than being based on pre-existing linguistic knowledge. Because constraints are negative statements, it is difficult to know how they could be acquired in the absence of negative evidence (e.g., corrective feedback), which has been empirically shown to be largely absent from children’s experience. Therefore, if young children are found to adhere to linguistic constraints, this would constitute circumstantial evidence that children are guided by the kinds of innate linguistic knowledge that are encoded in Universal Grammar.

This thesis reports the findings from three studies that investigated 3-5-year-old Mandarin-speaking children's acquisition of linguistic constraints. In previous research, it was found that Mandarin-speaking children and adults differed in the interpretation they assigned to the Mandarin disjunction word *houzhe* 'or' in simple negative sentences (e.g. *Yuehan meiyou dian shousi huozhe yidalimian*, 'John didn't order sushi or pasta'). Mandarin-speaking adults analyse disjunction as taking scope over negation (OR > NOT). Therefore, adults accept negated disjunctions in three circumstances: e.g., (i) when John only ate pasta, (ii) when John only ate sushi, and (iii) John didn't eat either sushi or pasta. Being more conservative than adults, children take negation to have scope over disjunction (NOT > OR). In contrast to adults, then, children only accept negated disjunctions in one circumstance, viz. (iii), when John didn't eat either sushi or pasta.

The first study in this thesis investigated the interpretations assigned by children and adults to the Mandarin disjunction word *huozhe* in negative sentences with Verb Phrase Ellipsis (e.g., *Yuehan dianle shousi huozhe yidalimian, Mali meiyou*, 'John ordered sushi or pasta, Mary didn't'). Because the disjunction word is not pronounced in the second clause (i.e., the clause with the elided verb phrase *Mary didn't...*), both children and adults were predicted to assign the same meaning, according to which Mary didn't eat pasta and didn't eat sushi. That is, both children and adults were predicted to interpret negation as having scope over disjunction at the level of semantic interpretation, because the disjunction word was covertly introduced, as part of the elided verb phrase.

The second study examined a constraint on the interpretation of *dou* ('all') (e.g., *Zai xiaomao huozhe xiaogou shenbian, gongfu xiongmao dou zhongle shu* 'Next to a cat or a dog, Kung Fu Panda planted a tree'). The adverbial quantifier *dou* ('all') quantifies over plural elements to its left. When the *dou* ('all') is forced to take scope over the disjunctive phrase (*Zai xiaomao huozhe xiaogou shenbian* 'Next to a cat or a dog'), it is predicted to generate a conjunctive

reading, called a Free Choice Inference. This study investigated the expectation that young Mandarin-speaking children would have knowledge of the constraints on the adverbial quantifier *dou* ('all'), including the complex semantic algorithm that is required in order to generate Free Choice Inferences.

The third study explored Mandarin preschool children's adherence to locality constraints on the adjunct *wh*-word *zenme* ('how') in sentences that contained *youmeiyou* ('whether or not'). The adjunct *zenme* is unlike argument *wh*-words in Mandarin, in that it is not always positioned *in situ* in the surface syntax. The study investigated children's interpretation of sentences like *Tanglaoya zenme faxian wupo youmeiyou bian piaoliang de* ('How did Donald Duck find out whether the witch had become beautiful?'). Due to a constraint, it was predicted that children would interpret such questions as asking how Donald Duck found out something, rather than how the witch had become beautiful. Children's interpretations of such sentences were compared with ones in which the positions of *youmeiyou* and *zenme* were reversed (e.g., *Tanglaoya youmeiyou faxian wupo zenme bian piaoliang de* 'Did Donald Duck find out how the witch had become beautiful?'). Due to locality constraints, the resulting sentence becomes a Yes/No question, at least for adults. The study investigated whether or not children assign the same Yes/No question interpretation as adults do to such sentences.

A common feature of the structures that were investigated in the thesis is the absence of evidence corresponding to these structures in the adult input to children. They all raise a 'poverty of the stimulus' argument. For this reason, the findings from these studies of preschool children can be invoked to distinguish between the experience-based approach to language acquisition and one based on innate linguistic knowledge. More specifically, the findings from these experimental studies demonstrate that Mandarin-speaking children interpret several abstract linguistic structures in the same way as Mandarin-speaking adults do, even without direct input from adults. Thus, the experimental investigations invite the

conclusion that children do not learn these structures from experience, but draw upon innately specified linguistic knowledge.

Acknowledgements

Even before writing up my thesis, I'd been looking forward to writing the acknowledgements. My journey of doing Ph.D. in Linguistics was an adventurous one, accompanied by exploration, struggles, enjoyment, frustration as well as fun. It was a rewarding and valuable experience, which I will miss and feel grateful for in my later life.

First and foremost, I attribute this precious Ph.D. experience to my three supervisors, Associate Professor Rosalind Thornton, Distinguished Professor Stephen Crain and Dr. Peng Zhou. I was brand new to theoretical linguistic research when I started it. Even knowing this, they agreed to be in my academic committee without hesitation. Their courage, patience, support and help all along the way impressed me and inspired me. There were many times when I felt frustrated by the research and would like to give up. However, my supervisors always kept me going through with their help, support and encouragement. Without their encouragement, help and support, it would have been impossible for me to finish this Ph.D. study.

My principal supervisor, Rozz, always offered to help me, from the beginning of my Ph.D. till the end of it. I received all kinds of help from her, even with tiny little things, including revising all kinds of forms, helping me find related conference and travel information. She was always there, ready to help me and easy to approach. I had many silly questions during the process of my study. She has always been patient with my questions and provided detailed answers to them. Moreover, she takes care of the whole language acquisition group and organizes as many group meetings as possible, so we could have the chance to be exposed to different studies and ideas. She always makes everyone, including visiting students and scholars, feel at home.

My associate supervisor, Stephen, is inspirational and very supportive. His passion and deep respect for research influence me and motivate me a lot. He helped me understand difficult theories and taught me a lot about writing, presenting and organizing my research. He always encourages me/some of his students to communicate with others, to make ourselves understood by others. As an experienced,

senior, respectable individual, he affected me and impressed me deeply with his sense of humour, his open-mindedness, his persistence, his way of delivering speeches and presenting his studies, his attitude to his work and other people.

Peng, my third supervisor, is also vitally important for me in the past three years' study. To me, he is more like an experienced elder brother than a supervisor. He was the one I've spent most time with during my Ph.D. study. Every meeting with him was beneficial for me, because he could always teach me something. There have been a large number of technical terms and linguistic theories related to my study. He explained them to me again and again to help me understand. For numerous times, he cheered me up and supported me emotionally. He witnessed and was an integral part of my growth, both as an academic and as an individual.

Besides, I am grateful for being a part of the Language Acquisition group. During most of our meetings, we had so much laughter and joy. I want to thank some former colleagues and current group members. Dr. Aijun Huang is always ready to help me with my study. Before I started my data collection, she went over my stories with me over and over again. She helped to improve details of my stories and watched me demonstrate my stories before I had left for data collection. Also, she invited me to spend weekends with her family, to swim together at gym, which was unforgettable memory for me. Dr. Anna Notley provided me help with designing experimental stories. She is easy to approach and very thoughtful. Dr. Mike Iverson is always helpful. He has brought so much joy and laughter to the lab with his sense of humor. Dr. Enzo Moscati and Dr. Jocopo Romoli have always been helpful. Their suggestions and questions are to the point and helpful. Cory Bill is helpful. His comments and suggestions during lab meeting are always to the point. In addition, my other current group members, Kelly Rombough, Neha Khetrapal, Dr. Weiyi Ma, Na Gao and Elena D'Onofrio help me with my English and research, whenever I need.

During the past three years, I've met a great number of people and made some intimate, life-long friends. I greatly appreciate them for being in my life, making my Ph.D. life precious and colourful. Here I would like to express special thanks to some of them, Qandeel Hussain, Mingchun Guo, Wei

Zhao, Susana Widyastuti, Jenny Yi Chen, David Haiquan Huang, Maggie Min Liao, Vasfiye Geckin, Vishnu K. K. Nair, Thembi Dube, Hui Chen, Benjamin Davis, for their friendship, support, help and encouragement along the way. Also, there were many others, including senior scholars, peers as well as close dear friends, who have helped me with my study and other aspects of life, cared about me genuinely, shared my happiness and worries, supported me during difficult times, taught me far more than just research, inspired me to be a better and happier person, enlightened me and deeply touched me in many different ways. The name list can go on and on.

In addition, I'd like to thank Associate Professor Mehdi Riazi in Linguistics Department as well. Without his help, I would not have had the chance to come to Macquarie University. Thanks go to Professor Liqun Gao at Beijing Language and Culture University for helping me contact participants. I thank all of the participants in my experiments, especially the children, who brought me so much laughter and made running experiments enjoyable and pleasant.

Thanks also go to Macquarie University and China Scholarship Council for providing me the financial support, iMQRES-CSC scholarship, for my study and the Australian Research Council Centre of Excellence for Cognition and its Disorders (CCD) for providing me all related fancy equipment and facilities. I enjoyed my time in Australian Hearing Hub very much and could not love my bright and spacious office more. Though windowless, my office has a fine view, where I can see green grass and trees, blue sky, white clouds and beautiful sunset and fantastic double rainbows after rains. These are some of the things I loved most and enjoyed most during my Ph.D. study.

Finally, I'd like to thank my family, including both my immediate and extended family members. Although they can not really understand what I was pursuing during my Ph.D. study, their deep love and forever support are with me, wherever I am, whatever I am doing.

Chapter 1: Introduction

Introduction

Language is a mapping between sequences of sounds and their corresponding meanings. Acquiring a language, then, amounts to acquiring knowledge about which sound sequences are associated with which meanings. Knowing a language consists of knowing how to map an unlimited number of sound/meaning correspondences. Knowledge of a language must therefore be characterized by a grammar, i.e., a procedure that forms an unlimited number of structured meanings from a finite set of basic building block (lexical items) and operating principles. In order for a grammar to be descriptively adequate, according to Chomsky (1965), it must provide a structural description for all and only the well-formed sequences of words (sentences) of the language. Therefore, a descriptively adequate grammar will license certain forms and meanings, while banning others. In some recent linguistic theories, grammars incorporate very general principles which over-generate, generating some forms and meanings that are not licensed in human languages. The output of these general principles must be held in check, therefore, in order to meet Chomsky's criteria for descriptively adequate grammars. The supposition is that a class of principles, called constraints, eliminates illegal forms and meaning (Chomsky 1981; 1986; 1995). Constraints contrast with phrase structure rules. Whenever a phrase structure rule is added to a grammar, the result is an increase in the number of sentences that are licensed in the language. In contrast to rules, when constraints are added to a grammar, the result is a reduction in the language (see, e.g., Crain and Thornton 1998; Guasti 2002). There are both constraints on form and constraints on meanings. Constraints on form prohibit certain syntactic operations, thereby limiting the ways in which words can be arranged. Constraints on prohibit sentences from having certain interpretations that would otherwise be allowed. By introducing either kind of constraint, the possible associations of sounds and meanings in a language is more restricted than it would be

without the constraint (Guasti 2002; Fodor and Crain 1987; Crain and Thornton 1998). By assuming that constraints are innately specified, as a part of the theory of Universal Grammar, one thereby explains certain ways in which children's linguistic hypotheses are held in check. Both constraints on form, and constraints on meaning are manifested across languages. We will begin by discussing constraints on form, using English to illustrate. We will then illustrate the kinds of linguistic constraints that govern sentence interpretation using Mandarin Chinese. The Mandarin examples are adapted from Huang et al. (2009).

Turning to constraints on form, consider the three of the examples in (1). All of these sentences contain the verb *remember*, and all three examples are acceptable. More specifically, the verb *remember* can take either a statement as its complement, as in (1a), or it can take an embedded question as its complement, as shown in (1b). Furthermore, as (1c) shows, the question word *what* can be extracted from the embedded (sentential complement) clause introduced by the verb *remember*.

- (1) a. John remembers Mary bought something.
 b. John remembers what Mary bought.
 c. What does John remember Mary bought?

However, things change when the verb *think* is substituted for the verb *remember*. This is illustrated in (2). The point to notice in (2) is that one of the sentences from (1) is no longer acceptable, when the verb *remember* has been replaced by the verb *think*. The verb *think* can take a statement (2a), and *think* also permits extraction of the *wh*-phrase *what* out of its embedded clause (2c). However, the verb *think* cannot take an indirect question as its complement, as indicated by the asterisk '*' in (2b).

- (2) a. John thinks Mary bought something.
 *b. John thinks what Mary bought.
 c. What does John think Mary bought?

As the final example, consider the sentences in (3), where the verb *wonder* has replaced the verb *remember*. The verb *wonder* differs from both *think* and *remember*. The verb *wonder* must select a question as its complement (3b), and it cannot take a statement as its complement (3a). Moreover, the verb *wonder* does not permit extraction of the *wh*-phrase *what* out of the embedded clause (3c).

- (3) *a. John wonders Mary bought something.
 b. John wonders what Mary bought.
 *c. What does John wonder Mary bought?

These examples in (1) - (3) illustrate the kind of intricate pattern of constraints on form that are manifested in English. As these examples illustrate, a series of constraints are somehow incorporated into the syntactic representations associated with different verbs, and violations any of these constraints yield unacceptable sentences.

A second kind of constraint applies to the meanings that can be associated with well-formed sentences. The following examples, from Huang, Li and Li (2009) are used to illustrate.

- (4) Zhangsan yiwei Lisi mai-le shenme?
 Zhangsan thinks Lisi buy-le what
 ‘What does Zhangsan think Lisi bought?’
 (5) Zhangsan xiang-zhidao Lisi mai-le shenme.
 Zhangsan wonder Lisi buy-le what
 ‘Zhangsan wonders what Lisi bought.’

(6) Zhangsan jide Lisi mai-le shenme

Zhangsan remember Lisi buy-le what

‘Zhangsan remembers what Lisi bought.’

‘What does Zhangsan remember Lisi bought?’

Example (4) must be interpreted as a direct question. Example (5) must be interpreted as a statement. Example (6) may be interpreted as a direct question or as a statement, depending on the intonation that is assigned to the *wh*-word *shenme*. These three examples show a constraint, which determines the kinds of speech acts and the range of interpretations that can be assigned to well-formed sentences.

Investigation into constraints can shed light on the ongoing debate between different theories of language acquisition. According to an experience-based account of language development, children gradually accrue the constructions of their local language based on general learning mechanisms, without assistance from any innate linguistic knowledge (Tomasello 2000, 2003; Ambridge and Lieven 2011; Lieven and Tomasello 2008). However, it is problematic on this account to explain how children come to know what sentences are not permitted in a language, or what meanings cannot be assigned to sentences. The reason this is problematic for experience-based accounts is that children do not receive evidence from their parents about which sentences in their language are ungrammatical (so-called negative evidence, cf. Baker 1979; Lightfoot 1991; Pinker 1984, 1989; Wexler and Culicover 1980). More specifically, parents do not express approval and disapproval at different rates in response to their children’s grammatical and ungrammatical sentences, or understand children’s grammatical sentences better if they are grammatical (Brown and Hanlon 1970; Morgan and Travis 1984; Marcus 1993). If children invoke general learning mechanisms, as the experience-based account posits, then children are expected to form generalizations that exceed the boundaries of the local language spoken by adults. In other words, children will speak a ‘superset’

language, as compared to that of adults. It is difficult to see, in the absence of negative evidence, how children retreat for the superset language, so as to achieve the same language as adult speakers. In response to this problem, the experience-based account resorts to mechanisms such as ‘entrenchment’ to explain how children reduce the number and kind of constructions (Langacker 1987, 1990; Tomasello 2003). Although this is logically possible, little empirical evidence has been offered demonstrating children’s elimination of illicit grammatical constructions.

According to the theory of Universal Grammar, the absence of negative evidence speaks directly to a key issue in the logical problem of language acquisition: whether or not children can count on negative evidence to refute any overly general hypothesis they hold. The finding that children do not have access to negative evidence invites researchers working in the Generative tradition to infer that children must rely on some endogenous mechanism to prevent or scale back over-generation. One way children prevent over-generation is by adherence to constraints. That is, they do not formulate non-adult hypotheses at any stage of acquisition. This makes negative evidence unnecessary for language acquisition. The fact that children adhere to linguistic constraints is the basis of what has been called the poverty of stimulus argument (Chomsky 1980; Hornstein and Lightfoot 1981; Bowerman 1987, 1988; Brown and Hanlon 1970; Morgan and Travis 1989; Marcus 1993). According to this argument, children do not acquire language solely on the basis of the linguistic input they receive. The argument points out that children know considerably more about language than is expected, given their limited linguistic experience. If children have linguistic knowledge that they could not have gained from exposure to language, this suggests they may be aided in their acquisition of language by some abstract innate linguistic knowledge. This argument is relevant for all of the experiments discussed in this thesis. In each case, I examine a property of Mandarin Chinese that is not supported well in the linguistic evidence that is available to

children. It is of interest, then, to find out whether or not children perform well on these various linguistic phenomena.

This thesis investigates children's knowledge of several linguistic constraints in Mandarin Chinese. These are all constraints that limit the interpretations or meanings that are available for certain sentence types. The present study examines a number of interpretations of structures that have not been investigated previously in languages other than English. More specifically, the present study focused on three structures: the interpretation of disjunction in sentences with Verb Phrase Ellipsis, the interpretation of disjunction in the scope of the adverbial quantifier *dou* 'all', and a locality constraint on adjunct *wh*-phrases. In the following sections, I will point out how particular constraints apply to these structures.

The interpretation of disjunction in Verb Phrase Ellipsis

Languages differ in the way in which disjunction words (English *or*, Mandarin *huozhe*) are interpreted in simple negative sentences. For example, both English-speaking children and adults assign a 'neither' interpretation to example (7), where the disjunction word *or* is interpreted in the scope of negation. The sentence entails that John did not order sushi AND John did not order pasta, as in one of de Morgan's laws of classical logic.

(7) John did not order sushi or pasta.

'John did not order sushi AND John did not order pasta.'

This same interpretation of negated disjunctions is found in other languages, including German, Greek, Korean and Romanian (cf. Szabolcsi 2002; Goro and Akiba 2004a, 2004b).

In contrast to these languages, adult speakers of Mandarin assign a different interpretation to the counterpart of (7), as example (8) illustrates.

(8) Yuehan meiyou dian shousi huozhe yidalimian.

John not order sushi or pasta

‘It is either sushi or pasta that John did not order.’

Mandarin-speaking adults assign a ‘not both’ meaning to example (8). On this interpretation, the sentence in (8) can be paraphrased as *John didn’t order sushi OR John didn’t order pasta, but I am not sure which he didn’t eat.*¹ As this paraphrase of (8) indicates, the disjunction word takes scope over negation at the level of semantic interpretation. The same interpretation is assigned in other languages, including Russian, Polish, Italian, Hungarian and Japanese (Goro and Akiba 2004a, 2004b; Szabolcsi 2002).

To account for the different interpretations, disjunction words have been proposed as Positive Polarity Items (PPIs) in some languages (i.e. Mandarin, Japanese, Hungarian), but not in others (e.g. English, Greek, Korean and German, cf. Szabolcsi 2002). By definition, PPIs take scope over negation. Therefore, the disjunction word *houzhe* takes scope over negation in Mandarin Chinese in example (8), giving rise to disjunctive truth conditions. By contrast, the disjunction word *or* does not take scope over negation in the English example (7). Rather, negation takes scope over disjunction, leading to the conjunctive interpretation of disjunction.

If this analysis is correct, then both languages are expected to generate the same conjunctive interpretation when linguistic contexts cancel the polarity sensitivity of PPIs. The thesis investigates one syntactic structure where the polarity sensitivity of PPIs is expected to be cancelled, namely in structures that undergo Verb Phrase Ellipsis (VPE). In VPE, the VP of the second conjuncts is deleted at the level of Phonological Form (PF) (see e.g., Chomsky and Lasnik 1993). Adopting this analysis, before VPs are elided, the contents of the elided

¹ In contrast to adults, Mandarin-speaking children assign a conjunctive interpretation to disjunction in sentences such as (8).

For now, we will pass over the implications of this difference in interpretation by children and adults.

verb phrase are generated in the syntax, ensuring that these contents are recoverable at the level of semantic interpretation. The study reported in Chapter 2 investigates the interpretation of elided VPs that contain disjunction words. Previous research (cf. Zhou and Crain 2012; Crain, Goro, Notley and Zhou 2013) indicates that when disjunction is not pronounced, its polarity sensitivity is cancelled. In such case, the disjunction word surrenders its status as a PPI, and is no longer forced to take scope over negation. Instead, negation takes wide scope, yielding a conjunctive interpretation in all languages (examined so far).

Chapter 2 investigates this analysis of the interpretation of disjunction in Mandarin with an experimental study, for the first time, in VP ellipsis structures. Before giving any details of the experiment, it is worth noting that this experiment raises the ‘poverty of the stimulus’ argument. In this experiment, children’s interpretations of elided, that is ‘silent’ verb phrases is tested. Clearly, since children do not hear the elided VP, they are not hearing any direct linguistic evidence for how such sentences should be interpreted. This is our first case where the ‘stimulus’ is impoverished; it is not sufficient to describe children’s knowledge, should it turn out to be the case that children interpret such elided verb phrases as adults.

The following examples will be used to illustrate the phenomena. First, consider the English example in (9) and its Mandarin counterpart in (10). There is no ellipsis in these examples.

(9) Min ordered sushi or pasta, but John didn’t order sushi or pasta.

(10) Min dianle shousi huozhe yidalimian, danshi Yuehan meiyou dian shousi
 Min order-ASP sushi or pasta but John not order sushi
 huozhe yidalimian.
 or pasta

‘Min ordered sushi or pasta, but John didn’t order sushi or pasta.’

In (9) and (10), the second conjunct of each sentence contains a disjunction phrase, and a negated VP. The interpretation of disjunction in the two sentences differs, in the same way as the interpretation of simple negated disjunction differs in English versus Mandarin (see examples (7) and (8) above). This difference in interpretation vanishes; however, when the disjunction phrases has been elided, as indicated in (11) and (12). Now, the English and Mandarin examples have the same meaning. In both cases, negation takes scope over disjunction, generating a conjunctive interpretation of disjunction.

(11) Min ordered sushi or pasta, but John didn’t ~~order sushi or pasta~~.

(12) Min *dianle* *shousi* *huozhe* *yidalimian*, *danshi* *Yuehan* *meiyou* ~~*dian shousi*~~
~~*huozhe yidalimian*~~.

Min order-ASP sushi or pasta but John not ~~order sushi~~
~~or pasta~~

‘Min ordered sushi or pasta, but John didn’t ~~order sushi or pasta~~.’

In the experiments reported in Chapter 2, we investigated the interpretation assigned to negated disjunction by Mandarin speakers both in simple sentences (as in (8)), and in sentences with VPE (as in (12)). If Mandarin-speaking adults and children know the constraints on the interpretation of disjunction in VPE structure, then both children and adults are expected to assign a conjunctive interpretation to disjunction in sentences like (12), despite the fact that adult assign a ‘disjunctive’ interpretation to disjunction in simple sentences with negation, such as (8) (see Footnote 1).

Consider how children learn to interpret the second conjunct of (12), with the elided verb phrase: *Yuehan meiyou* ~~*dian shousi huozhe yidalimian*~~. One possibility is that children

will interpret this sentence with VP ellipsis in the same way as if the VP were not elided; i.e., as having the meaning as *Yuehan meiyou dian shousi huozhe yidalimian*. For adults, such a negative sentences with overt disjunction are assigned an interpretation in which disjunction takes scope over negation. However, when disjunction is introduced covertly, as part of the elided verb phrases, adults interpret disjunction as being within the scope of negation, so the sentence generates a conjunctive interpretation, just as negative sentences with disjunction do in English or in German.

In order to prevent children from making non-adult interpretations, the theory of Universal Grammar supposes that children initially assign a conjunctive interpretation to disjunction in negative sentences, both with VP ellipsis and without VP ellipsis. This is an example of children's adherence to the Subset Principle (Crain, Ni and Conway, 1993; Berwick 1985; Wexler and Manzini 1987). In the case of VP ellipsis, children are not expected to differ from adults in the interpretation they assign. Both children and adults will assign the same conjunctive interpretation to sentences in which the elided VP contains a covert disjunction phrase.

However, the theory of Universal Grammar also makes a striking prediction about when child and adult languages will differ. This prediction follows from the Subset Principle. The prediction is that, across languages, children will initially assign a conjunctive interpretation to disjunction when it appears in negative sentences. This is not problematic for languages such as English. In English, adults assign a conjunctive interpretation to negative sentences with negation. However, we saw that adult speakers of Mandarin do not assign a conjunctive interpretation to negative sentences with disjunction. Nevertheless, the theory of Universal Grammar predicts that children will sometimes differ from adults in the way in which they interpret disjunction in negative sentences. This hypothesis is motivated by the need for children to avoid learnability problems that they would otherwise face in figuring out when

adults assign a conjunctive interpretation to negated disjunctions, and when they do not. To avoid learnability problems, children are expected to assign a conjunctive interpretation to disjunction in negative sentences in all languages, even in in language like Mandarin, where adults do not assign this interpretation. The difference in the interpretation children and adults assign to disjunction in negative sentences is important, because this difference indicates that adults are not the source of children's semantic interpretation of such sentences. Children presumably draw upon pre-existing 'default' assumptions in making their initial interpretations.

The interpretation of disjunction in the scope of *dou*

In Mandarin, *wh*-phrases generate Free Choice inferences, with a universal/conjunctive interpretation, when they are bound by the adverbial quantifier *dou* ('all') (Zhou 2013; Zhou and Crain 2011). Consider examples (13) and (14). Example (13) contains the *wh*-phrase *shenme* and (14) contains the Free choice item *renhe*. Both examples have the same meaning (Huang and Crain 2013), which is indicated by the English glosses.

(13) Yuehan shenme shuiguo dou chi

John what fruit all eat

'John eats any kind of fruit.'

(14) Yuehan renhe shuiguo dou chi

John any fruit all eat

'John eats any kind of fruit.'

Suppose there are three kinds of fruits, apples, oranges and bananas. In this circumstance, both (13) and (14) generate the same inference - that John eats apples, oranges and bananas.

According to a recent semantic theory (Chierchia 2013; Fox 2007), both the *wh*-phrase in (13) and the Free Choice item in (14) can be analysed as existential expressions. Chierchia refers to them as \exists -items, to indicate their logical equivalence to existential quantifiers. It has long been understood that existential expressions are equivalent to (finite) disjunctions, so disjunction phrases also count as \exists -items. This leads to the somewhat surprising prediction that disjunction phrases should generate Free Choice inferences when they are bound by the adverbial quantifier *dou*. Although the simple sentence *Yuehan pinguo houzhe juzi dou chi* ‘John ate both an apple and an orange’ is awkward, Mandarin-speakers clearly know that it receives a conjunctive interpretation.² The prediction that disjunction phrases would be assigned conjunctive Free Choice readings when they are bound by *dou* was tested in Chapter 3 using sentences like (15), as compared with (16).

(15) *zai xiaomao huozhe xiaogou shenbian, gongfu xiongmao dou zhong-le shu.*

at cat or dog next to Kung Fu Panda all plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat and next to a dog.’

(16) *zai xiaomao huozhe xiaogou shenbian, xiongmaomen dou zhong-le shu.*

at cat or dog next to pandas all plant-ASP tree

‘Pandas (all) planted a tree next to a cat or next to a dog.’

Based on linguistic theory, we predict that if the disjunctive expression in (15) was the optimal candidate to be associated with the adverbial quantifier *dou* (‘all’), then it would yield a conjunctive, Free Choice interpretation, as indicated in the gloss for (15): ‘Kung Fu Panda planted a tree next to a cat AND next to a dog.’ However, if an alternative plural NP

² The awkwardness may be attributed to the fact that the quantificational adverb *dou* must associate with a plural NP (to its left), and a disjunction phrases is ordinarily regarded as singular, rather than plural.

xiongmaomen ‘pandas’, precedes *dou*, as in (16), we expected *dou* to associate with this plural NP, and not with the disjunction phrase *xiaomao huozhe xiaogou* ‘a cat or a dog.’ If so, the sentence is expected to be interpreted to mean that all of the pandas planted a tree next to a cat OR planted a tree next to a dog.

The goal of the study in Chapter 3 was to determine whether children have the knowledge that disjunction is equivalent to *wh*-phrases and to Free Choice *renhe* when it appears in the scope of *dou*. If children know the semantics of *dou* (‘all’) and that disjunction is an \exists -item, then they are expected to assign a conjunctive Free Choice inference to disjunctive phrases in the test sentences used in Chapter 3. Since there is no direct input showing children that disjunction is an \exists -item, this study is expected to provide evidence for the innateness approach to language acquisition. That is, in order to overcome the poverty-of-the-stimulus, children are compelled to draw upon innate linguistic knowledge in the acquisition of language.

Locality constraints on *wh*-adjuncts in Mandarin

In English, *wh*-words move in the surface syntax to form questions. But the extraction of *wh*-phrases is not entirely free. There are linguistic contexts, known as ‘islands’, out of which *wh*-phrases cannot be moved. These linguistic contexts were named islands by Ross (1967). According to Ross (1967), there are seven types of islands, which include *wh*-islands and adjunct islands. Adjunct islands refer to expressions in which a sentence-initial *wh*-phrase cannot be interpreted as having originated inside an adjunct clause or a restrictive relative clause. Adjunct clauses are ones introduced by expressions including *because* or *when*, as example (17) illustrates.

- (17) a. She went home because she needed to get a coat.
 *b. What did she go home because she needed to do ____?

Example (17a) demonstrates the site of origin of the *wh*-phrases that has moved in (17b). However, as the asterisk indicates, this movement is blocked; the extraction of *wh*-words out of a *because*-clause is governed by a constraint. Chapter 4 reports the findings of a study exploring Mandarin-speaking preschool children's adherence to this locality constraint on the adjunct *wh*-word *zenme* ('how') in sentences that contain *youmeiyong* ('whether or not'). The adjunct *zenme* is unlike argument *wh*-words in Mandarin, in that it is not always positioned *in situ* in the surface syntax.

The study investigated children's interpretation of sentences like (18) and (19).

(18) Tanglaoya zenme faxian [wupo youmeiyong bian piaoliang] de?

Donald Duck how find out witch whether or not become beautiful DE

'How did Donald Duck find out whether the witch had become beautiful?'

a. How_i did [Donald Duck find out t_i [whether the witch had become beautiful]]?

*b. How_i did [Donald Duck find out [whether the witch had become beautiful t_i]]?

(19) Tanglaoya youmeiyong faxian [wupo zenme bian piaoliang de]?

Donald Duck whether or not find out witch how become beautiful DE

'Did Donald Duck find out how the witch had become beautiful?'

Due to a locality constraint, it was predicted that children would interpret the question in (18) as asking how Donald Duck found out something, rather than how the witch had become beautiful. Children's interpretations of questions like (18) were compared with ones in which the positions of *youmeiyong* and *zenme* were reversed, as in (19). Due to the locality constraint, example (19) becomes a yes/no question, at least for adults (see Huang 1982a, 1982b; Tsai 1999).

In the study in Chapter 4, we investigated whether or not children assign the same interpretation to (18) and (19), as adults do. Mandarin-speaking children were presented with

sentences of both kinds. If children have the knowledge of the relevant constraints on *wh*-adjunct movement, they were expected to interpret the word sequence in (18) as a *wh*-question and provide responses, answering the way of finding out. Moreover, Mandarin-speaking children were expected to interpret the sentence in (19) as a yes/no question.

In summary, this thesis investigates three constraints on meaning in child Mandarin. In each case, the constraint limits the meanings that can be assigned to the test sentences. The three studies in this thesis were trying to answer the following questions.

(i) How do Mandarin-speaking children interpret negated disjunction in Verb Phrase

Ellipsis structure?

(ii) How do Mandarin-speaking children interpret disjunction bound by adverbial

quantifier *dou* ('all')?

(iii) Do Mandarin-speaking children have adult-like knowledge of locality constraint on

wh-adjunct movement?

Significance

This thesis explores Mandarin-speaking children's acquisition of constraints on meaning. There are several reasons for studying the acquisition of constraints in child Mandarin. First, although there is now a considerable theoretical knowledge-base of Mandarin in the generative framework, children's acquisition of Mandarin within the generative framework is a relatively new research area. The constraints examined in this thesis have not been looked at in Mandarin Chinese by previous research. Our studies promise to deepen our understanding of the constraints in Mandarin Chinese. Moreover, Mandarin Chinese is a language, which typically differs from English. This makes Mandarin Chinese particularly significant for

theories of language development and a full picture of language universal properties. Investigation into these constraints, therefore, contributes to the advance of theoretical linguistic research.

More importantly, studying children's acquisition of these constraints also promises to shed light on the long-standing debate between the two main theories of language acquisition: the experience-based approach to language acquisition and one based on putatively innate linguistic knowledge. The experience-based approach maintains that children master language knowledge by exposure to the input. Children have to learn the language knowledge by exposing to caretakers, imitating what they hear and interacting with the environment (Lieven and Tomasello 2008; Tomasello 2000, 2003; Goldberg 1995, 2003, 2006; Langacker 1988, 2000). The innateness-based approach, by contrast, argues that language learning receives a major contribution from an innate language faculty (Chomsky 1965, 1986, 1995; Pinker 1995). Children draw upon a priori knowledge, which exists in human genome (Crain, Gualmini and Pietroski 2005; Crain and Pietroski 2001; Crain and Thornton 2006; Crain, Thornton and Khlentzos 2009). If children demonstrate some linguistic knowledge for which there is no corresponding evidence in the environment, then it is likely to be innately specified (Crain and Thornton 1998).

The Structure of the Thesis

This concludes the introduction. The reminder of the thesis is organized as follows. Chapter 2 looks at a constraint on meaning, focusing on the interpretation of negated disjunction in Verb Phrase Ellipsis structure. Chapter 3 examines another constraint on the interpretation of disjunction, namely, when it is bound by the adverbial quantifier *dou* 'all'. Chapter 4 explores a restriction on the form of linguistic structures, which prevents the movement of *wh*-words in certain circumstance. Chapter 5 concludes the thesis with a summary of the findings and a

discussion of the implications of these findings for theories of language acquisition. Also, Chapter 5 points out the directions for future research.

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Chapter 2: The interpretation of disjunction in Verb Phrase Ellipsis in Mandarin Chinese

This chapter is based on the following paper which is under preparation for submission to journals:

An, S., Thornton, R., Zhou, P., Crain, S. (in preparation). The interpretation of disjunction in Verb Phrase Ellipsis in Mandarin Chinese.

Abstract

Languages differ in the ways disjunction words (English *or*, Mandarin *huozhe*) are interpreted in negative sentences. Disjunction words generate a conjunctive interpretation in negative sentences in some languages, including English, but not in other languages, including Mandarin Chinese. To account for these cross-linguistic differences, it has been proposed that words for disjunction are Positive Polarity Items (PPIs) in languages like Mandarin Chinese, but not in languages like English. Although by definition Positive Polarity Items (PPIs) take scope over negation, the polarity sensitivity of linguistic expressions, including disjunction words, is cancelled in certain linguistic environments, such that disjunction reverts to a conjunctive interpretation in all human languages. The present paper investigates a novel linguistic environment that is predicted to cancel polarity sensitivity, namely Verb Phrase Ellipsis (VPE). When disjunction is elided in a negated VP, the ‘covert’ disjunction word is expected to be interpreted as taking narrow scope, under negation, even in languages where it takes wide scope when it is pronounced overtly. These predictions were investigated in an experimental investigation of the interpretation of disjunction by Mandarin speaking children and adults. As in previous research, one finding was that Mandarin-speaking children assigned a conjunctive interpretation to disjunction in negative sentences with overt disjunction, whereas Mandarin-speaking adults analyse disjunction as a PPI in such sentences. However, the novel finding is that both children and adults interpreted disjunction as generating a conjunctive interpretation in sentences with VPE. The findings are evidence that polarity sensitivity is a surface phenomenon, and that human languages adhere to principles of classical logic when the polarity sensitivity of PPIs is cancelled.

Keywords

Disjunction · Positive Polarity Items (PPIs) · Verb Phrase Ellipsis (VPE) · Mandarin

The interpretation of disjunction in Verb Phrase Ellipsis in Mandarin Chinese

Introduction

Languages differ in the way in which disjunction words (English *or*, Mandarin *huozhe*) are interpreted in simple negative sentences. For example, adult English speakers assign a ‘neither’ interpretation to example (1). This scope assignment is rendered symbolically as $\text{NEG} > \text{OR}$. The sentence entails that John did not order sushi AND John did not order pasta. We will call this the ‘conjunctive’ interpretation of disjunction.

(1) John did **not** order sushi **or** pasta. ($\text{NEG} > \text{OR}$)

‘John did not order sushi and John did not order pasta.’

In English, the surface syntax determines the scope relations between negation and disjunction, with negation taking scope over disjunction in sentences such as (1). This same interpretation is manifested in other languages, including German, Greek, Korean and Romanian (cf. Szabolcsi 2002; Lee 2010).

Another class of languages assigns a different interpretation to disjunction in simple negative sentences. Mandarin Chinese is one such language. The Mandarin sentence in (2) corresponds to the English example in (1). Mandarin-speaking adults do not interpret (2) in the same way that English-speakers interpret (1). Rather the interpretation they assign to (2) can be paraphrased as ‘John didn’t order sushi OR John didn’t order pasta, but I am not sure which one’.

(2) Yuehan meiyou dian shousi huozhe yidalimian. ($\text{OR} > \text{NEG}$)

John not order sushi or pasta

‘It is either sushi or pasta that John did not order.’

Although the Mandarin and English examples have the same surface word order, disjunction takes scope over negation in Mandarin (OR > NEG), whereas negation takes scope over disjunction in English (NEG > OR). Other languages that assign the same interpretation as Mandarin include Russian, Polish, Italian, Hungarian and Japanese (Szabolcsi 2002; Goro and Akiba 2004a, 2004b; Verbuk 2006).

To explain the observed cross-linguistic differences in the interpretation of disjunction in simple negative sentences, it has been proposed (cf. Szabolcsi 2002; Goro and Akiba 2004a, 2004b) that disjunction words are Positive Polarity Items (PPIs) in some languages (e.g., Mandarin, Japanese, Italian, Russian, Polish, Hungarian), but not in others (e.g., English, Korean, German, Greek, Romanian). Following Goro (2004, 2007), we will assume that these interpretive options across languages are encoded in the grammar by a lexical parameter called the Disjunction Parameter (also see Crain and Khlentzos 2008; Crain, Goro and Minai 2007; Crain, Goro and Thornton 2006; Szabolcsi 2002).

On this analysis, the disjunction operator *huozhe* ‘or’ in adult Mandarin is assigned the positive value of the Disjunction Parameter [+PPI]. By definition, PPIs must take scope over negation at the level of semantic interpretation. This explains why Mandarin disjunction takes scope over the negative marker *meiyou* ‘not’ in the Mandarin example (2), yielding the disjunctive truth conditions associated with inclusive-*or* in classical logic. In contrast to Mandarin, the English disjunction word *or* is assigned the negative value of the Disjunction parameter [-PPI], so it does not take scope over local negation in (1). Instead, negation takes scope over disjunction in both the surface syntax and at the level of semantic interpretation. Consequently, disjunction yields a conjunctive interpretation, as in one of de Morgan’s laws of classical logic, as we will now discuss.

Disjunction in logic and in human language

Disjunction words in human languages are assigned the truth conditions associated with inclusive disjunction in classical logic (see Crain, 2008; 2012). So, the logical formula with the disjunction operator ‘ \vee ,’ ($P \vee Q$), is true in three circumstances: (i) when P is true, but not Q, (ii) when Q is true, but not P, (iii) when both P and Q are true. Negated disjunctive statements are false only when both P and Q are false. On the [-PPI] setting of the Disjunction parameter, negated disjunctive statements are true if and only if both disjuncts are false, as in de Morgan’s law of propositional logic: $\neg(P \vee Q) \Rightarrow \neg P \wedge \neg Q$ (where ‘ \wedge ’ is the symbol for conjunction, ‘ \neg ’ for negation, and ‘ \Rightarrow ’ is logical entailment).

In human languages, the [-PPI] value of the Disjunction parameter corresponds to the scope assignment in which negation takes scope over disjunction (NEG > OR), as in the English example (1). In these sentences, disjunction is said to generate a conjunctive interpretation. On the alternative [+PPI] value, negative sentences with disjunction are true in circumstances in which only one of the disjuncts is false, as well as in circumstance in which both disjuncts are false. So, the logical formula associated with the [+PPI] value is: $\neg P \vee \neg Q$, as in Mandarin.

The Semantic Subset Principle

With a parametric account of scope relations on offer, we are invited to ask whether there is a default setting of the Disjunction parameter. Based on considerations of language learnability, Goro (2004, 2007) argued that the answer is affirmative, and that the initial setting of the Disjunction parameter is [-PPI]. This default value is required in order to avoid potential learnability problems that would arise if the alternative [+PPI] value is adopted. The critical observation is that the [+PPI] value makes sentences true in a superset of the circumstances that make the same sentences true on the [-PPI] value. To see this, note that, although $\neg(P \vee Q)$ entails $\neg P \vee \neg Q$, the reverse is not true. In human languages then, the English scope

assignment (NOT > OR) asymmetrically entails the Mandarin scope assignment (OR > NOT). From the fact that the (NOT > OR) scope assignment asymmetrically entails the (OR > NOT) scope assignment, we are logically entitled to infer that the [-PPI] value makes sentences true in a subset of circumstances corresponding to the value [+PPI]. This raises a familiar learnability problem, designated the ‘subset problem’ (Berwick 1985).

Here is the problem in a nutshell. Suppose that children initially adopt the superset value, [+PPI]. If so, this value would be confirmed by adults, even by adults who speak languages where the alternative ‘subset’ value is operative. Adults would confirm children’s hypothesis, despite assigning a different value to the Disjunction parameter, because adults would consistently produce negated disjunctions in one of the three sets of circumstances that would make negated disjunctions true for children, i.e., in circumstances where ‘neither’ of the disjuncts is true. Therefore, children who began with the superset [+PPI] value of the Disjunction parameter would not converge on the adult grammar, contrary to fact.¹ To avoid learnability problems in cases like this, a learnability principle was proposed, called the Semantic Subset Principle (Crain, Ni and Conway 1994; Crain 2012).

According to the Semantic Subset Principle (SSP), children initially adopt the subset value of the Disjunction Parameter. If adult speakers of the local language adopt the superset value, then the adult input will contain positive evidence informing children that negated disjunctions are true in circumstances in which only one disjunct is false, not just in circumstances in which both disjuncts are false. It follows from the Semantic Subset Principle that children acquiring languages in which adults assign the alternative [+PPI] value of the Disjunction parameter will initially assign different scope relations to negated sentences with disjunction, such that children will reject such sentences in circumstances in which adult

¹ We are assuming that children do not have access to negative evidence, such as parental feedback, informing them that certain meanings cannot be assigned to sentences.

accept them, viz., when only one of the disjuncts is true. Experimental studies by Goro and Akiba (2004a, 2004b) confirmed this prediction with Japanese-speaking children. The children in the Goro and Akiba study only accepted simple negative sentences like (3) in circumstances corresponding to the conjunctive interpretation of the Japanese disjunction word *ka* ‘or,’ where the pig ate neither the carrot or the pepper. If the pig had eaten one of the vegetables but not the other, children rejected sentence (3). In contrast to children, Japanese-speaking adults accepted sentences like (3) in circumstances in which the pig had eaten only one of the vegetables.

(3) Butasan-wa ninjin **ka** piiman-wo tabe-**nakat**-ta

pig-TOP carrot or pepper-ACC eat-neg-Past

‘It the carrot or the pepper that the pig did not eat.’

The same difference between child language and adult language was subsequently observed in Mandarin Chinese, Turkish, and Russian (Jing, Crain and Hsu 2005; Verbuk 2006; Geçkin, Crain and Thornton, in prep.).

Cancelling polarity sensitivity

The Disjunction Parameter encodes the fact that disjunction is a Positive Polarity Item (PPI) in some languages, but not in others. In linguistic contexts that cancel the polarity sensitivity of linguistic expressions therefore, both children and adults are expected to generate the same conjunctive interpretation to sentences with disjunction. The interpretation assigned by both children and adults, moreover, is expected to adhere to the laws of classical logic (see section 2). In the previous literature, two linguistic phenomena have been invoked to cancel the polarity sensitivity of linguistic expressions.

One linguistic environment that cancels the polarity sensitivity of PPIs, including disjunction, consists of complex (two-clause) sentences in which the Mandarin negative

marker (English *not*, Mandarin *mei*) appears in a higher clause than the one that contains the disjunction word (*huozhe*). This is illustrated in the Mandarin example in (4).

(4) Gen mei kanjian Taide dian yidalimian huozhe shousi.

Gen not see Ted order pasta or sushi

简没看见泰德点意大利面或者寿司。

‘Gen didn’t see Ted order pasta and Gen didn’t see Ted order sushi’

In contrast to simple (one-clause) negative sentences, when negation and disjunction reside in different clauses, negation takes scope over disjunction. In this configuration, disjunction is expected to generate a conjunctive interpretation in all human languages. This invites two conclusions. One conclusion is that polarity sensitivity is a locality restriction on semantic interpretation, and does not extend across clause boundaries. The second conclusion is that all human languages adhere to principles of classical logic in certain linguistic contexts (Crain 2012; see section 2).

Another linguistic context that cancels polarity sensitivity of disjunction words involves sentences with focus operators, such as Mandarin *zhiyou* (English *only*). This is illustrated in (5). Notice that the Mandarin disjunction word *huozhe* appears in the predicate phrase of (5). In this position, disjunction is no longer analysed as a PPI. The focus operator *zhiyou* ‘only’ makes two semantic contributions to sentences like (5), with disjunction in the predicate phrase. One semantic contribution pertains to the element in focus, as indicated in (5a). The other pertains to the individuals being contrasted with the element in focus, as indicated in (5b). The critical observation is that sentences with focus operators generate a negative entailment - the individuals being contrasted with the element in focus (*Yuehan*) must lack the property being attributed to the element in focus. In (5), the entailment is that everyone else did not order sushi or pasta (only *Yuehan* did).

(5) **Zhiyou** Yuehan dian-le yidalimianshi huozhe shousi.

only John order-ASP pasta or sushi

‘Only John ordered sushi or pasta.’

a. John ordered sushi or pasta.

b. Everyone else (being contrasted with John) did **not** order sushi **or** pasta.’

Notice that disjunction is in the scope of a ‘covert’ negation in the entailment (5b). Because negation is introduced covertly in the entailment of sentences with the focus operator *zhiyou* ‘only,’ it was expected that the polarity sensitivity of the Mandarin disjunction word *huozhe* would be cancelled (Zhou and Crain 2012; Crain, Goro, Notley and Zhou 2013). This expectation was confirmed in a series of experimental studies comparing the scope assignments of children and adult speakers of Japanese, Mandarin, and English using sentences like (5). The fact that English-speaking children and adults assigned a conjunctive interpretation to disjunction in sentences with the focus operator *only* is not surprising, because the English disjunction word *or* is [-PPI]. However, it is noteworthy that Japanese- and Mandarin-speaking adults assigned the same (NOT > OR) interpretation to sentences like (5), since disjunction is [+PPI] in these languages, at least for adults. The findings are also evidence that human languages conform to the laws of classical logic, once the polarity sensitivity of disjunction is cancelled (Crain 2012).

The fact that polarity sensitivity is cancelled in sentences (4) and (5) invites two conclusions. The first is that a candidate expression (with PPI potential) must reside in the same clause as negation. The second is that the candidate expression must be overtly realized in order to be interpreted as a PPI. If this analysis is on the right track, then the polarity sensitivity of would-be PPIs should also be cancelled in sentences in which disjunction resides in a clause that undergoes Verb Phrase Ellipsis.

Verb Phrase Ellipsis in Mandarin

In sentences with Verb Phrase Ellipsis (VPE), the verb phrase in the second of two conjuncts is not phonetically realized. Several theoretical accounts of the phenomena have been proposed (e.g., Chomsky and Lasnik 1993; Merchant 2001, 2004, 2007; Tancredi 1992; Williams 1977; Fiengo and May 1994; Culicover and Jackendoff 2005). In the present paper, we will assume that disjunction is generated in the syntax before it undergoes elision in sentences with VPE. This ensures that its content is recoverable at the level of semantic interpretation. The structures of sentences with VPE, then, take the following shape. The disjunction operator is introduced overtly in the first conjunct. This is followed by a second conjunct that contains a subject NP and a negated VP in which the disjunction operator is elided (see examples (8) and (9) below). In such sentences, we predict that the polarity sensitivity of the disjunction operator that is implicit in the second conjunct will be cancelled, such that disjunction will not be assigned scope over negation and, consequently, will generate a conjunctive interpretation. By contrast, disjunction is expected to become a PPI in the corresponding sentences without VPE.

To illustrate the linguistic structures we will investigate, let us first introduce the control sentences, without Verb Phrase Ellipsis. Consider the English example (6) and its Mandarin counterpart in (7).²

(6) Min ordered sushi or pasta, but John didn't order sushi or pasta.

(7) Min dianle shousi huozhe yidalimian, danshi Yuehan meiyou dian shousi huozhe

Min order-ASP sushi or pasta but John not order sushi or

² The Chinese VP ellipsis structure differs from that of English in terms of the presence of an auxiliary. In English, VP ellipsis with main verbs requires the presence of an auxiliary, an instance of *do*-support. Chinese differs from English in this aspect because there is no *do*-support in Chinese (Wu 2002).

yidalimian.

pasta

‘Min ordered sushi or pasta, but John didn’t order sushi or John didn’t order pasta.’

The critical comparison is between the interpretations of the second conjuncts in English (6) versus Mandarin (7). These examples reveal a difference that has been established in the interpretation of disjunction in simple negative sentences in the two languages. This difference in interpretation vanishes, however, in sentences where the disjunction words are elided, as illustrated in (8) and (9).

(8) Min ordered sushi or pasta, but John didn’t ~~order sushi or pasta~~.

(9) Min dian-le shousi huozhe yidalimian, danshi Yuehan meiyou ~~dian shousi huozhe~~

Min order-ASP sushi or pasta but John not ~~order sushi or~~

~~yidalimian~~.

pasta

‘Min ordered sushi or pasta, but John didn’t ~~order sushi or pasta~~.’

Crucially, the English example (8) and the corresponding Mandarin example (9) are equivalent in meaning. In both of these sentences, disjunction generates a conjunctive interpretation. This supports the analysis according to which elided disjunction words take narrow scope across languages (cf. Zhou and Crain 2012; Crain, Goro, Notley and Zhou 2013).

So far we have seen that languages differ in the interpretation of overt disjunction, but not in the interpretation of covert disjunction. It follows that the Disjunction parameter is only operative when negation and disjunction are overtly represented in the surface syntax. Putting it differently, it follows that, linguistic expressions that would be PPIs if they were realized overtly in sentences, lose their polarity sensitivity when they are covert. This is predicted to happen when disjunction words are elided at the level of surface syntax. We have seen that, in

simple sentences when the polarity sensitivity is not cancelled, Mandarin-speaking adults assign disjunctive interpretation to negated disjunction (whereas children assign conjunctive interpretation). If the polarity sensitivity of disjunction words is cancelled in the negated VP in the second conjunct of sentences with Verb Phrase Ellipsis, then Mandarin-speaking adults are predicted to assign a conjunctive interpretation to disjunction. Of course, Mandarin-speaking children are also expected to assign this interpretation, as they do in simple negative sentences.

Experiment

An experimental study was designed to investigate these predictions. In order to contrast the different interpretations of disjunction in different structures, the experiment had two conditions. In Condition 1, disjunction was introduced in simple negative sentences such as *Yuehan meiyou dian shousi huozhe yidalimian* ('John didn't order sushi or pasta'). Based on previous research, Mandarin-speaking adults were expected to analyse disjunction as [+PPI], so they were expected to accept the test sentences in circumstances that corresponded to the disjunctive interpretation. In contrast to adults, Mandarin-speaking children were expected to only accept the test sentences in circumstance in which disjunction generated a conjunctive interpretation.

In Condition 2, disjunction was introduced in sentences with Verb Phrase Ellipsis, such as *Yuehan dianle shousi huozhe yidalimian, Mali meiyou* ('John ordered sushi or pasta, Mary didn't'). In this condition, adults and children were predicted to accept the test sentences in the same, albeit restricted set of circumstances, in which disjunction generates a conjunctive interpretation. If so, this would confirm our prediction that, when disjunction is introduced covertly, its polarity sensitivity should be cancelled, such that negation takes scope over disjunction for both children and adults.

In both conditions, the test sentences incorporated negation, so it was important to satisfy the felicity condition associated with the use of negation (cf. Russell 1948). Essentially, a negative statement is felicitous only if the corresponding positive statement has already been introduced, or is under consideration in the conversational context. This is often referred to as the Condition of Plausible Dissent (e.g., Crain and Thornton 1998; cf. Crain et al. 1996). We indicate how we satisfied the Condition of Plausible Dissent as we describe typical trials in each condition.

Participants

Thirty-four Mandarin-speaking children participated in Condition 1. They ranged in age from 4;1 to 5;4, with a mean age of 4;9. Four children were eliminated from the analysis for Condition 1, because each of them produced more than 50% incorrect answers to the filler sentences. The remaining 30 children proceeded to the main session in Condition 1. Two of the same 34 children were eliminated from Condition 2, because they answered ‘Yes’ to the ‘false’ warm-up sentence, indicating that they did not understand the game. The remaining 32 children proceeded to the main session in Condition 2. The children were recruited from the kindergarten affiliated with Beijing Language and Culture University. In addition, we tested 25 Mandarin-speaking adults. All of the adults were students attending Beijing Language and Culture University.

Method

The methodology we chose was the Truth Value Judgment Task (TVJT). This task is designed to investigate the range of interpretations that children (and adults) assign to sentences (see Crain and Thornton 1998 for extensive discussion). The task involves two experimenters. One experimenter acts out short stories in front of the child participant, using toys and props. The second experimenter plays the role of a puppet, who watches the stories

alongside the child. In Condition 1, the Truth Value Judgment task was administered in the ‘description’ mode. In the description mode, the test sentences are presented at the end of each story. The puppet explains what he thinks happened in the story, using one of the test sentences. The child’s task is to judge whether or not the puppet described the story correctly. In order to ensure that the child participants know that the puppet can be right and wrong, the puppet is presented as not always paying close attention to the stories. If the child judges the puppet’s statement to be incorrect, the experimenter asks the child to explain to the puppet ‘what really happened’ in the story. This allows the experimenters to verify that the child is rejecting the test sentences for the right reason.

In Condition 2, the Truth value Judgment task was administered in the ‘prediction’ mode. In the prediction mode, the story is interrupted part way so the puppet can make a guess about how the story will end. After the puppet’s guess, the story is resumed. At the conclusion of the story, the puppet repeats its prediction, and the participant is asked to judge whether or not the puppet made the correct guess about how the story would turn out, and to explain what really happened if the puppet is judged to have produced an incorrect statement. The prediction mode is often used in experiments investigating the interpretation of sentences with disjunction words, because this mode introduces a degree of ‘uncertainty’ into the story contexts, which often makes the use of disjunctive statements more felicitous, at least for adults (see Chierchia et al. 2004; Crain, Gualmini and Meroni 2000; Gualmini, Crain and Meroni 2000; Notley, Zhou, Jensen and Crain 2012). Adult controls were tested using the same task, but with pictures instead of having the stories acted out for them individually, in real time.

Each condition consisted of four stories, and each story consisted of two sentences for the child participants to judge. One was a test sentence, and the other was a filler sentence. The filler sentence enabled us to control for the number of ‘true’ and ‘false’ judgments given

by each child. Whenever a child judged a test sentence to be false, the experimenter introduced a ‘true’ filler sentence, and vice versa. Appendix A contains the test stimuli and filler sentences for both conditions.

Before the experimental items were introduced, two practice trials were administered to familiarize the child with the task. On one practice trial, the puppet’s statement was a true description of the context; on the other practice trial, the puppet’s statement was false. This trial introduced the idea that the puppet didn’t always pay close attention to the stories, and would therefore sometimes say something incorrect about what had happened. Only child participants who produced correct judgments to both practice trials were included in the experiment. Children were introduced to the task and tested individually. Their responses to the test sentences were recorded on a digital audio recorder for later transcription and analysis.

Condition 1

Condition 1 assessed the interpretation of disjunction by Mandarin-speaking children and adults in simple negative sentences like (10).

(10) Xiaolaoshu meiyou chi juanxincai huozhe xilanhua

mouse not eat cabbage or broccoli

‘The mouse didn’t eat cabbage or broccoli.’

For Mandarin-speaking adults, we expected disjunction to take scope over negation in (10) (OR > NOT). On this interpretation, the meaning of (10) can be paraphrased as meaning ‘It is either cabbage or broccoli that the mouse didn’t eat, but I am not sure which one it didn’t eat’. By contrast, Mandarin-speaking children were expected to initially assign the stronger (NEG > OR) reading, according to which the disjunction word generates a conjunctive interpretation, and reject (10). This scope assignment is anticipated by the Semantic Subset Principle, as noted earlier. So, the meaning of (10) that children are expected to assign can be paraphrased

as a conjunction of two negative statements: ‘The mouse didn’t eat cabbage AND the mouse didn’t eat broccoli’. Here is a typical story from Condition 1.

In this story there are three animals - a mouse, a pig and a horse. They are going to have an eating contest. There are strawberries, cabbages and broccoli for them to eat (see Figure. 1.). All of the animals really like strawberries so all of them take a strawberry and finish it (see Figure. 2.). The horse likes vegetables and he is going to eat some. But he sees that both the cabbage and the broccoli are too big to finish. So he decides not to eat any vegetables. The mouse really likes broccoli, and she quickly finishes a big piece, in just ten seconds. The pig also finishes some broccoli, although he ate it at a much slower pace than the mouse (see Figure. 3.). After that, the mouse was too full to eat anything else, so she stopped eating. The pig likes vegetables a lot, though, so he ate one of the cabbages as well.



Figure. 1. Before the competition



Figure. 2. First round of the competition



Figure. 3. Second round of the competition



Figure. 4. Third round of the competition

Now it's time to reward the animals. If an animal ate both vegetables, and a strawberry, it gets a gold coin. If an animal ate a strawberry, but only one kind of vegetable, it gets a red coin. And if an animal ate a strawberry, but neither of the vegetables, it gets a yellow coin.

The child participants were then asked to hand out the rewards. Figure.5. illustrates the rewards that the competitors received. Following the story, the puppet was asked to tell the child what each competitor had eaten, based on the reward they had been given. But the puppet couldn't remember, so he had to make a guess.



Figure. 5. The System of Rewards

To satisfy the Condition of Plausible Dissent, children were told at the beginning of the story that all three animals like fruit and vegetables and that one possible outcome of the story was that the animals would eat all of the fruit and vegetables. Before producing the test sentence, the puppet underscored this possible outcome in a positive lead-in sentence *Sange dongwu dou xihuan chi shucai he shuiguo* ('All three animals like vegetables and fruit'). Following this lead-in, the puppet produced either the test sentence in (11) or one of the filler sentences in (12) or (13). Test sentences and fillers were presented in a pseudo-random order.

Because we anticipated that adult Mandarin-speakers would judge the test sentences to be true, whereas children would not, the test sentences were combined with different filler sentences for each group, in order to form an equal number of acceptances and rejections. Children were asked to judge sentences like (11) and (12), whereas adults were asked to judge sentences like (11) and (13). The order of mention of the two disjuncts in the test sentences was counterbalanced across the four trials.

(11) Xiaolaoshu meiyou chi juanxincai huozhe xilanhua.

mouse not eat cabbage or broccoli

'The mouse didn't eat cabbage or broccoli.'

(12) Xiaozhu chi le caomei.

pig ate-ASP strawberry

'The pig ate a strawberry.'

(13) Xiaozhu meiyou chi caomei.

pig not eat strawberry

'The pig didn't eat a strawberry.'

In the context under discussion, in which the mouse ate one of the vegetables, Mandarin-speaking adults were expected to accept sentence (11). In contrast to adults, Mandarin-speaking children were expected to reject sentence (11) because, for them, the sentence means the mouse ate neither of the vegetables.

Condition 2

Condition 2 was designed to see whether the polarity sensitivity of the disjunction word *huozhe* ('or') is cancelled in sentences with Verb Phrase Ellipsis such as (14).

(14) Gongzhu hui xuan xingxing huozhe beike, wangzi bu hui.

princess will choose star or seashell, prince not will

'The princess will choose a star or a seashell, but the prince will not.'

If so, the differences between Mandarin-speaking children and adults that were expected to be observed in Condition 1 should no longer be observed. Both groups were expected to interpret sentence (14) in the same way, with a meaning that can be paraphrased as 'The princess will choose a star OR the princess will choose a seashell, but the prince will not choose a star AND will not choose a seashell'. Here is a typical trial.

Here is a prince and a princess. Today they are going to have their tenth birthday (see Figure.6., panel (1)). Their mother, the Queen, said that she was going to give each of them a special birthday gift. She had a large pink treasure chest which was stored in a treasure room, but the children had never been there and had never seen the treasure chest (panel (2)). Today, as a special birthday treat, the Queen decided to show them the treasure chest in the room and let them each take one piece of treasure from the chest (panel (3)).



Figure. 6. The Prince and the Princess choose a gift

At this point in the story, the puppet (Kermit the Frog) made the following prediction (in Mandarin): “Here is my guess... the princess will choose a shell or a star, but the prince will not”. Then the story continued. At the conclusion of the story, the princess had chosen a blue shell as her birthday gift, and the prince had chosen a star as his birthday gift (panel (5) and panel (7)). Following the conclusion of the story, the puppet repeated his prediction using the Mandarin counterpart to the following statement: “Remember. I said... the princess will choose a shell or a star, but the prince will not.”

To satisfy the Condition of Plausible Dissent, it was made clear that the twins loved all of the gifts in the treasure box, and would (perhaps) take them all. The puppet emphasized this possible outcome by uttering a positive lead-in before the test sentence, which corresponded to the beginning part of the story, where the prince and princess were choosing a gift. In the

story under discussion, the positive lead-in was *sanzhong liwu tamen dou xihuan* ('They like all three kinds of gifts).’ Following the positive lead-in, the puppet produced either the test sentence in (15), or the filler sentence in (16). The filler sentence (16) is obviously true in the example context, because the princess chose a seashell and the prince chose a star. The test and filler sentences were presented in pseudo-random order. The order of the two disjuncts associated with *huozhe* ('or') was counterbalanced.

- (15) Gongzhu hui xuan xingxing huozhe beike, wangzi bu hui.
 princess will choose star or seashell prince not will
 ‘The princess will choose a star or a seashell, the prince will not.’

- (16) Tamen xuande liwu bu yiyang.
 they choose gift not same
 ‘They chose different gifts.’

Sentence (15) is a target VP ellipsis structure, in which the elided VP in the second conjunct contained the disjunction word *huozhe* ('or'). Since the disjunction word was not pronounced, we postulated that it would not be required to take scope over negation at the level of semantic interpretation, because its polarity sensitivity would have been cancelled. In the typical context in which the princess chose a seashell and a prince chose a star, both adults and children were expected to reject (15).

Results

First, we report the results for Condition 1. As expected, the child participants rejected the test sentences in this condition 80% of the time, whereas the adult controls rejected them only 7% of the time. Children’s justifications for their rejections showed that they had computed the conjunctive interpretation of disjunction. They either explicitly pointed out the puppet was incorrect because it said that the mouse ate neither of the vegetables (*Ta shuo xiaolaoshu*

liangge dou mei chi) or they pointed out that the mouse did eat one kind of vegetable (*Xiaolaoshu chile yizhong shucai*). The low rate of rejections by Mandarin-speaking adults suggests that they assign a disjunctive interpretation to disjunction in simple negated sentences, contrary to the conjunctive interpretation assigned by Mandarin-speaking children. A Mann–Whitney test revealed a significant difference in the responses of children and adults ($Z = 5.83, p < .0001$).

Here are the main findings for Condition 2. Also as expected, the child participants rejected the test sentences 91.4% of the time. Twenty-six of the 32 children consistently rejected the test sentences, and the remaining 6 children rejected them on 13 out of 24 trials. The negative judgments by these 6 children did not clearly indicate that they had assigned the conjunctive interpretation to disjunction in the target sentences. In the example story, for example, these children sometimes justified their rejections by pointing to an irrelevant feature of the story, such as “The prince chose a star” (*wangzi xuanle xingxing*). On other trials, the child may have assigned the conjunctive interpretation, but the reason they gave did not make this clear. An example is was “The second part is not correct” (*houbian budui*). It is possible that these rejections were for the right reasons. Most importantly, the pattern of responses by the adult controls in Condition 2 was similar to that of the 26 children who consistently rejected the test sentences. Adults rejected the target sentences 96% of the time. A Mann–Whitney test revealed no significant difference in the response rates of children versus those of adults ($Z=.008, p = .99$). Table 1 summary the results and Figure 7 illustrate them.

Table 1 & Figure 7: Percentage of rejection and Standard Deviation for Conditions 1 and 2 by children (Condition 1, N=30; Condition 2, N=32) and adults (N=25)

Test conditions	Children		Adults	
	Percentage of rejection	Standard Deviation	Percentage of rejection	Standard Deviation
Condition 1: Overt Disjunction	80% (96/120)	0.35	7% (7/100)	0.24
Condition 2: Covert Disjunction	91.4% (117/128)	0.25	96% (96/100)	0.20

Table. 1.

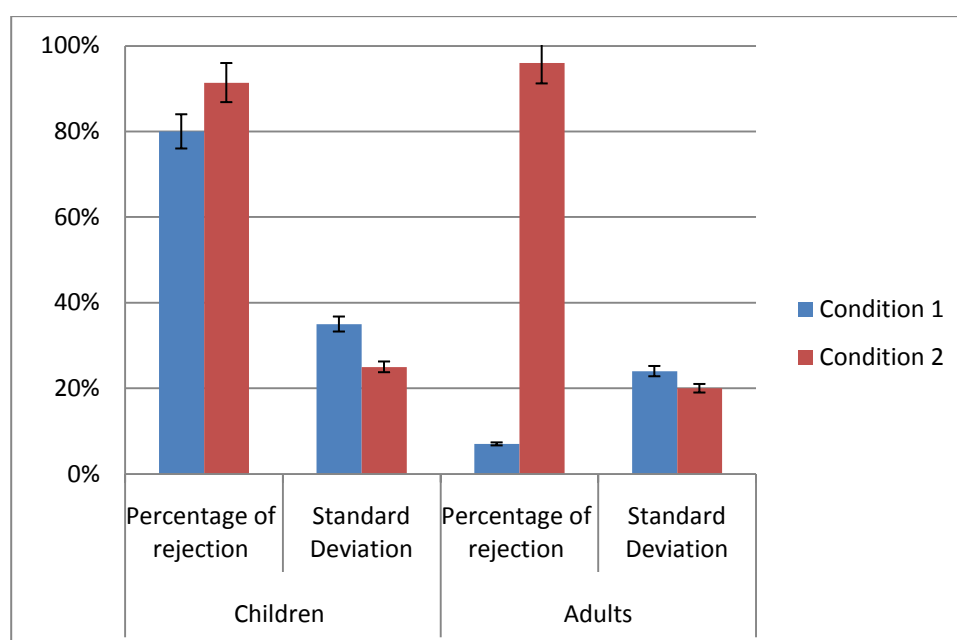


Figure. 7.

General Discussion

Based on the analysis of Positive Polarity Items we proposed, we hypothesized that Mandarin-speaking adults and children would demonstrate the same interpretive pattern in responding to negated Verb Phrase Ellipsis structures, in which disjunction is elided. In the experiment that was carried out to investigate this, one condition was designed to establish the

meanings assigned to disjunction in simple negated sentences by Mandarin-speaking adults and children, and a second condition was designed to see if the polarity sensitivity of PPIs is cancelled in VPE structures.

The findings were exactly as predicted. Mandarin-speaking adults and children differed in how they interpreted disjunction in simple negative statements, but both groups assigned the same interpretation to disjunction in VPE structures. The experimental results suggest that the polarity sensitivity of disjunction is cancelled in this linguistic environment and disjunction no longer takes scope over negation. Instead, negation has scope over disjunction. When the polarity sensitivity is cancelled, children and adults exhibit similar patterns in the interpretation of disjunction. Moreover, the common pattern by both children and adults is one that conforms to classical logic. In line with previous research, the findings of the present study suggest that the polarity sensitivity involves two expressions that must be spelled out at the level of surface syntax. When there is no realisation of disjunction in the surface syntax, linguistic expressions that would otherwise be a PPI are not required to take scope over local negation.

Conclusion

Languages differ in the ways in which words for disjunction (English *or*, Mandarin *huozhe*) are interpreted in simple negative sentences. Disjunction generates a conjunctive interpretation in some languages (e.g., English) but it generates a disjunctive interpretation in other languages (e.g., Mandarin Chinese). One account of these cross-linguistic differences proposes that words for disjunction are positive polarity items (PPIs) in some languages (e.g., Mandarin), but not in other languages (e.g., English) (see Goro 2004; Szabolcsi 2002). By definition, Positive Polarity Items take scope over negation. Consequently, all languages

should pattern in the same way when the polarity sensitivity of PPIs is cancelled (see Zhou and Crain 2012).

One linguistic context that is expected to cancel the polarity sensitivity of PPIs is Verb Phrase Ellipsis (VPE). Such sentences are interpreted as if the syntactic structure of the elided VP is intact, but suppressed at the level of Phonological Form. When disjunction is introduced covertly, as in an elided VP, it is not expected to take scope over local negation at the level of semantic interpretation (Zhou and Crain 2012). If VP ellipsis cancels the polarity sensitivity of disjunction (or any PPI), then disjunctive words are predicted to be assigned the same interpretation even in typologically distinct language such as Mandarin and English. More specifically, disjunction should generate a conjunctive interpretation in both languages, in accordance with one of de Morgan's laws of classical logic.

To test this theoretical prediction, Mandarin-speaking children and adults were tested using a Truth Value Judgment Task that was designed to assess subjects' interpretation of disjunction in negative statements both without VPE, and with VPE. As predicted, Mandarin-speaking children rejected the sentences that contained disjunction in negative statements without VPE 86% of the time, whereas adults rejected these sentences only 7% of the time. This difference between children and adults suggest that Mandarin-speaking children assigned a conjunctive (non-PPI) reading, as expected by the Semantic Subset Principle. By contrast, adults assigned a disjunctive (PPI) interpretation, as expected on the Mandarin value of the Disjunction Parameter. These findings replicate those of previous studies (e.g., Jing, Crain and Su 2005).

A second experiment was novel. This experiment investigated sentences with disjunction in an elided VP. As predicted, both Mandarin-speaking children and adults consistently rejected the target sentences (children = 90%, adults = 96%). The responses by

both children and adults suggest that the covert disjunction in the elided VP generated a conjunctive reading both both groups. Taken together, the findings from both experiments provide evidence that VPE structures cancel the polarity sensitivity of disjunction (or any PPI), thereby unveiling the same conjunctive interpretation for both children and adults.

The present findings bear on two theoretical proposals. First, the findings are consistent with the proposal that polarity sensitivity is a phonological process, which requires two logical expressions (negation and a PPI) to be spelled out at the level of phonetic form. Second, because disjunction is not phonetically realized in VPE structures, there is little decisive evidence in children's experience about how to analyse the covert disjunctive word in such structures. The fact that young children rapidly converge on the correct adult interpretation without explicit evidence is difficult to reconcile on an experience-based approach to language acquisition and, instead, tends to favour an approach that is based on innate linguistic knowledge.

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Chapter 3: The interpretation of disjunction in the scope of *dou* in child Mandarin

This paper is based on the following paper, which is under preparation for submission to journals:

An, S., Thornton, R., Crain, S., Zhou, P. (in preparation). The interpretation of disjunction in the scope of *dou* in child Mandarin.

Abstract

A recent theory provides a unified cross-linguistic analysis of the interpretations that are assigned to expressions for disjunction, Negative Polarity Items, Free Choice Items, and the non-interrogative uses of *wh*-phrases in languages such as Mandarin Chinese. If this approach is on the right track, children should be expected to demonstrate similar patterns in the acquisition of these linguistic expressions. Previous research has found that, by age four, children have acquired the knowledge that both the existential indefinite *renhe* ‘any’ and *wh*-words in Mandarin Chinese are interpreted as Negative Polarity Items when they are bound by downward entailing operators, but the same expressions are interpreted as Free Choice Items (with a conjunctive interpretation) when they are bound by deontic modals (Mandarin *keyi*) or by the Mandarin adverbial quantifier *dou* (‘all’). The present study extends this line of research to the Mandarin disjunction word *huozhe*. A Truth Value Judgment Task was used to investigate the possibility that disjunction phrases that are bound by the adverbial quantifier *dou* generate a conjunctive interpretation in the grammars of Mandarin-speaking 4-year-old children. The findings confirmed this prediction. We discuss the implications of the findings for linguistic theory and for language learnability.

Keywords

Mandarin, disjunction, *wh*-words, quantification, *dou*, child language acquisition

The interpretation of disjunction in the scope of *dou* in child Mandarin

Introduction

Recently a theory has been advanced that provides a unified semantic analysis of disjunction, Negative Polarity Items, Free Choice Items, and the non-interrogative interpretations of *wh*-phrases across languages (Chierchia 2013; Fox 2007). The present study tests the unification account directly, by asking if Mandarin disjunctive phrases evoke conjunctive inferences when they are bound by the quantificational adverb (Q-adverb) *dou*. This possibility is investigated in an experimental study with Mandarin-speaking children and adults. The main finding confirms the prediction, and provides circumstantial support for the unified account.

We begin with a brief tour of the semantics of existential expressions, so-called \exists -items. Three English \exists -items are illustrated in examples (1)-(4). These are the existential indefinite *some*, the disjunction word *or*, and the polarity sensitive expression *any*.

(1) *Someone* coughed.

(2) *Ted or Gen* coughed.

(3) Sally didn't hear *anyone* cough.

(4) If Sally hears *someone/Ted or Gen/anyone* cough, she breaks out the cold medicine.

Sentence (1), *someone coughed*, is true if and only if there exists an individual *x* such that *x* coughed. In a domain with just two individuals, Ted and Gen, (1) is logically equivalent to the disjunctive statement in (2), *Ted or Gen coughed* (e.g., Crain and Khlentzos 2010; Jayaseelan 2008). The polarity sensitive expression *any* is another \exists -item (e.g., Baker 1970; Klima 1964; Ladusaw 1979, 1980; Carlson 1980; Linebarger 1987; Horn 1989; Krifka 1995 among others). Sentence (3) *Sally didn't hear anyone cough* is true only if there does not exist an individual *x* such that Sally heard *x* cough. In the domain with two individuals, Ted and Gen, this

statement is true only if Sally didn't hear Ted cough and didn't hear Gen cough.¹ Example (4) illustrates the logical equivalence under discussion. In a domain with just two individuals, all three of the \exists -items we have discussed are licensed in the antecedent of a conditional statement.

In addition to their use as existential expressions (\exists -items), the English disjunction word *or* and the polarity sensitive expression *any* also generate Free Choice 'conjunctive' inferences in certain linguistic contexts (for discussion of *or*, see Kamp 1973; Zimmermann 2000; Geurts 2005; Barker 2010; Fox 2007; Chierchia 2013; for discussion of *any*, see Quine 1960; Vendler 1967; Lasnik 1972; Horn 1972; Ladusaw 1979; Carlson 1981; Dayal 1998). Both the disjunction word *or* and the polarity sensitive expression *any* license free choice inferences when they appear in the scope of a deontic modal, such as English *may* (Mandarin *keyi*) (Kamp 1973; Zimmermann 2000; Geurts 2005; Barker 2010; Zhou, Romoli and Crain, 2013; Dayal 1995; Lasnik 1972; Lee and Horn, 1994). This is illustrated in (5) and (6).

(5) Kung Fu Panda may drive the green car *or* the orange car.

(6) Kung Fu Panda may drive *any* of the cars.

Sentences (5) and (6) both convey the message that Kung Fu Panda is free to choose among the available cars. According to the unified account, the disjunction word *or* and the polarity expression *any* are initially analysed as \exists -items in sentences like (5) and (6). The fact that these sentences generate free choice (conjunctive) inferences is due to a process called recursive exhaustification, which we discuss next.

¹ The relationship between disjunction and existential quantification was made explicit in Kalish and Montague (1964). In logic texts, the symbol for disjunction is ' \vee '. Kalish and Montague adopted an enlarged disjunction symbol ' \vee ' to represent the existential quantifier (the symbol ' \exists ' in other logic texts). Similarly, to capture the relationship between conjunction and universal quantification, Kalish and Montague represented the universal quantifier using an enlarged version of the conjunction symbol ' \wedge ', namely ' Λ ' (rather than ' \forall ').

Recursive Exhaustification

A recent theoretical proposal by Chierchia (2013) and Fox (2007) attempts to provide a unified analysis of \exists -items. To see how recursive exhaustification works, we will describe how the free choice reading of disjunction is derived in sentence (7), *Kung Fu Panda may push the green car or the orange car*.

The first thing to note is that (7) can be paraphrased as a conjunctive statement: *Kung Fu Panda may push the green car and Kung Fu Panda may push the orange car* (for discussion, see Kamp 1973; Zimmermann 2000; Geurts 2005; Barker 2010; Fox 2007; Chierchia 2013; Zhou, Romoli and Crain, 2013). We will render the meaning of ‘may’ symbolically using the possibility operator, \Diamond . The generalization that disjunctive statements yield conjunctive truth conditions is represented by the inference pattern in (8).

(7) Kung Fu Panda may drive the green car or the orange car.

(8) $\Diamond(p \vee q) \sim \Diamond p \wedge \Diamond q$

The fact that the inference in (8) is legitimate is surprising, because a plain disjunctive sentence, i.e., one without a modal, never conveys the corresponding conjunctive inference. In fact, it typically conveys its negation. That is, from the statement *Kung Fu Panda pushed the green car or the orange car*, it does not follow that Kung Fu Panda pushed both cars. A recent explanation for the inference in (8) has been advanced by Fox (2007) and by Chierchia (2013). We will follow Chierchia’s formulation of the account, which involves a recursive application of an algorithm akin to that of a scalar implicature. The algorithm is referred to as recursive exhaustification because an exhaustivity (ONLY) operator is applied to its own output.

As in a typical scalar implicature, the algorithm compares the statement made by a speaker with alternative statements that the speaker might have made. According to the

algorithm in question, however, these alternative statements are enriched by the exhaustivity operator, to include their associated (negative) inferences. These are inferences that would have been attributed to the speaker if these alternative statements had been produced, instead of the actual statement. At the first step in the algorithm, then, the exhaustivity operator generates inferences that enrich the alternatives to what the speaker said. Then, the exhaustivity operator (ONLY) applies a second time, in order to eliminate those enriched alternatives that are stronger than what the speaker actually said. Having sketched the general idea, we will now provide a brief overview of the two steps involved in recursive exhaustification, using the disjunctive statement in (7), repeated here as (9).

(9) Kung Fu Panda may drive the green car or the orange car. $\Diamond(p \vee q)$

At the first step, the assertion is compared to its ‘subdomain’ alternatives. These subdomain alternatives are formed using these disjuncts in the predicate phrase of the original assertion, as shown in (10) and (11). These subdomain alternatives are compared to the assertion at the second step in the algorithm, but only after they have been enriched with their associated inferences.

(10) Kung Fu Panda may drive the green car. subdomain alternative = $\Diamond p$

(11) Kung Fu Panda may drive the orange car. subdomain alternative = $\Diamond q$

What are the inferences associated with (10) and (11)? When a speaker asserts (9), the question under discussion is which cars Kung Fu Panda (KFP) has been given permission to drive. The green car and the orange car are the relevant alternatives. Suppose that the speaker had asserted one of the subdomain alternatives, (10) or (11), instead of (9). If the speaker had asserted (10), this would have invited the inference in (12). Similarly, from the subdomain alternative in (11), we would have inferred (13).

(12) Kung Fu Panda may drive the green car, but not the orange car $\Diamond p \wedge \neg \Diamond q$

- (13) Kung Fu Panda may drive the orange car, but not the green car. $\Diamond q \wedge \neg \Diamond p$

Why do we make such inferences? Here is the intuition. Suppose your friend Mary asks *who coughed* in a situation with only two individuals, Ted and Gen. Another friend, Bruce, answers - *Ted*. We interpret Bruce's answer as shorthand for *Only Ted coughed*. That is, we infer from Bruce's fragment answer, *Ted*, that Gen did not cough. To account for this kind of inference, we posit that an implicit exhaustivity operator, ONLY, is operative in such discourse sequences that include disjunctive statements. This exhaustivity operator is responsible for generating the pragmatic inferences that enrich the subdomain alternatives (10) and (11), as illustrated in (14) and (15). This is the first step in the process of recursive exhaustification. It is schematically represented in (16).

- (14) ONLY [Kung Fu Panda may drive the green car]

$\sim \rightarrow$ Kung Fu Panda may drive the green car, but not the orange car. $\Diamond p \wedge \neg \Diamond q$

- (15) ONLY [Kung Fu Panda may drive the orange car]

$\sim \rightarrow$ Kung Fu Panda may drive the orange car, but not the green car. $\Diamond q \wedge \neg \Diamond p$

- (16) 1st Exhaustification:

a. $\text{ONLY}[\Diamond p] = \Diamond p \wedge \neg \Diamond q$

[$\Diamond p$ is a subdomain alternative, with inference $\neg \Diamond q$]

b. $\text{ONLY}[\Diamond q] = \Diamond q \wedge \neg \Diamond p$

[$\Diamond q$ is a subdomain alternative, with inference $\neg \Diamond p$]

At the second step in the algorithm, the enriched alternatives are stacked up against the original disjunctive sentence *Kung Fu Panda may push the green car or the orange car*, which is cast symbolically as $\Diamond(p \vee q)$. Let us refer to the enriched alternatives as the 'scalar alternatives' to the original assertion. The second step in the algorithm determines whether or not each of the scalar alternatives is stronger than the original statement made by the speaker.

In the example under consideration, the scalar alternatives to $\Diamond(p \vee q)$ are $\Diamond p \wedge \neg \Diamond q$ and $\Diamond q \wedge \neg \Diamond p$. If a scalar alternative is stronger than the speaker's statement, then we make the usual inference associated with scalar implicatures; that is, we infer that the speaker was not in a position to assert the scalar alternative, so we infer the negation of the scalar alternative. It can easily be verified that both of the scalar alternatives under consideration are stronger than the original disjunctive statement. The scalar alternative $\Diamond p \wedge \neg \Diamond q$ is stronger than the original assertion $\Diamond(p \vee q)$, and so is $\Diamond q \wedge \neg \Diamond p$. Consequently, we infer their negations: $\neg[\Diamond p \wedge \neg \Diamond q]$ and $\neg[\Diamond q \wedge \neg \Diamond p]$. This is the second step in the recursive exhaustification algorithm process. This step is represented in words in (17), and the remaining steps of the derivation are indicated symbolically in (18).

(17) ONLY [Kung Fu Panda may drive the green car or the orange car]

- a. $\sim \rightarrow$ It is false that Kung Fu Panda may drive the green car but may not drive the orange car
and
- b. $\sim \rightarrow$ It is false that Kung Fu Panda may drive the orange car but may not drive the green car

(18) 2nd Exhaustification

- a. $\text{ONLY}[\Diamond(p \vee q)] = \Diamond[p \vee q]$
- b. $\neg[\Diamond p \wedge \neg \Diamond q]$ (negation of scalar alternative)
- c. $\neg[\Diamond q \wedge \neg \Diamond p]$ (negation of scalar alternative)
- d. $\Diamond p \Leftrightarrow \Diamond q$ (from (b) and (c), and the definition of \Leftrightarrow)
- e. $\Diamond[p \vee q] \wedge \Diamond p \Leftrightarrow \Diamond q = \Diamond p \wedge \Diamond q$ (from (a) and (d))

From (17-a), it follows that if Ku Fu Panda may drive the green car, then he may also drive the orange car (18-b), and from (17-b) it follows that if Ku Fu Panda may drive the orange car, then he may also drive the green car (18-c). Therefore, if he is permitted to drive either one of the cars, he is also permitted to drive the other one. Together with the original statement – *Kung Fu Panda may drive the green car or the orange car* – the fact that Kung Fu Panda may drive either car if and only if he may drive the other (18d) entails that Ku Fu Panda may drive the green car and he may drive the orange car (18e). This completes our overview of the recursive exhaustification algorithm.

Predictions for Child Language

We have seen that, in a finite domain, disjunctive phrases are the logical equivalents of the free choice item *renhe*. We will see (in the literature review) that the free choice item *renhe* receives a conjunctive (universal) interpretation in sentences with *dou*. Therefore, it is a straightforward prediction that disjunction phrases in Mandarin are expected to generate a conjunctive inference when they are bound by the adverbial quantifier *dou*. This prediction was investigated in the present study. As far as we know, this prediction has not been previously noted, or verified, in either adult or child Mandarin.

To test this prediction, the disjunctive phrase must appear to the left of the Q-adverb *dou*, and there cannot be any intervening plural noun phrases. These are prerequisites to the study, because *dou* is typically associated with a plural NP to its left. These conditions are satisfied in sentences like (19), where the nearest NP to the left of *dou* is the singular name, *gongfu xiongmao* ‘Kung Fu Panda.’

(19) zai xiaomao **huozhe** xiaogou shenbian, gongfu xiongmao **dou** zhongle shu.

at cat or dog side Kung Fu Panda all plant-ASP tree

If the recursive exhaustification algorithm applies to (19), as expected, the following conjunctive interpretation should be a paraphrase of the meaning of (19): *Kung Fu Panda planted a tree next to a cat and next to a dog*. Mandarin-speaking children's interpretation of sentences such as (19) will be investigated in our experiment, which we will turn to momentarily. However, before we report on the details of the experiment, it will be useful to briefly review the findings of previous research on the acquisition of \exists -items by preschool-aged children. We will review studies that investigated children's interpretation of three kinds of sentences: Mandarin sentences with the disjunction operator *huozhe* and the deontic modal verb *keyi* 'may'; English sentences with a deontic modal verb and the Free Choice Item, *any*, and its Mandarin counterpart, *renhe*; and we will discuss Mandarin sentences with *wh*-words and the Q-adverb *dou*, such that we will add Mandarin *wh*-words to our stockpile of \exists -items.

Literature Review

This section reviews previous experimental studies of the acquisition of existential expressions, focussing mainly on Mandarin Chinese. The findings of previous research demonstrate that four-year-old Mandarin-speaking children draw free choice (conjunctive) inferences from disjunctive statements that contain the deontic modal operator *keyi* 'may' (Zhou, Romoli and Crain, 2013). In addition, research has demonstrated that four-year-old English-speaking children have acquired the dual interpretations of *any* (Tieu, 2010), and four-year-old Mandarin-speaking children have acquired the dual interpretations of the corresponding expression, *renhe* 'any' (Huang and Crain, 2013). Finally, 4-year-old Mandarin-speaking children have been found to demonstrate knowledge of the non-interrogative uses of *wh*-words (Zhou, 2013; Zhou and Crain, 2011). We will briefly review the findings of these studies.

Free Choice Inferences in Child Language

We begin with a study by Zhou, Romoli and Crain (2013). This study demonstrated that 4-year-old Mandarin-speaking children draw free choice inferences for disjunction phrases that occur in the scope of the deontic modal *keyi* ‘may’. The Zhou et al. study used the Truth Value Judgment task (Crain and Thornton 1998). In this task, children judge whether or not each test sentence, which is produced by a puppet, is an accurate description of the events that have taken place in a story that has just been acted out in front of the child and the puppet. In the Zhou et al. study, children were asked to judge sentences like (20). In the accompanying story, Kung Fu Panda was only given permission to drive the green car, but not the orange car.

(20) Gongfu xiongmao keyi kai lvse xiaochē huozhe juse xiaochē.

Kung Fu Panda may drive green car or orange car

‘Kung Fu Panda may drive the green car or the orange car’.

If children compute a free choice (conjunctive) inference for the disjunctive phrase in sentence (20), then they should judge it to be a false description of the story, because the sentence means that Kung Fu Panda was granted permission to drive both the green car and the orange car. Children’s judgments were exactly as predicted. Based on this finding, the authors concluded that children generate free choice inferences for disjunctive phrases that appear in the scope of the deontic modal *keyi* ‘may.’

Another study, by Tieu (2010), investigated the interpretations assigned by English-speaking preschool children to the existential expression *any*, both in linguistic contexts that license Negative Polarity Items (NPIs), and in linguistic contexts that license Free Choice Items (FCIs). To assess this, Tieu surveyed the transcripts of the spontaneous speech of 40 monolingual English-speaking children, ranging in age from 0;11 to 5;02, using the

CHILDES database (MacWhinney 2000). The entire corpus included 887,579 utterances. Twenty-six of the 40 children produced 15 or more instances of *any* in linguistic contexts that license NPIs. These children's productions of *any* emerged at the same time in declarative and interrogative contexts, whereas *any* emerged significantly later in linguistic contexts that license Free Choice Items.

Mandarin *renhe* behaves much like English *any*; it can appear both in linguistic contexts that license NPIs, and in contexts that license FCIs. In another study adopting the Truth Value judgment task, Huang and Crain (2013) investigated the interpretation assigned to *renhe* by 4- to 6-year-old Mandarin-speaking children in two experiments. In one experiment, *renhe* appeared in sentences with the modal expression *neng* 'can', such as (21). In the second experiment, *renhe* was omitted, as in (22). The finding was that the child participants assigned a conjunctive interpretation to sentences that contained *renhe*, such as (21), but not to sentences without *renhe*, as in (22). That is, children judged (21) to mean that Kung Fu Panda can push any one of the three cars that were made available in the experimental workspace, whereas children judged (22) to mean that Kung Fu Panda can only push a single car.

(21) Gongfuxiongmao neng tuidong renhe yi-ge chezi.

Kung Fu Panda can push any one-CL car

'Kung Fu Panda can push any one of the cars.'

(22) Gongfuxiongmao neng tuidong yi-ge chezi.

Kung-Fu-Panda can push one-CL car

'Kung Fu Panda can push one of the cars.'

In combination with *neng* ‘can’, *renhe* ‘any’ invokes a universal reading. The universal reading can be derived from an existential, such as Mandarin *renhe* ‘any’, by the same recursive exhaustification algorithm we described earlier. The beginning and end points of the derivation are as follows. The experimental workspace had three cars (green, orange and purple). Symbolically we can represent ‘*neng ... renhe*’ statements (e.g, 21) as $\Diamond \exists x \in \{p, q, r\}$. This is logically equivalent to the disjunctive statement $\Diamond(p \vee q \vee r)$, which serves as the input to the recursive exhaustification algorithm. The output of the algorithm is a conjunctive statement, $\Diamond p \wedge \Diamond q \wedge \Diamond r$, which is logically equivalent to the universal, $\Diamond \forall x \in \{p, q, r\}$. In words, the process can be represented as in (23).

- (23) a. Kung Fu Panda can push any car.
 b. Kung Fu Panda can push the green car or the orange car or the purple car.
 c. Kung Fu Panda can push the green car, and can push the orange car, and
 can push the purple car.

Wh-words and the Q-adverb dou in child Mandarin

The next series of experimental studies we review investigated children’s interpretation of Mandarin *wh*-words in combination with the Q-adverb *dou*. To appreciate the relevance of these experiments, it is pertinent to observe the similarity in meaning between sentences with *wh*-words and ones with the FCI *renhe* in sentences with *dou*. When the *wh*-word *shenme* precedes *dou*, as in (24), the *wh*-word generates a conjunctive (free choice) inference, just as FCI *renhe* ‘any’ does in (25). Both (24) and (25) have the same meaning - Kung Fu Panda (‘KFP’ hereafter) is free to choose which of the cars to drive. If the quantificational adverb *dou* is removed, however, the FCI *renhe* is no longer tolerated, resulting in the ungrammatical sentence (26). Moreover, in the absence of the quantificational adverb *dou*, *wh*-words no longer generate free choice inferences, so example (27) can only be interpreted as a *wh*-question.

- | | |
|---|---|
| <p>(24) Shenme che KFP dou keyi kai</p> <p>what car KFP all may drive</p> <p>‘KFP may drive any car.’</p> | <p>(25) Renhe che KFP dou keyi kai</p> <p>any car KFP all may drive</p> <p>‘KFP may drive any car.’</p> |
| <p>(26) *Renhe che KFP keyi kai</p> <p>any car KFP may drive</p> <p>‘KFP may drive any car.’</p> | <p>(27) Shenme che KFP keyi kai?</p> <p>what car KFP may drive</p> <p>‘What car may KFP drive?’</p> |

In view of the semantic parallelism between sentences with the FCI *renhe* and ones with *wh*-words, the unified account analyses them both as existential indefinite expressions (Chierchia 2013; Fox 2007). The fact that they are assigned a conjunctive interpretation is attributed to recursive exhaustification.

Four-year-old Mandarin-speaking children’s interpretation of the non-interrogative uses of *wh*-words has also been investigated.² Here, we review several representative studies. An experiment by Zhou (2013) compared minimal pairs of sentences such as (28) and (29). These sentences were used to assess children’s knowledge of the existential interpretation of *wh*-words in Mandarin Chinese in contexts that license NPIs, as in (28), and in contexts such as (29), where only the interrogative use of *wh*-words is licensed.

- (28) Meiyou xiongmao chi shenme shuiguo.

² A variant of the Truth Value Judgment Task, called the Question-Statement Task, was adopted in this study. In the task, stories are acted out in front of the child using toys and props, and after each story children judge whether the puppet made a statement or posed a question. If the puppet made a statement, then the child’s task was to judge whether or not the statement was an accurate description of what happened in the story. But if the puppet posed a question about the story, then the child’s task was to answer the question.

not-have panda eat what fruit

‘No panda ate any fruit.’

(29) Mei-zhi xiongmao dou chi-le shenme shuiguo?

every-CL panda all eat-ASP what fruit

‘What kind of fruit did every panda eat?’

In (28), the predicate phrase of the negative (downward entailing) quantificational expression *meiyou xiongmao* (‘no panda’) licenses the existential reading of the *wh*-word *shenme*. By contrast, the positive (upward entailing) predicate phrase of the quantificational expression *meizhi xiongmao* (‘every panda’) in (29) does not license the existential reading of a *wh*-word. On a typical trial, three pandas were eating breakfast. All of them took one strawberry, but none of them picked a lemon. Both children and adults rejected (28) 100% of the time in this context, and they justified their responses by pointing out that every panda ate some fruit. In response to sentence (29), both children and adults interpreted the sentence as a question, and responded with the answer “strawberry”.

A second experiment in the Zhou study investigated children’s understanding of the universal (conjunctive) interpretation of *wh*-words in Mandarin. For adults, the quantificational adverb *dou* is required to license the universal reading of *wh*-phrases. This is illustrated in (30) and (31). In (30), the *wh*-word *shei* (‘who’) is bound by *dou*, thereby yielding a universal reading. By contrast, (31) is a *wh*-question, because the *wh*-word *shei* is not bound by *dou*. Sentences (30) and (31) were tested in the second experiment.

(30) Shei dou tiao-guo-le fangzi.

who all jump-over-ASP house

‘Everyone jumped over the house.’

(31) Shei tiao-guo-le fangzi?

who jump-over-ASP house

‘Who jumped over the house?’

In a typical story there were three horses: a white horse, a black horse and a yellow horse. The horses engaged in a jumping competition. The white horse and the black horse easily jumped over a house, but the yellow horse was not as successful. Following the story, a puppet produced one of the test sentences; half of the children heard (30), and half heard (31). Both children and adults rejected sentences like (30) 95% of the time, and they justified their rejections by pointing out the yellow horse didn’t jump over the house. In response to sentence (31), both children and adults consistently provided the answer to a question, usually answering “the white horse and the black horse”. The author interpreted the findings as evidence that preschool Mandarin-speaking children have knowledge of the non-interrogative uses of *wh*-words.

The final study we review was conducted by Zhou and Crain (2011). This study investigated children’s sensitivity to the structural position of the Q-adverb *dou* and a *wh*-word using so-called *dou*-conditionals. If a *wh*-word appears in the antecedent of a *dou*-conditional, and is followed by *dou* (in the consequent clause), the *wh*-words generates a conjunctive interpretation (‘whoever’). On the other hand, *wh*-words that are preceded by *dou* function as *wh*-question markers. This contrast is illustrated in (32) and (33). Although both examples contain the *wh*-word *shei* (‘who’) and the quantificational adverb *dou*, due to these licensing conditions, example (32) is a statement, whereas (33) is a question. Using the Question/Statement task (see Footnote 2), Zhou and Crain conducted a study with 42 monolingual Mandarin-speaking children (mean age = 4;3) to investigate children’s interpretation of sentences like those in (32) and (33). In the story corresponding to (32) and

(33), three villagers (a pig, a rabbit, and a dog) were being harassed by a menacing crocodile. The village head, Mr Owl, called upon his superhero friends, Spiderman and Batman, to chase away the crocodile. After the superheroes had chased away the crocodile for the third and last time, a puppet presented (32) to one group of children, and (33) to a different group of children.

(32) Eyu qu yao **shei**, maotouying cunzhang **dou** zhao-le zhizhuxia bangmang.

crocodile go bite who, owl village-head all find-ASP Spiderman help

‘Whoever Mr. Crocodile went to bite, Mr. Owl asked Spiderman for help.’

(33) Eyu qu yao xiaozhu, maotouying cunzhang **dou** zhao-le **shei** bangmang?

crocodile go bite pig, owl village-head all find-ASP who help

‘Who did Mr. Owl ask for help when Mr. Crocodile went to bite Mr. Pig?’

The finding was that 37 of the 42 children consistently interpreted sentences like (32) as statements, and all 42 children interpreted sentences like (33) as questions, so they responded with the appropriate answer (e.g., “Batman”). This finding provides compelling evidence that young Mandarin-speaking children know the licensing conditions on *wh*-words appearing with the quantificational adverb *dou*.

Let us conclude with a brief outline of how the recursive exhaustification algorithm derives a universal reading for *wh*-words in sentences with *dou*. We will use sentence (32) as our example. The process is sketched in (34). First, *wh*-words such as *shei* are analysed as existential indefinites. In (32), the existential expression ranges over the three individuals in the domain of discourse, so we can render the meaning of the *wh*-word as $_{+WH}\exists x \in \{a, b, c\}$. The meaning of the *wh*-word is then converted into a disjunction, $[a \vee b \vee c]$, which is

logically equivalent. Then, the recursive exhaustification algorithm applies, as described in Section 2. The output of the algorithm is a conjunction $[a \wedge b \wedge c]$, which is the source of the universal force attributed to the sentence, $\forall x \in \{a, b, c\}$.

- (34) a. When Croc. went to bite $_{WH} \exists x \in \{a, b, c\}$, Owl asked Spiderman for help.
- b. When Croc. went to bite $[a \vee b \vee c]$, Owl asked Spiderman for help.
- c. When Croc. went to bite ONLY[ONLY $[a \vee b \vee c]$, Owl asked Spiderman
for help.
- d. When Croc. went to bite $[a \wedge b \wedge c]$, Owl asked Spiderman for help.
- e. When Croc. went to bite $_{WH} \forall x \in \{a, b, c\}$, Owl asked Spiderman for help.

In this section, we first reviewed previous research on children's acquisition of the existential expressions *any* in English and *renhe* 'any' in Mandarin Chinese. Then we reviewed the findings of studies in which children were asked to interpret *wh*-words in sentences with the Q-adverb *dou*, versus ones without *dou* or ones in which *dou* preceded the *wh*-word. The findings demonstrated that both young English-speaking and Mandarin-speaking children have acquired the dual interpretations of a variety of existential expressions. In the present study, we extend this line of research to the Mandarin disjunction word *huozhe*. We were interested to see whether young Mandarin-speaking children interpret the disjunctive phrases as having a conjunctive reading when they are bound by the adverbial quantifier *dou*.

Experiment

This experiment was devised to assess whether or not the presence of *dou* in the sentence converts disjunctive phrases into conjunctive meanings in child Mandarin. A typical minimal pair of test sentences is illustrated in (35) and (36).

(35) zai xiaomao huozhe xiaogou shenbian, gongfu xiongmao **dou** zhong-le shu.

at cat or dog side Kung Fu Panda all plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat and next to a dog.’

(36) zai xiaomao huozhe xiaogou shenbian, xiongmaomen **dou** zhong-le shu.

at cat or dog side pandas all plant-ASP tree

‘The pandas (all) planted a tree next to a cat or next to a dog.’

The unified account predicts that, when a disjunctive phrase occurs in the scope of the adverbial quantifier *dou*, the disjunctive phrase is converted into a conjunctive interpretation, via recursive exhaustification. This applies to sentences such as (35), where the Q-adverb *dou* takes scope over the disjunctive phrase *xiaomao huozhe xiaogou* (‘a cat or a dog’). In this sentence, *dou* cannot take scope over the (singular) proper noun Kung Fu Panda, so the disjunctive phrase is the only option. Therefore, the sentence in (35) is expected to mean that Kung Fu Panda planted a tree next to a cat and next to a dog. In (36), by contrast, there is a plural noun to *dou*’s left, *xiongmao men* (‘pandas’). Therefore, it is anticipated that the sentence means all of the pandas planted a tree next to a cat OR next to a dog. For brevity, we will refer to sentences like (35) as Type 1, and to sentences like (36) as Type 2.

We can now state our experimental hypothesis. In Type 1 sentences like (35), in which the disjunctive phrase occurs in the scope of the adverbial quantifier *dou*, children will give the disjunctive phrase a conjunctive interpretation. In Type 2 sentences like (36), in which *dou* takes scope over the plural NP, children will interpret the disjunctive phrase with disjunctive truth conditions.

Method

The methodology was the Truth Value Judgment Task (TVJT). The Truth Value Judgment Task (TVJT) is designed to investigate the range of interpretations children assign to sentences (Crain and Thornton 1998). The task involves two experimenters. One experimenter acts out short stories in front of the child participant, using toys and props. The second experimenter plays the role of a puppet, who watches the stories alongside the child. At the end of each story, the puppet explains what he thinks happened in the story, using one of the test sentences. The child's task is to judge whether or not the puppet said the right thing about the story. Child participants were assured that the puppet sometimes makes mistakes when he tries to describe what happened in the story. If the child judges the puppet's statement to be incorrect, then the experimenter asks the child to explain to the puppet 'what really happened' in the story. This allows the experimenters to verify that the child is rejecting the test sentences correctly.

The child participants were introduced to the task and tested individually. We made the decision to adopt a between-subject design for the two types of test sentences to avoid carry-over effects. The two critical test items were extremely similar, differing only by the plurality of the noun phrase in the sentence, as can be seen in (35) and (36) above. Before the experimental items were introduced, two practice trials were administered to familiarize the children with the task. On one practice trial, the puppet uttered a sentence that was true in the context and, on the other practice trial, the puppet said something false. This reinforced the idea that the puppet didn't always pay attention and would sometimes say something incorrect about what had happened in the stories. Only those children who gave correct judgments to the two practice trials were included in the experiment. Adult controls were tested using the same task, but with pictures instead of having the stories acted out in real time.

Participants

We tested 27 Mandarin-speaking children (age range 4;2-5;4, mean 4;7) on their interpretation of Type 1 sentences. Another 22 children (age range 4;3-5;0, mean 4;8) were tested on their interpretation of Type 2 sentences. In addition, 40 Mandarin-speaking adults were tested as controls: half of them were assigned to Type 1 sentences and the other half was assigned to Type 2 sentences. The child participants were recruited from the kindergarten at the Beijing Language and Culture University. All the adult participants were students at the Beijing Language and Culture University.

Materials

Four test stories were created for each type of test sentence (Type 1 and Type 2). For each story, the test sentence was followed by a filler sentence. For the (false) Type 1 sentences, the four filler sentences were accurate descriptions of some event that had taken place in the story. For the (true) Type 2 sentences, the four filler sentences were inaccurate descriptions of some event that had taken place in the story. The fillers were used to balance the number of true and false responses. Appendix B presents all of the test stimuli and filler sentences in this experiment. Two typical trials are used to illustrate, one for each sentence type.

Example Trial for Type 1 sentences (see Figure. 1.):

Kung Fu Panda is deciding where to plant his trees. He decides to plant one of the trees next to a cat (panel 2). He has another tree to plant, and decides to plant this tree next to another cat (panel 3). He has one more tree to plant, and he plants this one next to the third cat (panel 4).

The test sentence (37) and the filler sentence (38) were produced by the puppet on this trial. As seen from Figure 1, at the end of the story (panel 4), Kung Fu Panda has planted trees next

to all of the cats, but none of the dogs have trees next to them. In this experimental context, if children assign a conjunctive interpretation to the disjunction word in (37), this would make test sentence false. However, the filler sentence in (38) would be true.

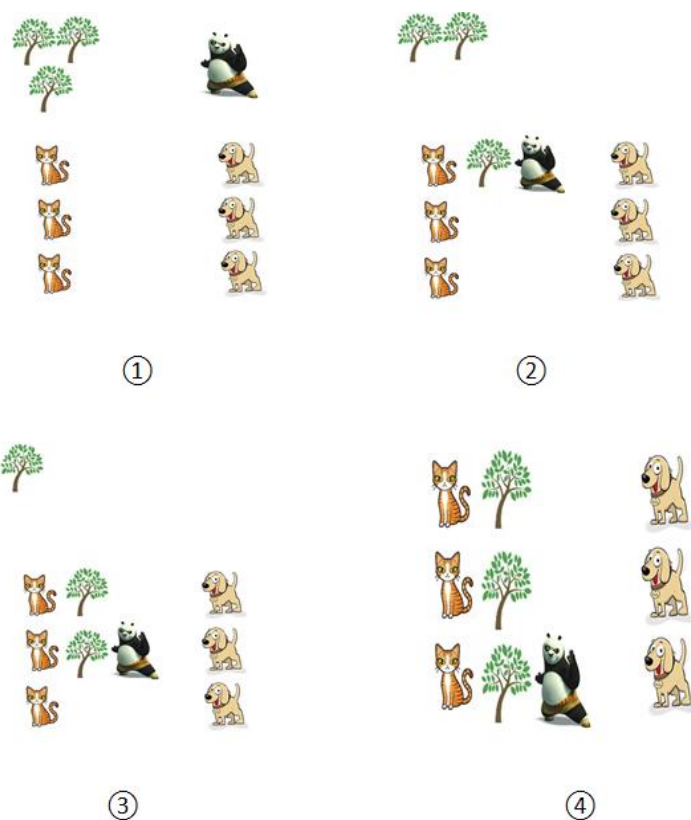


Figure. 1.

(37) Target Sentence

Zai xiaomao huozhe xiaogou shenbian, gongfu xiongmao dou zhong-le shu.

at cat or dog side Kung Fu Panda all plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat and next to a dog.’

(38) Filler Sentence

Zai xiaogou shenbian, gongfu xiongmao meiyou zhong shu.

at dog side Kung Fu Panda not plant tree

‘Kung Fu Panda didn’t plant a tree next to a dog.’

Here is a typical Trial for Type 2 sentences (see Figure. 2.):

There are three pandas. One of them is Kung Fu Panda. The pandas are all going to plant some trees. The pandas can choose to plant their trees next to a cat, or a dog. There are three cats and three dogs altogether. Kung Fu Panda plants his tree first. He decides to plant his tree next to a cat (panel 2). Then the other pandas also decided to plant their tree next to a cat (panel 3 and 4).

The test sentence (39) and the filler sentence (40) were produced by the puppet on this trial. As seen in Figure 2, at the end of the story (panel 4), the pandas have all planted a tree next to a cat and, once again, no trees have been planted next to any of the dogs. In this experimental context, the test sentence (39) is true and the filler sentence (40) is false.

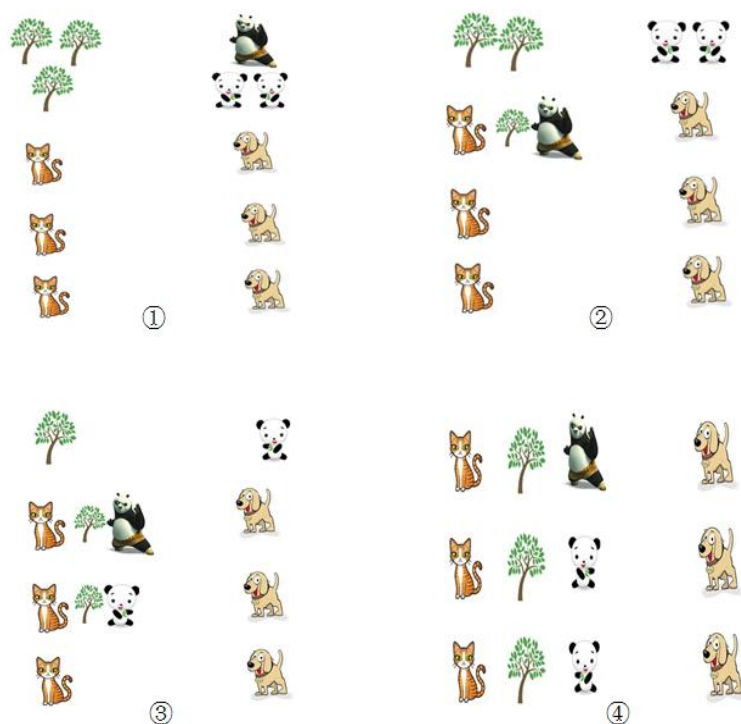


Figure. 2.

(39) Target Sentence

Zai xiaomao huozhe xiaogou shenbian, xiongmaomen dou zhong-le shu.

at cat or dog side pandas all plant-ASP tree

‘The pandas (all) planted a tree next to a cat or next to a dog.’

(40) Filler Sentence

Zai xiaogou shenbian, xiongmaomen zhong-le shu.

at dog side pandas plant-ASP tree

‘The pandas planted a tree next to a dog.’

To remind the participants of the events that had taken place in the story, the last events that had of the stories (represented by panel 4 in Fig. 1. and Fig. 2.) were visible to the child participants. We recorded the responses of the participants to the test sentences using a digital audio recorder.

Results

Before reporting the results, let us restate the experimental hypotheses. We hypothesized that, if Mandarin-speaking children know that the adverbial quantifier *dou* quantifies over the disjunctive phrases to its left, and thereby converting the disjunctive phrases into conjunctive interpretation, then they would be expected to reject (37) but they should accept sentences like (39). Consider the example test sentences and contexts. Example (37) means that Kung Fu Panda planted a tree next to a cat AND next to a dog. But in the corresponding context Kung Fu Panda only planted a tree next to a cat. Participants were, therefore, expected to reject (37) by making reference to the fact that Kung Fu Panda did not plant a tree next to a dog. By contrast, participants should accept (39), because the sentence means that the pandas all planted a tree next to a cat OR next to a dog, which was consistent with what happened in the story.

Here are the main findings. First, all children accepted the four true filler sentences, and rejected the four false filler sentences. Turning to the test sentences, children rejected Type 1 test sentences, such as (37), 89.8% of the time. The control group of adults rejected them 100%

of the time. More specifically, 23 out of the 27 children and all the 20 adults consistently rejected test sentences like (37). On the trial showcased above, for example, the children justified their rejections of (37) by explicitly referring to the fact that *xiaogou meiyou shu* ('the dogs didn't receive a tree') or by pointing at the dogs, meaning that there was no tree planted next to the dogs. All the adults justified their rejections of (37) by indicating that the dogs didn't receive a tree. A Mann–Whitney test revealed no significant differences between children and adults in the proportion of correct responses ($Z = 1.78, p = .13$).

In response to Type 2 test sentences, such as (39), children accepted them 93.2% of the time, and the control group of adults accepted them 100% of the time. More specifically, 20 out of the 22 children and all the 20 adults consistently accepted the test sentences. Again, a Mann–Whitney test revealed no significant differences in the proportion of their correct responses by children and adults ($Z = 1.37, p = .49$). The experimental results are summarized in Table 1 and illustrated in Figure 3.

Table 1 & Figure 3: Percentage of rejection and Standard Deviation for Sentence Type 1 and Type 2 by children (Type 1, $N=27$; Type 2, $N=22$) and adults ($N=20$)

Sentence types	Children		Adults	
	Percentage of rejection	Standard Deviation	Percentage of rejection	Standard Deviation
Type 1: Disjunction – Name	89.8% (96/108)	0.85	100% (80/80)	0
Type 2: Disjunction – Plural NP	93% (82/88)	0.21	100% (80/80)	0

Table. 1.

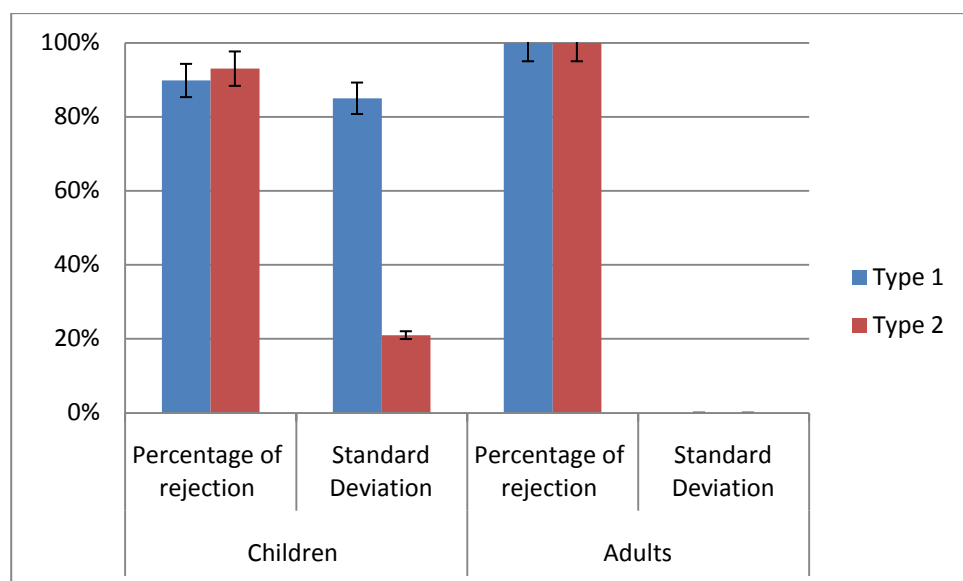


Figure. 3.

The experimental findings suggest that like adults, 4-year-old Mandarin-speaking children have the knowledge that *dou* quantifies over disjunctive phrases to its left, thereby giving disjunction phrases a conjunctive interpretation in such sentences.

Discussion

We have seen that, in Mandarin, *wh*-indefinites and the NPI *renhe* (English *any*) are licenced in the same downward entailing linguistic environments (e.g., in the scope of *meiyouren* ‘nobody’). In these environments, both *wh*-indefinites and *renhe* are typically analysed as existential (disjunctive) expressions. *Wh*-indefinites and *renhe* can also be bound by the quantificational adverb *dou* (roughly English ‘all’), which typically takes scope over plural noun phrases to its left. When bound by *dou*, *wh*-indefinites and *renhe* generate universal (conjunctive, free choice) truth conditions. This chameleon-like behaviour is reminiscent of English *any*, which is as an existential item (NPI) in some linguistic environments, but a universal (Free Choice) item in others. According to one recent approach, NPI *any* and Free Choice *any* are uniformly existential (disjunctive) expressions. In its guise as a Free Choice Item, *any* is converted from a disjunction to a conjunction by recursive exhaustification. The

same, two-stage process is invoked to explain how the universal force of *wh*-indefinites bound by *dou* is derived. Specifically, an exhaustivity function ONLY first applies to a set of domain alternatives, yielding suitably enriched alternatives, and then it applies again to the output of its first application. At the second step, the exhaustivity function ONLY negates any of the enriched domain alternatives that are stronger than the original assertion. Adopting this approach leads to an interesting prediction, namely that the Q-adverb *dou* should be able to bind disjunctive NPs to its left, converting them into conjunctive interpretations.

This approach was further confirmed in the present study using sentences like (41), where the disjunctive phrase *xiaomao huozhe xiaogou* ('cat or dog') is bound by the Q-adverb *dou* (in the absence of any plural NP antecedent to the left of *dou*). The result was taken as evidence that both children and adults generated a conjunctive interpretation of (41), which can be paraphrased as Kung Fu Panda planted a tree next to a dog and next to a cat. In (42), a plural NP *xiongmaomen* ('pandas') replaced the singular *gongfu xiongmao* ('Kung Fu Panda') in (41), such that *dou* had a plural NP to bind in (42), instead of the disjunction phrase. Consequently, the disjunctive phrase was assigned 'disjunctive' truth conditions in (42), again by both children and adults. So, sentence (42) was interpreted to mean that the pandas all planted a tree next to a cat or they all planted a tree next to a dog.

(41) Zai xiaomao **huozhe** xiaogou shenbian, gongfu xiongmao **dou** zhong-le shu.

at cat or dog side Kung Fu Panda all plant-ASP tree
'Kung Fu Panda planted a tree next to a cat and next to a dog.'

(42) Zai xiaomao **huozhe** xiaogou shenbian, xiongmaomen **dou** zhong-le shu.

at cat or dog side pandas all plant-ASP tree
'Pandas (all) planted a tree next to a cat or next to a dog.'

In previous work, we demonstrated that Mandarin-speaking children of the same age have adult-like command of sentences with *wh*-indefinites as well as the Q-adverb *dou* (Zhou

and Crain 2011; Zhou 2013). Taken together, these findings invited us to conclude that, by age 4, Mandarin-speaking children have knowledge of the semantics of *dou*, including recursive exhaustification. In drawing conclusions from the findings of the present study, however, it is important to be certain that the Mandarin disjunction word *huozhe* was responsible for the conjunctive interpretation assigned by children and adults.

To appreciate the potential problem, consider the sentences in (43) and (44). We will refer to (43) as a ‘parallel structure.’ Despite the absence of the disjunction word *huozhe*, (43) generates a conjunctive interpretation, just as (44) does. The pertinent observation is that both (43) and (44) contain the Q-adverb *dou*. This raises the possibility arises that we would have obtained the same findings in our study if we had used sentences without *huozhe*, such as (43) instead of ones with *huozhe*, such as (44).

(43) Zai xiaomao, xiaogou bianshang, Gongfu xiongmao **dou** zhong-le shu.

at cat dog side Kung Fu Panda all plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat and next to a dog.’

(44) Zai xiaomao **huozhe** xiaogou bianshang, Gongfu xiongmao **dou** zhong-leshu.

at cat or dog side Kung Fu Panda all plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat and next to a dog.’

It is important to deflect the force of this potential alternative explanation of the findings. We accomplish this by showing that, although the Q-adverb *dou* is critical for deriving a conjunctive interpretation of sentences with the disjunction word *huozhe*, it is not critical in deriving the meaning of parallel structure sentences like (43).

To see that *dou* is a critical ingredient in deriving the conjunctive interpretation of sentences with the disjunction word *huozhe*, it suffices to compare sentence (44) with

sentence (45), which contains *huozhe* but not the Q-adverb *dou* (as indicated by the strikethrough). Without *dou*, the disjunction phrase in sentence (45) takes on ‘disjunctive’ truth conditions, so (45) is true if Ku Fu Panda only planted a tree next to a cat. Sentence (44) would be false in this circumstance.

(45) Zai xiaomao ***huozhe*** xiaogou bianshang, Gongfu xiongmao ~~*dou*~~ zhong-le shu.

at cat or dog side Kung Fu Panda plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat or next to a dog’.

It remains to show that the Q-adverb ***dou*** is not critical in deriving the conjunctive reading of sentences with a parallel structure. This is accomplished using examples (46) and (47).³

(46) Zai xiaomao, xiaogou bianshang, Gongfu xiongmao ***dou*** zhong-le shu.

at cat dog side Kung Fu Panda all plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat and next to a dog’

(47) Zai xiaomao, xiaogou bianshang, Gongfu xiongmao zhong-le shu.

at cat dog side Kung Fu Panda plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat and next to a dog’

³ Another example is indicted in (i). This is another parallel structure where the Q-adverb *dou* is not critical in deriving a conjunctive interpretation.

(i) Gongfu xiongmao zai xiaomao, xiaogou bianshang zhong-le shu.

Kung Fu Panda at cat dog side plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat and next to a dog’

We conclude with a brief comment on how Mandarin-speaking children acquire the knowledge that they displayed in the experiment, i.e., that disjunction phrases yield a conjunctive interpretation in the scope of the universal quantifier *dou*. First, we want to deal with the possibility that children learn this from the adult input. If they do, then it should be possible to find evidence that adults produce sentences with both the disjunctive word *huozhe* and the quantifier *dou*, in sufficient abundance for children to learn the conjunctive interpretation that is assigned by adults in these sentences. To see if this acquisition scenario is on the right track, we conducted a corpus analysis of the 243,593 utterances contained in the six Mandarin Chinese corpora of CHILDES database (MacWhinney 2000). We found no sentences with both *huozhe* and *dou*, although there were 330 sentences containing *dou* alone, and 11 sentences with *huozhe* alone. A search of another Chinese corpus TCCM (Taiwan Corpus of Child Mandarin, which includes spontaneous adult-child language samples from nine children, age ranging from 1;6 to 4;3. c.f. Cheung, Chang, Ke and Tsay, 2011) resulted in 2 instances of *huozhe* and 1143 instances of *dou*. However, there were no sentence with the combination of *huozhe* and *dou*. It should be noted that these are relatively small corpora, and that this could be a sampling error, in which case, examples of *huozhe* and *dou* could potentially co-occur in a larger corpus. Nevertheless, this low frequency of relevant input in two separate corpora make it highly unlikely that children learn the conjunctive interpretation of disjunction based on the adult input. Therefore we propose an alternative learnability scenario. This scenario is based on the supposition that existential items, such as disjunction words, *wh*-words, NPIs and FCIs, are innately specified in children's grammar, as part of Universal Grammar. Following Fox (2007) and Chierchia (2013), we propose that children initially analyse both *wh*-words and disjunction as existential items, and know that when *wh*-words and disjunction occur in the scope of an exhaustification operator (e.g., the quantifier

dou), they yield a conjunctive interpretation using the kind of recursive exhaustification algorithm described in the present study.

Conclusion

A recent proposal by Chierchia (2013) offers a unified analysis of the interpretation assigned to disjunction words, Negative Polarity Items, Free Choice Items, and the non-interrogative use of *wh*-phrases in Mandarin Chinese. Evidence in support of the analysis include the finding that, by age four, Mandarin-speaking children interpret the existential indefinite *renhe* ‘any’ and *wh*-words (e.g., *shenme* ‘what’) as Negative Polarity Items when they are bound by downward entailing operators, but as Free Choice Items when they are bound by the deontic modal *keyi* ‘may’ in combination with the quantificational adverb *dou* (‘all’).

The study reported in Chapter 3 extends this line of research by investigating 4-year-old Mandarin-speaking children’s interpretation of the disjunction word *huozhe* ‘or’ in sentences with *dou*, with and without an intervening plural NP. In sentences with an intervening plural NP, children assigned ‘disjunctive’ truth conditions to disjunction phrases; but when there was a singular intervening NP, children assigned ‘conjunctive’ truth conditions to disjunction phrases. By age four, then, children exhibit adult-like knowledge that disjunction phrases generate a conjunctive interpretation in sentences with the quantificational adverb *dou*. This finding is taken as evidence supporting the unified analysis proposed by Chierchia (2013).

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Chapter 4: Locality constraints on *wh*-movement in child Mandarin

Abstract

The present study investigated adherence by Mandarin-speaking children to locality constraints on the interpretation of questions with *wh*-adjuncts, such as Mandarin *zenme* ('how'). Although Mandarin Chinese is considered to be a *wh-in-situ* language, adjunct *wh*-phrases such as *zenme* ('how') undergo overt movement (displacement). Moreover, Mandarin adjunct *wh*-phrases like *zenme* ('how') obey the same locality constraints on *wh*-movement that are operative in other languages with overt *wh*-movement. For example, the Mandarin A-not-A expression *youmeiyou* ('whether or not') prevents the extraction of adjunct *wh*-phrases, thereby restricting the interpretations that can be assigned. An experiment was designed to assess the interpretations made by children to sentences that contained *zenme* ('how') and the A-not-A expression *youmeiyou* ('whether or not'). The experimental hypothesis was that Mandarin-speaking children would adhere to locality constraints in interpreting the test sentences. The findings from a comprehension experiment confirmed this prediction. Young Mandarin-speaking children's interpretations of the test sentences were restricted by locality constraints, in the same way as adult Mandarin-speakers, and in a way that is consistent with current linguistic theory.

Keywords

Wh-movement, adjuncts, locality constraints, Mandarin Chinese

Locality constraints on *wh*-movement in child Mandarin

Introduction

Mandarin Chinese is known as a *wh-in-situ* language (Huang 1982a, 1982b; Cheng 1991; Huang, Li and Li 2009). In Mandarin, *wh*-phrases typically remain in argument position in the surface syntax⁸. By contrast, in other languages, including English, *wh*-questions are formed by the displacement of *wh*-phrases from their base-generated argument position to sentence initial position. The displacement operation is known as *wh*-movement. As an *in-situ* language, Mandarin *wh*-words do not typically undergo surface *wh*-movement. One consequence is that *wh*-phrases can sometimes be used both to ask questions and to make statements. In statements, for example, the *wh*-word *shenme* ‘what’, is similar in meaning to the existential polarity expression *renhe* ‘any’. This is illustrated in the ambiguous example (1), in which the same sequence of words can be used to ask the question *what fruit didn’t John eat?* or to make the statement *John didn’t eat any fruit*, depending on the intonation (Zhou, Crain and Zhan 2012).

⁸ Huang (1982a, 1982b) proposes that, although there is no *wh*-movement in the surface syntax, Mandarin *wh*-phrases undergo covert *wh*-movement at Logical Form, yielding the same interpretive patterns as those arising from overt *wh*-movement in other languages. An alternative proposal, by Aoun and Li (1993a, 1993b) and Tsai (1994), maintains that *wh*-phrases do not move at Logical Form, but are bound by an abstract operator. Implications of the difference between these theories are beyond the scope of the present paper.

(1) Yuehan meiyou chi shenme shuiguo

John not eat what fruit

‘What fruit didn’t John eat? / John didn’t eat any fruit.’

In contrast to argument *wh*-phrases, as in (1), adjunct *wh*-phrases in Mandarin are displaced from their original position to a focus position in the surface syntax (Lin 1992; Ko 2005; Huang et al. 2009). This is illustrated in (2), where the adjunct *wh*-phrase *zenme* ‘how’ has been displaced to focus position.

(2) Yuehan zenme qu xuexiao de

John how go school DE

‘How did John go to school?’

In languages with overt *wh*-movement (e.g., English), locality constraints are hypothesized to restrict the movement of *wh*-phrases. Since Mandarin adjunct *wh*-phrases like *zenme* (‘how’) also undergo displacement, the expectation is that they will obey the same locality constraints that are operative in languages with overt *wh*-movement (see, e.g., Lin 1992; Ko 2005; Huang et al. 2009). The experimental hypothesis of the present study was that Mandarin-speaking children would adhere to these locality constraints.

Although children younger than 6-years-old are frequently unable to perform grammaticality judgment tasks, children’s adherence to locality constraints can be assessed

using a comprehension methodology that probes interpretation. In order to see the effects of locality constraints on semantic interpretation, it will be useful to look first at a structure that is free from such constraints. We will begin with the English example (3).

- (3) How did Donald Duck find out ___ that the witch had become beautiful ___?
- a. Donald Duck found out by using binoculars the witch had become beautiful.
- b. Donald Duck found out the witch had become beautiful by drinking a potion.

The sentence in (3) is ambiguous. The ambiguity is indicated by the corresponding affirmative sentences in (3a) and (3b). The sentence in (3a) states how Donald Duck found out about the witch's transformation. We will refer to this as answering the 'upstairs' interpretation of the question in (3). The answer in (3a) indicates that the adjunct *wh*-phrase *how* is interpreted as if it were positioned after the verb phrase *find out*. The structure underpinning the interpretation in (3a) is represented in (4), where *how* originates in a position following the verb phrase *find out* in the main clause, and relocates from there, to sentence initial position.

- (4) How did [Donald Duck find out ~~how~~ [that the witch had become beautiful]]



The second sentence (3b) informs us how the witch had become beautiful. This answer to the question will be referred to as the 'downstairs' interpretation, to indicate that the adjunct *wh*-phrase *how* is interpreted as if it were positioned after the verb phrase in the embedded clause

had become beautiful. The structure underpinning the interpretation in (3b) is represented in (5), where *how* originates in a position following the verb phrase *had become beautiful* in the embedded clause, and relocates from there, to sentence initial position.

(5) How did Donald Duck find out [that the witch had become beautiful ~~how~~]



Now we turn to one kind of English sentence, example (6), which is governed by a locality constraint. Notice first, that example (6) which differs from example (3) by one word. We have replaced the complementizer *that* in example (3) with *whether* in (6).

(6) How did Donald Duck find out whether the witch had become beautiful?

a. How did [Donald Duck find out ~~how~~ [whether the witch had become beautiful]]



*b. How did [Donald Duck find out [whether the witch had become beautiful ~~how~~]]



In contrast to (3), example (6) can only be assigned the upstairs interpretation (6a). The question in (6) asks about how Donald Duck found out about the witch's transformation. It cannot be used to ask how the witch became beautiful. The absence of the downstairs reading is attributed to a locality constraint on the interpretation of *wh*-phrases (Ross 1967; Chomsky 1973; Rizzi 1990; Thornton et al. 1992). Metaphorically, the presence of the *wh*-word *whether* in the embedded clause constitutes an 'island' - from which nothing can escape (Ross 1967), hence 'how' cannot originate in the embedded clause.

The experimental hypothesis of the present study was that Mandarin-speaking children would adhere to the same locality constraints that are manifested in English. One of these constraints is illustrated in (7).

(7) Tanglaoya **zenme** faxian wupo **youmeiyou** bian piaoliang de?

Donald Duck **how** find out witch **whether or not** become beautiful DE

‘How did Donald Duck find out whether the witch had become beautiful?’

In example (7), the adjunct *wh*-phrase *zenme* (‘how’) is combined with the A-not-A expression *youmeiyou* ‘whether or not.’ As in English, the only available interpretation of (7) is an upstairs reading of the adjunct *wh*-phrase. The presence of *youmeiyou* ‘whether or not’ in the embedded clause creates an island for the extraction of the *wh*-phrase (Huang 1982; Huang, Li and Li 1999). So example (7) asks how Donald Duck found out about the witch’s transformation, and cannot ask how the witch had become beautiful. In the experiment described in section 5, we investigated Mandarin-speaking children’s interpretation of sentences like (7).

Another structure that was investigated in the present study is illustrated in (8). Here, the *wh*-adjunct is positioned inside the embedded clause, and the A-not-A expression *youmeiyou* ‘whether or not’ is in the main clause. In short, the positions of these two expressions have been reversed in (8), as compared to (7).

(8) Tanglaoya **youmeiyou** faxian wupo **zenme** bian piaoliang de]?

Donald Duck **whether or not** find out witch **how** become beautiful DE

‘Did Donald Duck find out how the witch had become beautiful?’

As noted, *youmeiyou* ‘whether or not’ is an island for *wh*-extraction. Therefore, the *wh*-word *zenme* ‘how’ in the embedded clause is prevented from relocating to a position closer to the beginning of the sentence. Instead, example (8) is interpreted as a yes/no question (Huang 1982a; Tsai 1999), asking whether or not Donald Duck found out that the witch had become beautiful.

In summary, the present study investigated the interpretations assigned to questions like (7) and (8) by 3-5-year-old Mandarin-speaking children. The research question was whether Mandarin-speaking children know the different interpretations assigned to questions such as these. The remainder of the paper is structured as follows. First, we introduce locality constraints on *wh*-movement in English and in Mandarin Chinese. Then we review previous research on children’s acquisition of locality constraints on *wh*-movement. Then we turn to our experiment and report the findings.

***Wh*-islands in English and in Mandarin**

In English, *wh*-questions are formed by the movement of *wh*-phrases in the surface syntax. In declarative sentences, when a constituent that follows the finite verb is questioned (see (9a)),

the constituent is replaced by the corresponding *wh*-word (see (9b)), and then moved to the sentence-initial position, labelled as Spec of CP. In generative grammar, a trace of the moved *wh*-phrase is left behind at the extraction site (see (9d)). The trace is co-indexed with the moved *wh*-phrase. The process of *wh*-movement is illustrated in Figure. 1.

- (9) a. John is cleaning with a vacuum (declarative sentence)
 b. John is cleaning how (conversion of the NP to the *wh*-phrase *how*)
 c. Is John cleaning how (I-to-C movement)
 d. How_i is John cleaning t_i? (*wh*-movement)

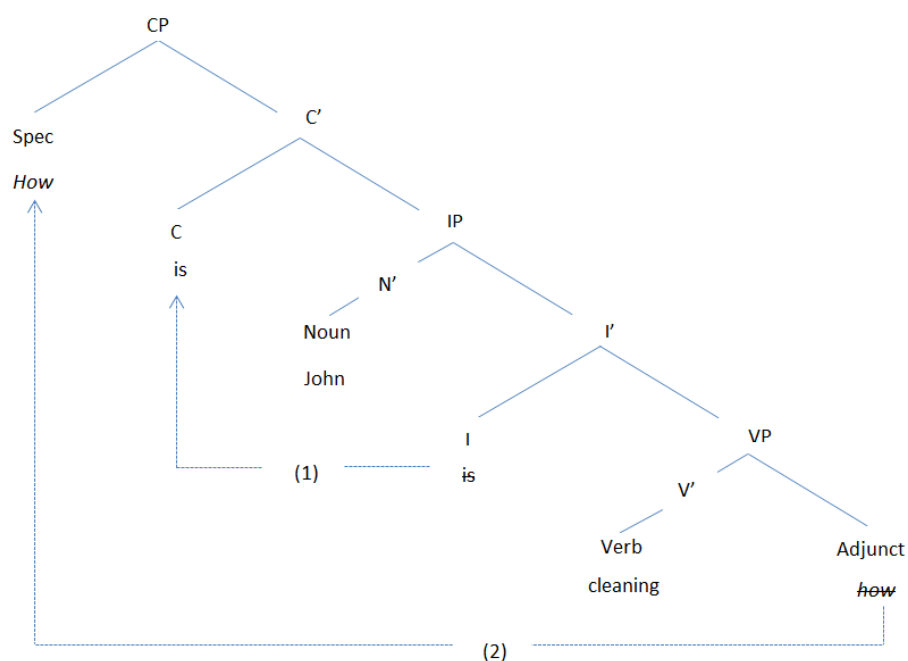


Figure. 1.

If there is more than one clause, a *wh*-phrase that originates in an embedded clause is required to move in a stepwise fashion from the extraction site to the landing site. As example (3)

illustrates, in complex sentences, a moved *wh*-phrase could have more than one extraction site, i.e., either from the matrix clause or from the embedded clause. The following example illustrates the (unambiguous) movement of a *wh*-phrase from an embedded clause. Figure. 2. demonstrates this movement process.

- (10) a. I think she danced. (declarative sentence)
 b. I think who danced (conversion of the NP to the *wh*-phrase *who*)
 c. Do you think who danced (I-to-C movement)
 d. Who_i do you think t_i danced? (*wh*-movement)

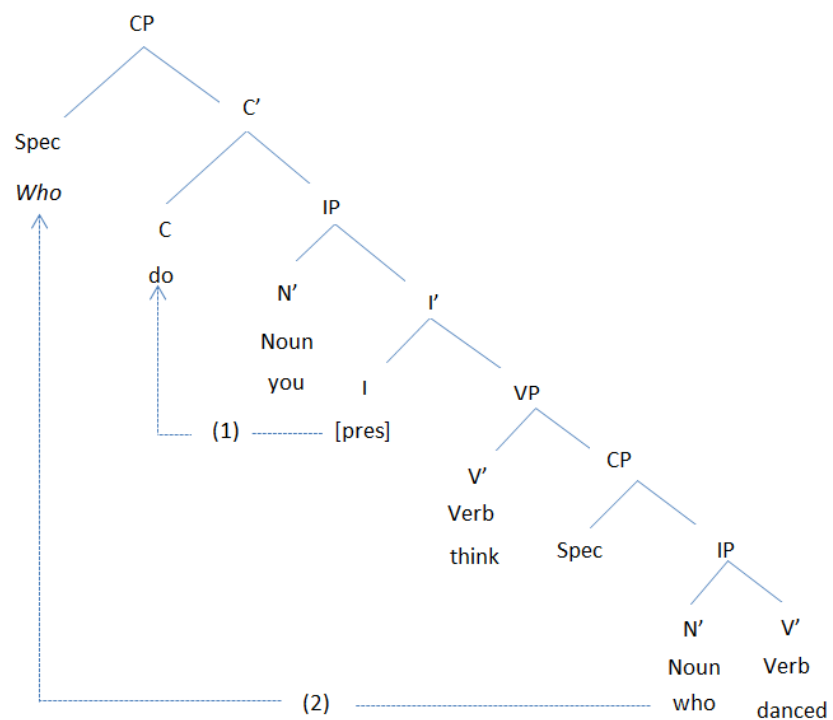


Figure. 2.

The movement of *wh*-phrases is not entirely free, however. There are positions from which *wh*-words cannot be extracted. These were called ‘islands’ by Ross (1967). According to Ross (1967), there are seven types of islands, including adjunct islands. Sentence-initial *wh*-elements cannot have their site of origin inside an adjunct clause, such as clauses introduced by expressions including *because*, *if*, *when*, as well as restrictive relative clauses (Ross 1967). In example (11) *whether* introduces an adjunct island, and the movement possibilities of ‘who’ are illustrated in the diagrams in (11c) and (11d). Figure. 3. is used to illustrate this.

- (11) a. I asked whether she danced.
b. I asked whether who danced.
*c. Who_i did you ask whether t_i danced?

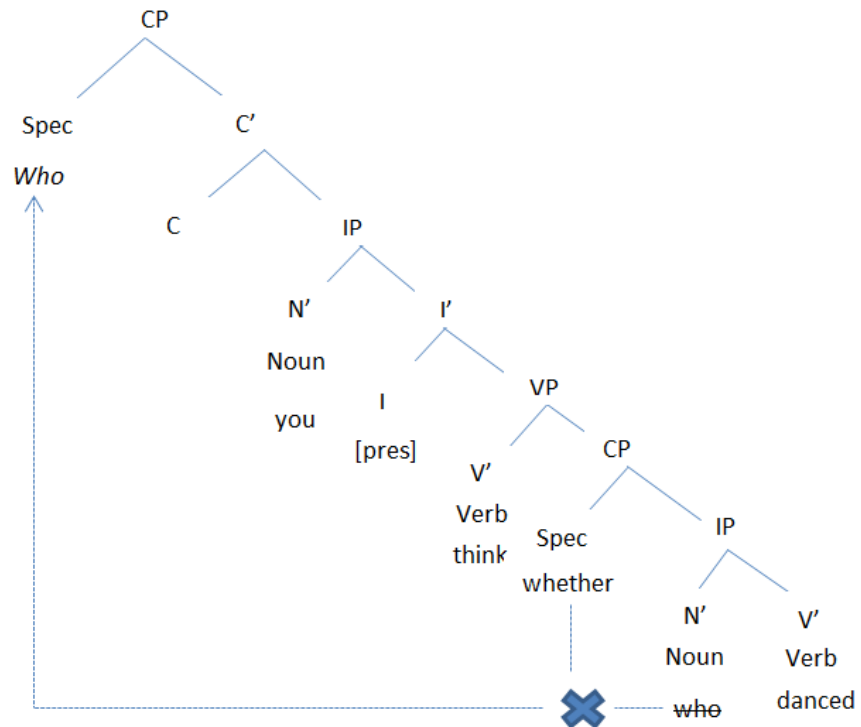


Figure. 3.

Various theories have been proposed to explain why it is not acceptable to extract a *wh*-phrase out of a *whether*-clause (Chomsky 1973). One analysis is known as Relativized Minimality (Rizzi 1990; Rizzi 1982). According to Relativized Minimality, *wh*-words must move in a stepwise fashion, such that each step in the derivation is local. *Wh*-movement is blocked, therefore, if there is an intervening expression of the same type, that is, another *wh*-phrase. Example (11c) depicts a violation of Relativized Minimality. In (11c), the expression ‘whether’ intervenes between ‘who’ and its trace. Therefore, (11c) is ungrammatical. Example (12b) shows that a *wh*-word cannot be extracted out of an embedded clause that is introduced by ‘why’. This constitutes another violation of Relativized Minimality.

- (12) a. Susan asked why Sam was waiting for Mary.

*b. Who_i did Susan ask why Sam was waiting for t_i?

As noted earlier, Mandarin Chinese *wh*-adjuncts such as *zenme* also undergo *wh*-movement. As such, they are subject to the same locality constraints as their English counterparts. For example, in Mandarin, a sentence with an adjunct *wh*-phrase like *weishenme* ‘why’ cannot be used to form a direct question if it originates inside a syntactic island (Huang, Li and Li 2009). Example (13) illustrates the ungrammaticality (taken from Huang et al. 2009).

(13) * ni zui xihuan [weishenme mai shu de ren]?

you most like why buy book DE person

‘Why do you like [the person who bought the books t]?’

In example (13), the extraction of *wh*-adjunct *weishenme* ‘why’ out of a relative clause is not possible. It cannot be extracted out of the relative clause, asking why the person bought the book. The resulting question would be ungrammatical because a relative clause is an island for *wh*-phrase movement. That is, a relative clause blocks the extraction of an adjunct *wh*-phrase. In Mandarin, A-not-A questions are one type of *wh*-island (Huang et al. 2009). This means that the expectation is that extraction of *wh*-adjuncts out of A-not-A questions will violate locality constraints. Before we present the details of the Mandarin experiment, we will briefly review the findings of previous research on children’s adherence to locality constraints.

Literature Review

Wh-movement and island constraints have been one important topic of investigation in the generative framework. There are a number of studies looking at English-speaking children's knowledge of locality constraints on *wh*-movement (e.g. Otsu 1981; de Villiers et al. 1990; Thornton 1990, 1992; Crain 1991; Thornton and Crain 1994; Otsu 2007; Sugisaki 2012).

One of the earliest studies investigating children's adherence to constraints on *wh*-movement was by Otsu (1981). Otsu investigated when and how English-speaking children master the locality constraints on the extraction of *wh*-words out of relative clauses. Consider, for example, the sentence *What is Jane drawing a monkey that is drinking milk with?* According to the constraint (which was known then as 'subjacency'), the *wh*-word 'what' cannot be extracted from the relative clause headed by 'a monkey', so that the sentence can only be asking what tool Jane is drawing with. In order to test children's knowledge of locality constraints on *wh*-extraction, Otsu examined 60 children aged between 3; 01 to 7; 11 with a story-telling task. On one typical trial, Jane is drawing a monkey with a crayon and the monkey is drinking milk with a straw. At the end of the story, children were asked to answer this question: *what is Jane drawing a monkey that is drinking milk with?* The prediction was that if children had the knowledge of the locality constraints, they should provide the answer 'a crayon'. But, if on the other hand, children did not have the relevant knowledge, they were expected to be at chance and provide either of the two possible answers, either 'a crayon' or

‘a monkey’. The results showed that the children consistently provided an answer like ‘a crayon’. This is evidence that English-speaking preschool children already have knowledge that *wh*-extraction out of relative clauses is prohibited.

In another study, de Villiers et al. (1990) investigated whether or not English-speaking children adhere to the constraints on long-distance movement of *wh*-words. Using a story-telling task, they tested 25 English-speaking preschool children between the ages of 3;7 and 6;11 on their interpretations of *wh*-questions. Six types of *wh*-questions were studied, as in (14) – (19). Note that (14) – (16) are *wh*-argument questions, (17) – (19) are *wh*-adjunct questions.

- (14) Who_i did the girl ask t_i to help t_i? (wh-argument with 0 medial)
- (15) Who_i did the girl ask t_i what to throw? (wh-argument with argument medial)
- (16) Who_i did Big Bird ask t_i how to paint t_i? (wh-argument with adjunct medial)
- (17) When_i did the boy say t_i he hurt himself t_i? (wh-adjunct with 0 medial)
- (18) How_i did Kermit ask t_i who to help? (wh-adjunct with argument medial)
- (19) When_i did the boy know t_i how he hurt himself? (wh-adjunct with adjunct medial)

As shown by the trace markers, the *wh*-words ‘who’ in (14) and in (16), and ‘when’ in (17) have two possible origins; the *wh*-phrase could have originated in either the matrix clause or the embedded clause. By contrast, the *wh*-words ‘who’ in (15), ‘how’ in (18) and ‘when’ in

(19) only have one possible origin – that is, they could only have been extracted from the matrix clause, due to the *wh*-word in the embedded Spec of CP. Parsing preferences aside, if children have adult-like knowledge of the constraints on long distance movement, then they should consistently allow both upstairs answers and downstairs answers for (14), (16) and (17), but only upstairs answers to (15), (18) and (19). This is because for (14), (16) and (17), there is no question word between the two clauses or extraction of a *wh*-argument out of a *wh*-adjunct clause, which means long distance movement is allowed for these three types of questions. For (15), (18) and (19), long distance is not allowed because the embedded clause in each question is headed by a *wh*-word, which is a barrier for *wh*-movement in that sentence.

Table. 1. Results of the experiment by de Villiers (1990)

Test sentences	Percentage of upstairs interpretation	Percentage of downstairs interpretation
(14)	68%	32%
(15)	70%	2%
(16)	63%	30%
(17)	50%	44%
(18)	23%	8%
(19)	48%	6%

Table. 1.

Table. 1. shows the experimental results. The experiment found that children at this age have not acquired a completely adult-like grammar. Children responded in an adult-like way to the ambiguous questions in (14) (16) and (17), with some proportion of upstairs answers (68%, 63% and 50%) and downstairs answers (32%, 30% and 44%). However, in addition to upstairs answers, children also provided some nonadult downstairs answers to (15), (18) and (19) (2%, 8% and 6% respectively). For example, children gave incorrect responses to questions like (18). Many children provided an answer to the embedded *wh*-word ‘who’, rather than the *wh*-word ‘how’ in the matrix. de Villiers et al. attributed this to the reason that children can only move one *wh*-phrase per sentence. More specifically, in first step, children move *wh*-word ‘who’ to the initial position of the embedded clause; after that, children stop moving the *wh*-adjunct further to the initial position of the sentence. Thus, de Villiers et al. interpreted this response as evidence to that the knowledge of successive cyclic movement is absent in children’s grammar. This is an interesting idea but it is worth noting that the data do not provide a great deal of support for this proposal as the numbers of errors are quite small.

Following on the previous study of de Villiers et al’s, Thornton and Crain (1994) investigated the emergency of successive cyclic movement, by testing English-speaking children’s interpretation of similar complex *wh*-questions, using the Truth Value Judgment Task. Contrary to de Villiers’ conclusion, the findings from this study suggest that children have knowledge of successive cyclic movement early in the course of acquisition. Fifteen children

(3;0-4;8, mean age=3;11) were tested on their production and comprehension of *wh*-questions in a series of experiments.

The first experiment was designed to elicit long-distance extraction of adjuncts. Children's correct production of adjunct extraction questions, i.e. *how do you think the Smurf got to the peanut store?*, would provide evidence for the claim that they have successive cyclic movement in their grammar. In this experiment, an experimenter acted out short vignettes using toys and props while another experimenter played the role of a puppet, who could not see what had happened. Child subjects were led to ask the puppet what had happened in the story. In this way, children produced long-distance extraction questions. The experiment found that four-year-old children successfully produced long-distance adjunct extraction questions. These questions are an indication that children have no difficulty with the computation associated with long-distance movement.

A following experiment were to test the prediction made by de Villiers et al that children who provided downstairs answers to ADJ + ARG questions would be the same as those who produce questions with a medial-*wh* in the production of long-distance questions. Children were tested of a comprehension task by de Villiers et al. and the elicitation task used in the first experiment in this study. In the comprehension task, experimenters acted out stories with toy characters. A puppet was required to answer the test question, which are ADJ + ARG questions, for each story. However, the question was too hard for the puppet to answer. So he

had to defer to the child. In this way, children had to provide answers to the ADJ + ARG questions. Children were tested in two parts, which were about one week apart. The experimental results showed that many children produced downstairs answers to ADJ + ARG questions. However, the wrong downstairs answers did not correlate with production of medial-*wh* questions in the elicitation experiment. That is, the findings do not support de Villier et al.' prediction that downstairs answers to ADJ + ARG questions and medial-*wh* in production are caused by the same reason. Rather, Thornton and Crain's study found there was a double dissociation. Children who give the 'wrong Q down' response are not necessarily the ones who ask medial-*wh* questions and children who produce medial-*wh* questions do not necessarily give the downstairs response.

Another experiment was designed to assess whether children have adult-like interpretation of questions, i.e. *What did he say was in the box?*. According to de Villiers et al., children don't have successive cyclic movement. If so, they were expected to associate the *wh*-words with the embedded clauses rather than the matrix clauses. On the contrary, if children have the knowledge of long-distance movement of *wh*-words in their grammar, they should provide upstairs answers to the test questions. The experimental results showed that all child participants provided upstairs answers to the test sentences, which means they interpret the questions in the same way as adults do. So the findings from this experiment do not support de Villiers' proposal that children lack knowledge of successive cyclic movement. Rather,

this experiment indicates that children have knowledge of successive cyclic movement in their grammar.

Despite some controversy, previous research on English-speaking children for the most part indicates that English-speaking children have knowledge of the locality constraints on *wh*-movement. However, as far as we know, only two studies have investigated children's knowledge of locality constraints in *wh*-in-situ languages like Mandarin Chinese and Japanese, one by Sugisaki (2012) and one by Otsu (2007). Both studies focused on Japanese. First, we review briefly Otsu's study. Otsu (2007) tested 20 three-year-old and 20 four-year-old Japanese-speaking children on their knowledge of *wh*-island constraints. Children were tested using a story-telling Task. A typical trial is illustrated in (20).

(20) a. *Experimenter*:

Hanako-wa [dare-ga suki ka] iimashita ka?

Hanako-Top who-Nom like Q said Q

'Did Hanako say who she likes?'

Puppet: Iie. 'No'.

b. *Experimenter*:

Taro-wa [dare-ga suki to] iimashita ka?

Taro-Top who-Nom like C said Q

'Who did Taro say that he likes?'

Puppet: Hai. ‘Yes.’

In the accompanying story, Taro and Hanako were watching TV together in the living room. Their mother came home, and brought them snacks. And she asked Taro, “Taro, who’s your favourite?” Taro replied, “Of course, I like Doraemon.” Mother asked Hanako, “And you?” Hanako likes Nobita, but felt a bit shy and replied, “That’s a secret.” When the story concluded, one experimenter asked questions as in (20a) and (20b) and the other experimenter who played the role of a puppet provided the corresponding answers as in (20a) and (20b).

The prediction was that if children have knowledge of the constraints on *wh*-words, then they would be expected to distinguish between (20a) and (20b). The *wh*-phrase in (20a) should not be able to take matrix scope due to the constraint, and thus (20a) functions as a yes/no question; but the *wh*-phrase in (20b) is in a declarative complement clause and should be able to take matrix scope, thereby making (20b) a *wh*-question. More specifically, children were expected to judge the puppet’s answer as correct for (20a) but as inappropriate for (20b). The prediction was borne out. Children provided 95% correct responses to (20a) and 92% of correct responses to (20b). The study indicated that Japanese-speaking children, as young as three years old, already have knowledge of the constraints on *wh*-phrases.

In a more recent study, Sugisaki (2012) examined children’s knowledge of *wh*-movement and its locality constraints in Japanese. Thirty seven Japanese-speaking children,

ranging in age from 3;10 years to 6;5 years were tested on their interpretation of questions containing a *before*-clause, an island for *wh*-movement. Representative test sentences are given in (21) and (22).

- (21) Naze gohan-o taberu maeni kaerusan-wa ofuro-ni hairimasita ka?

why meal-ACC eat before frog-TOP bath-DAT entered Q

‘Why did the frog take a bath before having a dinner?’

- (22) Naze kaerusan-ga kaettekita to okaasan-wa omoimasita ka?

why frog-NOM came-back COMP mother-TOP thought Q

‘Why did the mother think that the frog had come back home?’

The prediction was that, if children have knowledge of locality constraints on movement of *wh*-word *naze*, then they should not associate the *wh*-word in (21) with the *before*-clause (downstairs interpretation). That is, (22) can only be used to ask about the reason for why the frog took a bath, rather than why the frog had dinner (upstairs interpretation). By contrast, sentence (22) is ambiguous. It can be interpreted either as a question asking the reason why the frog came back in the mother’s mind (upstairs interpretation), or as a question, asking the reason why the mother got the idea that her son had already come home (downstairs interpretation).

The experimental results confirmed the prediction. In responding to (21), children interpreted *naze* as an element of the matrix clause and provided upstairs answer 98.6% of the time. By contrast, in responding to (22) both upstairs answers and downstairs answers were provided by children to an equal extent. The findings indicated that preschool Japanese-speaking children respect the constraint that rules out associating *naze* with the *before*-clause.

Taken together, previous research has shown that children abide by locality constraints in languages with overt *wh*-movement, such as English, as well as in languages with *wh*-words in-situ, such as Japanese. As far as we know, no study has been conducted to investigate locality constraints on *wh*-adjunct movement in Mandarin.

Since Mandarin Chinese and English are representative of languages from different typological types, the present study promises to provide critical data in evaluating whether locality constraints are a common property of human languages. In addition, the present study differs from Sugisaki (2012) in that we examine extraction out of a different island; the present study inquires whether or not children permit *wh*-movement out of an A-not-A island, while Sugisaki investigated sentences with a *before*-clause adjunct island. Furthermore, as we have noted, Mandarin is a different case from Japanese because in Mandarin, adjunct phrases move in the surface syntax, whereas argument phrases do not. So Mandarin represents a different cases from Japanese. Given the hybrid nature of Mandarin, we could imagine that children have some difficulty acquiring the constraints.

Experimental Hypothesis

The present study investigated Mandarin-speaking children's knowledge of the locality constraints on *wh*-adjunct movement. The study was constructed to investigate children's interpretations of the minimal pair in (23) and (24).

- (23) Tanglaoya zenme faxian [wupo youmeiyou bian piaoliang] de ?

Donald Duck how find out witch whether or not become beautiful DE

‘How did Donald Duck find out whether the witch had become beautiful?’

a. How_i did [Donald Duck find out t_i [whether the witch had become beautiful]]?

*b. How_i did [Donald Duck find out [whether the witch had become beautiful
t_i]]?

- (24) Tanglaoya **youmeiyou** faxian [wupo **zenme** bian piaoliang de]?

Donald Duck whether or not find out witch how become beautiful DE

‘Did Donald Duck find out how the witch had become beautiful?’

As discussed earlier, a *wh*-adjunct cannot move out of an island. The A-not-A expression *youmeiyou* ‘whether or not’ in Mandarin Chinese constitutes a *wh*-island, and blocks the extraction of the *wh*-adjunct *zenme*. In example (23), the embedded clause contains an A-not-A question. Therefore, *wh*-word *zenme* ‘how’ in the matrix could only have originated in the matrix clause following the verb *faxian* ‘find out’; it could not have originated in the embedded clause. Therefore, example (23) asks about the way in which Donald Duck found

out about the witch's transformation, rather than the way in which the witch had become beautiful. In this structure, the *wh*-adjunct *zenme* 'how' cannot be used to form a *wh*-question. Instead, the sequence of words must be interpreted as a yes/no question (see e.g., Huang 1982a). Hence, the experimental prediction of the present study is that Mandarin-speaking children will interpret word sequences such as (23) as *wh*-questions, but will interpret word sequences such as (24) as yes/no questions. Then children should provide an upstairs answer in response to (23), but should simply say 'Yes' in response to (24). The details of the experiment design are presented in the following section.

Experiment

The experiment was devised to investigate Mandarin-speaking children's knowledge of the locality constraints on *wh*-adjunct movement. The experiment tested sentences as illustrated in (25) and (26).

(25) Tanglaoya zenme faxian [wupo youmeiyou bian piaoliang] de?

Donald Duck how find out witch whether or not become beautiful DE

'How did Donald Duck find out whether the witch became beautiful?'

a. How_i did [Donald Duck found out t_i [whether the witch became beautiful]]?

*b. How_i did [Donald Duck found out [whether the witch became beautiful t_i]]?

(26) Tanglaoya youmeiyou faxian [wupo zenme bian piaoliang de]?

Donald Duck whether or not find out witch how become beautiful DE

‘Did Donald Duck find out how the witch became beautiful?’

As noted earlier, (25) is an unambiguous *wh*-question, that can only be targeting the matrix clause, that is, it can only be asking about the way in which Donald Duck found out about the witch. In contrast, with the position of the *youmeiyou* and *zenme* reversed, (26) is no longer a *wh*-question but a yes/no question that asks whether or not Donald Duck found out the witch became beautiful. We expected participants to provide an answer to the *wh*-question in (25) and to answer ‘yes’ in response to (26).

Participants

Thirty-two Mandarin-speaking children, ranging in age from 4;2 year to 5;3 years with a mean age of 4; 7, were tested on their interpretation of the two types of questions. In addition, twenty Mandarin-speaking adults were tested as controls. The child participants were recruited from the kindergarten at Beijing Language and Culture University in Beijing. The adult participants were all master’s students at Beijing Language and Culture University.

Method

The methodology was the two-alternative forced choice task (2AFC). The two-alternative forced choice is a research method, developed by Gustav Theodor Fechner, for eliciting responses from subjects (Gescheider 1997; Linschoten et al. 2001; Blackwell 1953). In the present study, three experimenters were involved. One experimenter acted out short stories in

front of the child participant, using toys and props. The second and third experimenters each played the role of a puppet, who watched the stories alongside the child participant. At the end of each story, the first experimenter asked a question about what happened in the stories, using one of the test sentences. Each puppet then provided one possible answer to the question. The child's task was to judge which puppet had provided the correct answer to the question.

The child participants were introduced to the task and tested individually. Before the experimental items were introduced, two types of practice trials were administered to familiarize the children with the task. On one type of trial, the experimenter asked a *wh*-question and on the other type of practice trial, the experimenter produced what should be interpreted as a yes/no question. For the experimental items, following each *wh*-question, the two puppets provided a possible answer, one being the upstairs answer and the other being the downstairs answer. Following each yes/no question, one puppet provided a positive answer while the other provided a negative answer. The child participants' task was to judge which answer was correct. Only those children who gave correct judgments to the two practice trials were included in the experiment. The adult control participants were led through the stories using pictures and responded to the stories in writing, indicating which of the two answers was correct.

Materials

Four test stories were created. Each story was followed by a *wh*-question and a yes/no question. Appendix C demonstrates all of the test stimuli in this experiment. Here we use one typical trial to illustrate.

Happy Goat grows many vegetables in his yard (see Figure. 4.). One day, he came back home after school. But he found out that the biggest tomato was missing (See Figure. 5.). He was wondering who has stolen the tomato from his yard. He asked his friend, Black Cat Police Chief, to help him find out who was the thief (see Figure. 6.). Black Cat Police Chief noticed there was a house at a corner of the yard (see Figure. 7.). He decided to hide at the top of the house, from where he can see clearly everything in the yard. And several days later, he saw there was one sheep coming into the yard, picking up one cauliflower with him and then left (see Figure. 8.) But the sheep was walking in a strange way, always holding a board to cover his face (see Figure. 9). Police Chief thought that the guy should be someone from Happy Goat's family or a friend, which he just didn't know. However, Black Cat Police Chief was surprised to see that the sheep took off his hat and coat. It was Grey Wolf (Figure. 10.). He decided to let Happy Goat know and then discuss how to prevent Grey Wolf entering into the yard.



Figure. 4.



Figure.5.



Figure.6.



Figure.7.



Figure. 8.



Figure. 9.



Figure. 10.

At the end of the story, the experimenter uttered the test questions in (27) and (28). After the questions, the two puppets provided the two possible answers as in (27a) and (27b) and also (28a) and (28b).

(27) Heimaotou jingzhang zenme faxian huitailang youmeiyou tou cai de?

Black Cat Police Chief how find out Grey wolf whether or not steal vegetable DE

‘How did Black Cat Police Chief find out whether Grey Wolf stole vegetables?’

A: Huazhuang cheng xiaoyang.

dress as sheep

‘By dressing himself as a sheep.’

B: Cang zai fangdingshang.

hide at roof

‘By hiding on the roof.’

(28) Heima jingzhang youmeiyou faxian huitailang zenme tou cai de?

Black Cat police chief whether or not find out Grey wolf how steal vegetable DE

‘Did Black Cat Police Chief find out how Grey Wolf stole vegetables?’

A: You, ta faxian le.

yes he find out-ASP

‘Yes. He found it out.’

B: Cang qilai.

hide

‘By hiding himself.’

After hearing the two possible answers to each question, children were asked to judge which answer was the correct one. The questions were repeated on request. The order of presentation of the two possible answers and the types of questions was counterbalanced across trials. To remind the participants of the events that had taken place in the story, the final scene of the stories (i.e. Figure. 10) was kept visible to the child participants.

Before reporting the results of our experiments, it is useful to restate our experimental hypotheses. If Mandarin speakers have the knowledge of locality constraints on *wh*-adjunct movement, we expect them to assign different meanings to the *wh*-questions with A-not-A

youmeiyou ‘whether or not’ in different positions. To be specific, Mandarin-speakers, including both adults and children, would interpret the sentence in (27) as a *wh*-question. They were expected to access only the upstairs interpretations for structures like (27). So they should choose the corresponding upstairs answers (e.g., (27a)). Participants should respond to (28) as a yes/no question, rather than a *wh*-question, and choose the positive answer provided by the puppet. For example, in the example context, they should accept the answer in (28a) but reject the answer in (28b).

Results

The responses of the child participants to the two types of test sentences were recorded using a digital recorder. Two children were eliminated from further data analysis because they gave less than 50% correct answers to the practice trials. The dependent measure in this study was the proportion of the participants’ correct answers to the questions.

Here are the main findings. In response to the sentences as in (27), all children and adults interpreted them as *wh*-questions and chose an answer. Children chose upstairs answers 93% of the time and adults gave upstairs answers 100% of the time. A Mann-Whitney test revealed no significant difference between children and adults in the proportion of correct responses ($Z = 1.20, p = .24$). In response to the sentences like (28), children chose a ‘yes’ answer 94.2% of the time while adults provided a ‘yes’ answer on 100% of the trials. Again, a Mann-

Whitney test revealed no significant difference in the proportion of correct responses by children and adults ($Z=.73, p=.47$). The results are presented in Table 2 and Figure 11.

Table 2 & Figure 11. Proportion of correct responses to, and Standard Deviation of the two types of test sentences by children (N=30) and adults (N=20)

Test sentences	Children		Adults	
	Proportion of Correct Responses	Standard Deviation	Proportion of Correct Responses	Standard Deviation
<i>Wh</i> -question	93.1% (117/120)	0.08	100% (80/80)	0
Yes/No question	94.2% (113/120)	0.20	100% (80/80)	0

Table. 2.

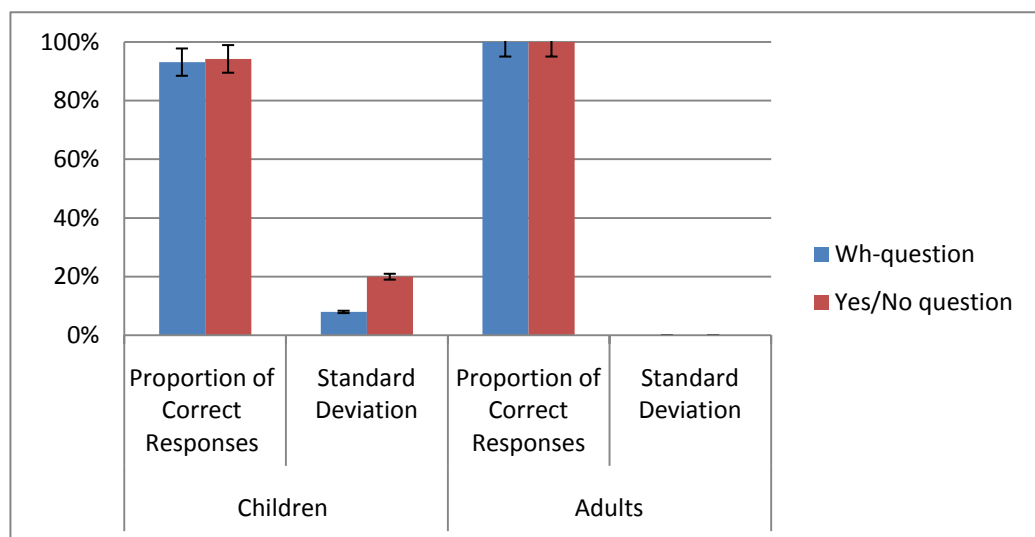


Figure. 11.

In summary, both children and adults interpreted the sentences with *wh*-words in the matrix clause as *wh*-questions. Since *youmeiyou* ‘whether or not’ in the embedded clause is an island for *wh*-extraction, only the upstairs interpretation is available in these questions. Mandarin speakers only chose the upstairs answers for sentences with *wh*-adjuncts in the matrix and *youmeiyou* ‘whether or not’ in the embedded clause. When *youmeiyou* ‘whether or not’ occurs in the matrix clause, Mandarin-speaking children and adults interpreted it as a yes/no question and chose a yes/no answer. This is evidence that Mandarin-speaking children have adult-like knowledge of locality constraints on *wh*-adjuncts movement.

Discussion

In English, *wh*-questions are formed by moving the *wh*-word to the Spec of CP position. There are, however, cases where *wh*-movement is prohibited, due to a constraint on extraction; for example, extraction is not permitted out of relative clauses, adjunct clauses etc. These cases are dubbed as islands (Ross 1967). Rizzi (1990) attributed the island phenomenon to Relativized Minimality, which prohibits a potential barrier of the same type (e.g. another *wh*-item) from intervening between *wh*-words and their traces. When there is an intervener between a *wh*-phrase and its trace, the sentence violates Relativized Minimality and results in ungrammaticality.

In Mandarin Chinese, *wh*-adjuncts move from their base-generated position to a focus position (Lin 1992; Tsai 1999). Although the landing site is different, this is like *wh*-

movement in English. Therefore, we expect the same locality constraints on *wh*-movement also apply to *wh*-adjuncts in Mandarin Chinese. The present study has extended this line of research to *wh*-questions containing an A-not-A question, which are *wh*-islands in Mandarin. Our experiment showed that Mandarin-speaking children have the knowledge that A-not-A questions are islands for *wh*-extraction. For a sentence with *wh*-word *zenme* ('how') in the matrix and A-not-A in the embedded clause, the only possible interpretation is a *wh*-question interpretation, with only the upstairs interpretation available. For a sentence with A-not-A in the matrix and *wh*-word *zenme* ('how') in the embedded clause, the structure is interpreted as a yes/no question. Our findings suggest that children can distinguish the two types of questions and choose corresponding answers, as adults do. This indicates that Mandarin-speaking children have adult-like knowledge of locality constraints on *wh*-adjunct movement. This is the first study, to our knowledge, that investigates children's knowledge of locality constraints in Mandarin Chinese.

Our experiment found that children adhere to the locality constraint on *wh*-adjunct movement in Mandarin Chinese. This is impressive, given that the input to children is not easy to sort out; some instances of *wh*-words are *in-situ*, while others are moved to a focus position. How does the child figure out when *wh*-words move, and in which cases the surface configuration is informative? It seems that if sorting this out is left to experience, children will be likely to make errors for some time. In fact, there is little evidence for complex questions

like the ones investigated in this study, so, even if children were to learn the relevant constraints from the adult input, it would be a slow process, given the paucity of relevant sentences. A search of the six Chinese corpora (including Beijing, Beijing 2, Chang, Context, Zhou 1 and Zhou 2) in the CHILDES database (MacWhinney 2000) yields few informative exemplars. Of the 243,593 utterances in the corpora, there are 1501 instances of *zenme* in the input of adults. However, no single instance of *youmeiyou* was found in the search. We did a search of the spontaneous adult-child language samples from nine different children (age range: 1;6 to 4;3) in the Taiwan Corpus of Child Mandarin (TCCM, Cheung, Chang, Ke and Tsay 2011). In this corpus, 1765 instances of *youmeiyou* were found. However, there were no sentences with the combination of *youmeiyou* and *zenme*. Given this scarcity of related evidence and the complexity of the structures we tested, it is unlikely that children could learn the possible interpretations of the test sentences based on the adult input. Of course, it is important to acknowledge that the Mandarin corpora in CHILDES and also the TCCM are limited in size and that our finding could be a sampling error. However, we are inclined to interpret our findings as evidence that children's language development process is assisted by innate linguistic knowledge.

Combined together with previous research, Mandarin, Japanese and English preschool children demonstrate that they have knowledge of *wh*-adjunct movement and the constraints that limit interpretation. The fact that early emergence of this knowledge has been

demonstrated in children's grammars across languages from different typological families invites the inference that locality constraints are an abstract property of human language. However, it is important to acknowledge that acquisition of Mandarin Chinese in the generative framework is still in its infancy. There are still many investigations on wh-movement in child Mandarin that remain to be done.

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Chapter 5: Conclusion

This chapter summarizes the major findings and discusses the relevance of these new findings for the field of language acquisition. This thesis presents investigations of Mandarin-speaking preschool children's acquisition of constraints in complex syntactic structures. In particular, we examined children's interpretations of three structures in Mandarin Chinese. We reported three studies, which addressed the following three research questions:

(i) How do Mandarin-speaking children interpret negated disjunction in Verb Phrase

Ellipsis structures?

(ii) How do Mandarin-speaking children interpret disjunction when it is bound by the

adverbial quantifier *dou* ('all')?

(iii) Do Mandarin-speaking children have adult-like knowledge of locality constraints

on *wh*-adjunct movement?

Children's understanding of these three kinds of structures and their possible interpretations is of interest because it is likely that children receive little information about their possible meanings in the input. As we have noted, in all of these situations there is a 'poverty of the stimulus'. Furthermore, given the accepted lack of negative evidence, children do not receive useful information about which interpretations are not possible. One question we have asked is how children acquire the adult-like range of sentence meaning pairs. Do children initially

make mistakes, and assign meanings that are not permitted in the adult grammar? If children's linguistic knowledge is all gleaned from the input, and analogy is an important learning mechanism, then it is likely that children will over-generate and make errors. In this case, the question that must be addressed is how children manage to recover from their errors and converge on the adult grammar. On the other hand, if children are born with a Universal Grammar that contains principles, or constraints, that hold certain kinds of overgeneralization in check, then children may be guided in the complex pattern of interpretations they permit for certain sentences. This thesis has assumed the latter position. The three structures that are tested in this thesis all probe whether or not children give the same range of interpretations to sentences as adults, and in particular, whether they rule out interpretations that are constrained by Universal Grammar.

On the nature of lexical parameters

Following the initial insights from Szabolcsi (2002) and Goro (2004, 2007), the experiments with Mandarin disjunction reported in the present thesis analyzed the cross-linguistic variation that is observed in the interpretation of disjunction in negative sentences by adopting the Principles and Parameters approach. More specifically, the observed cross-linguistic variation is attributed to a lexical parameter called the Disjunction Parameter. This analysis was first suggested by Szabolcsi (2002) and then further pursued by Goro (2004, 2007). The proposed analysis by Goro was adopted (and extended to conjunction) in subsequent work by

Crain (2008, 2012), Crain, Goro and Minai (2007); Crain, Goro, and Thornton (2006); Crain and Khlentzos (2008) .

The Disjunction Parameter partitions languages into two classes. In one class of languages, disjunction is a positive polarity item. By definition, a positive polarity item (PPI) takes scope over (local) negation. By definition, a Positive Polarity Item takes scope over negation at the level of semantic interpretation. The parameter value according to which disjunction takes scope over negation is designated OR= [+PPI]. This is the value of the Disjunction Parameter in Mandarin Chinese. Other adult languages that adopt this value include Japanese, Hungarian, Russian, Serbo-Croatian, Slovak, Polish, and Italian. In the other class of languages, disjunction is not a positive polarity item, so the logical form mirrors the surface syntax in negated disjunctions, with negation taking scope over disjunction. On the other parameter value, disjunction is designated OR = [–PPI]. This is the English value of the Disjunction Parameter. Other adult languages that adopt this value include German, French, Greek, Romanian, Bulgarian, and Korean. Due to the Semantic Subset Principle, children acquiring all human languages are expected to initially adopt the value OR = [–PPI], which corresponds to the Subset value of the parameter.

There is abundant empirical support for the analysis of disjunction as a lexical parameter. If disjunction words are PPIs in some languages, as we have suggested, then negation will take scope over disjunction in these languages in certain linguistic environments.

One linguistic environment that cancels the polarity sensitivity of PPIs is in sentences in which negation is situated in a higher clause than the one that contains disjunction. Of course, in languages where disjunction is not a PPI, negation takes scope over disjunction regardless of whether these expressions are situated in the same clause, or in different clause. But the critical observation is that all human languages should converge on the same conjunctive interpretation of disjunction when the polarity sensitivity of PPIs is canceled, as when negation and disjunction reside in different clause. This expectation of the parametric account adopted in the present study has been confirmed in a number of typologically distant languages, using a range of linguistic structures that cancel the polarity sensitivity of PPI (Crain 2008, 2012). We extended these linguistic structures, to included verb phrase ellipsis, in Chapter 2.

The idea that cross-linguistic variation is encoded in lexical parameters has been advocated in other research, for example in recasting the *wh*-movement parameter originally proposed by Huang (1982). According to Huang (1982), the *wh*-parameter partitioned languages into classes according to the level of representation at which *wh*-movement applied, i.e., whether *wh*-movement applied at S-structure, as in English, or at LF, as in *wh*-in-situ languages like Mandarin Chinese. Subsequently, however, Tsai (1994) recast the *wh*-movement parameter as a lexical parameter. The new formulation of the *wh*-parameter by Tsai (1994) makes no reference to the levels of representation, as in the formulation of the parameter offered by

Huang (1982). Instead, the lexical parameter that distinguished languages such as English from ones such as Mandarin was stated in terms of features that *wh*-words may or may not bear (cf. Huang, Li & Li, 2009). In brief, setting the *wh*-parameter amounted to deciding whether to assign a plus feature [+wh] or a minus feature [-wh] to a lexical item (the head of a *wh*-phrase). In English, *wh*-words are [+wh]. Consequently, *wh*-words have inherent quantificational force. By contrast, *wh*-words in Chinese are [-wh]. Consequently, *wh*-words in Mandarin Chinese lack inherent quantificational force, and function like variables which inherit their quantificational force from other quantificational expressions that are overt or inferred in languages such as Mandarin Chinese. Of course, this analysis is challenged by the unified account, proposed by Chierchia (2013), which contends that *wh*-words are simply existential items, as discussed in Chapter 3.

It is worth pointing out, finally, that there is another benefit to gain by analyzing logical expressions as lexical parameters. Adopting this analysis restricts the scope alternatives that are available for the application of the Semantic Subset Principle. By restricting the alternative scope possibilities to those specified in lexical parameters, we avoid generating a range of scope interpretations that are not attested across languages. To cite just one example, when the English PPI *some* appears in the Subject position of negative sentences (e.g., *Some detective did not find the clue*), it is never ‘reconstructed’ so as to be interpreted within the scope of negation (NOT > \exists). This is despite the fact that a ‘reconstructed’ analysis (NOT >

\exists) would generate a stronger (subset) reading, as compared to the in-situ (superset) analysis of some ($\exists > \text{NOT}$). On a parametric account, the English PPI some is never forced to undergo reconstruction, so the unattested reading is never generated. On the other hand, if a general purpose mechanism was responsible for generating scope ambiguities, it would be difficult to explain the absence of this strong (subset) reading of English negative sentences with some in the Subject position. In short, the lexical parameter account sets boundary conditions on the application of the Semantic Subset Principle, in exactly the right ways.

The interpretation of disjunction in Verb Phrase Ellipsis

As background to the two studies on disjunction, we have noted that Mandarin Chinese speakers and English speakers assign different interpretations to disjunction in negated sentences. For an English sentence, *John did not order sushi or pasta*, English speakers interpret it as ‘John did not order sushi AND John did not order pasta’. For its counterpart in Mandarin, *Yuehan meiyou dian shousi huozhe yidalimian*, Mandarin-speaking adults interpret it as ‘It is either sushi or pasta that John did not order’. Mandarin-speaking children, however, pattern with English speakers, assigning a conjunctive meaning to the sentence. This means that they are disregarding the linguistic evidence provided in the input. This is due to the fact that children are initially conservative in assigning interpretations, especially when the possible range of interpretations available for each language like in a subset-superset relationship; this is the Semantic Subset Principle (Crain, Ni and Conway 1994). This

difference among different languages is attributed to the disjunction operators (Szabolcsi 2002). To be more specific, in Mandarin, disjunction is a Positive Polarity Item (PPI), which takes scope over negation and therefore generating disjunctive interpretation. In English, disjunction is not a PPI. Disjunction does not need to take scope over negation. Rather, negation takes scope over disjunction, giving rise to conjunctive inference. These cross-linguistic differences are striking, but in certain circumstances, polarity sensitivity can be cancelled. Previous research indicated that, when the disjunction operator is not realized in the surface syntax, its polarity sensitivity is cancelled (see Zhou and Crain 2012; Crain et al. 2013). This background brings us to the first two studies. If children (and adults) know the polarity-sensitivity cancelling contexts that constrain the interpretations they permit for negated disjunction, then Mandarin-speaking adults and children are expected to assign the same interpretations for sentences with negated disjunction.

The first study investigated the interpretation of disjunction in structures with Verb Phrase Ellipsis (VPE), where the disjunction is not overtly realized, as illustrated in (2) below. Due to the fact that the polarity-sensitivity of ‘or’ is cancelled in VP ellipsis structures, Mandarin-speaking adults and children were predicted to interpret the negated disjunction in VPE in the same way, while their interpretations of simple sentences with the overt disjunction operator *huozhe* in (1) were expected to be treated differently.

(1) Min meiyou dian shousi huozhe yidalimian

Min not order sushi or pasta

‘Min didn’t order sushi or pasta.’

(2) Min dianle shousi huozhe yidalimian, danshi Yuehan meiyou

Min order-ASP sushi or pasta but John not

‘Min ordered sushi or pasta, but John didn’t.’

Using the Truth Value Judgement Task (Crain and Thornton 1998), we tested 34 Mandarin-speaking children, whose age ranged from 4;1 to 5;4. In addition, 25 adults were also tested. Our experiment found that Mandarin-speaking children assign a single conjunctive interpretation for (1). As expected, Mandarin-speaking adults differ in the interpretations they allow, since in this context, disjunction takes scope over negation. In the structure with Verb Phrase Ellipsis in (2), however, the difference disappears. Mandarin-speaking children patterned with Mandarin-speaking adults in their interpretation of (2), that is, both groups assigned a conjunctive meaning to it. In other words, our experiment confirmed the prediction that when disjunction is not overtly realized in structures with Verb Phrase Ellipsis, the polarity sensitivity is cancelled and no longer takes scope over negation.

The findings from Chapter 2 contribute to a recent theoretical proposal about how scope assignments are generated in human languages, about the nature of polarity sensitivity, and about the correspondence between logical expressions in classical logic and in human

languages. One of the claims of this proposal is that disjunction is a positive polarity item (PPI) in some languages, but not in others. Another claim of the proposal under consideration is that polarity sensitivity is a superficial phenomena, such that both negation and disjunction must be overt and contained in the same clause in order for an inverse scope reading to be generated, according to which disjunction takes scope over negation (OR > NOT). In the absence of an inverse scope reading, negated disjunctions are expected to be assigned a conjunctive interpretation, as in classical logic (NOT > OR). The findings of Chapter 2 provide empirical confirmation for these joint proposals. It turned out that, when disjunction was part of an elided verb phrase with negation, the interpretation of disjunction was consistent with de Morgan's laws of classical logic, for both children and adults. This finding supports the proposal that disjunction is a PPI when it is overt and when it resides in the same clause as negation. The findings also support the conclusion that human languages assigned disjunction an inclusive-or reading, such that it generates a conjunctive inference when it is interpreted as being in the scope of negation.

The interpretation of disjunction in the scope of *dou*

In Mandarin Chinese, *wh*-expressions and free choice items in the scope of *dou* ('all') generate a conjunctive interpretation (Zhou 2013; Zhou and Crain 2011; Huang and Crain 2013). Example (3) and (4) illustrate this.

(3) Yuehan shenme shuiguo dou chi

John what fruit all eat

‘John eats any kind of fruit.’

(4) Yuehan renhe shuiguo dou chi

John any fruit all eat

‘John eats any kind of fruit.’

A recent semantic theory (Chierchia 2013; Fox 2007) unifies *wh*-expressions, Free Choice items, such as *any* and disjunction operators as existential items, i.e. \exists -items. The relationship between existential quantification and disjunction is well known. In a finite domain, say with two individuals, Jon and Ted, the statement with an existential quantifier *Someone laughed* is logically equivalent to the disjunctive statement *Jon or Ted laughed*. This equivalence carries over straightforwardly to negation; the negative statement *Nobody laughed* is logically equivalent to the negated disjunction *Neither Jon nor Ted laughed*. This in turn, is logically equivalent to a conjunction of two negations. *Jon didn't laugh and Ted didn't laugh*. We have seen, further, that the Mandarin negative polarity expression *renhe* and the Mandarin *wh*-word *shenme* ‘what’ are existential expressions that can be bound by the quantificational adverb *dou*. When they are bound by *dou*, the NPI *renhe* and the *wh*-word *shenme* are assigned a universal interpretation. In a finite domain, a universal interpretation is logically equivalent to a conjunction. So, if the universal statement *Everybody laughed* is true in a

domain with two individuals, Jon and Ted, then this statement is logically equivalent to a conjunction: *Jon laughed and Ted laughed*. This leads to a specific prediction on a unified account. The prediction is that disjunctive phrases should generate a universal (‘conjunctive’) interpretation when they are bound by *dou* (‘all’).

We investigated this prediction in Chapter 3. Example in (5) and (6) illustrate a pair of test sentences in the study.

(5) Zai xiaomao huozhe xiaogou shenbian, gongfu xiongmao dou zhong-le shu.

at cat or dog next to Kung Fu Panda all plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat and next to a dog.’

(6) Zai xiaomao huozhe xiaogou shenbian, xiongmaomen dou zhong-le shu.

at cat or dog next to pandas all plant-ASP tree

‘Pandas (all) planted a tree next to a cat or next to a dog.’

Taken previous research together, we predict that when disjunction is bound by *dou* (‘all’), it gives rise to a conjunctive interpretation. In Mandarin Chinese, the adverbial quantifier *dou* (‘all’) normally quantifies over plural expressions. When there is no plural phrase available, as in (5), *dou* (‘all’) has to look for something else to quantify over. In the case of (5), *dou* (‘all’) takes scope the disjunctive phrase *xiaomao huozhe xiaogou* (‘a cat or a dog’),

generating a conjunctive inference. When there is a plural expression preceding *dou* ('all'), as in (6), it is expected that *dou* ('all') takes scope over the plural expression *xiongmaomen* ('pandas'), rather than the disjunctive phrase *xiaomao huozhe xiaogou* ('a cat or a dog'). In that case, it gives rise to the distributive meaning that all pandas plant a tree next to a cat or a dog.

This experiment also used the Truth Value Judgement Task to test children. A total of 27 Mandarin-speaking children (age ranging from 4;2 to 5;4) were tested on their interpretation of sentences as in (5). Twenty adults were tested as controls. In a context where Kung Fu Panda planted a tree next to a cat, Mandarin speakers judge sentence (5) false, for the reason that no dog received a tree. In a context where three pandas all planted a tree next to a cat, Mandarin-speaking children judged (6) to be true. This indicates that Mandarin-speaking children assign a conjunctive interpretation to the disjunction phrase *xiaomao huozhe xiaogou* ('a cat or a dog'), which it is bound by *dou* ('all'). These findings provide empirical evidence for the semantic theory (Chierchia 2013; Fox 2007). The experimental results confirm our hypothesis of this study, that when disjunction is bound by *dou* ('all'), it gives rise to conjunctive inference. Mandarin preschool children have this constraint in their grammar.

Locality constraints on *wh*-adjuncts in Mandarin

When forming *wh*-questions, *wh*-words in English move to the initial position. Moreover, when there is more than one clause in a sentence, *wh*-words move from their extraction site

successive-cyclically through intermediate clause positions to the initial position of the sentence. However, *wh*-movement is not entirely free. There are cases where *wh*-movement is constrained. For example, *wh*-words cannot move out of ‘islands’ (Ross 1967). Adjunct clauses, i.e. clauses introduced by *because*, *whether*, *if*, *when* et al., are all types of island for *wh*-movement. Our last study tested a constraint on movement out of an adjunct *wh*-island.

In contrast to *wh*-movement in English, Mandarin Chinese is considered to be a *wh*-in-situ language (Huang 1982). *Wh*-arguments in Mandarin stay in situ when forming *wh*-questions. *Wh*-adjuncts, however, need to move from their original base-generated position to a focus position, which is similar to *wh*-movement in English. Pursuing this analysis, it is expected that constraints on *wh*-movement will also apply to *wh*-adjuncts in Mandarin. This was tested in Chapter 4 with an experiment investigating children’s interpretations of sentences like (7) and (8).

(7) Tanglaoya zenme faxian [wupo youmeiyou bian piaoliang] de ?

Donald Duck how find out witch whether or not become beautiful DE

‘How did Donald Duck find out whether the witch had become beautiful?’

a. Howi did [Donald Duck find out ti [whether the witch had become beautiful]]?

*b. Howi did [Donald Duck find out [whether the witch had become beautiful
ti]]?

(8) Tanglaoya **youmeiyou** faxian [wupo **zenme** bian piaoliang de]?

Donald Duck whether or not find out witch how become beautiful DE

‘Did Donald Duck find out how the witch had become beautiful?’

The expression *youmeiyou* ‘whether or not’ is a *wh*-island in Mandarin, which blocks *wh*-movement out of the clauses headed by it. So we expected Mandarin speakers to interpret (7) as a *wh*-question, providing an answer for the way of finding out. And Mandarin-speakers were predicted to interpret (8) as a yes/no question.

For this study, we adopted a two-alternative forced choice task (Gescheider 1997; Linschoten et al. 2001). Twenty-six Mandarin-speaking children, whose age ranged from 4;2 to 5;3, were tested. Twenty adults were also tested as a control group. Our experiment confirmed the experimental hypothesis. Mandarin-speaking children can distinguish (7) and (8) and provide a corresponding answer for them, just as adults do. This means children adhere to the locality constraints on *wh*-adjunct movement in Mandarin Chinese.

Implications

Constraints are negative statements, which are not readily visible in the input from parents and other caretakers. Children’s adherence to the different constraints investigated in the present therefore shed light on the long-existing debate between alternative theories of language acquisition. The experience-based theory proposes that children have to be exposed to input from adults in order to learn the structure of language (Lieven and Tomasello 2008; Tomasello 2000, 2003; Goldberg 1995, 2003, 2006; Langacker 1988, 2000; MacWhinney,

2004). On the contrary, the UG-based theory maintains that children's language development is assisted by innate linguistic knowledge, which exists in human genome (Chomsky 1965, 1986, 1995; Pinker 1995; Crain, Gualmini and Pietroski 2005; Crain, Thornton and Khlentzos 2009). Part of this knowledge of Universal Grammar is knowledge of principles or constraints. Our three studies found that children demonstrated adult-like knowledge in interpreting different linguistic structures, even though there is no corresponding input from local language environment. Given the relatively limited data available to children during the period in which they acquire complex linguistic structures, it appears unlikely that children learn how to interpret such structures based on the input they receive from adult speakers of the local language. Therefore, we interpret the evidence from the experimental studies reported in the thesis as evidence favouring the UG-based account of language acquisition.

Future Directions

There are many other constraints, which have not yet been investigated in Mandarin Chinese. For example, few studies have focused on the locality constraints of *wh*-movement in Mandarin Chinese. Most of the islands constraints have not been examined in child grammars. For example, in Mandarin Chinese, adverbial clauses as well as *before*-clause are islands for *wh*-movement (Huang et al. 2009), and have not been investigated yet. In future research, I plan to pursue investigation of these constraints in Mandarin-speaking children. Existing research (Sugisaki 2012) has established that Japanese-speaking children have the knowledge

of locality constraints when interpreting *before*-clause. Investigation into these islands in Mandarin Chinese promises to shed light on constraints, provide a clearer picture for the knowledge in this area. If it is found that Mandarin-speaking children demonstrate other constraints in their grammar, then it will add evidence to innateness-based language acquisition approach.

Our studies were carried out with typically-developing preschool children. We can expand these studies on children's knowledge of linguistic principles to atypical populations, which may deepen our understanding of the cognitive process of language development. Specifically, investigation into atypical populations may shed some light on the nature of their impairments. That is, a comparison of typical children's language performance with that of atypical ones may provide some information on the deficits of atypical ones, in particular, whether the deficit is caused by the representation of syntactic structures or processing limitations. There is some suggestion that *wh*-movement is problematic for children with autism, but this has not been confirmed for Mandarin-speaking children. In addition, we can adopt different experimental techniques, including eye-tracking and MEG, to obtain more detailed information about children's language processing. Eye-tracking and MEG, by measuring eye movement or brain activities, can gain more information about language processing. Therefore, the cognitive development can be understood better.

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Appendices

Appendix A

Test Stimuli for the Experiment in Chapter 2

Test Stories for Condition 1

Story 1

Test sentence:

Xiaolaoshu meiyou chi juanxincai huozhe xilanhua.

mouse not eat cabbage or broccoli

‘The mouse didn’t eat cabbage or broccoli.’

Filler sentence:

Xiaozhu chi-le caomei.

pig ate-ASP strawberry

‘The pig ate a strawberry.’

Story 2

Test sentence:

Xiyangyang meiyou zhai qingjiao huozhe hongjiao.

Happy Goat not pick green capsicum or red capsicum

‘Happy Goat didn’t pick green capsicum or red capsicum.’

Filler sentence:

Lanyangyang zhai-le sanzhang lajiao.

Lazy Goat pick-ASP three kinds capsicum

‘Lazy Goat picked three kinds of capsicums.’

Story 3

Test sentence:

Milaoshu meiyou mai dangao huozhe bingqiling.

Mickey Mouse not buy cake or ice cream

‘Mickey Mouse didn’t buy cake or ice cream’.

Filler sentence:

Gaofei mai-le niunai.

Goofy buy-ASP milk

‘Goofy bought milk.’

Story 4

Test sentence:

Xiaohouzi meiyou xuan motuoche huozhe zixingche.

monkey not choose motorcycle or bicycle

‘The monkey didn’t choose motorcycle or bicycle.’

Filler sentence:

Xiaogou xuan-le huaban.

dog choose-ASP skateboard

‘The dog chose skateboard.’

Test Stories for Condition 2

Story 1

Test sentence:

Gongzhu hui xuan xingxing huozhe beike, wangzi bu hui.

princess will choose star or seashell prince not will

‘The princess will choose a star or a seashell, the prince will not.’

Filler sentence:

Tamen xuande liwu bu yiyang.

they choose gift not same

‘They chose different gifts.’

Story 2

Test sentence:

xiaozhu hui mai pingguo huozhe juzi, xiaoma bu hui.

pig will buy apple or orange horse not will

‘The pig will buy an apple or an orange, the horse will not.’

Filler sentence:

Xiaozhu he xiaoma dou meiyou mai caomei.

pig and horse all not buy strawberry

‘Neither the pig nor the horse bought strawberries.’

Story 3

Test sentence:

Milaoshu hui chi dangao huozhe putao, tanglaoya bu hui.

Mickey Mouse will eat cake or grapes Donald Duck not will

‘Mickey Mouse will eat a cake or grapes, Donald Duck will not.’

Filler sentence:

Milaoshu he tanglaoya dou meiyou chi bingqiling.

Mickey Mouse and Donald Duck all not eat ice cream

‘Neither Mickey Mouse nor Donald Duck ate icecream.’

Story 4

Test sentence:

xiaoxiong hui zhai xilanhua huozhe xihongshi, xiaolaohu bu hui.

bear will pick broccoli or tomato tiger not will

‘The bear will pick broccolis or tomatoes, the tiger will not.’

Filler sentence:

Xiaoxiong he xiaolaohu dou meiyou zhai hulongbo.

bear and tiger all not pick carrot

‘Neither the bear nor the tiger picked carrots.’

Appendix B

Test Stimuli for the Experiment in Chapter 3

Test Stories for Type 1 sentence

Story 1

Test Sentence:

Zai xiaomao huozhe xiaogou shenbian, gongfu xiongmao dou zhong-le shu.

at cat or dog side Kung Fu Panda all plant-ASP tree

‘Kung Fu Panda planted a tree next to a cat and next to a dog.’

Filler Sentence:

Zai xiaogou shenbian, gongfu xiongmao meiyou zhong shu.

at dog side Kung Fu Panda not plant tree

‘Kung Fu Panda didn’t plant a tree next to a dog.’

Story 2

Test Sentence:

Zai zhuozi huozhe yizi shang, hongyifu milaoshu dou tie-le tiehua.

at table or chair on red clothes Mickey Mouse all stick-ASP sticker

‘The Mickey Mouse in red put a sticker on the table or the chair.’

Filler Sentence:

Zai yizi shang, hongyifu milaoshu meiyong tie tiehua.

at chair on red clothes Mickey Mouse not stick sticker

‘The Mickey Mouse in red didn’t put a sticker on the chair.’

Story 3

Test Sentence:

Zai fangdingshang huozhe fangzili, meiyangyang dou cang-le jinbi.

at roof or inside Beauty Goat all hide-ASP gold coin

‘Beauty Goat hid a gold coin at the roof or inside the house.’

Filler Sentence:

Zai fangzili, meiyangyang meiyong cang jinbi.

at inside Beauty Goat not hide gold coin

‘Beauty Goat didn’t hide a gold coin inside the house.’

Story 4

Test Sentence:

Zai dashu huozhe xiaoshu shang, weinixiong dou ji-le qiqiu.

at big tree or small tree on Winnie the Pooh all tie-ASP balloon

‘Winnie the Pooh tied a balloon to the big tree or the small tree.’

Filler Sentence:

Zai xiaoshu shang, weinixiong meiyou ji qiqiu.

at small tree on Winnie the Pooh not tie balloon

‘Winnie the Pooh didn’t tie a balloon to the small tree.’

Test Stories for Type 2 sentence

Story 1

Test Sentence:

Zai xiaomao huozhe xiaogou shenbian, xiongmaomen dou zhong-le shu.

at cat or dog side pandas all plant-ASP tree

‘The pandas (all) planted a tree next to a cat or next to a dog.’

Filler Sentence:

Zai xiaogou shenbian, xiongmaomen zhong-le shu.

at dog side pandas plant-ASP tree

‘The pandas planted a tree next to a dog.’

Story 2

Test Sentence:

Zai zhuozi huozhe yizi shang, milaoshumen dou tie-le tiehua.

at table or chair on Mickey Mouses all stick-ASP sticker

‘The Mickey Mouses put a sticker on the table or the chair.’

Filler Sentence:

Zai yizi shang, milaoshumen meiyou tie tiehua.

at chair on Mickey Mouses not stick sticker

‘The Mickey Mouses didn’t put a sticker on the chair.’

Story 3

Test Sentence:

Zai fangdingshang huozhe fangzili, meiyangyangmen dou cang-le jinbi.

at roof or inside Beauty Goats all hide-ASP gold coin

‘Beauty Goats hid a gold coin at the roof or inside the house.’

Filler Sentence:

Zai fangzili, meiyangyangmen meiyou cang jinbi.

at inside Beauty Goats not hide gold coin

‘Beauty Goats didn’t hide a gold coin inside the house.’

Story 4

Test Sentence:

Zai dashu huozhe xiaoshu shang, weinixiongmen dou ji-le qiqiu.

at big tree or small tree on Winnie the Poohs all tie-ASP balloon

‘Winnie the Poohs tied a balloon to the big tree or the small tree.’

Filler Sentence:

Zai xiaoshu shang, weinixiongmen meiyou ji qiqiu.

at small tree on Winnie the Pooh not tie balloon

‘Winnie the Poohs didn’t tie a balloon to the small tree.’

Appendix C

Test Stimuli for the Experiment in Chapter 4

Test Stories

Story 1

Test sentence 1:

Heimao jingzhang zenme faxian huitailang youmeiyou tou cai de?

Black cat police chief how find out Grey wolf whether or not steal vegetable DE

‘How did Black Cat Police Chief find out whether Grey Wolf had stolen vegetables?’

A: Huazhuang cheng xiaoyang.

dress as sheep

‘By dressing himself as a sheep.’

B: Cang zai fangdingshang.

hide at roof

‘By hiding at the roof.’

Test sentence 2:

Heimao jingzhang youmeiyou faxian huitailang zenme tou cai de?

Black Cat Police Chief whether or not find out Grey wolf how steal vegetable DE

‘Did Black Cat Police Chief find out how Grey Wolf had stolen vegetables?’

A: You, ta faxian-le.

yes he find out-ASP

‘Yes. He found it out.’

B: Cang qilai.

hide

‘By hiding himself.’

Story 2

Test sentence 1:

Lanjingling zenme faxian wupo youmeiyou bian piaoliang de?

Smurf how find out witch whether or not become beautiful DE

‘How did Smurf find out whether the witch had become beautiful?’

A: He mofa shui.

Drink magic potion

‘By drinking the magic potion.’

B: Touguo chuangu hu kan.

through window look

‘By looking through the window.’

Test sentence 2:

Lanjingling youmeiyou faxian wupo zenme bian piaoliang de?

Smurf whether or not find out witch how become beautiful DE

‘Did Smurf find out how the witch had become beautiful?’

A: You, Lanjingling faxian-le.

yes Smurf find out-ASP

‘Yes. He found it out.’

B: Zai chuanguhu wai kanjian de.

at window outside see DE

‘By seeing through the window.’

Story 3

Test sentence 1:

Weinixiong zenme kanjian tanglaoya youmeiyou yingde bisai de?

Winnie the Pooh how see Donald Duck whether or not win competition DE

‘How did Winnie the Pooh see whether Donald Duck had won the competition?’

A: yong wangyuanjing.

use telescope

‘With a telescope.’

B: youyong.

swim

‘By swimming.’

Test sentence 2:

Weinixiong youmeiyou kanjian tanglaoya zenme yingde bisai de?

Winnie the Pooh whether or not see Donald Duck how win competition DE

‘Did Winnie the Pooh see how Donald Duck had won the competition?’

A: You, ta kanjian-le.

yes he saw-ASP

‘Yes, he did.’

B: yong wangyuanjing.

use telescope

‘With a telescope.’

Story 4

Test sentence 1:

Xiaoma zenme kanjian xiaozhu youmeiyou zuo jiaozi de?

horse how see pig whether or not make dumpling DE

‘How did the horse see whether the pig had made dumplings?’

A: touguo boli kan de.

through glass see DE

‘By seeing through the glass.’

B: yong shui zhu.

use water boil

‘By boiling with water.’

Test sentence 2:

Xiaoma youmeiyou kanjian xiaozhu zenme zuo jiaozi de?

horse whether or not see pig how make dumpling DE

‘Did the horse see how the pig had made dumplings?’

A: You, xiaoma kanjian-le.

yes horse see-ASP

‘Yes, the horse did.’

B: tongguo boli kandao de.

Through glass see DE

‘By seeing through the glass.’

Appendix D

Ethics approval

RE: HS Ethics Final Approval (5201200772)(Condition met)

Fhs Ethics fhs.ethics@mq.edu.au

10/31/12

Dear A/Prof Thornton,

Re: "Constraints on Negation in Verb Phrase Ellipsis"(5201200772)

Thank you for your recent correspondence. Your response has addressed the issues raised by the Faculty of Human Sciences Human Research Ethics Sub-Committee and you may now commence your research.

This research meets the requirements of the National Statement on Ethical Conduct in Human Research (2007). The National Statement is available at the following web site:

http://www.nhmrc.gov.au/files_nhmrc/publications/attachments/e72.pdf.

The following personnel are authorised to conduct this research:

A/Prof Rosalind Thornton

Dr Peng Zhou

Miss Shasha An

Mr Cory Bill

Ms Kelly Rombough

Prof Stephen Crain

Please note the following standard requirements of approval:

1. The approval of this project is conditional upon your continuing compliance with the National Statement on Ethical Conduct in Human Research (2007).
2. Approval will be for a period of five (5) years subject to the provision of annual reports.

Progress Report 1 Due: 31st October 2013

Progress Report 2 Due: 31st October 2014

Progress Report 3 Due: 31st October 2015

Progress Report 4 Due: 31st October 2016

Final Report Due: 31st October 2017

NB. If you complete the work earlier than you had planned you must submit a Final Report as soon as the work is completed. If the project has been discontinued or not commenced for any reason, you are also required to submit a Final Report for the project.

Progress reports and Final Reports are available at the following website:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms

3. If the project has run for more than five (5) years you cannot renew approval for the project. You will need to complete and submit a Final Report and submit a new application for the project. (The five year limit on renewal of approvals allows the Sub-Committee to fully re-review research in an environment where legislation, guidelines and requirements are continually changing, for example, new child protection and privacy laws).
4. All amendments to the project must be reviewed and approved by the

Sub-Committee before implementation. Please complete and submit a Request for Amendment Form available at the following website:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms

5. Please notify the Sub-Committee immediately in the event of any adverse effects on participants or of any unforeseen events that affect the continued ethical acceptability of the project.

6. At all times you are responsible for the ethical conduct of your research in accordance with the guidelines established by the University.

This information is available at the following websites:

<http://www.mq.edu.au/policy>

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/policy

If you will be applying for or have applied for internal or external funding for the above project it is your responsibility to provide the Macquarie University's Research Grants Management Assistant with a copy of this email as soon as possible. Internal and External funding agencies will not be informed that you have final approval for your project and funds will not be released until the Research Grants Management Assistant has received a copy of this email.

If you need to provide a hard copy letter of Final Approval to an external organisation as evidence that you have Final Approval, please do not hesitate to contact the Ethics Secretariat at the address below.

Please retain a copy of this email as this is your official notification of final ethics approval.

Yours sincerely,

Dr Peter Roger

Chair

Faculty of Human Sciences Ethics Review Sub-Committee

Human Research Ethics Committee

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RE: Ethics Amendment 1 - Approved (Ref No. 5201200772)

Fhs Ethics fhs.ethics@mq.edu.au

11/7/12

Dear A/Prof Thornton,

RE: 'Constraints on Interpretation in Mandarin Chinese ' (Ref: 5201200772)

Thank you for your recent correspondence regarding the amendment request.
The amendments have been reviewed and we are pleased to advise you that the
amendments have been approved.

This approval applies to the following amendments:

1. Change in the title of the project - from 'Constraints on Negation in Verb Phrase Ellipsis' to 'Constraints on Interpretation in Mandarin Chinese';
2. Additional data collection - to include sentences in relation to 'locality';
3. Change in payment - \$30, instead of \$15, for children participants aged 3 - 5.5 years old;
4. Revised Information and Consent forms.

Please accept this email as formal notification that the amendments have been approved.

Please do not hesitate to contact us in case of any further queries.

All the best with your research.

Kind regards,

FHS Ethics

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