THE ACQUISITION AND PROCESSING OF RELATIVE CLAUSES: EXPERIMENTAL EVIDENCE FROM MANDARIN

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The acquisition and processing of relative clauses: Experimental evidence from Mandarin

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CERTIFICATION OF ORIGINALITY

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it reproduces no material previously published or written, nor material that has been accepted for the award of any other degree or diploma, except where due acknowledgement has been made in the text.

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YANG Wenchun (Name of student)

Abstract

This thesis studies the acquisition and processing of relative clauses (RCs) in Mandarin-speaking children.

The first study examined the production of a wide range of Mandarin relativized positions including Subject (S), Agent (A), Patient (P), Indirect Object (IO), Oblique (OBL) and Genitive (GEN). One hundred and thirteen Mandarin monolingual children aged 3;0 to 5;0 were tested by a sentence repletion task adapted from Diessel & Tomasello (2005). Children showed similar patterns across age groups. The difficulty ranking is S>A=OBL>P>GEN ('> easier'), and IO (double object datives) > IO (prepositional datives). Developmental predictions based on Noun Phrase Accessibility Hierarchy (NPAH, Keenan & Comrie, 1977) cannot adequately account for this specific pattern of results.

The second study revisited the issue of subject-object processing asymmetry in Mandarin RC acquisition and processing. This is the first study using an online method to study this issue in child Mandarin, and the first study comparing two types of subject and object relative clauses: I) RC de DCL N (DCL-RC): relatives with the head nouns specified with a demonstrative (D) and a classifier (CL), and II) RC de N (DE-RC): relatives with bare head nouns. Thirty-six four-year-old Mandarin monolingual children were recruited. Children's eye movements were coded when they heard the test sentences and chose a referent that the sentence describes (Brandt, Kidd, Lieven, and Tomasello, 2009; Chan, Yang, Chang & Kidd, 2018; Rahmany, Marefat & Kidd, 2014). Online results revealed different

asymmetry patterns for the two types of RCs. For DCL-RCs, children showed an object advantage, whereas for DE-RCs, the same children showed a subject advantage. This differential pattern of results is not predicted by theories that make general predictions of subject or object advantage within a language (e.g. structural distance hypothesis (Lin & Bever, 2006); Dependency Locality Theory (Gibson, 2000)), but maps well onto the distributional properties/frequencies in the input.

The third study investigated the subject-object processing asymmetry in Mandarin and extended it to a bilingual context. Forty-six Kam-Mandarin bilingual children aged 5;11-10;3 were recruited in a Kam village in Mainland China, and were tested on the comprehension of head-final subject and object RCs in both Kam (L1) and Mandarin (L2) using a picture-pointing task. As expected, children found object RCs more difficult than subject RCs in both Kam and Mandarin, but they found object head-final RCs significantly more difficult in Kam than in Mandarin even though Kam is their L1 and the stronger language (for the younger group). This specific pattern of results cannot be adequately accounted for by structural perspectives to RC acquisition/processing (e.g. structural distance hypothesis by Lin and Bever, 2006 and structural intervention accounts by Friedmann, Belletti and Rizzi, 2009) but can be predicted by approaches that consider how relationships between constructions impact acquisition/processing outcomes (Rowland, Noble & Chan, 2014): Kam, but not Mandarin, has competing head-final and head-initial RC constructions.

The current studies are significant in many ways both empirically and theoretically. Empirically, they bring in novel online data comparing two

different RC types on the issue of subject-object asymmetry in young Mandarin-speaking children; novel comprehensive developmental data from a wide range of relativized positions that go beyond the frequently studied subject and object RCs in child L1 Mandarin; and novel developmental data from Kam-Mandarin bilingual children that allow us to reflect on the nature of difficulty in comprehending object RCs in Kam versus Mandarin. Theoretically, the developmental patterns exhibited are not predicted by several theoretical perspectives (e.g. Dependency Locality Theory by Gibson, 2000; and perspectives based on the Noun Phrase Accessibility Hierarchy, Keenan & Comrie, 1977). Rather, they support approaches that emphasize a close relationship between acquisition/processing and similarity to other structures and language specific distributional properties/frequencies of the input (Diessel & Tomasello, 2005; Chen & Shirai, 2015).

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List of Abbreviations

A	Agent
ASP	Aspectual marker
CL	Classifier
COMP	Object of Comparison
DCL	Combination of Demonstrative and Classifier
Dem	Demonstrative
DE	Relative marker, possessive marker
EXP	Experiential aspect marker
EXCL	Exclamation
GEN	Genitive
IO	Indirect object
N, NP	Noun, Noun phrase
DO/O	Object
OBL	Oblique
P	Patient
PFV	Perfective aspect marker
PROG	Progressive aspect marker
RC	Relative clause
RP	Resumptive pronoun
S	Subject
SG	Singular
V, VP	Verb, Verb phrase

Chapter One

Introduction

1.1 Introduction

The acquisition/processing of relative clauses (henceforth RCs) has received a considerable amount of attention in the past decades because of its relevance to the fundamental properties underlying syntactic processing (e.g., Gibson, 2000; MacDonald, 1999). In English and some European languages, there is a broad consensus that, with some qualifications, subject RCs such as (1) are easier to acquire/process than object RCs such as (2) (e.g. English: Diessel & Tomasello, 2005; German: Brandt, Kidd, Lieven, & Tomasello, 2009; Italian: Adani, 2011; Contemori & Belletti, 2014; French: Labelle, 1990, 1996; and in addition to Hebrew: Arnon, 2010; Friedman, Belletti, & Rizzi, 2009).

(1) English subject RC

$_{\text{Head noun}}$ The cat that [$_{\text{RC}}$ chased the dog] is black.

(2) English object RC

$_{\text{Head noun}}$ The cat that [$_{\text{RC}}$ the dog chased_] is black.

There have been a range of theoretical perspectives to account for this general subject preference, considering factors such as structural complexity as derived by formal syntactic theory (Friedmann et al., 2009; Lin & Bever, 2006), linear factor (Gibson, 1998, 2000), subject prominence (O'Grady,

2011), canonical word order (Diessel & Tomasello, 2005) and input frequency (Kidd, Brandt, Lieven & Tomasello, 2007). However, this apparent 'universal' subject advantage has been challenged when one goes beyond the more frequently-studied languages. For example, data from Basque (Carreiras, Duñabeitia, Vergara, De la Cruz-Pavía, & Laka, 2010), Quechua (Courtney, 2006, 2011), Japanese (Ozeki & Shirai, 2007), Cantonese (Chan, Matthews & Yip, 2011; Yip & Matthews, 2007) and Mandarin (Chen & Shirai, 2015) show that object RCs are easier to acquire/process or not more difficult than subject RCs (c.f. Kidd et al., 2007). The broader coverage of typologically diverse languages is important both empirically and theoretically (Kidd, 2011), as it allows one to test to what extent the diverse theoretical perspectives can adequately account for the developmental and processing phenomena across languages.

Mandarin has attracted increasing attention in the RC processing/acquisition in the literature in recent years. One major reason is that Mandarin is like English in having SVO canonical word order, but unlike it in having head-initial RCs with the head noun placed before the RC. Mandarin, by contrast, has head-final RCs with the head noun placed after the RC, as in example (3) (The morpheme 'de' functions as a relative marker like 'that' in English).

(3) Mandarin head-final RC

[$_{RC}$ Zhangsan mai] de $_{\text{head noun}}$ shuiguo

Zhangsan buy DE fruit

'the fruit that zhangsan bought'

The combination of SVO basic word order and head-final RCs is typologically rare. In fact, according to Dryer's (2013a, 2013b) observation of 879 languages, only five languages have the combination of SVO word order and head-final RCs. They are Mandarin, Cantonese, Hakka and two other languages being influenced from Chinese including, Bai, and Amis. This special word order configuration results in processing demands based on structural constraints and those based on linear properties competing in opposite directions (this issue will be elaborated in section 1.2).

This thesis concerns how young children comprehend and produce Mandarin RCs. In addition, in one of the studies, the study also brings in novel data from a minority language called Kam, which has similar properties of SVO canonical word order and head-final RCs. This introductory chapter is organized as follows: Section 1.2 provides an overview of the theoretical perspectives that have been commonly considered in the RC acquisition literature. The overview will be restricted to focus on those are particularly relevant to Mandarin and Kam RCs. Section 1.3 briefly introduces the three studies.

1.2 Theoretical perspectives on RC processing

A number of theoretical perspectives have been proposed to account for RC processing. This section highlights only those major theoretical perspectives that are more relevant to Mandarin and Kam RC processing, including the Noun Phrase Accessibility Hierarchy (Keenan & Comrie, 1977), structural-based perspectives (Friedmann et al., 2009; Lin & Bever, 2006), linear

distance between the filler and gap (Gibson, 1998; 2000), subject prominence from a functional perspective (Bornkessel-Schlesewsky & Schlesewsky, 2009; O'Grady, 2011) and two perspectives that are compatible with each other: accounts emphasizing relationships between structures (Abbot-Smith & Behrens, 2006; Diessel & Tomasello, 2005; Fitz, Chang & Christiansen, 2011, Rowland, Noble & Chan, 2014) and input frequency-based perspectives (Ambridge, Kidd, Rowland & Theakston, 2015). Each theoretical perspective will be introduced respectively in turn.

1.2.1 Noun Phrase Accessibility Hierarchy (NPAH, Keenan & Comrie, 1977)

The NPAH proposed by Keenan and Comrie (1977) is a typological generalization describing the ease or difficulty of accessibility to relativization of various syntactic types or positions. It is observed both within a language and across languages that certain syntactic positions are consistently easier to relativize than others. The hierarchical ranking of syntactic positions is described in (4). The higher a position is on the hierarchy, the easier it is to be relativized.

(4) Noun Phrase Accessibility Hierarchy ('>' means 'higher than')

Subject (S) > Direct Object (DO) > Indirect Object (IO) > Oblique (OBL) > Genitive (GEN) > Object of Comparison (COMP)

In this hierarchy, the higher position is regarded as less marked and is easier to be relativized. S is in the highest position and is the easiest to be relativized, then followed by DO, IO, OBL, GEN, and COMP.

NPAH has been extended to explain the differential ease of acquisition of positions on the hierarchy. Certain data from European languages suggest that the acquisition order follows the NPAH (Diessel & Tomasello, 2000, 2005). Diessel and Tomasello (2000) found that English-speaking children aged 1;9 to 5;2 produced RCs following an order of 'S>DO>OBL' in their naturalistic speech. Based on their corpus data, Diessel and Tomasello (2005) used a sentence repetition task to test the production of different types of RCs in English- and German- speaking children (Mage=4;7) and found that the order of difficulty in production is 'S>DO>IO>OBL>GEN' ('>' higher than). By contrast, some Mandarin studies do not show findings consistent with the predictions of NPAH. In Mandarin, object RCs are more frequently used than subject RCs in adult child-directed speech and child's naturalistic speech (Chen & Shirai, 2015).

In fact, the applicability of NPAH in accounting for the acquisition and processing phenomena in East Asian languages has attracted considerable attention recently. One evident demonstration is, for instance, the journal *Studies in Second Language Acquisition* which devoted a special volume in 2007 to specifically address this theme. One theoretical issue of interest is that some accounts propose that RCs in certain East Asian languages like Korean, Japanese, Chinese (Mandarin and Cantonese) are qualitatively different from RCs in English and some other European languages (Comrie, 1996, 1998, 2002). RCs in these East Asian languages can be analysed as a subset of attributive clauses or noun modifying constructions involving no syntactic operation such as gap-filling or movement (Matthews & Yip, 2016; Matthews & Yip, 2017). Consequently, the acquisition pattern and the

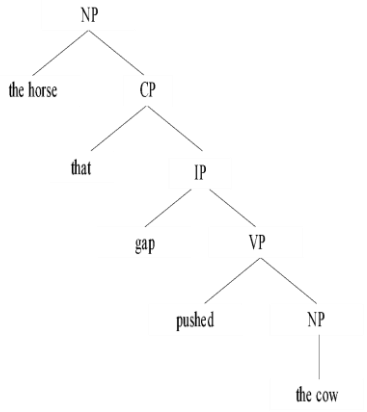
factors that play a more significant role in RC acquisition may be different between the East Asian languages and the European languages which are assumed to have conventional RC structures (Chen & Shirai, 2015). For instance, Chen and Shirai (2015) reported an object advantage in child Mandarin and argued that multiple factors including input frequency and similarity to simple canonical sentences, rather than NPAH or other purely structure-based accounts, jointly determine the learning trajectory in Mandarin RC acquisition. However, there has been so far no child first language acquisition study which has systematically investigated the acquisition/processing of a wide range of relativized positions in Mandarin. The extent to which NPAH can adequately account for the developmental phenomena in child L1 Mandarin remains an issue that deserves further investigation. Study one of this thesis will address this research gap (see Chapter Two).

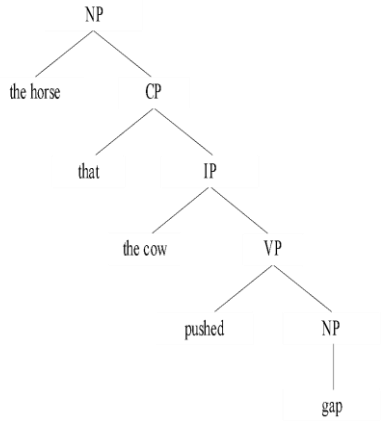
1.2.2 Structural perspective

The structural perspective concerns the intervening elements between the filler and the gap in a hierarchical sentence structure. Two types of structural factors have been proposed in the RC acquisition literature. The first one concerns the structural distance between the filler and gap, which considers the depth of embedding of the gap in a hierarchical structure (Hawkins, 2004; Lin & Bever, 2006; O'Grady, 1997). Despite different ways in computing the structural distance, the basic idea of this account is that the deeper a gap is embedded in the hierarchy structure, the longer the structural distance it is

and the more difficult it is to process. Taking English RCs as an example, an object RC such as (5b) has a deeper embedded gap and thus longer structural distance between the filler and gap than a subject RC (5a). Therefore, in English, a subject RC is easier to process than an object RC.

(5) a. English subject RC b. English object RC





Another structural factor concerns the structural intervention (Friedmann et al., 2009). Structural intervention is relevant to the notion of Relativized Minimality (RM, Rizzi, 1990, 2004). Relativized Minimality concerns the local constraints on dependencies in a sentence. In the configuration (6), "*Z intervenes between X and Y if and only if Z c-commands Y and Z does not c-command X"* (Rizzi, 2004, p. 225).

(6) X…Z…Y

In other words, when there is an intervener, like Z, the local relation between X and Y is blocked, and structural intervention effect arises, as RM is violated. A dependency is harder when there are intervening elements (Friedmann et al., 2009). Object RC has an overt embedded subject intervening between the head and the gap, but subject RC does not have such

an intervener, as in example (7) and (8). In object RC, the dependency between the head and the gap has to cross over the subject of the RC ‘the dog", resulting in difficulties in comprehension. In subject RC, there is no intervening constituent in the dependency, and thus it is easier to process.

(7) subject RC: the cat that [_ chased the dog]

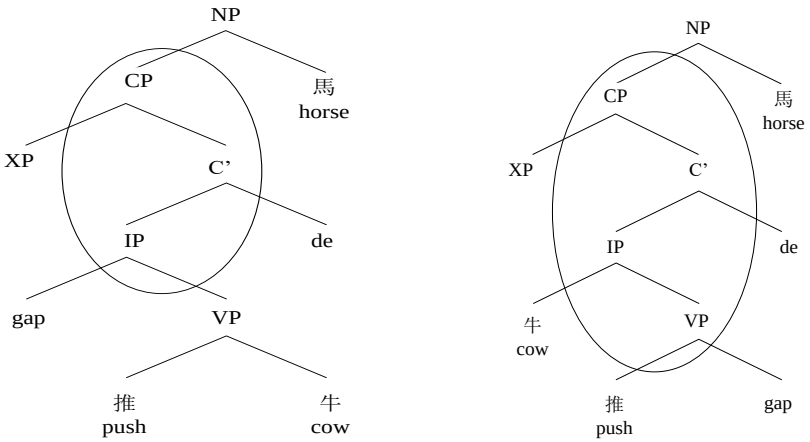
Head gap

(8) object RC: the cat that [the dog chased _]

head intervener gap

In Mandarin, the structural-based perspective predicts a general subject advantage as Mandarin subject RCs have shorter structural distance between the filler and the gap and have no intervening elements between the head and its c-commanded gap, as shown in example (9).

(9) a. Mandarin subject RC b. Mandarin object RC



The structural-based perspective has been adopted to account for the acquisition data in some previous child Mandarin RC studies (e.g., Hsu, Hermon & Zukowski, 2009; Hu, Gavarro, Guasti, 2016a; Hu, Gavarro, Vernice & Guasti, 2016b). These previous studies usually focused on

contrasting between structural-based perspectives and perspectives based on linear properties. For instance, Hu et al. (2016a, 2016b) focused on contrasting between the structural intervention perspective and linear distance-based perspective. Hsu et al. (2009), on the other hand, compared the structural distance-, linear distance- and canonical word order- based perspectives. The theoretical perspectives contrasted in these studies, including the structural-based, linear distance-based and canonical word order-based perspectives all make a uniform prediction of either a subject or an object advantage within a language and do not make differential predictions for different types of subject and object RCs within a single language. Considering that there are different types of subject and object RCs in a language, it is possible that the input frequency-based perspective could make differential predictions for each type of subject and object RCs that has not been considered in the existing literature. Based on theoretical perspectives that consider and compare language-specific characteristics across languages, Study 2 and Study 3 are going to fill in this research gap (see Chapter Three).

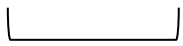
1.2.3 Linear distance-based approach

Linear distance-based perspectives concern the number of intervening elements (words or words with discourse referents) between the filler and the gap on the surface form. The basic idea is that the more intervening elements there are between the filler and the gap, the longer the linear distance which taxes working memory more it is, and the more difficult it is to process. One

representative theoretical perspective based on linear distance is the 'Dependency Locality Theory (DLT)' proposed by Gibson (1998, 2000). DLT considers linear distance to compute the computational resources required for processing. According to DLT, the computational resources are measured in two dimensions: i) storage-cost concerns maintaining predictions about upcoming syntactic elements; and ii) retrieval-cost concerns retrieving earlier encountered representations from memory when assembling the structures (Gibson & Wu, 2013). In English, an object RC has longer linear distance than a subject RC, see (10).

(10) a. English subject RC

the cat that [__ chased the dog]



filler gap

b. English object RC

the cat that [the dog chased __]

filler gap

It is, therefore, more demanding to maintain the incomplete dependencies and retrieve the stored elements in an English object RC with longer linear distance. DLT predicts that an English object RC is more difficult to process than a subject RC.

In contrast to the head-initial language such as English, the linear distance between the filler and gap is shorter in the head-final object RC in

Mandarin, as shown in the example (11). Thus, in Mandarin, the linear distance favours object RCs rather than subject RCs.

(11) a. Mandarin subject RC

[__ zhui xiaomao] de xiaogou

gap filler

chase cat DE dog

'the dog that chased the cat'

b. Mandarin direct object RC

[xiaomao zhui __] de xiaogou

gap filler

cat chase DE dog

'the dog that the cat chased'

Apart from the linear distance effect, Mandarin object RC is also favoured by the canonical word order effect as the head-final object RC has the similar SVO word order to the SVO canonical transitive sentences (more elaboration is given in Section 1.2.5). As a result, one cannot tease apart the linear distance effect and canonical word order effect when object advantage is observed in Mandarin (e.g., Gibson & Wu, 2013). Study one will address this issue when linear distance and canonical word order are compared in a post-hoc comparison between genitive subject RCs (i.e RC in which the NP containing the genitive functions as subject, e.g. 'ta de gou xia dao le zhu de na ge shushu' *the man whose dog scared the pig*) and genitive object RCs

(i.e. RC in which the NP containing the genitive functions as object, e.g., 'shushu mo ta de tuzi de na ge nvhai' *the girl whose rabbit the man touched*), since both are SVO in form but the linear distance is longer in genitive subject RCs than genitive object RCs (see Chapter Two). Additionally, similar to the structural-based perspective described in Section 1.2.2, linear distance-based perspective makes a uniform prediction of either a subject or an object advantage within a language but not differential predictions for different types of subject and object RCs. Study two (see Chapter Three) will address this issue.

1.2.4 Subject prominence

The general notion of prominence of subjects subsumes a wide range of related notions such as topicality (Givon, 1984; Mak, Vonk, & Schriefers, 2006), perspective (Kuno, 1976; MacWhinney, 1977, 1982), salience, given information, thematic prominence (Bornkessel-Schlesewsky & Schlesewsky, 2009), profiling, centre of attention, and empathy (O'Grady, 2011; Kim & O'Grady, 2016). This account sees prominence as the most promising factor to account for the subject preference in acquisition data from a functional perspective rather than from a structural-based perspective. The specific proposal by O'Grady (2011) is that "*the ease with which the processor establishes an aboutness relationship with a nominal is proportional to the prominence of that nominal's referent within the relative clause. (A referent functioning as subject within the relative clause is most prominent, a referent functioning as direct object is next most prominent,*

and so on.) (p. 21)". Following this argument, this perspective would make a uniform prediction of subject preference across languages. For Chinese, in particular, O'Grady (2011) also claimed that subject prominence would favour the subject relatives. Like the structural-based and linear distance-based perspectives, this theoretical perspective does not consider the different types of subject and object RCs within a language. This issue will be addressed in study two (see Chapter three).

1.2.5 Relationships between constructions

These accounts emphasize relationships between acquisition/processing and similarity to other structures. For example, the canonical word order hypothesis proposes that "*children extract schemas of canonical sentences and use such schemas to guide comprehension of syntactic structures* "(Slobin & Bever, 1982, p.231). In the case of English, a subject RC has the SVO configuration which is identical to the canonical SVO word order in simple transitive constructions and thus is predicted to be easier to process than an object RC, because an object RC is not similar to simple SVO sentences (compare (12a) and (12b), Slobin & Bever; 1982, MacDonald & Christiansen, 2002). Following this idea, English-speaking children would use the NVN/SVO schema to facilitate their interpretation of the subject RC but not the object RC.

(12) a. English subject RC

Where is the horse that [_ pushed the cow]?

N V N

b. English object RC

Where is the horse that [the cow pushed_]?

N N V

Unlike English, in Mandarin, it is the object RC rather than subject RC resembling simple transitive sentences, see example (13) being replicated here. As such, the canonical word order hypothesis would predict an object advantage in Mandarin.

(13) a. Mandarin subject RC

[__ zhui xiaomao] de xiaogou

V N N

chase cat DE dog

'the dog that chased the cat'

b. Mandarin direct object RC

[xiaomao zhui __] de xiaogou

N V N

cat chase DE dog

'the dog that the cat chased'

This canonical word order hypothesis was further modified by Diessel and Tomasello (2005). Based on English- and German-speaking children's RC acquisition data, Diessel and Tomasello (2005) suggested that "*it is primarily the initial position of the agent, rather than a fully developed word-order schema*" that accounts for the subject advantage in English and German (p. 900). They also argued that the similarity between the various types of relative clauses and their relationship to simple sentences in the target language plays a primary role in acquisition. Specifically, acquisition/ processing of an RC type would be facilitated if it resembles simpler sentences in the main clause. A compatible perspective has been proposed to account for some Mandarin RC acquisition data. Chen and Shirai (2015) reported that young Mandarin-speaking children produced a large number of isolated NPs modified by object RCs in the overall distribution of different RC types (52.7%) in their early stage of naturalistic speech, such as (14).

(14) baba mai de ban

N V N

daddy buy DE board

'the board daddy bought'

Chen and Shirai (2015) suggested that the predominance of this kind of isolated NPs is likely due to their structural simplicity and similarity with canonical simple sentences. Children might use the NVN/SVO schema to bootstrap onto constructing the object RCs.

Theoretically, these ideas also align with the 'constructivist' view of language acquisition: complex constructions could be constructed from

simpler ones. For instance, Lewis and Elman (2001) and Reali and Christiansen (2005) presented evidence from computational models to suggest that relatively infrequent complex syntactic structures in English, such as correct auxiliary fronting in complex polar interrogatives (e.g., *'Is the lady who is there eating?*), can be learnt via bootstrapping from knowledge of simpler sentences. In Fitz et al.'s (2011) connectionist model, the frequent substructures across all of the constructions in the language are partially responsible for the ease of activating the target structures. Specifically, the ease of constructing subject RCs is facilitated by the substructure 'THAT VERB' across all the constructions in English.

Similarly, Abbot-Smith & Behrens (2006) proposed the 'construction conspiracy hypothesis': the acquisition of complex constructions could be supported by the prior acquisition of simpler related constructions. The idea came from their analyses of an unusually dense corpus of a German boy in which they found that the child acquired *sein*- before the *werden*- passive. They explained the finding by suggesting that the acquisition of the *sein*-passive was supported by his prior acquisition of the simpler *sein* copula construction (as a source construction), while this was not the case for the *werden*-passive.

On the other hand, it is also possible that similarity between constructions can elicit competition resulting in hindrance to acquisition/processing. Rowland et al. (2014) investigated the acquisition of dative constructions in Welsh-, English- and Cantonese- speaking children and reported that the Welsh children acquired prepositional datives earlier than the English and Cantonese children. They argued that there is a

competition between constructions in language acquisition and the difference in the speed of acquisition between the three language groups is due to the presence of competing structures within the language. Specifically, there is no alternative dative in Welsh, while there is alternative double object dative in English and other competing dative structures in the input of Cantonese. The competing constructions bring in competing information that could bear on children's semantic role assignment when processing datives, and as such could hinder acquisition.

Competition between constructions is also possible across languages for a bilingual/multilingual child when these languages come into contact in course of development. For example, in Cantonese-English bilingual children, Kidd, Chan and Chiu (2015) found a large number of head errors in the comprehension of Cantonese object RCs: they chose the first noun (subject of the RC) as the head noun when comprehending object RCs. Chan, Chen, Matthews and Yip (2017) reported that the Cantonese-Mandarin-English trilingual children also frequently made similar head errors when comprehending Cantonese and Mandarin head-final object RCs. This type of head errors was argued to occur under the influence of two competing constructions (Chan et al., 2017; Kidd et al., 2015): canonical SVO transitive constructions in Cantonese/English/Mandarin and NVN/SVO subject RCs from English that are head-initial. In addition, Chan et al. (2017) hypothesized that these head errors are further promoted by the competition between a general developmental tendency of taking the first noun of a Noun-Verb-Noun (NVN) structure as the agent and head noun, and assigning the second noun as the head noun in NVN head-final object RCs.

In the RC literature, competition within a language is still under-explored. In this respect, a minority language in Southwest China, Kam, can enrich the literature. What makes Kam especially intriguing is that like Mandarin it is an SVO language attesting head-final RCs, but unlike it in that both head-final and head-initial RCs are attested within Kam. As a result, one could reasonably expect competition between not only the head-final NVN/SVO object RCs and canonical SVO transitive constructions but also additional competition from head-initial NVN/SVO RCs within the same language. Kam-Mandarin bilingual children provide an excellent opportunity to compare these two languages in a within-subject design, because the head-final object NVN/SVO RCs in both languages are likely susceptible to competition from canonical SVO transitive constructions and the developmental tendency to assign the first noun as agent/head but also head-final object RCs in Kam will experience additional competition from head-initial RCs. Study three will address this hypothesis (see Chapter Four).

1.2.6 Input frequency

Frequency effects are ubiquitous in child language acquisition. The basic notion is that structural frequency facilitates processing. The more frequent a structure is in the language input, hence, in a learner's experience, the higher probability it is meet the expectation on the upcoming elements resulting in easier processing (Hale, 2001; Levy, 2008). There are different types and levels of frequency effects ranging from the level of concrete lexical strings to the level of abstract cues to thematic-role assignment, and

ranging in token, type, absolute and relative frequencies (Ambridge et al., 2015). In children's acquisition of RCs, frequency effects have been exhibited at different levels ranging from target structures, sequences that resemble the target structures (i.e. target structure-like sequences) to abstract cues such as word order and animacy contrast (see Ambridge et al., 2015 for a review).

Taking English which has the most data as an example. Subject RCs emerge earlier and are more frequent in English naturalistic speech (Diessel & Tomasello, 2000), and this subject RC preference has been supported by experimental evidence (Kidd & Bavin, 2002; Diessel & Tomasello, 2005). Fitz et al. (2011) offered a new perspective to account for this subject RC preference. They argued that frequent substructures can also facilitate the processing of target structures. Specifically, they argued that the frequency of "THAT VERB" over “THAT ARTICLE NOUN” in English across constructions facilitates the construction of subject RCs. That is, the proposal is that the more frequent a substructure, the easier it is to activate the complex structure that consists of the specific substructure (Fitz et al., 2011). In addition to the level of the target RC structures and the level of substructures representations, frequency effects also exist at the level of abstract cues such as animacy contrast. Some types of RCs occur more frequently with a particular pattern of animacy contrast. For example, Kidd et al. (2007) reported that most subjects of RCs are the first and the second person pronouns, and object RCs occur more frequently with inanimate head nouns in both English and German. When these distributional properties are manipulated in the experimental context, the subject advantage is neutralized.

Children performed even better when producing the frequent object RCs with inanimate heads and pronouns as subject of the RCs (Kidd et al., 2007; Brandt et al., 2009).

The input frequency-based perspective is also compatible with the canonical word order hypothesis. Generally, canonical sentences are frequent in the input, and thus they are predicted to be facilitated by their high frequency of exposure. This perspective allows differential predictions of subject/object asymmetry based on the specific distributional properties of various RC types. A recent Cantonese study has supported predictions of this theoretical perspective (Chan, Yang, Chang & Kidd, 2018). Chan et al. (2018) reported a differential pattern of two types of Cantonese RCs: ge3 RCs and classifier RCs. Specifically, there was a subject advantage for ge3 RCs but an object advantage for classifier RCs. They found that this specific processing pattern maps well onto the distributional properties relevant to the two types of RCs. The object advantage in classifier RCs is consistent with the predictions based on distributional properties in which object classifier RCs and simple SVO transitives that share identical surface form with object classifier RCs were much more frequent in Cantonese children's naturalistic data.

Different from English naturalistic data reporting a subject advantage, child Mandarin corpus studies reported an object advantage. Chen and Shirai (2015) found that object RCs were more frequent than subject RCs in Mandarin-speaking children's (age range: 0;11 to 3;5) naturalistic speech (61.5% vs. 18.6%) and in caregivers' speech (58.6% vs 17.6%). Moreover, among the first ten sentences that children produced, 62.5% are object RCs

and 22.5% are subject RCs. Similar findings were reported in another corpus study, Liu (2015) found that object RCs were more frequent than subject RCs in 3;00 to 6;00 years old Mandarin-speaking children's utterances as well as in mother-to-child speech. These previous Mandarin corpus studies did not report on detailed information such as animacy contrast and substructures or RC-like word order sequences. It is possible that the more frequent object RCs attested are mostly having animacy contrast cues. For example, object RC ''wo chuan de na lan de kuzi jiu da' *the blue pants that I wore are big*' (extracted from Chen and Shirai (2015), p.403) is having an inanimate head and an animate subject of the RC. More detailed analyses of the distributional properties of RCs and RC-like sequences in Mandarin adult input are needed. Study two will provide a detailed corpus analyses on subject and object RCs in Mandarin adult input (see Chapter Three). In addition, the role of distributional properties of input in the acquisition/processing of different variations of RCs has not been systematically examined in child Mandarin. Study one and study two address this issue (see Chapter Two and Chapter Three).

1.3 This thesis

Despite Mandarin having received increasing attention in the RC literature, previous studies have mainly focused on studying only certain types of RCs (e.g., subject versus object RCs) and contrasting theoretical perspectives that make a uniform prediction of either a subject or an object advantage within the language (Hsu et al., 2009; Hu et al., 2016a, 2016b). There is yet to be

an attempt that considers how the distributional input properties could make differential predictions for different RC types within a language and test this hypothesis. This thesis consists of three studies on the acquisition/processing of RCs in young Mandarin-speaking children to address a range of empirical and theoretical issues that have not been considered or examined in the previous literature on Mandarin child language acquisition of RCs. The three studies are highlighted as follows:

i) Unlike the existing literature that mainly focuses on only subject and object RCs, study one would test the processing of a wide range of relativized positions that go beyond the frequently studied subject and object RCs in child L1 Mandarin (see Chapter Two).

ii) Unlike the existing literature that only considers and tests one type of subject versus object RCs, study two would analyze and compare the distributional properties of two types of subject and object RCs, specifically, i) RC de DCL N (DCL-RC): relatives with the head nouns specified with a demonstrative (D) and a classifier (CL), and ii) RC de N (DE-RC): relatives with bare head nouns, and revisit the issue of subject-object asymmetry by comparing the online processing of these two RC types in child L1 Mandarin (see Chapter Three).

iii) Unlike the existing literature that has mainly focused on studying Mandarin and Cantonese as 'model' cases for SVO languages that rarely attest head-final RCs, study three would study an additional SVO language attesting head-final RCs that is under-

studied, a minority language Kam. The study would investigate the issue of subject-object asymmetry in Kam-Mandarin bilingual children to reflect on the nature of difficulty in processing head-final object RCs in Mandarin versus Kam, and to examine the possibility of cross-linguistic influence and its directionality in these bilingual children (see Chapter Four).

Chapter Two
Beyond subject/object asymmetry: Mandarin children's production of different relative clause types

2.1 Introduction

This study goes beyond the frequently tested subject and object RCs and investigates a wide range of relativized positions including also Indirect Object- (IO), Oblique- (OBL) and Genitive- (GEN) RCs. The past studies on child L1 Mandarin have mainly concentrated on studying subject and object RCs (e.g. Lee, 1992; Hsu, 2014; Hsu et al., 2009; Hu et al., 2016a, 2016b; He, Xu, Ji, 2017). Other types of Mandarin RCs such as RCs that use a resumptive pronoun relativization strategy are still largely under-explored. Studying the acquisition/processing of a wide range of RC types is important as it allows the theoretical perspectives relevant to RC acquisition/processing to be tested against a wider set of empirical evidence. Specifically, the new data can contribute to the ongoing debate on the applicability of Noun Phrase Accessibility Hierarchy (NPAH, Keenan & Comrie, 1977) in accounting for the acquisition phenomena in East Asian languages. In addition, this wider set of data allows one to test the theoretical perspective that emphasizes relationships between constructions (Abbot-Simith & Behrens, 2006; Chen & Shirai, 2015; Diessel & Tomasello, 2005; Fitz et al., 2011; Rowland et al., 2014). This is especially interesting when one considers RC types that use the resumptive pronoun strategy in Mandarin, as resumptive RCs are

structurally similar to other structures due to the presence of a resumptive pronoun (RP). This chapter is organized as follows. Section 2.2 introduces the characteristics of each RC type and highlights the predictions for each RC type in light of the perspectives based on NPAH (Keenan & Comrie, 1977) and the 'constructivist' perspectives that emphasize relationships between constructions (Abbot-Smith & Behrens, 2006; Fitz et al., 2011; Rowland et al., 2014). Section 2.3 reviews the study of RCs with resumptives in the RC acquisition literature. Section 2.4 describes the current study which examines the production of a wide range of RC types in Mandarin-speaking children. Section 2.5 describes a follow-up study that also examines the production of different RC types in Mandarin-speaking children, but using double object datives instead of prepositional datives for the IO-RC sentences, to further test the theoretical perspectives. Section 2.6 discusses the findings. Section 2.7 concludes this chapter.

2.2 Mandarin RCs

Two relativized strategies, gapping and resumptive, are attested in Mandarin RCs. Gapping strategy leaves a 'gap' in the original position of the head noun, whereas resumptive strategy places a co-indexed resumptive pronoun in the original position of the head noun. The lower positions on the NPAH such as indirect object, oblique, and genitive RCs use the resumptive pronoun strategy in Mandarin. One interesting characteristic of Mandarin RCs in these lower positions is that the presence of a resumptive pronoun causes the RCs to be identical in surface form to other simpler constructions in the

language. As such, studying a wide range of RC types in child Mandarin acquisition offers a unique opportunity to test the theoretical perspectives based on NPAH, the 'constructivist' perspectives that emphasize relationships between constructions, and contrast their developmental predictions. In what follows, each RC type under the current investigation would be introduced in turn.

Subject and Object RCs

Mandarin subject and direct object RCs generally use a gapping strategy, as shown in examples (1) and (2).

(1) Mandarin subject RC

[__ zhui xiaomao] de xiaogou

chase cat DE dog

'the dog that chased the cat'

(2) Mandarin object RC

[xiaomao zhui __] de xiaogou

cat chase DE dog

'the dog that the cat chased'

Theories differ in their predictions regarding the relative ease/difficulty in processing/acquiring subject versus object RCs in Mandarin. Some theoretical perspectives predict a subject over object advantage, including perspectives based on the NPAH （Keenan & Comrie, 1977）because the subject role is more accessible than the object role on the hierarchy, and

perspectives that consider structural constraints (Friedmann et al., 2009; Lin & Bever, 2006) or a general subject prominence (Bornkessel-Schlesewsky & Schlesewsky, 2009; O'Grady, 2011). Other theoretical perspectives predict an object over subject advantage, such as perspectives that consider linear-distance constraints (Gibson, 1998, 2000), similarity to canonical sentences (Diessel & Tomasello, 2005; Chen & Shirai, 2015) and input frequency (Chen & Shirai, 2015). This is a major reason why comparing the ease of processing/acquiring subject versus object RCs in Mandarin has attracted a lot of attention in the past, because it provides a good opportunity to test these opposite predictions.

Indirect object RC

Example (3) illustrates an Indirect Object RC using prepositional dative in Mandarin. Comparable constructions (i.e. Indirect Object RCs using prepositional datives) have also been assessed in child English and German by Diessel and Tomasello (2005), which provide a good opportunity for interesting cross-linguistic comparisons. From the perspectives based on NPAH, since the prepositional dative IO-RC is placed in a relatively "middle" position on the hierarchy (below "Subject" and "Direct Object" but above "OBL", "GEN"), one could predict that it would be more difficult to process than Subject and (Direct) Object RCs, but easier to process than Oblique and Genitive RCs (Keenan & Comrie, 1977). This type of IO-RC in Mandarin is particularly intriguing to study, when one also considers the theoretical perspectives that emphasize the relationships between constructions, because there are factors that arguably favour and disfavour its processing/acquisition.

Regarding factors that might favour/facilitate its processing/acquisition, the prepositional dative RC, marked by [ ] in example (3), is identical in surface form with a prepositional dative main clause, as in (4). From a 'constructivist' perspective, children could use a simpler prepositional dative construction as a 'subpart' construction to bootstrap onto constructing a more complex prepositional dative IO-RC. Compare (3) and (4).

(3) Prepositional dative IO-RC

[nvhai song liwu gei ta] de nanhai

girl give gift prep. 3.SG. DE boy

'the boy that the girl gave a gift to'

(4) Prepositional dative main clause

nvhai song liwu gei ta

girl give gift prep. 3.SG.

'the girl gave a gift to him/her'

However, there are also factors that complicate and disfavour its processing. Specifically, the 'entire' complex noun phrase (i.e. the RC plus the head noun), as in (3), repeated below as (5), is also identical in surface form to a simpler prepositional dative construction with 'DE' functioning as a genitive marker[1], as in (6). This complete isomorphism in surface structure could lead to structural ambiguity, resulting in competition between the two constructions and possibly misparsing, especially when the competing construction is structurally simpler.

[1] The particle 'DE' is versatile in Mandarin and can be used as a relative marker, a general modification marker and a genitive marker (Deng, 2017).

(5) Prepositional dative IO-RC

[nvhai song liwu gei ta] de nanhai

girl give gift prep. 3.SG. DE boy

'the boy that the girl gave a gift to'

(6) Prepositional dative main clause

nvhai song liwu gei ta de nanhai

girl give gift prep. 3.SG. DE boy

'the girl gave a gift to her/his boy'

In addition, due to the structural ambiguity of a prepositional dative IO-RC, pronoun resolution could become a lot more challenging. Specifically, there are three possible referents for the pronoun 'ta'. In examples (3) and (4), the pronoun 'ta 3.SG.' could refer to 1) the noun 'nanhai boy' (in the IO-RC interpretation), 2) the first noun 'nvhai girl' (in the simple prepositional dative construction interpretation), or 3) 'someone else' mentioned in the previous discourse (also possible in the simple prepositional dative construction interpretation). Pronoun resolution, as such, could become more taxing, because it involves searching the possible referents and testing the acceptability of the candidates found, under the constraints of working memory limitations especially for young children (Oakhill & Yuill, 1986).

Studying the processing/acquisition of prepositional dative RC in young Mandarin-speaking children, therefore, provides a unique opportunity for one to evaluate its developmental phenomena in light of the theoretical perspectives considered above.

Oblique RC

An Oblique (OBL) RC involves a preposition and a resumptive pronoun in Mandarin, as illustrated in (7).

(7) Oblique RC

[nanhai	wei	ta	na	bao]	de	nvhai
N	prep./coverb	3.SG.V	N			
boy	for	3.SG	take	bag	DE	girl

'the girl that the boy took bag for'

Viewing from the perspectives based on NPAH, one would predict that OBL-RCs, positioned in the rather lower end of the hierarchy, are generally more complex to process, and would be more difficult to process than IO-RC because OBL-RC is in a lower position on the hierarchy (Keenan & Comrie, 1977). By contrast, theoretical perspectives that emphasise relationships between constructions would predict an advantage for OBL-RCs in Mandarin, because the OBL-RC, marked by [ ] in (7), is structurally similar to a serial verb construction frequently attested in the language. Compare (7) repeated as (8) below, and (9). Prepositions in Mandarin have been treated as co-verbs due to their functional similarity to verbs (Li & Thompson, 1981).

(8) Oblique RC

[nanhai	wei	ta	na	bao]	de	nvhai
N	prep./coverb	3.SG.	V	N		
Boy	for	3.SG.	take	bag	DE	girl

'the girl that the boy took bag for'

(9) Serial verb construction

nanhai	bang	ta	na	bao
N	V	3.SG.	V	N
boy	help	3.SG.	take	bag

'the boy helps her take bag.'

Serial verb constructions are attested very early as young as two years old in Chinese children's spontaneous utterances (Fung, 2011), and are likely frequently attested in the adult input as they are highly productive in Chinese. From a 'constructivist' perspective, children could use their earlier acquired serial verb constructions as 'subpart' constructions to bootstrap onto constructing a more complex oblique RC (Abbot-Smith & Behrens, 2006; Diessel & Tomasello, 2005; Fitz et al., 2011).

In addition, unlike the prepositional dative IO-RC described above, Oblique RCs in Mandarin do NOT have structural ambiguity: the 'entire' complex noun phrase, i.e. the RC and the head noun, is NOT similar in surface form to another (simpler) construction in the language. Pronoun resolution when processing oblique RCs in Mandarin would also NOT be as complicated as in the case of prepositional dative IO RCs in Mandarin, because the pronoun '*ta*' could only refer to one possible referent (i.e. nvhai (girl) in example (8).

Studying the processing/acquisition of OBL RCs in Mandarin becomes particularly interesting when one contrasts the two theoretical perspectives considered above, because they would make opposite predictions regarding the relative ease of processing IO vs OBL RCs: perspectives based on NPAH

would predict OBL being more difficult than IO RCs, but 'constructivist' perspectives would predict OBL being easier than IO RCs.

Genitive RC

A Genitive (GEN) RC in Mandarin is illustrated in example (10).

(10) Genitive RC

[ta de mao zhuadao le laoshu] de nainai
3.SG.DE cat catch-EXP ASP mouse DE old-woman
'the old woman whose cat caught a mouse'

GEN-RCs are in the second lowest position in the NPAH. Viewing from the perspective of NPAH, one would expect that GEN-RCs are complex to process for young children (Keenan & Comrie, 1977). By contrast, viewing from the perspectives that emphasize the relationships between constructions, one might consider whether its processing could be (partly) facilitated by the structural similarity between the RC clause and a simpler construction in the language (Abbot-Smith & Behrens, 2006; Diessel & Tomasello, 2005; Fitz et al., 2011). Specifically, similar to OBL-RCs, the presence of a resumptive pronoun causes the GEN-RC clause, marked by [ ] in (10), repeated as (11) below, being structurally similar to a simple transitive construction with a possessive NP as its subject, as in (12) below.

(11) Genitive RC

[ta de mao zhuadao le laoshu] de nainai
3.SG.DE cat catch-EXP ASP mouse DE old-woman
'the old woman whose cat caught a mouse'

(12) Transitive SVO main clause

ta de mao zhuadao le laoshu

3.SG.DE cat catch-EXP ASP mouse

'His cat caught a mouse.'

Following the constructivist perspective, a learner could make use of a transitive SVO construction as a 'subpart' construction to bootstrap onto constructing a more complex genitive RC.

However, processing a Genitive RC is essentially complicated by the fact that this construction is generally structurally and semantically complex, as it involves resolving the structural and semantic relationships between three animate noun phrases (when animacy cues are neutralized), identifying the relevant referent of the resumptive pronoun '*ta*' among the possible candidates, and identifying the possessor-possessee relationship. Resolving all these relationships is challenging and taxing even for adults when they try to interpret a genitive RC (especially when animacy cues are neutralized), let alone young children with working memory limitations.

Studying the processing/acquisition of Genitive RCs in young Mandarin-speaking children, therefore, provides a good opportunity for one to evaluate its developmental phenomena in light of the conceptual perspectives considered above.

2.3 Resumptives in RC acquisition

Resumptives have been extensively investigated in child language acquisition of RCs. Some earlier studies on European languages focused on

the issue of whether the use of resumptive indicates wh-movement in child's grammar (Italian: Guasti & Cardinaletti; 2003; French: Labelle 1990, 1996; Guasti & Sholonsky, 1995; English: Pérez-Leroux, 1995). Other cross-linguistic studies are more concerned with showing that resumptives have a functional use in alleviating the complexity associated with long-distance dependencies (English: McKee & McDaniel; 2001), helping children to track and identify the semantic role of its co-indexed head noun (Hebrew: Arnon, 2005; Persian: Rahmany, Marefat & Kidd., 2014), or eliminating the isomorphism between the object classifier RCs and simple transitive constructions and thereby facilitating the head noun assignment of object RCs (Cantonese: Lau, 2016).

In the Mandarin RC acquisition literature, previous studies have mainly focused on 'gapped' subject and object RCs (a detailed review is given in Section 3.2). Other types of RCs (i.e. RCs using the resumptive strategy) are largely under-explored. This section focuses on reviewing the small handful of studies that have included resumptive RCs. So far, only a few published studies have studied one more type of RCs other than subject and object RCs (Chen & Shirai, 2015; Lee, 1992; Su, 2004). In Mandarin acquisition studies, RCs with resumptives appear to be infrequently attested in children's naturalistic speech (Chen & Shirai, 2015) or difficult to process by children in experiments (Lee, 1992; Su, 2004). Chen and Shirai (2015) analyzed the naturalistic speech of Mandarin children aged 0;11 to 3;5 years old and reported that OBL RCs (9.6%) were produced far less than subject RCs (18.6%) and object RCs (61.5%). In an experimental context, Lee (1992) reported that even the older 8-year-old Mandarin-speaking children

experienced great difficulties in comprehending the IO RC in particular when the head noun of the IO RC is the object of the matrix clause (the mean score was as low as 0.85 out of 4). In an elicited production study, Su (2004) reported that five to six years old Mandarin children tended to avoid using the target OBL RCs but used simple sentences to describe the complex proposition instead.

Studies have also reported frequent resumptive errors in Mandarin children's non-target structures when they attempted to produce the subject and object RCs, and this happened more often with object RCs than with subject RCs (Hsu et al., 2009; Hu et al., 2016a; Su, 2004). Resumptive error refers to the head noun being copied as an identical NP or a co-indexed pronoun being added in the gap position of the RC, as in (13) extracted from Hu et al. (2016a, p.10).

(13) *[mama qin xiaopengyou] de xiaopengyou

mother kiss child DE child

'the child that the mother kisses (the child)'

Hsu et al. (2009) reported that Mandarin-speaking children aged 4;8 made more resumptive errors in object RCs than subject RCs (18.2% vs 3.3%). A consistent pattern was also found in the older children. Su (2004) found that Mandarin-speaking children aged 5;3 produced resumptive errors in 11.4% of the object RCs but only 3.1% of the subject RCs. Similarly, in Hu et al. (2016), Mandarin-speaking four to eight years olds committed resumptive NP errors in 11.8% of the object RCs but only 1.3% of the subject RCs. The resumptive error may be related to the language-specific characteristics of

Mandarin, namely, the 'gap' precedes the antecedent (Hu et al., 2016a), and possibly is a processing strategy for children to reduce their memory load when processing long dependencies (Hsu et al., 2009). According to Hsu et al. (2009), when a person produces an RC, a head noun would be planned first and stored in memory, and then the 'production system' would look for a gap as soon as possible to retrieve the planned head noun and fill in the gap. In Mandarin head-final object RCs, the object gap comes later, hence more taxing for working memory, and for small children, it is possible that the planned head noun cannot be held in working memory any longer when it reaches the gap, and thus the head noun is more likely to be pronounced at the object gap position. By contrast, in Mandarin subject RCs, the subject gap comes earlier; and the planned head noun may be 'unloaded' earlier. On the other hand, if one considers these resumptive errors from a 'constructivist' view, the frequent resumptive errors found when children produced Mandarin object RCs suggest that the children might have used a simple transitive SVO structure to construct an RC construction. For example, in (13), the object RC clause, marked by [ ], became a simple transitive SVO construction 'mama qin xiaopengyou *mother kisses the child*' by copying the head noun 'xiaopengyou *child'* in the object 'gap' position.

To summarize, according to the existing literature, Mandarin resumptive RCs were reported to be infrequent in young children's spontaneous speech and were more difficult to process than subject and object RCs. Additionally, the studies also suggested that Mandarin-speaking children may use resumptives as a strategy to reduce working memory load or use resumptives to form a simple transitive SVO construction to bootstrap

onto constructing a more complex RC structure. However, these findings were often reported based on limited empirical data, and there is yet to be a study which systematically and comprehensively examines the production of a wide range of RC types, in particular, resumptive RCs in child Mandarin.

2.4 The Current Study

The current study investigated the production of the following types of RCs in young Mandarin-speaking children: Intransitive Subject RC, Transitive Subject RC (called "Agent" RC in subsequent sections), Direct Object RC (called "Patient RC" in subject sections), Indirect Object-RC, Oblique RC, and - Genitive RC. Two types of subject RCs were tested that differ in transitivity of the verb in the RC. One type of subject RCs uses intransitive verbs; another type uses transitive verbs. These two types of subject RCs have been argued to be different in discourse function and grammar (Fox, 1987), and based on the results from previous studies, one would predict that subject RCs with intransitive verbs are easier to process than subject RCs with transitive verbs because the former are structurally and semantically simpler (Hamburger & Crain, 1982; Diessel & Tomasello, 2005).

2.4.1 Method

The current study adapted the sentence repetition task used in Diessel & Tomasello (2005) and Kidd et al. (2007) with German-speaking and English-speaking children to Mandarin-speaking children. The sentence repetition

task allows a wide array of relative clauses to be tested and enables a significant degree of control over children's productions not possible in other production tasks such as elicited production, where children are free to use alternative syntactic strategies. The method is not purely a measure of the ability to repeat a string of words but involves conceptual, lexical and syntactic representations used for language (see Frizelle, O'Nell & Bishop, 2017 for a review).

2.4.1.1 Participants

Fifty-nine (N=59) children participated. There were thirty-one four-year-olds aged 4;3 to 4;9 (mean=4;6, SD=0;2) and twenty-eight five-year-olds aged 5;3 to 5;9 (mean=5;6, SD=0;2). All were monolingual Mandarin-speaking children and were recruited from a kindergarten in Xi'an, China. The children had no known language or cognitive impairments.

2.4.1.2 Materials

There were twenty-four test sentences and sixteen fillers. Following Diessel and Tomasello (2005), the syntactic role of the head noun was manipulated, including subject (S, RCs with a subject gap and intransitive verb), agent (A, RCs with a subject gap and transitive verb), patient (P, RCs with a direct object gap), indirect object (IO, RCs with a prepositional dative indirect object resumptive pronoun), oblique (OBL, RCs with an oblique resumptive pronoun) and genitive (GEN, RCs with a genitive resumptive pronoun). GEN comprised two types: i) GEN-S (RC containing a genitive NP as

subject) and GEN-O (RC containing a genitive NP as direct object) (for a full list of sentences, see Appendix A).

There were four trials in each condition. In order to lower the processing demands, all the testing sentences were presentational relatives in the form of 'This is [RC] head noun' (Diessel & Tomasello, 2005; Chan, Lau, Lieven & Tomasello, 2007). Fillers were simple transitive clauses and existential constructions, which were interspersed between test trials. The sentences were pseudo-randomly ordered into four sets and each child was randomly assigned to one order set. The sentences were controlled for length (13-15 syllables long) and animacy (all animate nouns).

2.4.1.3 Procedures

A powerpoint slideshow was created in which each test sentence was paired with a picture depicting the head referent and the event/situation expressed by the RC. Sentences were audio recorded by a female native speaker of Mandarin. The audio file for each sentence was linked to the corresponding powerpoint slide.

The children were introduced to a 'parrot-game', in which they would act like a parrot repeating what they heard from the computer. They were instructed that they would see a picture on the screen and then would hear a sentence about the picture, which they should repeat after they heard a beep sound, just as a parrot would do. The beep sound occurred 500ms after the offset of each target sentence so that children would have to listen to the full sentence before attempting to repeat it.

Before proceeding to the actual test sentences, children completed three practice trials, which served to familiarize them with the task requirements. Children received generic positive feedback throughout the task (e.g., zhenbang "good job"). If children lost their attention or did not make any response after hearing the sentence, the experimenter reminded them to focus on the task and played the sentence one more time. If a sentence was played twice and the child still did not respond, the experimenter moved to the next item.

2.4.1.4 Scoring

The scoring scheme was adapted from Kirjavainen, Kidd and Lieven (2017) and Diessel and Tomasello (2005).

A score of 1 was given to a correct verbatim repetition. Some minor changes which did not affect the meaning and the structure of the test sentence were permitted. For example,

- Change of demonstratives, e.g. 'this' for 'that';
- Change of classifiers;
- Change or omission of the adverbials, e.g. '*gangcai*' just now' for '*ganggang'* just now';
- Minor change in word order which did not affect the meaning and structure of the sentence, e.g. ''*zheshi gangcai houzi…'* this is just now the monkey… for '*zheshi houzi gangcai…*' this is the monkey just now…';

- Minor change of the noun phrases within the RC or the head noun, e.g. '*nanhai'* boy for *'xiaopengyou'* child.

A score of 0 was assigned to a response with meaning and structure completely changed. For example:

- No response;
- Incomplete sentences;
- Ungrammatical sentences;
- Omission of the relativizer 'de' resulting in a different structure;
- Target changed to other structures, e.g. 'zheshi gangcai heixiong qindao de na zhi daxiang*' This is the elephant that the bear kissed just now*' for *'*zheshi gangcai heixiong qindao daxiang*' This is the bear is kissing the elephant just now*.

2.4.2 Results

Figure 2.1 presents the mean proportion of correct responses and standard errors for each RC type. The five-year-old group performed slightly better than the four-year-old group overall, and they did not appear to differ from the younger group in their pattern of accuracy across RC types. Children performed best on S, followed by A and OBL, then P, then GEN. IO was the most difficult RC type.

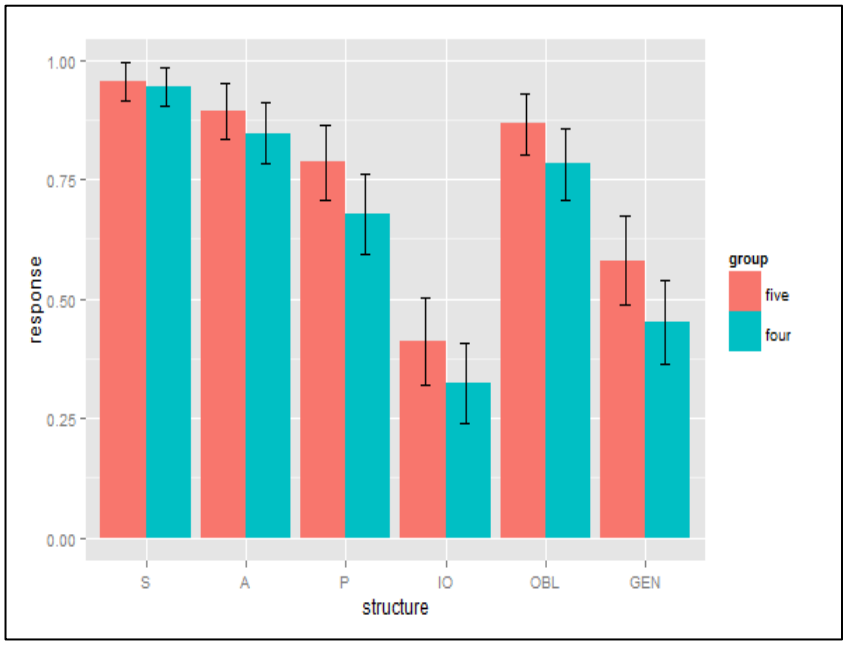


Figure 2.1. The mean proportion of correct responses for each RC type (four: 4 years old; five: 5 years old)

The data were analyzed using Generalized Linear Mixed Models (GLMM) (Baayen, Davidson & Bates, 2008; Jaeger, 2008), which were calculated using the *lme4* package for Linear Mixed Effects (Bates & Maechler, 2010) in *R* (version 3.4.3, R Core Development Team, 2017). The inclusion of the age × structure interaction did not improve the fit of the model, and thus it was removed in subsequent analyses. The main effect of structure (i.e. RC type) significantly improved model fit ($\chi^2 = 355.6$, df = 5, $p < .001$), and the main effect of age group only marginally improved fit and was therefore dropped ($\chi^2 = 2.98$, df = 1, $p = .084$). The final model contained the fixed effects of structure (6 levels: S, A, P, IO, OBL and GEN), as well as participants and items as random effects. Table 2.1 presents the results of contrasts between each RC type.

Table 2.1. Results of contrasts between each RC type in study one

	A	**P**	**IO**	**OBL**	**GEN**
S	β = -1.16, z = -3.13, p < .01	β = -2.25, z = -6.42, p < .001	β = -4.26, z = -11.85, p < .001	β = -1.58, z = -4.41, p < .001	β = -3.47, z = -9.86, p < .001
A		β = -1.09, z = -4.12, p < .001	β = -3.1, z = -11.35, p < .001	β = -0.43, z = -1.53, NS	β = -2.31, z = -8.77, p < .001
P			β = -2.01, z = -8.61, p < .001	β = 0.67, z = 2.7, p < .01	β = -1.22, z = -5.42, p < .001
IO				β = 2.68, z = 10.52, p < .001	β = 0.79, z = 3.68, p < .001
OBL					β = -1.88, z = -7.7, p < 001

2.4.3 Interim Summary

The major results based on the statistical findings reported in Table 2.1 are summarized as follows. The Mandarin-speaking children showed a subject over object advantage. Specifically, S was the easiest, and A was significantly better than P. Children found OBL-RCs as easy to produce as A- RCs, but found the prepositional dative IO-RCs most difficult to produce.

GEN-RCs were generally difficult to produce, though significantly easier than the prepositional dative IO-RCs for these young children. The overall hierarchy of difficulty was S>A=OBL>P>GEN>prepositional dative IO (> means ‘easier than’; = means ‘similar to’).

The subject over object advantage is consistent with the predictions based on NPAH (Keenan & Comrie, 1977). However, this finding can also be alternatively accounted for by theoretical perspectives that emphasize the relationships between constructions. Specifically, for object RCs in Mandarin, the entire complex noun phrase, i.e. the object RC marked by [ ] in example (14) plus the head noun, resembles a simple transitive SVO construction, and therefore it is possible that the simpler transitive construction could be a competing construction when children processed Mandarin object RCs. Compare (14) and (15).

(14) Object RC

[houzi zhuadao] de na zhi xiongmao

S V O

monkey catch-EXP DE Dem CL panda

‘the panda which monkey caught’

(15) Simple transitive SVO construction

houzi zhuadao na zhi xiongmao

S V O

monkey catch-EXP Dem CL panda

‘the panda which monkey caught’

This possibility is supported by the observation that a large number of errors children made when asked to repeat Mandarin object RCs were conversions to simple transitive SVO constructions. Subject RCs in Mandarin, which are non-canonical VOS in surface form, by contrast, do not resemble any simple constructions frequently attested in the language, and therefore unlike object RCs, would NOT encounter competition from another simple construction.

Other results are inconsistent with the developmental predictions based on NPAH (Keenan & Comrie, 1977). For instance, OBL- RCs, which are positioned lower than P- and IO- RCs in the hierarchy, turned out to be significantly easier for children to produce and were even as easy as A- RCs that are positioned toward the higher end of the hierarchy. Rather, this result aligns with the prediction by the "constructivist" perspective: OBL- RCs could be easy to produce in Mandarin, because children could make use of their earlier acquired serial verb construction, frequently attested in their language experience, as "subpart" construction to bootstrap onto constructing a more complex OBL- RC in Mandarin. IO-RCs, on the other hand, turn out to be the most difficult type to produce, another finding that goes against the developmental predictions based on NPAH, as IO-RCs are positioned along the middle of the hierarchy. Perhaps more surprising was that children were significantly less accurate when attempting to produce IO-RCs than attempting to produce a construction as complex as GEN-RC. Difficulty with prepositional dative IO-RCs in Mandarin is predicted by its structural ambiguity and the ensuing complexity in pronoun resolution described in section 2.2 because the entire complex noun phrase, i.e. the RC plus the head noun, is identical in surface form to a simpler prepositional

dative construction in the language. This hypothesis is supported by the observation that children made frequent conversion errors to simpler prepositional dative constructions when attempted to repeat prepositional dative IO-RCs. Although it has also been acknowledged in section 2.2 that a prepositional dative IO-RC in Mandarin could possibly be facilitated as children could make use of a simpler prepositional dative construction as "subpart" construction to bootstrap onto constructing a more complex IO-RC, a potential factor that could favour its processing, it appears that structural ambiguity as well as the ensuing complexity in pronoun resolution, factors that co-exist to disfavour the processing of IO-RCs, outweigh the potential facilitating factor, resulting in an overall disadvantage in processing this kind of IO-RCs in young Mandarin-speaking children.

Regarding the question of how processing/acquisition could be affected by similarity between constructions, the case of prepositional dative IO-RC in Mandarin suggests that similarity between a complex construction and a simpler construction could lead to a positive or negative effect: a complex construction could be 'facilitated' when its subpart is identical in surface form to a simpler construction; by contrast, a complex construction could be 'hindered' when the entire construction is identical in surface form to a simpler construction, leading to structural ambiguity and complexity in processing. In the case of prepositive dative IO-RC in Mandarin, these factors that favour and disfavour its processing could co-exist, and the developmental phenomenon exhibited suggests that the factors that disfavour its processing outweigh the factor that favour its processing.

To further evaluate these perspectives, a follow-up study was conducted using another type of IO-RC in Mandarin instead: double object dative IO-RC. This type of IO-RCs in Mandarin neutralizes the factor that is hypothesized to disfavour the processing of prepositional dative IO-RC in Mandarin, because unlike prepositional dative IO-RC, there is NO identity in surface form between the entire complex noun phrase, i.e. the RC plus the head noun, and a simpler construction in the language, and therefore NO potential structural ambiguity would arise in the case of double object dative IO- RCs.

2.5 Follow-up Study

The follow-up study again tests the production of S-, A-, P-, IO-, OBL- and GEN- RCs in Mandarin-speaking children. The difference was that double-object dative IO-RCs were used instead of prepositional dative IO-RCs.

From the perspectives based on NPAH, since NPAH does not explicitly make distinctions between prepositional dative IO-RC and double object dative IO-RC, it, therefore, would not have differential predictions for these two types of IO-RCs in acquisition.

By contrast, viewing from the perspectives that emphasize how similarity between constructions could impact on acquisition/processing outcomes, one could predict that double object dative IO-RC would be easier to process than prepositional dative IO-RC. Recall that double object dative IO-RC, unlike prepositional dative IO-RC, is structurally unambiguous in terms of allowing only the target RC interpretation. There is NO

isomorphism in surface form between the 'entire' complex noun phrase (i.e. RC plus head noun) and another simpler construction in the language, for double object dative IO-RC. Rather, there is a 'subpart' structure of the entire complex noun phrase having an isomorphism in surface structure with a simpler construction in the language. Due to the presence of RP, double object dative IO-RC, marked by [ ] in example (16), is identical in surface form to a simpler double object dative construction, as in (17).

(16) Double object dative IO-RC

[nvhai song ta liwu] de nanhai

girl give 3.SG. gift DE boy

'the boy that the girl gave a gift to'

(17) Double object dative main clause

nvhai song ta liwu

girl give 3.SG. gift

'the girl gave her/him a gift'

From a constructivist perspective, children, therefore, could make use of a simpler and earlier acquired double object dative construction as a subpart construction to bootstrap onto constructing a more complex IO-RC. In addition, when one compares a double object dative construction *versus* a prepositional dative construction, as a potential "subpart" construction, to constructing a more complex IO-RC, the double object dative construction might have an additional advantage of being more frequently attested in the input than the prepositional dative construction (Yao & Liu, 2010). Moreover, unlike the prepositional dative IO- RCs, pronoun resolution

would be relatively easier for double object dative IO- RCs as there is only one possible referent for the pronoun.

An additional remark about the design of this follow-up study. This study did not include double object dative IO-RC as an additional sentence type, but instead, used double object dative IO-RC to replace prepositional dative IO-RC in the IO-RC condition, so as not to further increase the duration of the experiment for young children. Rather, comparison of performance between the double object dative-IO RCs and the prepositional dative-IO RCs was drawn across the two studies by recruiting a similar group of four-year-olds, matched in age and vocabulary knowledge to the first study, in the follow-up study. Moreover, we assessed an additional younger group of three-year-olds in this follow-up study to further examine the developmental patterns in younger children, since four-year-olds and five-year-olds performed similarly in study one.

2.5.1 Method

The same sentence repetition task was used in this follow-up study.

2.5.1.1 Participants

Two groups of monolingual Mandarin-speaking children were recruited in Xi'an, Mainland China. There were twenty-eight four-year-olds aged 4;3 to 4;9 (mean=4;6, SD=0;4) and twenty-six three-year-olds aged 3;3 to 3;9 (mean=3;6; SD=0;2). The children had no known language and cognitive impairments.

2.5.1.2 Materials

All materials and orders of sentence stimuli were exactly the same as those in the first study, except that the IO-RC stimuli using prepositional datives in the first study were replaced by double object datives (see Appendix A).

2.5.1.3 Procedure & Scoring

The procedure and scoring were exactly the same as those in the first study.

2.5.2 Results

Figure 2.2 reports the mean proportion of correct responses and standard errors for each RC type. The overall pattern of production accuracy in this follow-up study was similar to that in the first study- children performed best on S, followed by A, OBL, and then followed by P. There were also differences registered between the two studies. IO-RC was no longer the most difficult type to produce- children found IO-RCs easier to produce when asked to repeat double object dative IO-RCs instead. GEN- RCs became the most difficult type for children to repeat. In general, the older four-year-old group performed better than the younger three-year-old group.

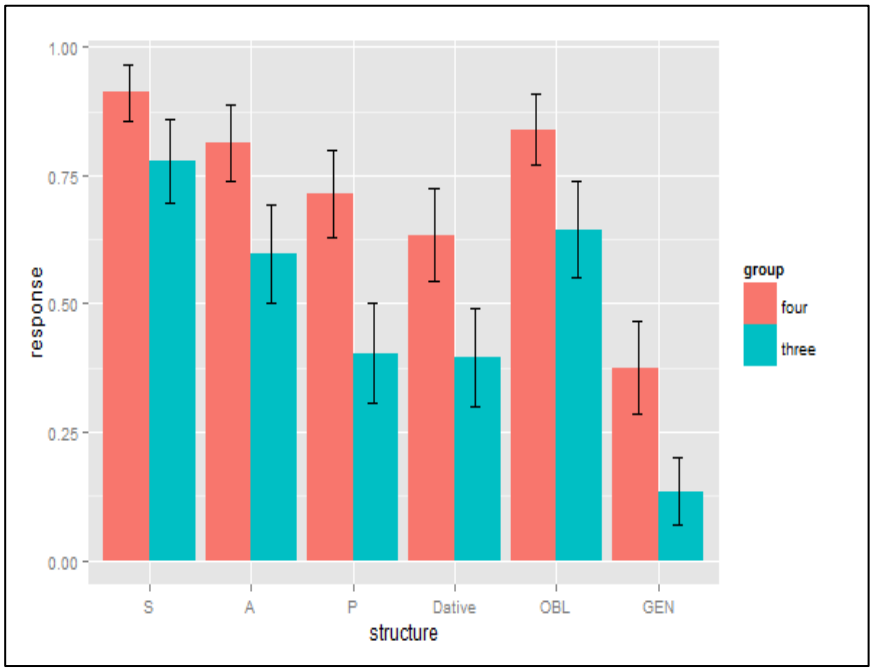


Figure 2.2. The mean proportion of correct responses for each RC type in the follow-up study (four: 4 years old, five: 5 years old)

The data were analyzed using Generalized Linear Mixed Models (GLMM) (Baayen, Davidson & Bates, 2008; Jaeger, 2008), which were calculated using the *lme4* package for Linear Mixed Effects (Bates & Maechler, 2010) in *R* (version 3.4.3, R Core Development Team, 2017). There was no interaction between age and structure, and thus age × structure interaction as an independent variable was removed from the model. The main effect of structure (i.e. RC type) significantly improved model fit χ^2 = 242.3, df = 5, $p < .001$, and the main effect of age group also significantly improved fit, χ^2 = 18.99, df = 1, $p < .001$ (β = -1.29, z = -4.69, p < .001). The final model included the independent variables of structure (6 levels: S, A, P, double object datives IO, OBL, and GEN) and age group (2 levels: three-year-olds vs four-year-olds). Table 2.2 shows the results for each RC type.

Table 2.2. Results of contrasts between each RC type in the follow-up study

	A	**P**	**Dative**	**OBL**	**GEN**
S	β = -0.97, z = -3.73, p < .001	β = -1.74, z = -6.8, p < .001	β = -1.98, z = -7.7, p < .001	β = -0.74, z = -2.83, p < .01	β = 3.37, z = -12.12, p < .001
A		β = -.77, z = -3.43, p < .001	β = -1.01, z = -4.46, p < .001	β = 0.23, z = 0.95, NS	β = -2.4, z = -9.74, p < .001
P			β = -0.233, z = -1.08, NS	β = 0.99, z = 4.33, p < .001	β = -1.63, z = -6.95, p < .001
Dative				β = 1.23, z = 5.34, p <.001	β = -1.39, z = -5.99, p < .001
OBL					β = -2.62, z = =10.42, p < .001

2.5.3 Interim Summary

The major results based on the statistical findings reported in Table 2.2 are summarized as follows. Similar to the first study, children found S easiest to produce, A significantly easier than P, and OBL as easy as A. Children also found GEN difficult to produce: it was the second most difficult type in study

one and the most difficult type in this follow-up study. On the other hand, children, even the younger three-year-olds, found IO-RCs significantly easier to produce in this follow-up study, when asked to repeat double object dative IO-RCs instead: double object dative IO- RCs were significantly easier than GEN- RCs, even as easy as P- RCs. The overall hierarchy of difficulty attested in this follow-up study was S>A=OBL>P=double object datives IO>GEN (> means 'easier than'; = means 'similar to').

2.5.4 Error Analysis

The error patterns attested were highly similar across the five RC types (i.e. S, A, P, OBL and GEN) assessed in both studies, and so the error patterns for each of these RC types were reported collectively in Table 2.3. Table 2.3 shows the error types and their rate of occurrence for each RC type and for each age group. In general, there were three main types of errors: ungrammatical sentences, conversion of RCs into other types of sentences, and omission of some lexical items.

Table 2.3. Error types across RC types and age groups

RC type	Main types of errors	Subtypes of errors	Age groups (out of total number of responses)		
			3;6	**4;6**	**5;6**
S	Ungrammatical		0%	2.5%	0%
A	Ungrammatical		19.2%	5.9%	0%
	Conversion	simple transitive SVO construction	9.6%	2.1%	1.8%
P	Ungrammatical		4.8%	5.1%	0%
	Conversion	simple transitive SVO construction	51.9%	20.8%	15.2%
DoIO	Ungrammatical		43.5%	21.4%	
	Conversion	double object dative construction	1.0%	0.9%	
PrepIO	Ungrammatical			35.5%	27.7%
	Conversion	prepositional dative construction		33.9%	33.9%
		DoIO		7.3%	8.0%
OBL	Ungrammatical		18.3%	10.2%	6.3%
	Conversion	serial verb construction	3.8%	3.0%	0.9%
	Omission	resumptive pronoun	3.8%	1.7%	0.9%

It was also observed that, interestingly, within the GEN- RC condition, the GEN-S and the GEN-O RCs, elicited a different pattern of error proportions, and therefore their error patterns were reported separately in Table 2.4. Following Diessel and Tomasello (2005), there were two tokens

of GEN-S and two tokens of GEN-O RCs in the GEN-RC condition for both studies.

Table 2.4. Error types in GEN-RCs across age groups

RC type	Main types of errors	Subtypes of errors	Age groups (out of total number of responses)		
			3;6	**4;6**	**5;6**
GEN-S	Ungrammatical		32.7%	15.3%	21.4%
	Conversion	simple transitive SVO construction	30.8%	13.6%	5.4%
	Omission	Resumptive pronoun	21.2%	19.5%	8.9%
GEN-O	Ungrammatical		48.1%	19.5%	14.3%
	Conversion	simple transitive SVO construction	9.6%	5.1%	0%
	Omission	Resumptive pronoun	1.9%	3.4%	5.4%

Children produced ungrammatical sentences frequently, particularly when asked to repeat prepositional dative IO- and genitive RCs, reflecting that children might have difficulties in processing these complex structures.

Regarding the conversion errors, children also often produced a simpler main clause structure instead when attempting to repeat RCs. This error pattern occurred frequently with P-RCs and prepositional dative IO-RCs (labelled as 'PrepIO' in Table 2.3) in particular. Specifically, when attempting to repeat a P-RC as in (18), the children would instead produce a simple SVO transitive construction as in (19). In fact, more than half of the

P- RC sentence stimuli (51.9%) were converted into simple SVO transitive main clauses by the 3;6-year olds, and 20.8% by the 4;6-year olds and 15.2% by the oldest 5;6-year olds.

(18) Test sentence (P- RC)

houzi zhuadao de na zhi xiongmao
monkey catch-EXP DE Dem CL panda
'the panda that the monkey caught.'

(19) Child's response (simple SVO transitive main clause)

houzi zhuadao na zhi xiongmao
monkey catch-EXP Dem CL panda
'The monkey caught a panda.'

As for prepositional dative IO- RCs, when attempting to repeat this RC type as in (20), the children would instead produce a simpler prepositional dative construction as main clause as in (21). The four-year-olds converted 33.9% of the prepositional dative IO test sentences into prepositional dative main clauses. This type of error did not appear to decrease significantly as children grew older. The older five-year-old group committed the same error rate as the younger four-year-old group (33.9%).

(20) Test sentence (Prepositional dative IO- RC)

nanhai song le hua gei ta de na ge ayi
boy give ASP flower prep. 3.SG.DE Dem CL lady
'the lady whom the boy gave a flower to'

(21) Child's response (prepositional dative construction as main clause)

nanhai song le hua gei na ge ayi

boy give ASP flower prep. Dem CL lady

'the boy gave a flower to the lady.'

This specific pattern of conversion errors, common among P-RCs and prepositional dative IO- RCs in particular, is consistent with the hypothesis that these two RC types were particularly challenging for young children to process because of their structural similarity with a simpler construction in the language (see section 2.2).

As for omission errors, children were more likely to omit the resumptive pronoun when they attempted to repeat GEN-S RCs, than when they attempted to repeat other resumptive RC types such as GEN-O, OBL- and IO- RCs. Specifically, when attempting to repeat GEN-S RCs as in (22), the children would instead omit the resumptive pronoun as in (23).

(22) Test sentence (GEN-S RC)

ta de niao zhuadao le hudie de na ge ayi

3.SG.DE bird catch-EXP ASP butterfly DE Dem CL lady

'the lady whose bird caught a butterfly'

(23) *Children's response (omission of resumptive pronoun)

niao zhuadao le hudie de na ge ayi

bird catch-EXP ASP butterfly DE Dem CL lady

'the lady that the bird catches a butterfly'

In GEN-RCs, the genitive relationship between the subject of the RC and the head noun could not be established when the RP and the genitive

marker ‘de’ were omitted. The 3;6-year olds omitted the resumptive pronoun when attempted to repeat 21.2% of the GEN-S RC sentences. The rate of this error type dropped significantly to 8.9% in the oldest five-year-old group. Compared to the GEN-S RCs, the omission of resumptive pronoun was less frequent in repeating GEN-O RC sentences across the three age groups. The difference in omission of resumpitve pronoun between GEN-S and GEN-O is possibly related to maintaining the RP in memory (Gibson, 1998, 2000). In a head-final resumptive RC, the RP occurs earlier than the co-indexed head noun. Therefore, children have to hold the RP in memory and then look for the co-indexed referent as soon as possible from the incoming words as the sentence unfolds. In GEN-S RC, the RP occurs in the initial position of the sentence and the co-indexed head noun occurs in the final position, as in (22), and thus the linear distance between the resumptive pronoun and the co-indexed head noun is long. It would be taxing for small children to hold the RP in working memory and integrate the RP to the co-indexed head noun in such a long dependency. By the time the co-indexed head noun was reached, the RP stored earlier might no longer be held in working memory. This long linear dependency between the RP and the co-indexed head noun could be more challenging for the younger children who are more constrained by their limited working memory capacity than the older children. By contrast, for the GEN-O RCs, the RP occurs later and the linear distance between the RP and the head noun is shorter. More importantly, the RP of GEN-O RCs occurs immediately after the verb of the GEN-RC clause serving as part of the object of the verb, as illustrated in (24), and so it could

be relatively less taxing to keep the RP in working memory when processing a GEN-O RC structure.

(24) Genitive RC-object

[nainai mo ta de mao] de nanhai

old-woman touch 3.SG.DE cat DE boy

'the boy whose cat the old woman touched'

2.6 Discussion

This chapter presents two studies that systematically assessed the production of a wide range of relativized positions in young Mandarin-speaking children. Taking the results of the two studies together, the overall ranking of difficulties was 'S>A=OBL>P>GEN'. Subject RC using intransitive verb (S) was significantly easier than subject RC using transitive verb (A). There was a subject over object advantage (A>P), and GEN-RCs were difficult for children to process. Children found OBL RCs relatively easy to produce, as easy as A- RCs. Regarding the two types of IO-RCs, children were significantly less accurate when attempting to repeat prepositional dative IO-RCs, but found double object dative IO- RCs significantly easier to produce when attempting to repeat this type of IO- RCs. The findings for each RC type will be discussed in turn below.

Subject (S and A) and Object (P) RCs

S was the easiest type for the Mandarin-speaking children to produce. Similarly, English- and German-speaking four-year-olds also found S- RCs easiest to produce among all RC types in the sentence repetition studies reported by Diessel & Tomasello (2005). These findings are consistent with the predictions based on NPAH (Keenan & Comrie, 1977). However, this pattern of finding can also be accounted for by considering the general syntactic and semantic complexity of S-RCs. S-RC involves only an intransitive verb and one animate referent, and as such, is syntactically and semantically simpler than the other RC types which involve transitive or ditransitive verbs and more animate referents.

In addition, the Mandarin-speaking children performed better on A- than P-RCs, showing a subject over object advantage. This finding is also consistent with the predictions based on NPAH. However, this pattern can also be accounted for by perspectives that consider how similarity between constructions could affect acquisition/processing outcome. The poorer performance with object RCs could be due to structural ambiguity with and competition from a simpler construction that is frequently attested in the language. Recall that for object- RCs in Mandarin, the entire complex noun phrase (i.e. the RC plus the head noun) is similar in surface form to a simple SVO transitive construction, giving rise to potential structural ambiguity and competition from a simpler construction. The error analysis on P-RCs further supports this hypothesis. The error of converting P-RCs into simple SVO transitive constructions was the most common error type in the responses to

P-RCs. More than 50% of P-RCs were converted into simple SVO transitive constructions in the three-year-old children's responses.

Oblique-RC

Mandarin-speaking children found OBL-RCs relatively easy to produce. OBL-RCs were easier to produce than P-RCs and as easy as A-RCs. These results are different from English- and German-speaking children (Diessel &Tomasello, 2005). Diessel and Tomasello (2005) reported that the four-year-old English-speaking children showed no difference in the production of OBL- and P- RCs, whereas the German-speaking four-year-old were significantly more accurate with P-RCs than with OBL-RCs. Diessel and Tomasello (2005) argued that the relationships between constructions play a significant role in the processing of RCs. More recently, Kirjavainen et al. (2017) examined the comprehension of subject, object- and OBL-RCs in four-year-old Finnish-speaking children and reported that OBL-RCs were more difficult than object RCs. Kirjavainen et al. (2017) argued that the ease/difficulty of processing/acquiring OBL-RCs was associated with the distributional frequency and the relative complexity of the relativizer. The current finding that Mandarin-speaking children found OBL-RCs significantly easier to produce than P-RCs and were as easy as A-RCs go against the developmental predictions based on NPAH (Keenan & Comrie, 1977), because OBL is positioned lower than A (Subject) and P (Direct Object) in the hierarchy.

Rather, the current finding could be accounted for by perspectives that consider how similarity between constructions could affect

acquisition/processing outcome (Abbot-Smith & Behrens, 2006; Fitz et al., 2011): specifically, children could make use of their earlier acquired serial verb construction, which is likely also frequently attested in the input, as a 'subpart' construction to bootstrap onto constructing a more complex OBL-RC, as OBL-RC in Mandarin is unique in terms of being similar in surface form to a serial verb construction in the language. Fung (2011) reported that Chinese-speaking children start producing serial verb constructions in their spontaneous speech at an early age around two years old. Serial verb constructions are highly productive in Chinese and thus are likely to be frequently attested in the language input. In addition, the preposition '*wei4* for' and its following resumptive pronoun in OBL-RCs is an informative local cue to pronoun resolution. That is, the pronoun only can be co-indexed with the head noun but not with other noun phrases. Taken together, it is possible that OBL-RCs are relatively easy for Mandarin-speaking children.

Indirect Object RCs

Regarding the two types of IO-RCs, prepositional dative IO-RC was the most difficult type to produce for the Mandarin-speaking children in study one and children's performance was significantly improved when using double object dative IO-RCs. Even for the younger three-year-olds, the accuracy of producing double object dative IO-RCs was as high as P-RCs in Mandarin. The processing difficulties with prepositional dative IO-RCs in Mandarin were different from the child English and German findings reported in Diessel & Tomasello (2005). In that sentence repetition study, English- and German- speaking children found prepositional dative IO-RCs as easy to

produce as OBL-RCs and prepositional dative IO-RCs were easier than GEN-RCs in their target language (Diessel & Tomasello, 2005). The developmental phenomena attested when children attempted to repeat IO-RCs in Mandarin were also inconsistent with the predictions based on NPAH, because IO is positioned higher than OBL and GEN in the hierarchy, and perspectives based on NPAH would not predict differential ease of acquisition/processing between the two types of IO-RCs.

By contrast, the language-specific developmental patterns attested in Mandarin align with perspectives that emphasize how similarity between constructions affect acquisition/processing outcomes (Abbot-Smith & Behrens, 2006, Fitz et al., 2011). The difficulties in the processing of prepositional dative IO-RCs are likely due to the structural ambiguity caused by the isomorphism in surface form between the entire complex noun phrase structure (the RC plus the head noun) and a simpler prepositional dative construction in the language. The isomorphism in surface form between the two constructions may elicit competition between the two constructions, leading to higher complexity in processing (c.f. Rowland et al., 2014). The error analysis of prepositional dative IO-RCs was consistent with this hypothesis. The most frequent error type when children attempted to repeat prepositional dative IO-RCs was conversion to simpler prepositional dative constructions, accounting for 33.9% of the responses for prepositional dative IO-RCs from the four-year-olds and from the five-year-olds. Additionally, pronoun resolution is complex when processing prepositional dative IO-RCs due to the structural ambiguity. Unlike prepositional dative IO- RCs, double object dative IO-RCs are structurally unambiguous with only the 'subpart'

structure of the entire complex noun phrase being similar in surface form to a simpler construction. The processing/acquisition of this type of IO-RCs may be facilitated by the 'partial' structural similarity between the RC and a simple construction. Children might use the 'subpart' simple construction to bootstrap onto constructing the complex double object dative IO-RC (Abbot-Smith & Behrens, 2006, Fitz et al., 2011). Therefore, it is reasonable to expect that children would perform significantly better with double object dative IO-RCs than with prepositional dative IO-RCs.

Genitive-RC

Similar to the English- and German- speaking children (Diessel & Tomasello, 2005), Mandarin-speaking children also experienced difficulties with GEN-RCs. This finding was consistent with the predictions based on NPAH (Keenan & Comrie, 1977) because GEN is positioned in the low end of the hierarchy. However, difficulty with this structure can also be explained by the general syntactic and semantic complexity of GEN-RCs. Interpreting a GEN-RC involves resolving the syntactic and semantic relationships between the three animate referents (when animacy cues are neutralized), identifying the relationship between the head noun and the relative clause by a genitive attribute, and resolving the dependency of co-indexation relationship between the resumptive pronoun serving as the possessor in the RC and the head noun. This structure is hard even for adults to process, let alone young children with working memory limitations.

A post-hoc comparison between children's performance with GEN-subject RCs and GEN-object RCs were conducted. The reason for this comparison is that in Mandarin, canonical word order and linear-distance factors are confounded in object RCs. That is, both factors could be argued to favour the processing of object RCs because object RCs have the NVN canonical word order and shorter linear distance[2]. As a result, one cannot tease apart the two factors in studies reporting an object advantage (e.g., He et al., 2017). The comparison between GEN-subject and GEN-object provides a unique opportunity to address this issue. GEN-subject and GEN-object RCs are similar in a number of ways but they differ crucially differ in the linear distance between the head noun and the co-indexed resumptive pronoun. Specifically, these two subtypes of GEN-RCs are similar in terms of input frequency because both types are believed to be infrequently attested in children's language experience. They are also similar as the GEN-RC clauses, denoted by [ ] in (25) and (26), share the same canonical NVN/SVO word order for both RC types. However, GEN-subject RCs have a longer linear distance between the resumptive pronoun and the head noun, while GEN-object RCs have a shorter linear distance for this dependency.

[2] By contrast, in the current study, object RCs were argued to be 'disfavoured' due to similarity to and competition from simple SVO transitive constructions.

(25) Genitive RC-subject

[ta de mao zhuadao le laoshu] de nainai

N V N N

3.SG. DE cat catch-EXP ASP mouse DE old-woman

'the old woman whose cat caught a mouse'

(26) Genitive RC-object

[nainai mo ta de mao] de nanhai

N V N N

old-woman touch 3.SG. DE cat DE boy

'the boy whose cat the old woman touched'

A post-hoc analysis showed that GEN-object RCS were significantly more accurate than GEN-subject RCs for the 3;6- and the 4;6-year olds, but this effect no longer exists in the 5;6-year olds. These findings suggest that when younger children who are more constrained by their working memory limitations process more complex structures like genitive RCs, linear distance effect could become more prominent.

2.7 Conclusion

This chapter presents two studies that systematically investigated a wide range of relativized positions in Mandarin RCs including subject and object RCs, two types of Indirect Object: prepositional dative IO-RC and double object dative IO-RC, Oblique and Genitive RCs. The developmental patterns exhibited are not fully consistent with the developmental predictions based on NPAH (Keenan & Comrie, 1977). By contrast, theoretical perspectives that emphasize how similarity between constructions would affect processing/acquisition outcomes, a language-specific feature that would depend on the configurational details of the target language, offer a better account in explaining the developmental phenomena exhibited (Abbot-Smith & Behrens, 2006; Diessel & Tomasello, 2005; Fitz et al., 2011; Rowland et al., 2014). In addition, other factors may also jointly influence Mandarin-speaking children's RC processing/acquisition, such as general subject prominence[3], general syntactic and semantic complexity, cues to pronoun resolution in the more complex structures, and linear distance involved in resolving the dependency between the resumptive pronoun and its referent when working memory is especially taxing (see also Chen &

[3] The production ease with subject RCs in the current study is also consistent with the general subject prominence hypothesis based on functional notions such as topicality and perspective (MacWhinney, 1977; Kim & O'Grady, 2016). This study cannot tease apart whether the current subject over object advantage is an outcome arisen from the lack of a competing simpler construction in the case of subject RCs but not object RCs, or general subject prominence, or both. Conceptually both factors can co-exist, as the functional assumptions in the general subject prominence hypothesis are not incompatible with a constructivist perspective to language acquisition. As such, the general subject prominence factor is also mentioned here.

Shirai, 2015; Diessel & Tomsello, 2005; Mansbridge, Tamaoka, Xiong, Verdonschot, 2017).

Chapter Three
Mandarin-speaking children's online processing of subject and object RCs

3.1 Introduction

This study revisits the issue of subject/object processing asymmetry in child Mandarin. Empirically, the novelty lies in comparing the comprehension of two types of subject and object RCs in young Mandarin children using an online method, in addition to documenting the distributional properties of these two types of subject/object RCs and their related structures in young Mandarin-speaking children's linguistic experience. The relative ease of processing/acquiring subject versus object RCs in Mandarin has attracted increasing interest, because Mandarin presents certain linguistic properties that are typologically distinctly rare in languages of the world, in particular, the combination of SVO canonical word order and head-final RCs, and these special properties provide important opportunities to tease apart predictions of theories that would make opposite predictions regarding the relative ease of processing/acquiring subject versus object RCs in the language (the so-called "subject-object asymmetry"). For instance, structural-based perspectives predict a subject over object advantage (Friedmann et al., 2009; Lin & Bever, 2006); whereas linear distance-based and canonical word order-based perspectives predict an object over subject advantage (Gibson, 1998, 2000; Diessel & Tomasello, 2005). However, thus far the existing

child Mandarin studies have been largely conducted without considering that there can be different types of subject versus object RCs within a language, and these types can vary in their linguistic/syntactic analyses and their distributional properties in children's linguistic experience, which could potentially lead to variations in processing preferences between these types. This perspective stands in contrast to the conceptual perspectives such as structural-based and linear-based sentence processing theories mentioned above, which would make predictions of a uniform subject or object advantage within a language. This chapter presents a corpus and an experimental study attempting to address these issues. The chapter is organized as follows: Section 3.2 reviews the existing literature on subject/object processing asymmetry in child Mandarin and highlights the current limitations. Section 3.3 describes the current study, including a corpus analysis on the distributional properties of the RCs and the RC-like structures, and a study on the online comprehension of two types of subject and object RCs in child Mandarin. Section 3.4 discusses the findings. Section 3.5 concludes this chapter.

3.2 The subject/object processing asymmetry in Mandarin

Unlike English and other European languages which often report a general subject over object advantage in the RC acquisition/processing literature, previous child language studies on Mandarin RC acquisition show mixed results. Some studies point to a subject over object advantage, while others show an object advantage or no significant difference between subject and

object RCs. Table 3.1 presents a summary of the existing child language literature on Mandarin children's RC comprehension and production.

In young children's naturalistic speech, Chen & Shirai (2015) reported that Mandarin-speaking children produced more object RCs than subject RCs. They analyzed the Fang corpus (age range: 0;11 to 3;5; Min, 1994) and reported that ORCs were more frequent than SRCs in Mandarin children's utterances and the adults' input. Similar results were reported in Liu (2015) which analysed the adult child-directed speech in another Mandarin corpus- 'ZHOU2' featuring children aged 3 to 6. These findings indicate that the RC usage patterns of children's early spontaneous speech appear to align with those attested in children's linguistic experience (i.e. the adult input). It is possible that the object RCs attested in children's early naturalistic speech and in their adult input are often restricted in semantics/functions (e.g. object RCs are often with inanimate heads and animate subjects of the RC, Kidd et al., 2007; Kirjavainen et al., 2017), although currently there is no study that systematically offers a more fine-grained examination of the distributional properties of the RC types and their related structures attested in Mandarin-speaking children's language input and in their early naturalistic speech. Such kind of analyses allows one to document more specific patterns of children's linguistic experience, as a basis to allow one to further examine how specific properties of the children's linguistic experience could relate to their competence with RCs in naturalistic speech and experiments in the case of Mandarin.

Regarding experimental studies, some earlier studies using various measures such as act-out task, picture pointing task, elicited production task

and sentence repetition task have reported a subject advantage (Lee, 1992; Hsu et al., 2009), an object advantage (Ning & Liu, 2009) or no difference (Chang, 1984; Su, 2004; see Chan et al. (2011) for a review). On the other hand, the more recent studies seem to consistently show a subject over object advantage in both comprehension (Hu et al., 2016b) and production (Hsu, 2014; Hu et al., 2016a). An exception is He, Xu and Ji (2017), which reported an object advantage in Mandarin children's comprehension data using a picture pointing task.

Table 3.1. A summary of existing literature on Mandarin children's RC comprehension and production

Study	**Method**			**Findings**
	Subject	**Method**	**Stimuli**	'>' more or easier
Chang (1984)	N=48, aged 7, 8, 10, 12	Act out task	SS, SO, OS, OO	No significant difference between SS and SO and between OO and OS
Lee (1992)	N=61, aged 4-8	Act out task	SS, SO, OS, OO, SIO, OIO	Sentences involving subject relativization (SS, SO) were significantly easier than those involving object relativization (SO, OO) or indirect object relativization (SIO, OIO)
Su (2004)	N=20, aged 5;7-6;5;	Elicited production task	S, O, Preposition-of-Object,	Fewer correct Subject RCs (84% in the younger

	N=20, aged 5;0-5;6		Clausal Complement, Unextractable Subject	group and 78% in the older group) than Object RCs (88% in the younger group and 83% in the older group), but the difference was not significant. 50% target Prepositional object RCs were in the younger group, and 68% in the older children.
Hsu et al. (2009)	N=23, aged 4;0-6;5	Elicited production task	SRC and ORC with control of embeddedness	SRCs > ORCs
Chan et al. (2011)	N=23, aged 4;3-4;9	Picture pointing task	S and O	No significant difference between SRCs and ORCs
Hsu (2014)	N=14, aged 3 N=18, aged 4 N=18, aged 5	Sentence repetition task	SRC and ORC with control of sentence length	3-year-olds produced more subject than object RCs, but the overall percentage was less than 25%. 4-year-olds performed better with long SRC than long ORC, but no difference in short SRC and ORC. 5;6-year-olds showed

				clear subject over object advantage in both long and short conditions.
Chen & Shirai (2015)	N=4, aged 0;11-3;5	Corpus data		Significantly more Object RCs (61.5%) than Subject RCs (18.6%) and a small proportion of Oblique (10.3%) were attested in children's speech. The development is DO>S>OBL.
Liu (2015)	N=140, aged 3-6	Corpus data		ORCs > SRCs
Hu et al. (2016a)	N=125, aged 3-8	Elicited production task	S and O	SRCs > ORCs
Hu et al. (2016b)	N=120, aged 3-8	character–matching task	S and O	SRCs > ORCs
He et al. （2017）	N=95, aged 3;5-6;5	Picture pointing task	SS,SO,OS,OO	SO,OO > SS,OS SO,SS > OS,OO

Apart from the mixed findings on subject/object asymmetry in child Mandarin, the past studies have only focused on comparing one type of subject versus object RCs. For example, most of the previous studies have only examined relative clauses with the head nouns presented as bare nouns

(e.g., Hu et al., 2016b; He et al., 2017). In addition, in terms of conceptual orientation, these previous child Mandarin studies have mainly considered theoretical perspectives that would make a uniform prediction of subject or object advantage for Mandarin, and have often restricted the focus to contrasting structural based versus linear based theories of sentence processing (e.g., Hu et al., 2016a, 2016b, Hsu et al., 2009). Thus far these child Mandarin studies have been largely conducted without considering that there can be different types of subject versus object RCs within a language, and these types can vary in their linguistic/syntactic analyses and their distributional properties in children's linguistic experience, which could potentially lead to variations in processing preferences between these types. A notable exception is a recent child language study by Chan et al. (2018) featuring Cantonese. This study considered and compared two different types of subject versus object RCs within Cantonese (classifier RCs and RCs marked with the relative marker '*ge3*'), and reported that the four-year-old Cantonese-speaking children displayed a differential pattern of subject/object asymmetry for these two RC types despite the fact that the two are largely similar in surface form. Specifically, there was a subject over object advantage for *ge3* RCs but an object over subject advantage for classifier RCs. The authors suggested that the distributional properties of the input could offer a reasonable perspective to account for the differences in children's processing preferences. For instance, the object over subject advantage in the classifier RC condition was consistent with certain distributional properties of children's linguistic experience (i.e. input experience), in which object classifier RCs and simple SVO transitive

constructions that share identical surface form with object classifier RCs were much more frequent in Cantonese children's linguistic experience. In addition, a merit of Chan et al. (2018) is that the study used an online eye-tracking method to track children's processing pattern in real time, allowing them to capture differences which were not evident in offline measures. As for Mandarin, the existing child language studies examining RC comprehension have only used offline measures thus far.

Like Cantonese, Mandarin has two types of RCs, i) RC de DCL N (DCL-RC): relatives with the head nouns specified with a demonstrative (D) and a classifier (CL), and ii) RC de N (DE-RC): relatives with bare head nouns, which are largely similar in surface form, as illustrated in examples (1) and (2).

(1) RC de DCL N (DCL-RC)

[$_{RC}$ mama mai] de na ge wanju huai le

mother buy DE that CL toy broke PFV

'The toy that mother bought has broken.'

(2) RC de N (DE-RC)

[$_{RC}$ mama mai] de wanju huai le

mother buy DE toy broke PFV

'The toy that mother bought has broken.'

These two RC types have been argued to differ in their syntactic analyses and distributional properties of usage, providing an interesting point of

comparison regarding the issue of subject-object asymmetry for theories of RC acquisition and processing. Specifically, according to the non-uniform approach to the syntactic analyses of Chinese RCs (Cheng & Sybesma, 2009; Cheung & Li, 2015), i.e. the view that NOT all types of RCs involve filler-gap dependencies in Chinese, DE-RCs are analysed as complementation structures with filler-gap dependencies, but DCL-RCs are analysed as apposition structures by Cheng & Sybesma (2009) or adjunction structures by Cheung & Li (2015) without filler-gap dependencies, due to their differences in syntactic behaviors. If so, then one would expect that DE-RCs in Mandarin, but NOT DCL-RCs in Mandarin, would be structurally similar to the conventional RCs in English and some European languages that have been analysed as syntactically governed by extraction-type filler-gap dependency. The implication could be that the structural factors/constraints, such as structural intervention, that have been proposed to crucially affect the processing/acquisition of this kind of 'syntactic filler-gap dependency type' RCs should be applicable to DE-RCs but not DCL-RCs in Mandarin. Following this line of reasoning, one would predict that subject over object advantage would be exhibited with DE-RCs, because, for example, that there is structural intervention violating relativized minimality in object RCs but not in subject RCs of this type; but for DCL-RCs, a lack of subject over object advantage is possible because this type of RCs are not subject to the same kind of syntactic constraints.

Although it is interesting to test these syntactic perspectives, one should acknowledge that there is also considerable debate in theoretical linguistics concerning the syntactic analyses of Chinese RCs and RCs in general. For

example, the ‘uniform’ approach to the syntactic analyses of Chinese RCs, a dominant perspective in the field of Chinese syntax, by contrast, views all Chinese RCs as involving filler-gap dependencies (Aoun & Li, 2003; Simpson, 2002). In addition, there is a theoretical discussion of East Asian noun-modifying constructions in Comrie's typology when he proposed to rethink the typology of relative clauses, arguing that the so-called relative clauses in some Asian languages like Chinese and Japanese are qualitatively different from the relative clauses in English and other European languages, and the RCs in these Asian languages can be analysed as a subset of noun modifying constructions in their target language, that are governed by semantic-pragmatic factors with NO syntactic filler-gap dependency (Comrie, 1996, 1998, 2002). Even for the so-called conventional type of RCs in English, alternative analyses exist, see for example van Trijp (2014) in which long-distance dependencies are formalized from an alternative cognitive-functional approach without assuming the filler-gap extraction type of syntactic dependency. As such, the non-uniform approach to the syntactic analyses of Chinese RCs (Cheng & Sybesma, 2009; Cheung & Li, 2015), although interesting and acknowledged here, is not uncontroversial, and constitutes only one approach from many.

Perhaps of more psychological reality is to consider psycholinguistic models/perspectives that the human language acquisition or processing mechanisms are sensitive to frequency effects and distributional properties of the input, and that there is a tight link between specific patterns of linguistic experiences and acquisition outcomes/processing preferences. Relating back to the two types of RCs in Mandarin under investigation, there

appears to be some suggestive evidence that they differ in their distributional properties in actual usage patterns. Specifically, Chen et al. (2015) analyzed the Lancaster Corpus of Mandarin Chinese and reported that object DCL RCs were more frequent than subject DCL-RCs (70% vs 16%), but subject DE-RCs were more frequent than object DE-RCs (91% vs 4%). This is an interesting observation that can potentially make differential predictions of processing preferences for these two RC types, although this corpus features mostly written Mandarin Chinese texts, and therefore should be viewed with caution in the context of language acquisition and processing in young children. Best would be to analyse child-directed speech, as a basis to examine the distributional properties of these two types of RCs in Mandarin children's linguistic experience, and then discuss how they may generate predictions for children's processing preferences for these two RC types on the issue of subject-object asymmetry. The current study attempts to address this research gap.

3.3 The Current study

A detailed corpus analysis on Mandarin child-directed speech was first conducted to consider and compare the distributional properties of these two RC types in children's linguistic experience. The ensuing predictions of processing preferences for the two RC types would also be highlighted. A referent selection eye-tracking task was conducted to assess the comprehension of these two RC types in young Mandarin-speaking children, to test the developmental predictions.

3.3.1 Corpus study of adult child-directed speech

Frequency effects can occur at different levels (Ambridge et al., 2015) including target structures and their related structures (Diessel & Tomasello, 2000), and the level of abstract cues to semantic-role assignment such as animacy (Brandt et al., 2009; Kidd et al., 2007). However, the existing Mandarin corpus studies were either based on written corpora (Hsiao & Gibson, 2003; Jager et al., 2015; Vasishth et al., 2013) which may not be most relevant to language acquisition/processing in young children, OR the adult child-directed speech analyses only counted and compared the frequency of occurrence of the target subject versus object RCs (Chen & Shirai, 2015; Liu 2015), without considering also the related structures (e.g. RC-like structures/sequences, see Vasishth et al. (2013), and without examining whether the target RC constructions are restricted in certain semantic types or function such as patterns of animacy contrast. The current corpus study of Mandarin adult child-directed speech aimed to address these gaps.

3.3.1.1 Structural frequencies of RC-like structures and target RCs

Structural frequencies were computed at two levels. The first level was a more general level targeting RC-like sequences explained below (see also Vasishth et al. (2013). All the morphologically tagged adult utterances from six Mandarin corpora (approximate 380,000 words in total) in CHILDES were extracted, and the subject RC-like and object RC-like sequences were

analyzed. Specifically, the utterances attesting a subject RC-like pattern 'V N de (CL) (N)' and object RC-like pattern 'N V de (CL) (N)' were extracted from AcadLang corpus (Zhou doi:10.21415/T5SC9D), Chang1 & Chang 2 corpus (Chang, 1998), Tong corpus (Deng & Yip, 2018) and Zhou 1 (Zhou, 2001) & Zhou 2 (Li & Zhou, 2004). Overall, DE RC-like utterances were far more frequent than DCL RC-like utterances (1903 vs 23 tokens). As for the frequency of subject RC-like versus object RC-like sequences, there is a very interesting pattern of contrast consistent with the observations in Chen et al. (2015). Regarding the DCL RC-like utterances, object RC-like patterns were more frequent than subject RC-like patterns (19 vs 4 tokens), as shown in Figure 3.1.

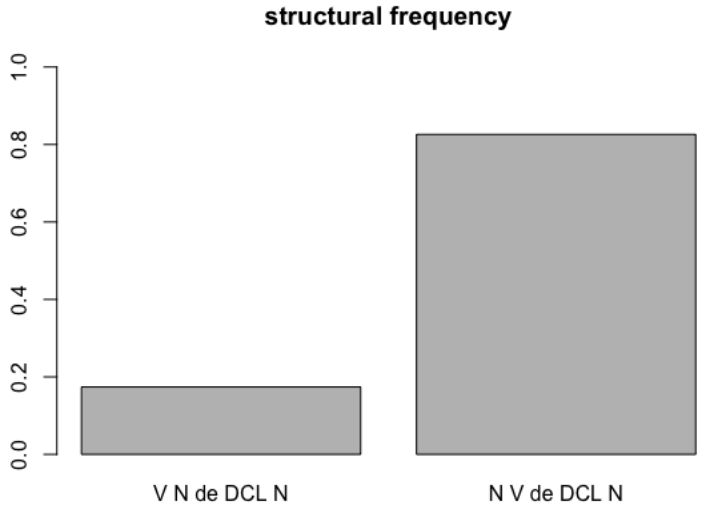


Figure 3.1. Structural frequencies of DCL RC-like sequences attested in adult child-directed speech (subject RC-like: V N de DCL N; object RC-like: N V de DCL N)

By contrast, for the DE RC-like utterances, the pattern is reversed: subject RC-like patterns are more frequent than object RC-like patterns (1430 vs 473 tokens), as shown in Figure 3.2.

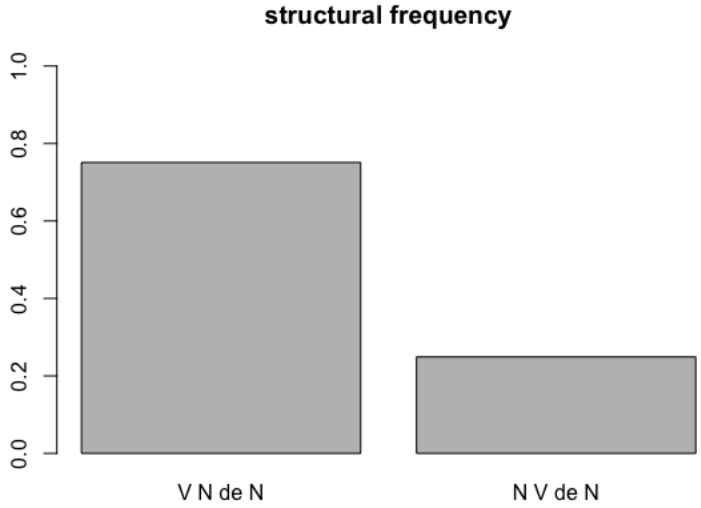


Figure 3.2. Structural frequencies of DE RC-like sequences attested in adult child-directed speech (subject RC-like: V N de N; object RC-like: N V de N)

The second level of analyses was restricted to the target RC constructions. Since the particle 'DE' in Mandarin is versatile in serving multiple functions, for example, as a relative marker, adjective marker, possessive marker or sentence final particle (Deng, 2017), the next step was to exclude the irrelevant utterances, so that the analysis could be restricted to those containing authentic RCs. Out of this set, there were again fewer DCL RCs than DE RCs (14 vs 121 tokens). All the 14 DCL RCs were object RCs, and no subject DCL RC was attested. On the other hand, there were 121 utterances containing DE RCs, with more object RCs (N=95) than subject

RCs (N=26) attested. This general pattern of more object RCs than subject RCs being used in adult child-directed speech is consistent with previous corpus findings (Chen & Shirai, 2015; Liu 2015).

3.3.1.2 Animacy contrasts

Animacy has been repeatedly reported to be a factor that modulates the subject/object processing asymmetry (see e.g. Hsiao & MacDonald, 2013; Kidd et al., 2007; Mak et al., 2002). This study did not aim to manipulate animacy contrast as a variable to be tested, but instead aimed to focus on holding the animacy constant. Still, it could be helpful to gather a more concrete idea of the kind of animacy cues present when young Mandarin-speaking children experienced RCs in their naturalistic linguistic environment, as it may be useful to relate this information to their performance in an experimental context during which animacy contrast cues are controlled and neutralized. As such, the animacy contrast between the RC internal noun phrase and the head noun was analysed from a subset of the data. A total of 93 adult utterances containing 'DE demonstrative' and 4733 adult utterances containing 'DE' were extracted from the Zhou2 corpus published on CHILDES. The Zhou2 corpus was chosen for the animacy contrast analysis as this corpus features naturalistic adult-to-child interactions from as many as 140 Mandarin-speaking children from ages 3 to 6 in Mainland China, capturing a preschool age range that is similar to the age tested in the current experiment.

Table 3.2 summarizes the results for the DCL and the DE subject and object RCs. Regarding DCL-RCs, DCL subject RCs were rare in the input

(in fact, no token was attested in the current sample as mentioned above). DCL object RCs were predominantly with animate RC internal NPs and inanimate head nouns (92.9%), consistent with previous results reported for Mandarin in Wu (2009) and Dutch and German (Mak et al., 2002). For the DE RCs, more than half of the subject RCs attested contained inanimate RC internal NPs and inanimate head nouns (61.5%), and 38.5% of the subject RCs attested contained animate head nouns and inanimate RC internal NPs. As for DE RCs, a large proportion of object DE RCs contained animate RC internal NPs and inanimate head nouns (71.6%), again consistent with previous corpus findings (Wu, 2009; Mak et al., 2002). These findings suggest that, as far as the target RC structures are concerned, children frequently encounter object RCs with inanimate heads and with contrastive animacy pattern between the head noun and the subject of the RC, comparatively more often than object RCs with animate head nouns and subject RCs in general in their language experience. On top of these, children also encounter far more often DE RC-like utterances, which are predominantly subject RC-like patterns (1903 tokens attested), and relatively far less often DCL RC-like utterances (only 23 tokens attested), which are mostly object RC-like patterns (19 out of 23 tokens).

Table 3.2. Animacy of RC internal NP and head noun of DCL and DE subject and object RCs

		Animate RC internal NP		**Inanimate RC internal NP**	
		Animate Head	**Inanimate Head**	**Animate Head**	**Inanimate Head**
DCL	**Subject RC**	0% (0/0)	0% (0/0)	0% (0/0)	0% (0/0)
	Object RC	7.1% (1/14)	92.9% (13/14)	0% (0/14)	0% (0/14)
DE	**Subject RC**	0 %(0/26)	0%(0/26)	38.5% (10/26)	61.5% (16/26)
	Object RC	5.3% (5/95)	71.6% (68/95)	0% (0/95)	23.2% (22/95)

Integrating the above corpus findings, one could argue that the DCL and DE RCs present interesting differences in their distributional properties of structural frequencies in children's linguistic experience that could impact on their processing preferences. Although DCL RCs and DCL RC-like structures are not high frequency structures in children's linguistic experience, they consistently show an object rather than subject bias: children encounter more object, than subject, DCL RCs and DCL RC-like structures in their input. Although the kind of object RCs attested in children's linguistic experience are often restricted in semantic types (frequently with inanimate heads and animate subjects of the RC), children are very rarely exposed to subject DCL RCs and DCL RC-like structures (recall zero instance of DCL RC was attested out of 14 adult child-directed

utterances in the current corpus finding). By contrast, for DE RCs, although children also encounter more object than subject DE RCs (95 versus 26 tokens), children also overwhelmingly encounter far a lot more subject than object DE RC-like sequences in their input (1430 vs 473 tokens). Viewing from the perspective of how specific patterns of linguistic experience might impact developmental processing preferences, one could have the following predictions:

1. Children might show an object over subject processing preference when processing DCL RCs.

2. By contrast, children might show a subject over object processing preference when processing DE RCs.

3.3.2 Online study of developmental processing preferences

A referent selection task was conducted to assess the online comprehension of two types of RCs, 'RC DCL NP' (DCL) and 'RC DE NP' (DE) by young Mandarin-speaking children. The task was adapted from Brandt et al. (2009), Rahmany et al. (2014) and Chan et al (2018). Children's eye gazes were recorded and analysed.

3.3.2.1 Participants

Thirty-six (N=36) monolingual Mandarin-speaking children participated in the study. All children were recruited from kindergartens in mainland China and aged from 4;3 to 4;9 (Mean=4;6, SD=0;1). Children were tested on both

DCL and DE RC types in a within-subject design. Since this study was interested in children's online sentence processing when they correctly interpreted the RC, children whose accuracy was too low to offer an accurate record of their eye movements were excluded. Following Chan et al. (2018), the inclusion criterion was set to 50% overall comprehension accuracy. As such, fourteen children's data were excluded from the analyses for the DE type, and fourteen children's data were excluded from the analyses for the DCL type. The final sample consisted of twenty-two (N=22) children for each RC type. All participants were typically developing with no known language impairments.

The high drop-out rate (38.9%) is likely due to the younger age of the children tested. Similarly, the Cantonese study by Chan et al. (2018) reported a high attrition rate (47%) from a group of 4-year-old Cantonese speaking children. The high attrition rate suggests that the study is capturing RC processing at an age where there is significant variation among Mandarin-speaking children in their competence with RCs. The findings are likely to reflect online processing of RCs as relatively newly acquired structures even for the children included in the final analyses who showed fairly good competence with comprehending the target RC structures.

3.3.2.2 Materials

Sixteen test sentences were constructed: eight in the DE condition and another eight in the DCL condition, with four subject RCs and four object RCs for each condition. The test sentences used animal names (e.g. dog, lion,

zebra, bear, pig, monkey, cow, tiger, elephant, giraffe, horse, sheep, panda), and transitive verbs (e.g. chase, kick, wipe, tickle, lick, bump, bite, push, touch, feed) that are familiar to young children. All the sentences were pre-recorded by a female native Mandarin speaker. Table 3.3 shows some examples of the test sentences (see Appendix B for the full list).

Table 3.3. Examples of test sentences

Sentence Type	**Example**
Subject DCL	zhui xiaoshizide de na zhi xiaogou chase lion DE Dem CL dog 'the dog that chases the lion'
Object DCL	xiaoma tui de na zhi xiaogou horse push DE Dem CL dog 'the dog that the horse pushes'
Subject DE	tian banma de shizi lick zebra DE lion 'the lion that licks the zebra'
Object DE	xiongmao tian de shizi panda lick DE lion 'the lion that the panda licks'

3.3.2.3 Procedures

Referent selection task

The testing and data coding procedures followed those established in Chan et al. (2018) for Cantonese-speaking children. The general experimental set-up is first described as follows. Two video-cameras were used. The first one was placed under a table with a hole cut in the centre to record children's eye movements. The second camera was placed behind the participants to record their actions and the locations of the animal toys. Four animal toys serving as head referent, distractor, relevant referent, and unrelated referent were placed on the table at the four corners equidistant from the central camera (see Figure 3.3). A smiley face sticker was placed at the centre of the table just below the camera to centralize the child's eye gaze and draw the child's attention from the toy referents to the centre before the target sentence was played. Two experimenters were involved in the experiment. The first experimenter laid out the four toys in the appropriate positions, played the pre-recorded sentences from a laptop and acted out each trial. The second experimenter monitored the camera under the table to ensure that it recorded the child's eyes. Before placing each animal toy on the table, the experimenter asked the child to name each animal character to ensure that the child knew the animal names.

Figure 3.3. The layout of the toy props and the hidden digital camera in the visual world eye tracking task

Two background scenes with one target scene (see (a) for an example to describe the target scene) and one distractor scene (see (b) for an example to describe the distractor scene) were presented to provide a felicitous discourse context for using a restrictive RC (see (c) for an example of the test sentence) (Correa, 1995; Hamburger & Crain, 1982). The experimenter acted out each of the background scenes and then returned the animals back to their original positions before the next sentence played, as shown in Figure 3.4.

(a) 你看！这只小狗在追这只狮子。

Ni kan! Zhe zhi xiaogou zai zhui zhe zhi shizi

You look! This CL dog PROG chase this CL lion

'Look! This dog is chasing the lion.'

(b) 咦！另外一只小狗在亲这只狮子。

Yi! Lingwai yi zhi xiaogou zai qin zhe zhi shizi

EXCL another one CL dog PROG kiss this CL lion

'The other dog is kissing the lion '

Attention getter:

现在,请看一下中间那个笑脸。

Xianzai qing kanyixia zhongjian na ge xiaolian

Now please look-at centre Dem CL smiley face

'Now please look at the smiley face in the centre.'

(c) 你可不可以拿起

Ni ke-bu-keyi naqi

You can-not-can pick-up

刚才追小狮子的那只小狗呀？

gangcai zhui xiaoshizi de na zhi xiaogou ya

just-now chase lion DE that CL dog SFP

'Can you pick up # the dog that just chased the lion?'

(#: pause)

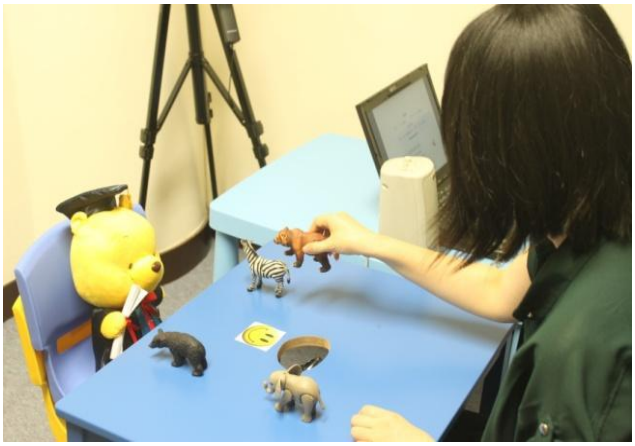


Figure 3.4. Experimenter acting out the background sentences

An attention getter ‘now please look at the smiley face in the centre’ was played after the background scenes before launching the test sentence. The attention getter served not only as a reminder to turn children’s attention and eye movements to the centre, but also as a signal for the children to get ready for the coming target sentence. Children’s eye fixations when they heard the test sentences were recorded and coded. The order of presenting the target scene and the distractor scene in the background were counterbalanced across trials, with half of the trials presenting the target scene first and the other half of the trials presenting the target scene second. The location of the toys was pseudorandomized across trials. From the child’s perspective, the head referent and the distractor were put horizontally or diagonally, but never put along the same vertical plane. The experiment was designed this way as the eye-movements were coded offline (Snedeker & Trueswell, 2004). When children looked at the head and the distractor that were put in a horizontal or diagonal line, they were more likely to make saccades or head movements and as such it could capture the eye movements more accurately and clearly. By contrast, if the target and the distractor were put along a vertical line, it would be difficult to track and differentiate a

child's eye movements when her gaze shifted between the two referents. When a child picked up one of the four referents after hearing the test sentence, it indicated that s/he had processed the RC as a noun modifier. On a few occasions, children asked for clarification to replay the sentences. The experimenter played that trial again, but the eye movements were only coded for the trial presented for the first time. There were two practice trials that helped children familiarize with the expectation and procedure of the experiment. The entire experiment lasted approximately 25 minutes per child.

Eye-movement coding

Children's eye movements were recorded by the camera placed under the table. Specifically, the top-half part of children's face was recorded to enable eye movement coding. The eye movements were coded frame-by-frame using the visual editing program Sound Forge©. This program allows the video files to be played frame-by-frame and thus enables us to code the eye-movements to the four referents placed at the four corners at a specific frame rate. Each frame was 40ms. Figure 3.5 presents how the visual image (i.e. the top-half part of a child's face) is shown in the window with a synchronized audio file on the bottom, indicating the particular time point of the sentence heard by the child.

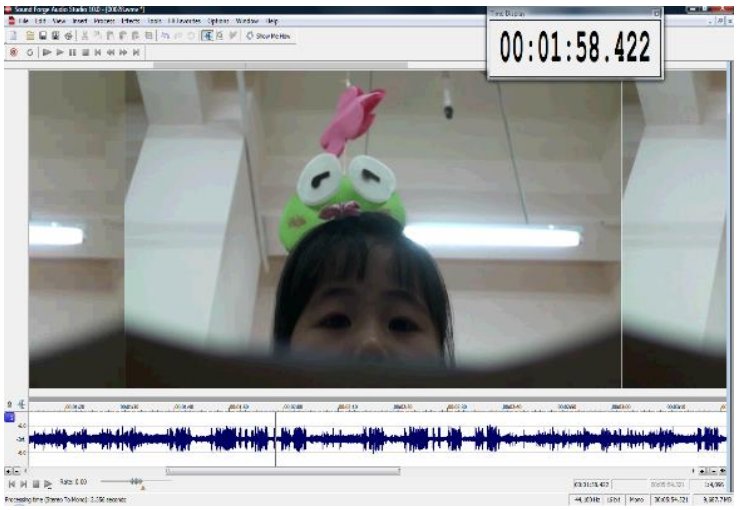


Figure 3.5. Eye movement coding using SONY Sound Forge Audio Studio software

Coding started from the onset of the first syllable of the RC. The entire RC was included for coding, as RCs are head-final in Mandarin. The onset of the relative marker ‘DE’ was taken as the critical point for ambiguity resolution; when children reached the onset of ‘DE’, it was possible for them to disambiguate sentences from other possible interpretations to the target RC interpretation, and to identify the forthcoming noun phrase as the head noun. Currently the eye-movements till 2400ms post RC-onset were reported. Since this is the first eye-tracking study on Mandarin RC processing in young children, meaning there was no previous work to refer to, there was no specific hypothesis with respect to the specific point of statistical effects in the eye-movements when children heard the sentences.

3.3.2.4 Results

3.3.2.4.1 Offline responses

The analyses again followed those established in Chan et al. (2018) for Cantonese-speaking children. Children's offline responses were analyzed by Generalized Linear Mixed Effects Models (GLMM; Jaeger, 2008) using the lme4 package for Linear Mixed Effects (Bates & Maechler, 2010) in R (version 3.2.2; R Core Development Team, 2014). The fixed effects were: i) sentence type (DE/bare versus DemCL/DCL), ii) extraction (subject versus object), and iii) their interaction. The random effects were participants and items. Figure 3.6 presents children's offline correct responses to the two types of RCs.

Results showed no main effects on sentence type, extraction, and interaction. The accuracy of subject RCs was numerically higher than object RCs in both DE and DCL conditions, but the differences were not significant as the standard error bars overlap.

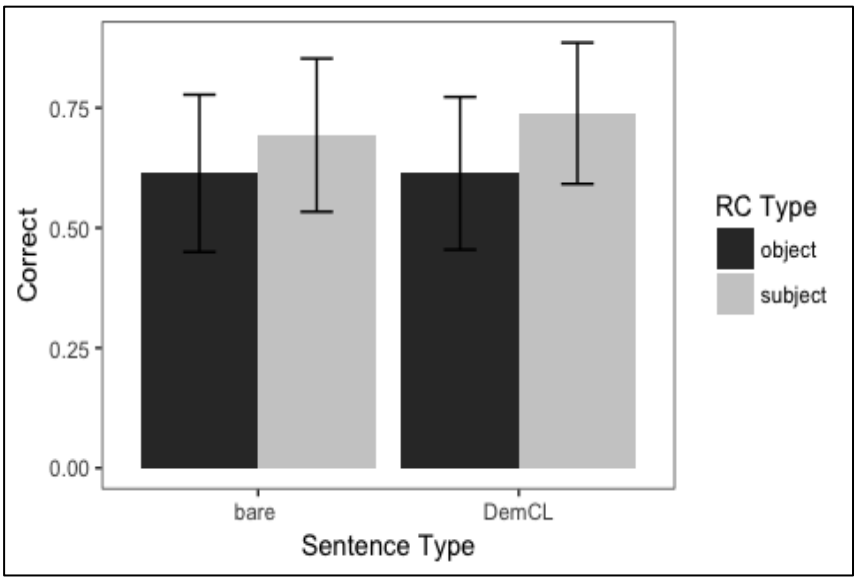


Figure 3.6. Accuracy of offline responses for subject and object DCL and DE RCs

3.3.2.4.2 Online data

Since this study is interested in the online processing of sentences that children interpreted correctly, only the eye-tracking data for those trials that children chose the correct referent were analyzed. Following Chan et al.'s (2018), this study did not follow those so-called standard approaches that analyze the eye-tracking data by dividing them into a series of 200ms windows and examine the interaction between the time-window and the test stimuli. These approaches could be effective in dealing with the well-studied languages, such as English, because differences have been observed within these windows. However, it is difficult to predict the differences or effects in the time course in a less-studied language like Mandarin. Therefore, a non-parametric permutation analysis was used. The permutation test is useful when no sufficient information or appropriate assumptions about the distribution of the data are available. It has been found to be robust in dealing

with noisy data in electrophysiological studies (see Groppe, Urbach & Kutas, 2011 for an overview; Maris, 2012; Maris & Oostenveld, 2007; Eklund, Nichols, & Knutsson, 2016).

To avoid any assumptions about where the significant differences between subject and object RCs would occur in the time window, every frame (40 ms) coded was used as a time bin and a t-test was run to provide a list of the observed bins with significant differences. To reflect the fact that the adjacent windows were not independent but a processing event, the adjacent time bins where there were a statistically different results across conditions ($p<.05$) were clustered. The next step was to shuffle the extraction randomly and assigned them to eye-tracking data. This would destroy any association between the extraction and the eye-tracking data (the null hypothesis). Then the shuffles were repeated for 1000 times and the differences between the means of the two extraction types were recorded.

The proportions of looks to the target were averaged along the time bins from the onset of the RC (0 ms) to 2400 ms. Figure 3.7 presents the average target proportions of looks for the DE and the DCL types.

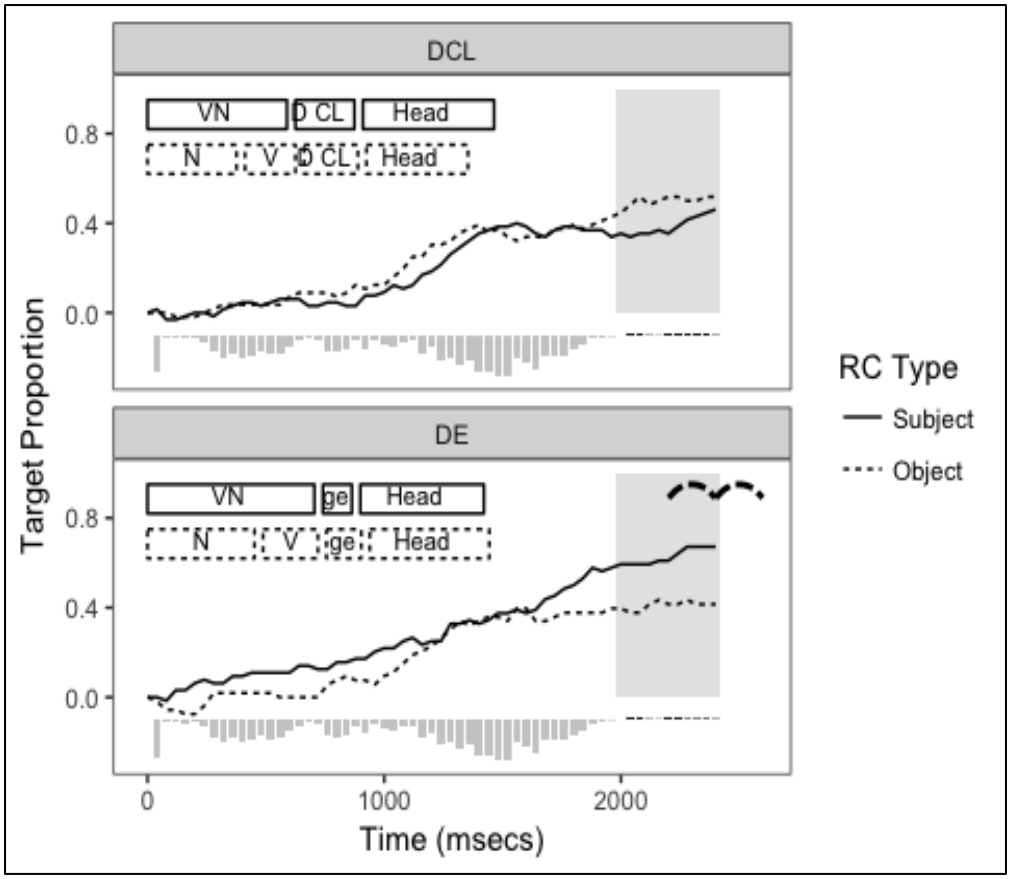


Figure 3.7. Average target proportions of looks for the DCL (top panel) and the DE (bottom panel) RCs are shown by solid/dashed lines. Onsets/offsets for different units are shown by the size of the rectangles at the top left (solid for subject RCs, dashed for object RCs). Small grey/black bars near -0.1 are p-values for individual time bins. The large grey bars represent the time-windows identified by the permutation analysis as significant. Curved lines represent 200ms windows identified as significant by mixed-model post-hoc analyses.

First, regressions were applied to each time-window to predict the target proportion with subject/object RC condition. The bar on the horizontal axis indicates the difference between *p*-values and .05 which spreads around -0.1. When the p value is greater than .05 (non-significant), the bar is below -0.1. When the *p*-value is smaller than 0.05 (significant), the bar is above -0.1.

Adjacent bins were clustered if they were significant. The permutation analysis was run for each significant time bin and repeated for 1000 times. Regression was run to predict the observed target proportion. Then the t-values for each time bin within each cluster were summed to produce the sum-t-distribution.

The permutation analysis revealed one significant cluster for each sentence type. For DCL RCs, children looked at the head noun referent of the object RCs significantly more than that of the subject RCs between 2000 ms and 2433 ms (total window time=433 ms, sum t = 12.03, p<.001), suggesting a significant object advantage. For DE RCs, children looked at the head noun referent of the subject RCs significantly more than that of the object RCs between 2000 ms and 2433 ms (total window time=433 ms, sum t = 22.011, p<0), suggesting a significant subject advantage.

Comparison of permutation test and mixed model analysis

Previous studies on acquisition data usually used the traditional mixed model analysis, and few have applied the permutation analyses. It is, therefore, worthwhile to compare these two types of analyses, as in Chan et al. (2018). First, the proportion of target looks for each 200 milliseconds window for each child participant in each extraction type (subject RC, object RC) for both types of RCs (DE, DCL) was averaged, and then a mixed model to the proportion of target looks with window, extraction type, and RC type (all centered) was conducted. The model contained random effects of subjects and items and random slopes for window and extraction across both

subjects and items. There was a main effect of window [β=.049, SE=.0022, χ^2(1)=480.71, p<.001], an interaction of window with extraction type [β=-.004, SE=.0044, χ^2(1)=.61, p=.434], and a three-way interaction of window, extraction type, and RC type [β=.019, SE=.0087, χ^2(1)=4.99, p=.025]. Post-hoc comparisons were performed to further explore the three-way interaction. Subject and object extraction types in each window in both DCL and DE RCs were compared with p-values being adjusted for the 24 multiple comparisons (Bretz, Hothorn & Westfall, 2011). It was found that only the 1800-2000 window did the DE RCs show significant differences between subject and object RCs (DE-2200 p=.044; DE-2400 p=.03).

The significant regions in the mixed model analysis are shown as curve lines on the permutation analysis in Figure 3.7 above. Although there was a three-way interaction of window, extraction type, and RC type, the post-hoc analysis only identified the significant regions for DE RCs, but not for DCL RCs. It is likely due to the fact that the post-hoc analysis uses the arbitrarily defined 200 msec windows which are larger than the cluster used in the permutation analysis and may include more noise. Additionally, the *p*-values threshold in the post-hoc analysis was adjusted for multiple comparisons. In this case, it is possible that it could have reduced the regions that were identified. In other words, the traditional mixed effect model is weaker than the permutation analysis in this case.

3.4 Discussion

The current study analysed the distributional properties of DCL and DE RCs and RC-like structures in Mandarin-speaking children's language experience and examined the comprehension of these two types of RCs in four-year-old monolingual Mandarin-speaking children. The corpus analyses showed different patterns for DCL- and DE-RCs. Specifically, for the DCL condition, object RC-like structures were more frequent than subject RC-like structures. By contrast, for the DE condition, subject RC-like structures were far more frequent than object RC-like structures. In the comprehension experiment, children's offline responses showed no significant differences between subject and object RCs in both DCL and DE conditions. The online data, on the other hand, captured a different pattern of subject-object asymmetry for the two conditions. Specifically, there was an object over subject preference for the DCL type, but the same children exhibited a subject over object preference for the DE type. Interestingly, this finding is similar to the Cantonese data in which there is a subject advantage for Cantonese *Ge3* RCs but an object advantage for classifier RCs (Chan et al., 2018).

This differential pattern of subject-object asymmetry for the two types of RCs cannot be adequately accounted for by the theories which predict a uniform subject or object advantage across RC types within a language. These theoretical perspectives include those that have been considered and used to account for the child first language and adult Mandarin data in the existing literature. For instance, structural factors pointing to a subject advantage (Friedmann et al., 2009; Lin & Bever, 2006), general subject

prominence (Bornkessel-Schlesewsky & Schlesewsky, 2009; O'Grady, 2011) and linear properties predicting an object advantage (Gibson, 1998, 2000).

Interestingly, the differential patterns of subject-object asymmetry between these two RC types exhibited in the online developmental data appear to be also consistent with predictions based on a non-uniform approach to the syntactic analyses of these two RC types (see section 3.1 above). However, this syntactic perspective would only predict a subject advantage for DE RCs, and a 'lack of subject advantage' for DCL RCs. It would not specifically predict an object advantage for DCL RCs, a pattern shown by the current children in their online processing preference.

On the other hand, this differential pattern of processing preference maps well onto the distributional properties/frequencies of the input that are relevant to these two RC types in Mandarin adult child-directed speech. The distributional frequencies relevant for these two RC types are distinctively different in children's linguistic experience. Regarding the DE type, children encounter far more tokens of subject RC-like sequences than object RC-like sequences. By contrast, for the DCL type, children encounter more often object than subject RC-like sequences and RCs. Subject RC-like sequences and RCs are rarely encountered (or even virtually absent) in young children's linguistic experience. Overall, children's online processing preference when comprehending these two types of RCs is consistent with the distributional properties of the input for these two RC types in children's experience. An experience-based approach that identifies a close link between specific patterns of linguistic experience and children's processing preferences,

therefore, provides a better approach in accounting for the current set of findings.

An additional remark about children's error patterns between the two RC types. Head errors when comprehending head-final object RCs have been commonly reported in previous studies (Chan et al., 2017; Kidd et al., 2015; Hu et al., 2016a). Young children tend to interpret the first noun (i.e., subject of the RC) as the head noun when comprehending object RCs. Consistent with previous studies, head error was the most common error type in children's offline responses to object RCs. An interesting observation in the current study is that among all children's responses (N=36), head errors occurred less often in the DCL object condition than in the DE object condition (16.7% vs 22.2%), although the difference was not statistically significant, see Figure 3.8.

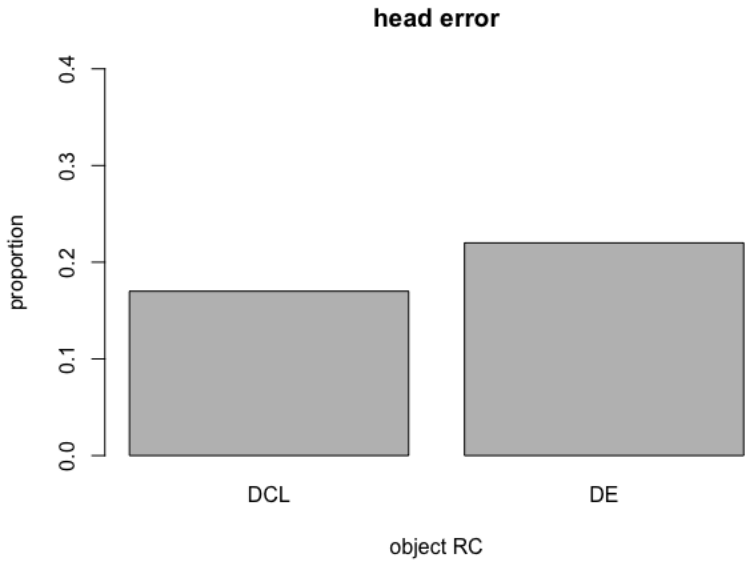


Figure 3.8. Mean proportion of head errors in the behavioural responses to the two types of object RCs

The difference in head noun error rate between the two types of object RCs is likely due to the presence and the discourse function of the demonstrative. In Mandarin, the demonstrative functions as a cue for the forthcoming arrival of a definite or given referent or as a 'linking device' to signal for the need to search backward for the relevant referent in the discourse (Chen et al., 2015; Huang, 1999; Tao, 1999). In the current study, the relevant referent has been previously introduced in the background discourse. In the DCL construction, when a listener heard a demonstrative and a classifier, s/he would expect a given referent forthcoming and 'search' backward to the previous background discourse to identify the referent. The occurrence of a demonstrative and a classifier is an informative cue for the following noun to be identified as the head noun, and therefore fewer head assignment errors could be expected when comprehending DCL object RCs (a listener is less likely to erroneously take the other noun (subject of the RC) as the head noun). By contrast, in the DE construction, the definiteness marking is relatively less strong/explicit for the head noun (it is presented as a bare noun), so relatively more errors in head noun assignment when a listener, especially a child learner, interprets this construction may occur. As the previous comprehension studies in the literature have mainly focused on only testing the DE RC type, the head noun error rate in comprehending head-final object RCs may be relevant to the specific RC type tested. Future research can consider comparing the two RC types using another comprehension paradigm, such as the picture pointing task, which was frequently used by the previous studies.

3.5 Conclusion

This study examined and compared the distributional properties of DCL and DE RCs in Mandarin adult-child directed speech and compared the comprehension of these two RC types on the issue of subject-object asymmetry in young Mandarin-speaking four-year-olds. The online measures indicated a subject over object advantage when children comprehended DE RCs but indicated an object over subject advantage when the same children comprehended DCL RCs. The new developmental data challenged theories which make predictions of either a uniform subject or object advantage within a language, for example, structural-based theoretical perspectives (Friedmann et al., 2009; Lin & Bever, 2016), linear distance-based theoretical perspectives (Gibson, 1998; 2000) and theoretical perspectives that consider a general subject prominence (Bornkessel-Schlesewsky & Schlesewsky, 2009; O'Grady, 2011). By contrast, these developmental processing preferences map well onto the distributional properties/frequencies in the input, suggesting that an experience-based approach that identifies a tight link between specific patterns of linguistic experience and developmental processing preferences provides a better account in explaining the current set of findings.

Chapter Four
Kam-Mandarin bilingual children's comprehension of subject and object RCs

4.1 Introduction

Chinese languages such as Cantonese and Mandarin are interesting among the SVO languages because they attest the typologically rare combination of SVO canonical word order and head-final RCs. Dryer (2013a, 2013b) observed as many as 879 languages, and reported that only 5 languages (Mandarin, Cantonese, and three other languages being influenced by Chinese: Hakka, Bai, Amis) attest this distinctively rare typological combination. These special word order properties allow one to tease apart predictions of theories in ways that examining most European languages do not allow. This chapter presents a child language study that features another SVO language, Kam 侗語, the native language spoken by minority Kam people in South West China. Kam is one of the languages in Kam-Shui language branch which belongs to Kam-Tai Family. The genetic relationship of Kam-Tai language is still on debate with some arguing part of Sino-Tibetan languages (Li, 1965; 1973) and others arguing part of Austronesian languages (Benedict, 1942, 1975, 1990). Kam also attests head-final RCs (due to influence from Mandarin), but is yet to be recorded in Dryer's (2013a, 2013b) language samples. The study, therefore, brings in new data from a substantially understudied language, Kam, on the issue of subject-object

asymmetry in child language acquisition. Specifically, we study how bilingual children comprehend head-final subject and object RCs in their first language (L1) Kam and second language (L2) Mandarin. Kam is interesting because it instantiates not only head-final RCs but also head-initial RCs (Wu, 2015; Yang, 2017), and as such, this language specific characteristic would bear on the theoretical theme of competition between constructions (Rowland, et al., 2014). The study features bilingual children acquiring the minority language Kam as their heritage language being also intensively exposed to Mandarin, and therefore also provides an excellent opportunity to examine the possibility of cross-linguistic influence, and its directionality, from the theoretical perspective of structural overlaps (Hulk & Muller, 2000). As the study unfolds, this study will argue for a specific case of backward L2 to L1 positive transfer in the younger group of bilingual children, despite L1 Kam being their stronger language. This chapter is organized as follows. Section 4.2 proposes three hypotheses and briefly reviews the relevant literature under each hypothesis. Section 4.3 presents the current study. Section 4.4 discusses the major findings. Section 4.5 concludes this chapter.

4.2 Hypotheses

This study has three hypotheses. The first hypothesis concerns the issue of subject/object asymmetry in Mandarin and Kam. Several recent studies have focused on the subject/object asymmetry in Mandarin-speaking children in bilingual as well as trilingual contexts and consistently show that children displayed a subject over object advantage and found Mandarin NVN object

RCs difficult to comprehend. For instance, Chan, Chen, Matthews and Yip (2017) reported that Cantonese-Mandarin-English trilingual children aged 5;6 to 6;1 showed a subject over object advantage in their comprehension of Mandarin RCs. In a bilingual acquisition context, Tsoi et al (resubmitted)_ found that both Mandarin-English bilingual children (age range: 4;5-10;10, N=55) and Mandarin monolinguals (age range: 4;3-5;10, N=59) found subject RCs easier to comprehend than object RCs in a picture pointing experiment. In addition, the bilingual Cantonese data also pointed to a subject over object advantage. The Cantonese data are relevant because like Mandarin, Cantonese has SVO word order and head-final RCs. Using a picture pointing task, Kidd et al. (2015) reported that Cantonese-English bilinguals aged 5 to 12 also displayed a subject over object advantage in comprehending Mandarin RCs. These bilinguals experienced greater difficulties with object RCs, especially Cantonese classifier object RCs.

These studies also documented that children made a lot of errors in head noun assignment, erroneously taking the subject of the RC as the head noun (Chan et al., 2017; Kidd et al., 2015; Tsoi et al., resubmitted). Chan et al. (2017) proposed that this difficulty may arise from competition between a general developmental tendency of taking the first noun of a Noun-Verb-Noun (NVN) structure as the agent and head noun, and assigning the second noun as the head noun in NVN head-final object RCs. Given these previous findings, it is predicted that the bilingual children in this study would also display a subject over object advantage when they comprehend Mandarin RCs. As for Kam, since Kam is similar to Mandarin in terms of attesting head-final RCs in an SVO language, one could reasonably hypothesize that

children would also display a subject over object advantage when they comprehend Kam head-final RCs, as the children would also experience difficulty in comprehending NVN head-final object RCs.

The second hypothesis concerns the extra challenge in comprehending head-final object RCs in Kam relative to Mandarin. Unlike Mandarin attesting only head-final RCs, Kam has not only head-final RCs (see (1) for an example of object RC) but also head-initial RCs (see (2) for an example of object RC).

(1) Kam head-final object RC

[jaʊ nin-pe seɪ] li sam liʊ meɪ

1.sg. last-year plant marker three CL tree

'the three trees that I planted last year'

(2) Kam head-initial object RC

sam liʊ meɪ [jaʊ nin-pe seɪ] tɕa

three CL tree 1.sg. last-year plant that

'the three trees that I planted last year'

The head-final and head-initial object RCs are "competing constructions" given their similarity in function but difference in form. Since more than one form is possible to express a similar function in the language, these competing form-function mappings are more challenging to acquire than a consistent one-to-one form-function mapping for a child language learner (Rowland et al., 2014). In addition, another potential competing construction

is the head-initial subject RC in Kam that is also SVO in form (as shown in example (3)).

(3) Kam head-initial subject RC

la-mie [nu: le] tɕa

Girl read book that

'the girl who is reading a book'

In this case, there is a similarity in form (SVO) but a difference in function, potentially leading to structural ambiguity due to structural overlaps. Given these competing head-initial RC constructions that are present in Kam but not in Mandarin, it is further hypothesized that head-final object RCs would be more difficult in Kam than in Mandarin. Specifically, head noun assignment would be especially challenging when comprehending head-final NVN object RCs in Kam. Bilingual children offer an excellent opportunity to compare these two SVO languages (Kam vs Mandarin), both instantiating head-final RCs, in a within-subjects design.

The third hypothesis concerns cross-linguistic influence and its directionality from the theoretical perspective of structural overlaps. Cross-linguistic transfer has been commonly reported in bilingual child language studies (Dopke, 1998; Foroodi-Nejad & Paradis, 2009; Kidd et al., 2015; Yip & Matthews, 2000). Structural overlaps have been proposed as a condition for cross-linguistic influence to occur (Hulk & Muller, 2000). Hulk and Muller (2000) hypothesized that *"syntactic cross-linguistic influence occurs only if language A has a syntactic construction which may seem to allow more than one syntactic analysis and, at the same time,*

language B contains evidence for one of these two possible analyses. In other words, there has to be a certain overlap of the two systems at the surface level. (p.228-229)." Relating to the current case of relative clause construction under investigation, Kam, considered from the above perspective, would have relative clauses which may seem, to a child language learner, to allow more than one syntactic analysis (head-final and head-initial), and at the same time, Mandarin would contain consistent evidence for only head-final analysis. Given these perspectives, this study further hypothesizes a specific directionality of positive influence from Mandarin to Kam but not from Kam to Mandarin, consider the language-specific characteristic of Mandarin having a consistent form-function mapping instantiating only head-final RCs. Specifically, we predict that higher exposure to Mandarin would lead to better performance and fewer head noun errors when comprehending object head-final RCs in Kam for the bilingual children.

4.3 The current study

4.3.1 Participants

This study targets a group of Kam-Mandarin bilingual children who have thus far received little attention in research. Most of these children are so-called 'left-behind' children who are left in rural areas while their parents work in urban regions in the minority regions of China. They are being taken care of instead by their grandparents who are native speakers of Kam. They

acquired Kam as home language as their first language (L1) and acquired Mandarin as their second language (L2) at school as it was the medium of instruction from the age of three. Forty-two (N=42) bilingual Kam-Mandarin children participated in this study with sixteen nine-year-olds (M_{age}=9;6, SD=0.3, range=9;1-10;3) and twenty-six six-year-olds (M_{age}= 6;5, SD=0.3, range=5;11-6;11). All the children were recruited from Ping Deng Town, Guangxi Zhuang Autonomous Region in South China. These children lived in a town with the majority population being the Kam ethnic group speaking Kam from their birth and had never lived in another place for more than one month. Sixteen adult monolingual Kam speakers were also recruited to ensure that the test sentences were grammatical in Kam. The adults scored 100% accuracy when comprehending the Kam RCs in the pointing task.

This study did not include monolingual children of the two languages as control groups because of the following reasons. First, it was not feasible to recruit monolingual Kam-speaking children due to the predominant Putonghua (Mandarin) as lingua franca language policy in mainland China, which requires children to be exposed to and acquire Mandarin. Therefore, children who were exclusively exposed to Kam are rare or even do not exist. Second, the study aimed to test the three hypotheses mentioned above, and it was not necessary to include a monolingual child Mandarin group to test these three hypotheses.

4.3.2 Method

The comprehension of RCs was assessed by a picture pointing task. Children's language background was evaluated by demographic questionnaires completed by their parents, guardians or teachers. In addition to the main task of RC comprehension, an expressive vocabulary test was conducted to assess the bilingual children's vocabulary knowledge (Multilingual Naming test, Gollan, Weissberger, Runnqvist, Montoya, & Cera, 2012; Ivanova, Salmon, & Gollan, 2013).

4.3.2.1 Language background questionnaire

Most of these bilingual children were 'left-behind' children and were taken care of by the children's grandparents who were monolingual Kam speakers. At the time of testing, the younger children spent about seven hours per day at kindergarten which was a Mandarin-speaking environment and all the other time in a Kam-speaking environment. The older children were attending a boarding primary school, and they stayed at school where Mandarin was the language of instruction from Monday to Friday every week. The older children only spoke Kam at home during the weekends.

A language background questionnaire was distributed to parents, teachers or guardians to provide children's language background information, including children's date of birth, place of birth, first and other languages that they were exposed to, age of first exposure and in what contexts they were exposed to Kam and Mandarin, time spent and frequency in speaking the two languages, caregivers, and the languages the caregivers spoke to

children (see Appendix E). Parents/caregivers were also asked to evaluate their children's ability in both languages using a scale of 1 to 8.

Based on the language background questionnaire, the older children spent significantly more time in Mandarin-speaking than Kam-speaking environments (Wilcoxon signed-rank test, $z= 0.99$, $p < .001$). On the contrary, younger children spent significantly more time in Kam-speaking than Mandarin-speaking environments ($z= 0.85$, $p < .001$). Table 4.1 shows the mean hours per day children spent in each language environment for the bilingual children. The standard deviation in the older group is zero because every child got the same proportions of exposure to Kam and Mandarin.

Table 4.1. Percentage of hours per week spent in each language environment

	%hours per week spent in each language environment			
	Kam		**Man**	
	M	*SD*	*M*	*SD*
Younger	71.88%	0.11	28.12%	0.11
Older	8.33%	0.00	91.67%	0.00

As for the language proficiency in the two languages, there was no significant difference in understanding between the two languages in the two groups from their parents' or their own ratings. Table 4.2 presents the mean score of parent/self-rated abilities to understand each language (8-point scale, 1=poor, 8-excellent). The younger group's score was rated by their parents or guardians, while the older group was rated by themselves.

Table 4.2. Mean scores of parent/self-rated abilities to understand each language

	Parent/self-rated abilities to understand each spoken language	
	Kam	Mandarin
Younger	7.00	6.67
Older	7.00	7.00

To summarize, according to the questionnaire, the two groups of children got different exposure patterns to the two languages. The younger children had more exposure to the Kam-speaking than the Mandarin-speaking environment, whereas the older children had more exposure to the Mandarin-speaking than the Kam-speaking environment. However, their parent or self-rated abilities in understanding the two languages were equally well.

4.3.2.2 Test of vocabulary knowledge: Multilingual Naming Test (MINT, Gollan et al., 2012; Ivanova et al., 2013)

The Multilingual Naming Test (Gollan, et al., 2012, Ivanova et al., 2013) was used to assess the bilingual children's Kam and Mandarin's vocabulary knowledge, which serves as an objective proxy measure for language experience. Children's vocabulary measures in the two languages would also be used later as a basis to evaluate their language dominance (see section 4.3.3.3). MINT was developed by Gollan et al. (2012) and includes 68 black-and-white line drawings arranged in order of increasing difficulty. Children

were presented with a picture one at a time and were asked to name the object depicted in the picture. Some simple semantic or phonemic prompts were allowed to elicit the target word, for example, “What do you do with that?” or “The word for this starts with the sound ____.” The answer was recorded with a remark when the experimenter used cues. Testing discontinued after 6 consecutive failures. The total score was 68. The raw score was calculated by subtracting the total number of ‘don’t know’ or errors from the total score. The order of testing language was counterbalanced with half of the children being tested in Kam first and then in Mandarin and half vice versa.

The Wilcoxon signed-rank test was run for the pairwise comparisons of vocabulary scores between the two languages. Table 4.3 shows the MINT vocabulary scores in Kam and Mandarin in the two children groups. The younger group’s expressive vocabulary scores in Kam were significantly higher than that in Mandarin ($p < .01$), whereas the older group’s expressive vocabulary scores were significantly higher in Mandarin than that in Kam ($p < .001$). This suggested that the younger children had higher vocabulary competence in Kam than in Mandarin, whereas the older children exhibited the opposite pattern. These patterns are also consistent with the relative proportions of language exposure to the two languages in the two groups. The younger children had more exposure to Kam and thus had better vocabulary knowledge in Kam and the older children had more exposure to Mandarin and thus had better vocabulary knowledge in Mandarin.

Table 4.3 MINT scores in Kam and Mandarin in the younger and the older groups

	Kam		Mandarin	
	M(SD)	Range	M(SD)	Range
Younger	47.62 (4.74)	37-55	47.12 (5.01)	34-55
Older	54.00 (3.24)	47-58	55.44 (3.99)	49-64

4.3.2.3 Test of RC comprehension

4.3.2.3.1 Materials

A picture pointing task was conducted to examine children's comprehension of subject and object RCs. This task has already been established and used successfully to assess the comprehension of RCs in Cantonese-English bilingual children (Kidd et al., 2015), Cantonese-English-Mandarin trilingual children (Chan et al., 2017), and Mandarin-English bilingual children (Tsoi et al., resubmitted). Sixteen test sentences were constructed in each language, with eight for subject (agent) RCs and eight for object (patient) RCs. Examples are shown below in Table 4.4. Animal names that are familiar to young children were used as the head nouns and the RC internal NPs (e.g. *chicken, mouse, lion, bear, dog, monkey, duck, rabbit, tiger, horse, giraffe, elephant, cow, pig, mouse and sheep*). Transitive verbs that are familiar to young children were used in the RCs (e.g. *push, hug, kiss* and *feed*). Each verb occurred twice in SRCs and twice in ORCs. Word length was controlled. Kam RCs contained seven to ten monosyllabic characters (mean=8 characters). Mandarin RCs contained nine to ten characters

(mean=9 characters). Animacy cues were neutralized by using animate head nouns and animate RC internal NPs for all the test sentences, since the study did not aim to examine how animacy cues modulate RC comprehension in these bilingual children (Kidd et al., 2007; Brandt et al., 2009). Appendices C and D show a full list of the test sentences. In addition, there were eight filler sentences interspersed between the RC test sentences. The test and the filler sentences were presented in a pseudo-random order to avoid predictable orders. There were also four practice trials with simple non-RC sentences such as "where is the bigger fish?" at the beginning of the experiment to help children become familiarized with the task expectations and procedures.

Table 4.4. Examples of RC test sentences in Mandarin and Kam

Sentence Type	Example
Mandarin subject RC	na yi ge shi [qin gongji de laoshu] ? which one CL is kiss cock DE mouse 'Which one is the mouse that is kissing the cock?'
Kam subject RC	tɕia nəu ɕi [pu suɪ-kaɪ li nuo]? CL which is kiss cock marker mouse 'Which one is the mouse that is kissing the cock?'
Mandarin object RC	na yi ge shi [laoshu tui de xiaoya] ? which one CL is mouse push DE duck 'Which one is the duck that the mouse is pushing?'
Kam object RC	tɕia nəu ɕi [la-miaʊ wa li la-pən] CL which is cat feed marker duck 'Which one is the duck that the cat is feeding?'

Each child was tested twice in total, once for each language. The testing order of the two languages was counterbalanced across children. The experimenters were native Kam and Mandarin speakers.

4.3.2.3.2 Procedures

Children were presented with pairs of pictures on a computer screen. Character identification and practice trials were run before proceeding to the test trials. Each test trial consisted of visual scenes presented in a series as depicted in Figure 4.1. First, a picture of a causative event between two animals was shown on one side of the screen, with the accompanying verbal description, e.g. 'Look, the chicken is hugging the mouse' (see picture A of Figure 4.1). Then, another picture depicting the same animal pairs enacting the same causative event but differ only in role reversal was presented at the other side of the screen, accompanied by the verbal description, e.g. 'Look, now the mouse is hugging the chicken' (see picture B of Figure 4.1). These two background pictures served to provide a felicitous context for the use of a restrictive RC (the test sentence). Then the two causative events were shown at the same time side by side on the screen (see picture C of Figure 4.1). Children were asked to point to one of the four animals on the screen, according to their interpretation of the RC test sentences (e.g. 'which one is the mouse that is hugging the chicken'? (SRC) or 'which one is the chicken that the mouse is hugging?' (ORC)). The experimenter praised the children verbally for engaging with the task regardless of the accuracy of the responses.

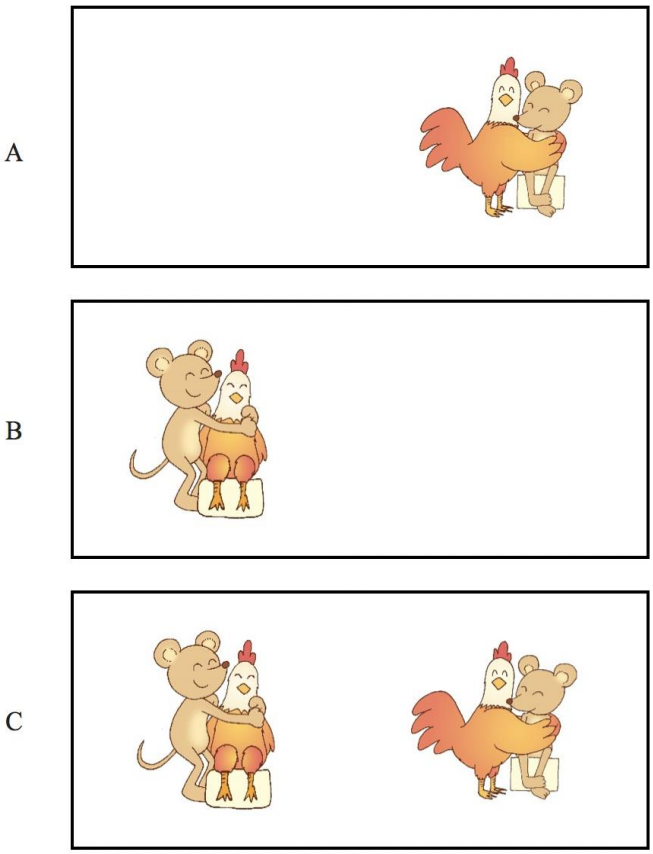


Figure 4.1. Example of a test trial

4.3.2.3.3 Coding

Children's responses were coded into five categories: i) correct (correct picture and correct animal); ii) head error: correct agent-patient relation but wrong head assignment (correct picture but wrong animal); (iii) reversal error: correct head assignment but wrong agent-patient relation (correct animal but wrong picture); (iv) other error: wrong agent-patient relation and wrong head assignment (wrong picture and wrong animal); and v) no attempt. (children didn't point to any animal in the picture). In this study, all the children had made an attempt to point to one animal for each sentence.

4.3.3 Results

The mean proportion of correct responses for subject and object RCs in the two age groups is presented in Figure 4.2. Overall, the bilingual children found subject RCs easier than object RCs in both Kam and Mandarin (Younger: M_{KamSRC}= 0.66, M_{KamORC}= 0.34, M_{ManSRC}= 0.54, M_{ManORC}= 0.53; Older: M_{KamSRC}= 0.91, M_{KamORC}= 0.77, M_{ManSRC}= 0.84, M_{ManORC}=0.71). The older group performed better in both languages than the younger group.

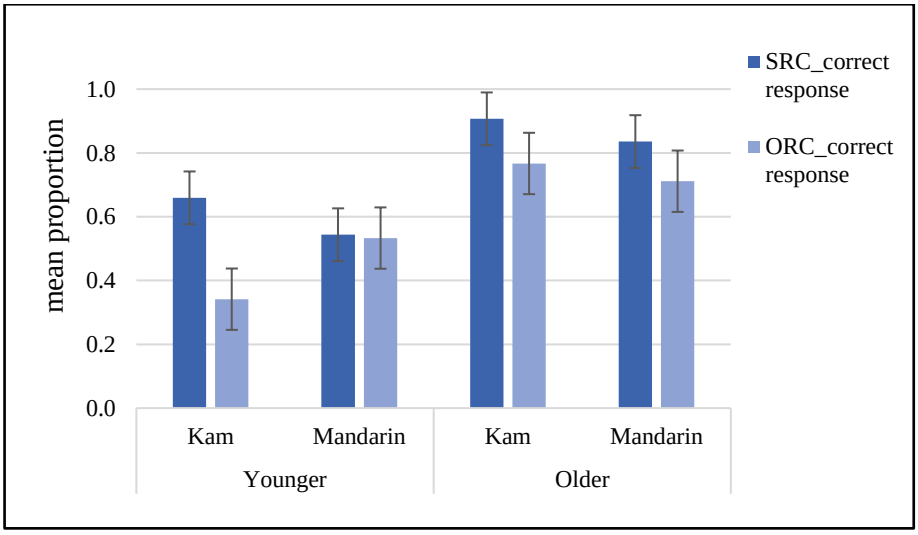


Figure 4.2. Bilingual children's mean proportion of correct responses for subject and object RCs by age group

4.3.3.1 Overall analysis

The correct responses were first analyzed to examine the relative ease of comprehending subject versus object RCs in the two languages. The data were analyzed using Generalised Linear Mixed Effects Models (GLMM), which were calculated using the *lme4* package (version 1.1-15) for Linear

Mixed Effects (Bates, 2016) in *R* (version 3.4.3, R Core Development Team, 2017). The fixed effects were: i) extraction (subject versus object), ii) language (Mandarin versus Kam), iii) age group (6-year olds vs 9-year olds) and iv) their interaction. The random effects were participants and items. First, a null model containing random effects for participants and items was built. Second, fixed effect terms were added to the model one at a time and then compared the new model to the null using *anova* function to check the contribution of the fixed effects. Third, the non-significant terms were dropped. Extraction [χ^2 =27.59, df = 1, $p < .001$] and age group [χ^2 = 28.38, df = 1, $p < .001$] significantly contributed to the model fit, showing that subject RCs were performed significantly better than object RCs and older children performed significantly better than younger children. No effects were found in language. The interaction between extraction and age group also significantly improved the model fit [χ^2 = 57.13, df = 3, $p < .001$], meaning that the difference in performance between the subject and the object RCs was not uniform between the two age groups. The significant terms in the final overall model were shown in Table 4.5.

Table 4.5. Significant terms in the final overall model of children's RC comprehension (extraction= subject versus object RCs; Age Group = young versus old).

	β	SE	*z*	*p*
Intercept	-1.393	.291	-4.788	<.001***
Extraction	.850	.126	6.755	<.001***
Age Group	-1.654	.277	5.975	<.001***
Age Group : Extraction	.448	.176	2.540	< .05*

logLik = -607.6, Number of observations = 1344, ***p < .001, **p <.01, *p <.05

Children's correct responses in each language were then analysed using the same analysis strategy. In Kam, age group, extraction and their interaction were included as fixed effects. Participants and items were random effects. There were a significant age group effect [χ^2 = 36.13, df = 1, p < .001], an extraction effect [χ^2 = 31.69, df = 1, p < .001] and a significant age group X extraction interaction [χ^2 = 21.39, df = 3, p < .001]. Both the older children [β = 1.404, *se* = .408, z = 3.439, p < .001] and the younger children comprehended subject RCs significantly better than object RCs in Kam. In Mandarin, using the same analysis strategy, there were three significant main effects: age group [χ^2 = 12.86, df = 1, p < .001], extraction [χ^2 = 4.28, df = 1, p < .05] and age group X extraction [χ^2 = 21.39, df = 3, p < .001]. The significant age group X extraction interaction was driven by the fact that the older children found subject RCs significantly easier to comprehend than object RCs [β = 1.225, *se* = .413, z = 2.963, p < .01], whereas the younger children showed neither subject nor object preference

[β = 143, *se* = .202, *z* = .707, *p* = .479]. Table 4.6 summarizes the pattern of results for each language and age group.

Table 4.6. Correct responses of subject and object RCs across groups and languages

	Younger group	Older group
Kam	Subj > Obj**	Subj > Obj***
Man	Subj = Obj	Subj > Obj **

Note: '>' means 'higher than', '=' means 'no significant difference'. ***$p < .001$, **$p < .01$, *$p < .05$

4.3.3.2 Error analysis

There are three types of errors in children's responses: i) head errors; ii) reversal errors; and iii) other errors. As in Kidd et al. (2015) and Chan et al. (2017), only the head errors and the reversal errors were analyzed, since children's processing strategies when making these two types of errors are more readily interpretable.

4.3.3.2.1 Head Errors

The fixed effects included extraction, language, age group, and their interaction. The random effects included participants and items. There were three significant fixed effects. Age [χ^2 =22.17, df = 1, $p < .001$], extraction [χ^2 =45.49, df = 1, $p < .001$], and Age X Extraction interaction [χ^2 =78.80, df

= 3, $p < .001$] significantly contributed to the model fit. These results showed that children made significantly more head errors with object RCs relative to subject RCs, the errors were significantly reduced when children were older, and the reduction in error rate between the older and the younger children was not uniform between the subject and the object RCs. Figure 4.3 shows the mean proportion of bilingual children's head errors when comprehending SRCs and ORCs in the two languages.

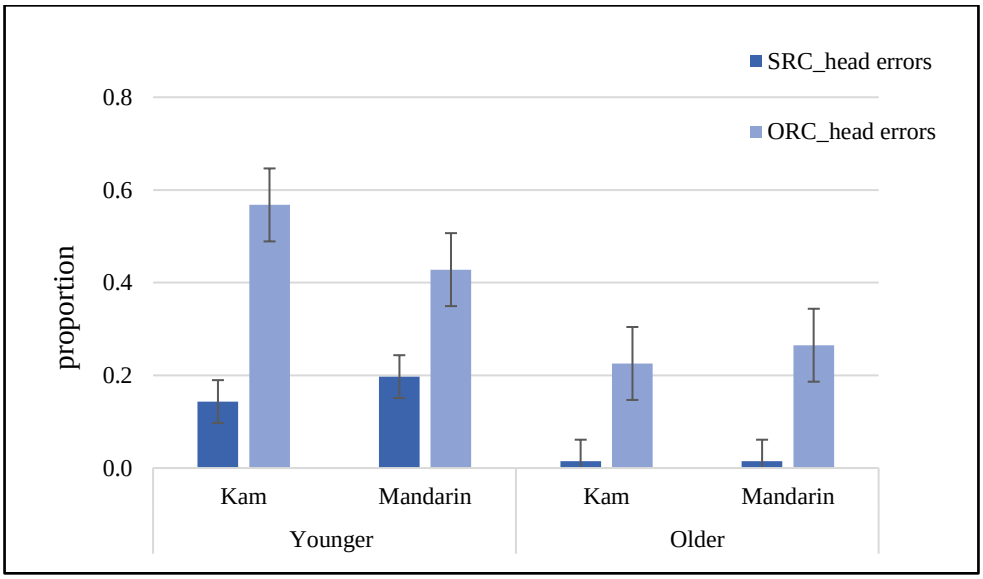


Figure 4.3. Bilingual children's mean proportion of head errors for subject and object RCs by age group

Further analyses were conducted for each language and each age group. In Mandarin, both the older children [β = -4.001, *se* = .843, *z* = -4.854, $p < .001$] and the younger children [β = -1.448, *se* = .247, *z* = -5.868, $p < .001$] made significantly more head errors with object RCs than subject RCs.

In Kam, both the older group [β = -3.754, *se* = .860, *z* = -4.364, $p < .001$] and the younger group [β = -2.208, *se* = .258, *z* = -8.533, $p < .001$] made significantly more head errors with object RCs than subject RCs. In addition,

there was a significant age group X extraction interaction [χ^2 = 62.494, df = 3, p < .001]. Table 4.7 summarizes the patterns of results for head errors when children comprehended the two types of RCs in each age group and each language.

Table 4.7. Head errors with subject and object RCs across groups and languages

	Younger group	Older group
Kam	O> S***	O > S ***
Man	O> S***	O> S ***

Note: '>' means 'higher than', '=' means 'no significant difference'. ***p < .001, **p <.01, *p <.05

The reversal errors were not analysed further in the mixed model analyses, because the proportions across groups were very low. As shown in Table 4.8, most reversal errors were made by the younger group when they comprehended SRCs, which are non-canonical VOS in form.

Table 4.8 Reversal errors (tokens) when bilingual children comprehended subject and object RCs

	Younger		**Older**	
	Kam	Man	Kam	Man
S	12/208	19/208	5/128	9/128
O	6/208	2/208	0	0

4.3.3.3 Cross-linguistic influence

The next set of analyses aimed to address the issue of possible cross-linguistic influence, if any, in these bilingual children's comprehension of RCs. The analyses examined whether children's experience with their language(s) affected their comprehension of RCs. First, bivariate correlation analyses were conducted to identify the associations between children's vocabulary scores (the proxy measure for language experience), age (in months), children's bilingual dominance, and their performance in comprehending subject and object RCs. Following Kidd et al. (2015) and Tsoi et al. (resubmitted), bilingual dominance was operationalized by computing a difference score, subtracting the bilingual children's Kam MINT vocabulary score from their Mandarin MINT vocabulary score, and converting the difference to a z-score. All correlation analyses were Spearman Rank Order correlations. Follow-up analyses were then conducted after the correlation analyses using mixed effect models analyses. Since there was a significant age effect in children's RC performance at the group level, and the two age groups differed in their exposure patterns to the two languages, the two age groups were analyzed separately.

4.3.3.3.1 Correct response

Table 4.9 shows results from the simple bivariate correlations between Kam vocabulary score, Mandarin vocabulary score, age (in months), bilingual dominance, and subject RC and object RC accuracy for the younger group.

In these younger bilingual children, object RC accuracy was significantly positively associated with age and vocabulary size in both languages. Subject RC accuracy, on the other hand, was significantly positively associated with only vocabulary size in Kam. Additionally, age was significantly positively associated with vocabulary size in Mandarin, but not with vocabulary size in Kam, indicating that among this younger group of children the relatively older ones had better expressive vocabulary competence in Mandarin. There was also a significant negative correlation between age and bilingual dominance. This negative correlation indicates that among this younger group of bilingual children, the relatively older ones happened to be less Mandarin dominant.

Table 4.9. Simple bivariate correlations between Mandarin MINT vocabulary score, Kam MINT vocabulary score, age (in months), bilingual dominance, and Subject RC and Object RC accuracy for the younger group

Younger group					
	S	O	ManMINT[4]	KamMINT[5]	Dominance[6]
Age	.060	.098*	.160***	-.045	-.262***
S		-.330***	.035	.125*	.067
O			.211***	.143**	-.054

[4] Man MINT = 'Mandarin vocabulary'
[5] Kam MINT= 'Kam vocabulary'
[6] Dominance = 'bilingual dominance'

Table 4.10 shows results from the simple bivariate correlations between Kam vocabulary score, Mandarin vocabulary score, age (in months), bilingual dominance, and subject RC and object RC accuracy for the older group. In these older bilingual children, age was somehow negatively associated with performance on both RC structures, indicating that among this older group of bilingual children, the relatively older ones happened to perform less well in the RC comprehension task. Note that age also happened to negatively correlate with vocabulary scores in both languages here, indicating that among this older group of bilingual children, the relatively older ones happened to have lower vocabulary scores in both languages. The two findings above, taken together, suggest that, in this older group of bilingual children, the relatively older children happened to be less advanced in their two languages; and this is possible, as age is not always the best proxy measure for general language proficiency, given individual differences in children's rate of language acquisition. Turning next to children's RC performance, their subject RC accuracy was negatively associated with age (as mentioned above), but significantly positively associated with vocabulary size in both languages. Object RC accuracy, on the other hand, was negatively associated with age (as mentioned above), but significantly positively associated with only vocabulary size in Kam. Additionally, bilingual dominance was significantly positively associated with subject RC accuracy, but not object RC accuracy. This positive correlation indicates that children who were more Mandarin dominant were more accurate on subject RCs.

Table 4.10. Simple bivariate correlations between Mandarin MINT vocabulary score, Kam MINT vocabulary score, age (in months), bilingual dominance, and Subject RC and Object RC accuracy for the older group

Older group					
	S	O	ManMINT	KamMINT	Dominance
Age	-.187**	-.194**	-.302***	-.333***	.070
S		.173**	.201**	.311***	.138*
O			.122	.168**	.049

These correlational analyses were then followed up with mixed models analyses. For the younger group, age (in months), Kam vocabulary score, and Mandarin vocabulary score, were included as predictors. Bilingual dominance based on MINT scores was not included as a predictor in the mixed models because there were no significant correlations between bilingual dominance and RC performance in the correlation analyses. There were main effects of Mandarin vocabulary score [β = .333, *se* = .099, *z* = 3.368, $p < .001$] and Kam vocabulary score [β = .329, *se* = .085, *z* = 3.876, $p < .001$], and a three-way Mandarin vocabulary X Kam vocabulary X extraction interaction [β = -.414, *se* = .104, *z* = -3.974, $p < .001$]. This result suggested that although Kam and Mandarin vocabulary scores were positively associated with RC accuracy in the simple correlation analyses, more in-depth scrutiny revealed that, Kam and Mandarin vocabulary scores predicted only object RC accuracy and predicted only Kam object RC

accuracy in particular in the follow-up mixed model analyses [β = -1.701., *se* = .354, *z* = -4.804, *p* < .001].

As for the older group, age (in months), Kam vocabulary score, Mandarin vocabulary score, and bilingual dominance were included as predictors. There were a main effect of Kam vocabulary score [β = 1.06, *se* = .504, *z* = 2.103, *p* = .035] and a two-way interaction between Kam vocabulary and extraction [β = 2.478, *se* = .638, *z* = 3.887, *p* =< .001]. The interaction indicated that Kam vocabulary predicted only subject RC performance in the two languages. Thus, although the simple correlations suggest that Mandarin vocabulary score and bilingual dominance were associated with subject RC accuracy, these specific effects did not survive upon further scrutiny in the mixed model analyses.

4.3.3.3.2 Head errors

Similar to the accuracy data analyses, simple bivariate correlation analyses were first run on the head error data, separately for the younger and the older groups. Table 4.11 shows results from the simple bivariate correlations between Mandarin vocabulary score, Kam vocabulary score, age (in months), bilingual dominance, and subject RC and object RC head errors for the younger group. In these younger bilingual children, age was significantly negatively associated with both structures, indicating that children made fewer head errors as they were older. Object RC head errors were negatively correlated with vocabulary scores in both languages, indicating that those

children with higher vocabulary scores in Mandarin and Kam made fewer object RC head errors.

Table 4.11. Simple bivariate correlations between Mandarin MINT vocabulary score, Kam MINT vocabulary score, age (in months), bilingual dominance, and Subject RC and Object RC head errors for the younger group

Younger group					
	S	O	ManMINT	KamMINT	Dominance
Age	-.150**	-.111*	.160***	-.045	-.262***
S		-.303***	-.046	-.001	.049
O			-.183***	-.124**	.048

Table 4.12 shows results from the simple bivariate correlations between Mandarin vocabulary score, Kam vocabulary score, age (in months), bilingual dominance, and subject RC and object RC head errors for the older group. In these older bilingual children, age was significantly positively associated with object RC head errors, indicating that relatively older children in this group made more head errors as they comprehended object RCs. This is because, as mentioned, there were also significant negative correlations between age and vocabulary scores in both languages, suggesting that, actually, the relatively younger children in this group happened to be more proficient in both languages (hence higher vocabulary scores in both languages, and fewer head errors when comprehending object RCs). Moreover, object RC head errors were significantly negatively

correlated with vocabulary scores in both languages, indicating that those children with higher vocabulary scores in Mandarin and Kam made fewer object RC head errors.

Table 4.12. Simple bivariate correlations between Mandarin MINT vocabulary score, Kam MINT vocabulary score, age (in months), bilingual dominance, and Subject RC and Object RC head errors for the older group

Older group					
	S	O	ManMINT	KamMINT	Dominance
Age	.048	.174**	-.302***	-.333***	.070
S		.145*	-.110	-.101	0
O			-.128*	-.153*	-.028

Similar to the accuracy data analyses, these correlation analyses were then followed up with mixed models analyses. Results were reported only for the younger group, because the older group made only very few head errors in general, and no significant effects were found in the mixed model analyses. The predictors were age (in months), vocabulary score in Mandarin, and vocabulary score in Kam. Since there were no significant correlations between bilingual dominance based on the MINT scores and children's RC performance in the correlation analyses, bilingual dominance was not included as a predictor in the mixed model analyses. There were main effects of age [β = -1.425, *se* = .569, *z* = -2.503, *p* <.05], Mandarin vocabulary scores [β = -.302, *se* = .149, *z* = -2.035, *p* < .05], and a three-way age X Mandarin vocabulary X extraction interaction [β = .665, *se* = .195, *z* = 3.415, *p* < .001].

The interaction was due to an interaction between age X Mandarin vocabulary X object RC head errors in Kam [β = -.589, *se* = .205, *z* = -2.870, *p* <.01] and an interaction between age X Mandarin vocabulary X object RC head errors in Mandarin [β = -.511, *se* = .202, *z* = -2.522, *p* <.05]. These findings suggested that the head errors significantly decreased with age, and with Mandarin vocabulary scores (in other words, experience with and proficiency in Mandarin), but not with Kam vocabulary scores. Specifically, the significant negative associations were only found with object RC head errors, not with subject RC head errors, in the two languages.

To summarize, the findings indicated that vocabulary scores significantly predicted children's performance on comprehending head-final RCs. Specifically, both Kam and Mandarin vocabulary scores positively predicted only Kam (but not Mandarin) head-final object RC accuracy, and Mandarin vocabulary scores, in particular, negatively predicted head-final object RC (but not subject RC) head error rates in Kam and Mandarin. These findings, taken together, suggested that Mandarin vocabulary scores, an objective proxy measure for children's amount of experience with Mandarin, but not Kam vocabulary scores, specifically predicted children's performance in comprehending Kam head-final object RCs. That is, a bilingual child having more experience with Mandarin (indicated by her/his higher Mandarin vocabulary score) was more accurate and made fewer head errors when comprehending Kam head-final object RCs.

4.4 Discussion

This study provides novel data on young bilingual children's comprehension of head-final subject and object RCs in Kam and Mandarin. Mandarin and Kam attesting the typological rare combination of SVO word order and head-final RCs are languages that are especially interesting with regard to the issue of subject/object asymmetry. The unique language specific features of Kam attesting both head-final and head-initial RCs within a language added an interesting dimension to examine how competition between constructions could affect acquisition outcomes. In addition, the structural overlaps between Kam and Mandarin offer a good testing ground to examine the possibility of cross-linguistic influence and its directionality in bilingual Kam-Mandarin children in this domain of grammar.

The three hypotheses were supported. First, consistent with previous findings studying Mandarin/Cantonese-English bilinguals (Kidd et al., 2015; Tsoi et al., resubmitted), trilinguals (Chan et al., 2017) and recent findings studying monolingual Mandarin-speaking children (Hu et al., 2016a, 2016b), the Kam-Mandarin bilingual children showed, in general, a subject over object advantage when comprehending Kam and Mandarin head-final RCs. The error analysis showed that head errors were the most common error type when children comprehended object RCs, again consistent with the results reported in the existing literature studying comprehension of NVN/SVO head-final object RCs in bilingual/trilingual children (Kidd et al., 2015; Chan et al., 2017; Tsoi et al., resubmitted).

Second, as predicted, Kam-Mandarin bilingual children, the younger group, in particular, experienced the greatest challenge in comprehending Kam head-final object RCs, although Kam is their first language and the younger children's exposure to Kam was significantly more than that to their L2 Mandarin. The vulnerability of Kam head-final object RCs can be attributed to the additional competition between constructions within Kam. The additional competition arises from i) the head-final and head-initial object RCs which have the same noun modification function but are different in form (head directionality in particular), and ii) Kam head-initial subject RCs which share the same surface SVO word order but differ in function.

Third, the data suggested a specific directionality of positive influence from Mandarin to Kam but not in the other directionality. Although the current bilingual language dominance measure based on vocabulary scores did not significantly predict children's comprehension of RCs, Mandarin vocabulary knowledge, in particular, significantly predicted children's comprehension of Kam head-final object RCs for the younger group. If we take vocabulary knowledge of a language as an objective proxy measure for amount of experience with the language, this would suggest that the younger children having more exposure to Mandarin would comprehend the Kam head-final object RCs better and would be less likely to make head noun errors. These results suggested a positive cross-linguistic influence from L2 Mandarin to L1 Kam. In Kam, RC structures can be head-final and head-initial (Wu, 2015; Yang, 2017), whereas in Mandarin, they are only head-final. There is a consistent form-function mapping in Mandarin RCs (because RCs are always head-final) but Kam allows a function to be mapped onto

two alternative forms (head-final and head-initial). According to Hulk and Muller's (2000) hypothesis, possible cross-linguistic influence is predicted to occur from Mandarin to Kam (see section 4.2). Our results are consistent with their hypothesis, suggesting that positive transfer occurs when there are structural parallels between the head-final object RCs in Mandarin and Kam, and the directionality of influence is driven not by language dominance, but by considering the language-specific characteristics of the language pair: in the current case, positive transfer is manifested from a language instantiating consistent form-function mappings (i.e. Mandarin) to a language instantiating variable form-function mappings (i.e. Kam) in the target domain of grammar.

4.5 Conclusion

This chapter presents the first experimental study investigating the comprehension of subject and object head-final RCs in Kam-Mandarin bilingual children. The bilingual children in general showed a subject over object preference in both languages, a pattern that is consistent with the existing literature on bi- and tri- lingual Mandarin-speaking children (Kidd et al., 2015; Chan et al., 2017; Tsoi et al., resubmitted). The results also showed that the bilingual children found object head-final RCs in Kam significantly more difficult than those in Mandarin, even though Kam was their first language and the stronger language for the younger group. The third major result indicated that children's exposure to and knowledge of Mandarin (reflected by their Mandarin vocabulary scores) significantly

positively predicted their accuracy in comprehending Kam object head-final RCs in particular, and significantly negatively predicted their head noun error rate when comprehending Kam object head-final RCs in particular (i.e. children having more experience with and knowledge of Mandarin would be less likely to mistakenly take the first noun (subject of the RC) as the head noun of the RC when comprehending NVN/SVO object head-final RCs in Kam, in particular). These findings provided an excellent opportunity to demonstrate how certain language specific characteristics (e.g. the instantiation of head-initial and head-final RCs in Kam but not in Mandarin) leads one to consider how relationships between constructions create more competition in one language than the other language in children's linguistic experience that could impact on the acquisition outcomes in bilingual children. Moreover, this study also demonstrates how structural overlaps between languages, which by nature can be taken as another way of conceptualizing relationships between 'constructions/structures' across languages, could impact on the possibility and the nature of cross-linguistic influence and its directionality in bilingual children.

Chapter Five
General Discussion and Conclusions

5.1 Introduction

This chapter will 1) review the major findings of the three experimental studies, 2) discuss the significance of the findings, 3) suggest future research work and 4) conclude the thesis.

5.2 Summary of the major findings

This thesis consists of three studies on the acquisition and processing of relative clauses in Mandarin-speaking children and Kam-Mandarin bilingual children involving offline and online methods. The studies tested different types of RCs. The findings of the three studies are first summarized below.

Study one (Chapter two) used the sentence repetition task to test the production of a wide range of Mandarin RC types by Mandarin-speaking children. One hundred and thirteen monolingual Mandarin-speaking children aged three to five participated in the study. Sentence stimuli were manipulated in terms of the syntactic role of the head noun that can be relativized including Subject, Direct Object/Patient, Indirect Object, Oblique and Genitive. The overall hierarchy of difficulty in production was S>A=OBL>P=double object dative IO>GEN>prepositional dative IO (> means 'easier than'; = means 'similar to'). This specific pattern of difficulty did not fully accord with the predictions derived from Keenan & Comrie's

(1977) linguistic universal NPAH. Specifically, NPAH would predict OBL to be difficult as it is at a relatively low position in the hierarchy, but children found it rather easy to produce- OBL was as easy to produce as A and even easier than P which is in a higher position on the hierarchy. Prepositional Indirect Object RC, which positions around the middle of the hierarchy, by contrast, turned out to be the most difficult type for children to produce. On the other hand, when the study used another type of IO RC, in particular, the more frequent double object datives Indirect Object RC, children found it significantly easier to produce. These findings are better predicted and accounted for by theoretical perspectives that consider how relationships between constructions (in particular, structural overlaps with other canonical simpler constructions) input frequency jointly affect acquisition and processing.

The second study revisited the issue of subject-object asymmetry in Mandarin RC acquisition and processing. It is the first study using an online method to study this issue in child Mandarin, and the first study that systematically compares two types of subject and object relative clauses within the same language: I) RC de DCL N (DCL-RC): relatives with the head nouns specified with a demonstrative (D) and a classifier (CL), and II) RC de N (DE-RC): relatives with bare head nouns. Thirty-six four-year-old Mandarin monolingual children were recruited with data from twenty-two children included in the final sample for data analyses. Children's eye movements were coded as they heard the test sentences and chose a referent that the sentence describes (Brandt, Kidd, Lieven, and Tomasello, 2009; Chan, Yang, Chang & Kidd, 2018; Rahmany, Marefat & Kidd, 2014). Online

results revealed different asymmetry patterns for these two types of RCs. For DCL-RCs, children showed an object over subject advantage, whereas for DE-RCs, the same children showed a subject over object advantage. This differential pattern of results is not predicted by theories that make general predictions of a uniform subject or object advantage within a language (e.g., structural distance hypothesis (Lin & Bever, 2006); Dependency Locality Theory (Gibson, 2000)), but maps well onto the distributional properties/frequencies in the input.

The third study again examined the relative ease of comprehending subject vs object RCs- not only in child Mandarin but also extended the investigation to another SVO language attesting head-final RCs, Kam, in a bilingual acquisition context. Forty-six Kam-Mandarin bilingual children aged 5;11-10;3 were recruited in a Kam village of Mainland China and tested on the comprehension of head-final subject and object RCs in both Kam (L1) and Mandarin (L2) using a picture-pointing task. As expected, children found object RCs more difficult to comprehend than subject RCs in both Kam and Mandarin, but they found object head-final RCs significantly more difficult in Kam than in Mandarin even though Kam is their L1 and the stronger language (for the younger group). This specific pattern of results cannot be adequately accounted for by structural perspectives to RC acquisition/processing (e.g., the structural distance hypothesis by Lin and Bever, 2006 and structural intervention accounts by Friedmann, Belletti and Rizzi, 2009). Rather, these findings can be predicted by and better accounted for by approaches that consider how relationships between constructions impact acquisition/processing outcomes (Rowland, Noble & Chan, 2014):

Kam, but not Mandarin, has competing head-final and head-initial RC constructions.

5.3 Significance of the studies

The current studies are significant in many ways both empirically and theoretically.

5.3.1 Empirical significance

The first study provides novel comprehensive developmental data from a wide range of relativized positions that go beyond the frequently studied subject and object RCs in child L1 Mandarin. Most previous studies have focused only on comparing the relative ease of acquiring/processing subject and object RCs (Hsu, 2014; Hsu et al., 2009; Hu et al., 2016a, 2016b) and very few studies have included one more type of RCs in addition to subject and object RCs (Indirect Object in Lee, 1992; Oblique in Su, 2004). There is yet a study which comprehensively investigates a wide range of RC types, in particular, RCs using resumptive relativization strategy. Study one included not only the subject and the object RCs but also resumptive RCs including Indirect Object, Oblique and Genitive RCs in Mandarin-speaking three to five years olds.

The second study brings in novel online data comparing two different RC types on the issue of subject-object asymmetry in young Mandarin-speaking children. Past child language studies have focused on only one type

of subject vs object RCs in Mandarin (mostly DE-RCs). These two types of RCs have been argued to have different syntactic structures that could bear on whether or not there is an extraction-type filler-gap dependency (Cheung & Li, 2015), although the syntactic analyses of Chinese RCs are also subject to debates from different theoretical perspectives. More interestingly, these two RC types exhibit different distributional patterns in the child-directed speech that would predict differential patterns of processing ease regarding whether it is subject RC or object RC that is easier to process. The new empirical datasets allow us to test a range of perspectives that have been considered in the RC acquisition/processing literature.

The third study brings in new developmental data from Kam, an understudied SVO language attesting head-final RCs which is a typologically rare combination, and developmental data from a new language pair, Kam and Mandarin, in bilingual child language acquisition. These new data allow us to address a number of conceptual issues such as (i) the issue of subject/object asymmetry in languages attesting the rare combination of SVO canonical order and head-final RCs; (ii) the nature of difficulty in comprehending object RCs in Kam versus Mandarin; and (iii) the possibility, nature and directionality of cross-linguistic influence in bilingual children, given the structural overlaps.

5.3.2 Theoretical significance

The findings are also theoretically significant in a number of ways. The findings from the sentence repetition study (chapter 2) are not predicted by

the perspectives based on the Noun Phrase Accessibility Hierarchy (Keenan & Comrie, 1977). The current ranking of production difficulties is S > A = OBL > P > GEN and IO (double object datives) > IO (prepositional datives), which is not consistent with the prediction based on NPAH 'S > O > IO > OBL > GEN'. These findings challenged the analyses in which the acquisition of relative clauses (RCs) is crucially determined by the varying distance between filler and gap (c.f. NPAH, Keenan & Comrie 1977). These findings therefore provide new evidence to the ongoing debate on the extent to which NPAH is still of descriptive and explanatory value to account for the developmental and processing phenomena observed in the acquisition and processing of RCs in an non-European Asian language context. Rather, the findings can be better accounted for by constructivist perspectives that emphasize how similarity between the various types of relative clauses and simpler frequently attested constructions in the target language could affect acquisition and processing outcomes (Diessel & Tomasello, 2005).

In addition, the developmental patterns exhibited in the second study (chapter 3) challenged several theoretical perspectives making predictions of either a uniform subject or a uniform object advantage within a language for Mandarin. For example, one set of theories based on structural constraints predicts a general subject advantage in Mandarin because subject RCs have shorter structural distance (Lin & Bever, 2006) or do not have the problem of structural intervention between the filler and gap (Friedmann et al., 2009). Another set of theories predicts an object advantage in Mandarin because object RCs have shorter linear filler-gap distance (Gibson, 1998, 2000) and they are similar in surface form with simple SVO transitive sentences

(Diessel & Tomasello, 2005; Slobin & Bever, 1982). These theories do not make differential predictions for different types of subject and object RCs within a language and cannot adequately explain the differential pattern of subject/object asymmetry exhibited by the same group of young children for the two RC types in the current online results (i.e. an object advantage for DCL RCs but a subject advantage for DE RCs). Rather, these developmental processing preferences align with the distributional properties/frequencies in the input, suggesting that an experience-based approach that identifies a tight link between specific patterns of linguistic experience and developmental processing preferences provides a better account in explaining the current findings.

Moreover, from a constructivist perspective, the findings from the third bilingual study (chapter 4) demonstrate how language specific characteristics (e.g. the instantiation of head initial and head final RCs in Kam but not in Mandarin) leads one to consider how relationships between constructions create more competition in one language than the other language in children's linguistic experience that could impact on the acquisition outcomes in bilingual children. Furthermore, the results demonstrate how structural overlaps between languages, which can be taken as another way of conceptualizing relationships between 'constructions/structures' across languages, could impact on conceptual issues such as the possibility and the nature of cross-linguistic influence and its directionality in bilingual children.

5.4 Suggestions for future research

5.4.1 Testing ‘DCL RC de N’ constructions in Mandarin

Study two showed that children displayed differential pattern of processing preference when comprehending two types of subject vs object RCs in Mandarin. Apart from studying and comparing ‘RC de DCL N (DCL-RC)’ versus ‘RC de N (DE-RC)’, there is another type of RC in Mandarin with the demonstrative and the classifier placed before the entire RC (i.e. ‘DCL RC de N), as shown in example (1).

(1) DCL RC de N

na ge [$_{RC}$ mama mai] de wanju huai le

that CL mother buy DE toy broke PFV

‘The toy that mother bought has broken.’

Some syntactic analyses have argued that ‘DCL RC de N’ and ‘DCL-RC’ constructions may differ in their syntactic structures. ‘DCL RC de N’ are argued to be complementation structures with extraction-type filler-gap dependency, whereas ‘DCL-RC’ are adjunction structures without extraction-type filler-gap dependency (Cheung & Li, 2015). As such, to the extent that the presence of filler-gap dependency could impact on children’s processing preferences of subject versus object RCs (although the theoretical analyses of Chinese RCs are also subject to intense debates), it would be interesting to study and compare the comprehension of ‘DCL RC de N’ versus ‘DCL-RC’ constructions on the issue of subject/object asymmetry. More interestingly, previous studies have also reported that these two RC

types show differential patterns of subject/object RCs distribution in their usage. Specifically, 'DCL RC de N' tend to be subject RCs and the 'DCL-RC' tend to be object RCs in written corpora (Chen el et al., 2015; Ming & Chen, 2010; Tang, 2007; Wu, 2009) as well as adult-to-adult spoken corpora (Pu, 2008; Sheng & Wu, 2013). Future studies could examine and compare the distributional properties of these two types of RCs in adult child-directed speech and compare the comprehension of these two types of RCs on the issue of subject/object asymmetry in Mandarin-speaking children.

5.4.2 Conducting input studies on Kam-Mandarin bilingual children

Thus far there is yet a corpus study reporting the distributional properties of RCs in Kam adult child-directed speech. Input studies are therefore important, to further evaluate the extent of which distributional properties of the input could impact acquisition outcomes. the Recall that both head-initial and head-final RCs are attested in Kam. Head-initial RCs are predominantly used by the older generations. Head-final RCs are a type of variation under the influence of Mandarin and Southwest Chinese dialects and commonly used by the younger generations below 40 years old (Yang, 2017). This means that bilingual Kam-Mandarin children who are taken care by the older generations such as children's grandparents are likely to have relatively more exposure to Kam head-initial RCs, whereas those who are taken care by the younger generations such as children's parents are likely to have relatively more exposure to Kam head-final RCs. Future studies could compare these

two groups of bilingual children in terms of the distributional properties of RCs and the RC-related structures in their language experience, and children's performance in comprehending and producing RCs in their two languages, to examine the extent of which input properties can account for the possible differences observed between these two groups of bilingual children.

5.4.3 Investigating how individual differences in working memory and statistical learning abilities relate to children's competence with RCs in Mandarin

Individual differences have been consistently observed across studies in Mandarin children's RC processing, even when children were in the same age group or were at the same level of vocabulary competence. One possibility is that these variations are modulated by individual differences in cognitive skills such as working memory (Arosio, Guasti & Stucchi; 2011; Bentea, Durrleman & Rizzi, 2016; Booth, MacWhinney & Haraskai, 2000; Boyle, Lindell & Kidd, 2013; see also Kidd 2013 for a review). In Mandarin, Chen, Ning, Bi & Dunlap (2008) reported that adult participants with low working memory span showed an object advantage, whereas the ones with high working memory span showed no difference in reading time between subject and object RCs. There are however no comparable studies in child Mandarin examining how individual differences in working memory relate to children's performance in RC experimental tasks. Thus far, this issue only remains as an idea to consider. For example, Hsu (2014) suggested that age

associating with working memory capacity might jointly influence Mandarin children's RC processing, when she reported the differences in results from the younger three-year-olds versus the older five-year-olds.

Another potentially relevant cognitive skill is statistical learning abilities (Wells, Christiansen, Race, Acheson & MacDonald, 2009; Kidd, 2012). Statistical learning ability is the capacity to track sequential probabilities of elements in the environment and has been shown to be related to language acquisition (Saffran, 2003). In child language study, Kidd & Arciuli (2015) investigated the associations between statistical learning and the comprehension of syntactic constructions including actives, passives, subject RCs and object RCs in six- to eight- years old English-speaking children. They reported that children's statistical learning ability independently predicted their comprehension of passives and object RCs and argued that individual differences in statistical learning ability predict children's acquisition of syntactic structures. However, again, to date there are no studies examining the role of statistical learning ability in children's competence with relative clauses in Mandarin. Future research should take up this issue.

5.4.4 Using multiple methods in a dual comprehension-production and within-subject design

Previous studies showed mixed findings in subject/object processing preference and some methodological factors may be responsible for the inconsistent results. For example, studies used different methods that tap into

different underlying processes (e.g. comprehension task versus production task) and that each method tested a different group of subjects. These studies also differed in the test stimuli used (e.g. structural complexity of the main clause as well as semantic factors such as whether animacy is controlled) and the test procedures involved, even when some of these studies used the same type of method. Moreover, some earlier studies did not present the target RC sentences in a supportive discourse context (e.g. Chang, 1984; Lee, 1992). In other studies, the experiment used a picture-sentence matching task instead of a referent/character selection task such that children could rely simply on the canonical SVO word order comprehension strategy to be able to point to the correct picture without having to fully parse the RC sentence to assign the head noun referent correctly, and thereby giving rise to a possible object RC advantage in Mandarin (He et al., 2017). Conceptually, one should also make a careful distinction between production experiments and comprehension experiments. For example, comprehension tasks, such as the current referent pointing task used in this thesis, assesses head noun referent assignment, while production tasks (e.g., elicited production task) are more concerned about whether children can formulate an RC to describe the intended referent. It is possible that certain factors have effects in production that are not matched in comprehension. For example, the effects of similarity between a RC and a simpler canonical construction could be different between production and comprehension. While Mandarin-speaking children may make use of a simple transitive SVO construction to bootstrap onto constructing a more complex object RC in their production (a facilitating effect), the resemblance of Mandarin object RCs to simple SVO

transitives may create competition between constructions causing problems in comprehension, leading object RCs to be misparsed as SVO main clauses (Lau 2006, Chan et al., 2011). Future research could therefore test the same batch of children using multiple methods in a dual comprehension-production and within-subject design. This allows us to gather multiple sources of experimental evidence from both comprehension and production modalities to shed further light on the issue of subject/object asymmetry in Mandarin RC acquisition.

5.5 Conclusion

This thesis studies the acquisition and processing of relative clauses in young Mandarin-speaking children. It provides novel developmental data assessing RCs from a wide range of relativized positions in child L1 Mandarin (study one, Chapter Two); novel online data comparing two different RC types on the issue of subject-object asymmetry in Mandarin-speaking children (study two, Chapter Three); and novel developmental data from Kam-Mandarin bilingual children (study three, Chapter Four). The developmental patterns exhibited could not be adequately accounted for by several theoretical perspectives that have been adopted in the existing literature on child and adult processing of Mandarin relative clauses (e.g. Structural-based perspectives (Fredmann et al., 2009; Lin & Bever, 2006), Dependency Locality Theory (Gibson, 1998; 2000); and perspectives based on the Noun Phrase Accessibility Hierarchy (Keenan & Comrie (1977)). Rather, they could be better accounted for by approaches that emphasize a close

relationship between acquisition/processing and similarity to other structures and language-specific distributional properties/frequencies of the input (Diessel & Tomasello, 2005; Chen & Shirai, 2015).

Appendix A Mandarin RC stimuli-Sentence Repetition task

This is [RC] de head noun.

Subject

1. [飞 上 屋顶] 的 那 只 小鸟
   fei1 shang4 wu1ding3 de na4 zhi1 xiao3nia
   fly up roof marker that CL bird
   'the bird that flew up to the roof'

2. [躺 在 树 下] 的 那 个 男孩
   tang3 zai4 shu4 xia4 de na4 ge4 nan2hai2
   lie at tree below marker that CL boy
   'the boy that lied under the tree'

3. [睡 在 草地 上] 的 那 头 牛
   shui4 zai4 cao3di4 shang4 de na4 tou2 niu2
   sleep at lawn above marker that CL cow
   'the cow that slept on the lawn'

4. [坐 在 车 里] 的 那 个 女孩
   zuo4 zai4 che1 li3 de na4 ge4 nv3hai2
   sit at car inside marker that CL girl
   'the girl that sat in the car'

Agent

1. [抓到　　奶牛]　　的 那 只　狮子
   zhua1dao4 nai3niu2 de na4 zhi1 shi1zi
   catch-EXP cow marker that CL lion
   'the lion which caught a cow'

2. [踢到　　大象]　　的　那　只　斑马
   ti1dao4 da4xiang4 de na4 zhi1 ban1ma3
   kick-EXP elephant marker that CL zebra
   'the zebra that kicked the elephant'

3. [追到　　兔子]　的　那 只　　小猫
   zhui1dao4 tu4zi de na4 zhi1 xiao3mao1
   chase-EXP rabbit marker that CL cat
   'the cat that chased a rabbit'

4. [摸到　　小狗]　　的　那 只 小猪
   mo1dao4 xiao3gou3 de na4 zhi1 xiao3zhu1
   touch-EXP dog marker that CL pig
   'the pig that touched a dog'

Patient

1. [猴子　抓到]　　的　　那　只 熊猫
   hou2zi zhua1dao4 de na4 zhi1 xiong2mao1
   monkey catch-EXP marker that CL panda
   'the panda which monkey caught'

2. [斑马　　咬到]　　的 那 只　长颈鹿
   ban1ma3 yao3dao4 de na4 zhi1 chang2jing3lu4
   zebra bite-EXP marker that CL giraffe
   'the giraffe that the zebra bit'

3. [男孩　推倒]　的　那　个　女孩
   nan2hai2 tui1dao3　de　na4　ge4　nv3hai2
   boy　push-to-fall down　marker that　CL　girl
   'the girl that the boy pushed'

4. [黑熊　亲到]　的　那　只　大象
   hei1xiong2 qin1dao4　de　na4　zhi1 da4xiang4
   black-bear　kiss-EXP　marker that CL　elephant
   'the elephant that the black bear kissed'

Prepositional datives Indirect object

1. [叔叔　递　了　球　给　她] 的　那　个　女孩
   shu1shu　di4　le　qiu2　gei3 ta1 de　na4 ge4 nv3hai2
   man　pass　PFV ball　give 3.sg marker that CL　girl
   'the girl who the man passed a ball to'

2. [老师　借　了　书　给　他]　的　那　个　男孩
   lao3shi1　jie4　le　shu1 gei3 ta1　de　na4　ge4　nan2hai2
   teacher　lend PFV　book　to　3.sg marker　that　CL　boy
   'the boy who the teacher lent a book to'

3. [奶奶　送　了　糖　给　她] 的　那　个　妹妹
   nai3nai　song4 le　tang2　gei3 ta1　de　na4　ge4　mei4mei
   old-lady give　PFV candy　to　3.sg marker that CL　girl
   'the girl who the old-lady gave a candy to'

4. [男孩　送　了　花　给　她]　的　那 个　阿姨
   nan2hai2 song4 le　hua1　gei3　ta1　de　na4　ge4　a1yi2
   Boy　give　PFV flower　to　3.sg　marker that CL　woman
   'the woman who the boy gave flowers to'

Double object datives Indirect object

1. [叔叔 递 她 球 的] 那 个 女孩
   shu1shu di4 ta1 qiu2 de na4 ge4 nv3hai2
   man pass 3.sg ball marker that CL girl
   'the girl who the man passed a ball to'

2. [老师 借 他 书 的] 那 个 男孩
   lao3shi1 jie4 ta1 shu1 de na4 ge4 nan2hai2
   teacher lend 3.sg book marker that CL boy
   'the boy who the teacher lent a book to'

3. [奶奶 送 她 糖 的] 那 个 妹妹
   nai3nai song4 ta1 tang2 de na4 ge4 mei4mei
   old-lady give 3.sg candy marker that CL girl
   'the girl who the old-lady gave a candy to'

4. [男孩 送 她 花 的] 那 个 阿姨
   nan2hai2 song4 ta1 hua1 de na4 ge4 a1yi2
   boy give 3.sg flower marker that CL woman
   'the woman who the boy gave flowers to'

Oblique

1. [男孩 为 她 梳头 的] 那 个 女孩
   nan2hai2 wei4 ta1 shu1tou2 na4 ge4 nv3hai2
   boy for 3.sg comb-hair marker that CL girl
   'the girl for whom the boy combed hair'

2. [姐姐 为 他 穿袜子 的] 那 个 宝宝
   jie3jie wei4 ta1 chuan1wa4zi de na4 ge4 bao3bao
   girl for 3.sg put on-sock marker that CL baby
   'the baby on whom girl put socks'

3. [女孩 为 他 打伞 的] 那 个 爷爷
nv3hai2 wei4 ta1 da3san3 de na4 ge4 ye2ye
girl for 3.sg hold-umbrella marker that CL old-man
'the old man for whom the girl held an umbrella'

4. [叔叔 为 她 洗手 的] 那 个 女孩
shu1shu wei4 ta1 xi3shou3 de na4 ge4 nv3hai2
man for 3.sg wash-hand marker that CL girl
'the girl for whom man washed hands'

Genitive

1. [她 的 鸟 抓到 了 蝴蝶 的] 那 个 阿姨
ta1 de niao3 zhua1dao4 le hu2die2 de na4 ge4 a1yi2
3.sg GEN bird catch-EXP PFV butterfly marker that CL woman
'the woman whose bird caught a butterfly.'

2. [他 的 狗 吓到 了 猪 的] 那个 叔叔
ta1 de gou3 xia4dao4 le1 zhu1 de na4ge4 shu1shu
3.sg GEN dog scare-EXP PFV pig marker that CL man
'the man whose dog scared the pig.'

3. [叔叔 摸 她 的 兔子 的] 那 个 女孩
shu1shu mo1 ta1 de tu4zi de na4 ge4 nv3hai2
man touch 3.sg GEN rabbit marker that CL girl
'the girl whose rabbit the man touched.'

4. [奶奶 喂 他 的 小猫 的] 那 个 男孩
nai3nai wei4 ta1 de xiao3mao1 de na4 ge4 nan2hai2
old-lady feed 3.sg GEN cat marker that CL boy
'the boy whose cat the old lady fed.'

Appendix B Mandarin RC stimuli-Referent selection task

Can you pick up [relative clause] head noun?

Subject DCL RCs

1. 追小獅子的那只小狗

   Zhui1 xiao3shi1zi de na4 zhi1 xiao3gou3
   Chase lion de that CL dog
   'the dog that chases the lion'

2. 踢斑马的那只狗熊

   Ti1 ban1ma3 de na4 zhi1 gou3xiong2
   Kick zebra de that CL bear
   'the bear that kicks the zebra'

3. 擦小猪的那只小猴

   Ca1 xiao3zhu1 de na4 zhi1 xiao3hou2
   Wipe pig de that CL monkey
   'the monkey that wipes the pig'

4. 挠小猴的那只小牛

   Nao2 xiao3hou2 de na4 zhi1 xiao3niu2
   Tickle monkey de that CL cow
   'the cow that tickles the monkey'

Object DCL RCs

1. 小马推的那只小狗

   Xiao3ma3 tui1 de na4 zhi1 xiao3gou3
   Horse push de that CL dog
   'the dog that the horse pushes'

2. 老虎咬的那只狗熊

   Lao3hu3 yao3 de na4 zhi1 gou3xiong2
   Tiger bite de that CL bear
   'the bear that the tiger bit'

3. 小羊摸的那只小猴

   Xiao3yang2 mo1 de na4 zhi1 xiao3hou2
   Sheep touch de that CL monkey
   'the monkey that the sheep touches'

4. 老虎喂的那只牛

   Lao3hu3 wei4 de na4 zhi1 niu2
   Tiger feed de that CL cow
   'the cow that the tiger feeds'

Subject DE RCs

1. 舔斑马的狮子

   Tian3 ban1ma3 de shi1zi
   Lick zebra de lion
   'the lion that licks the zebra'

2. 撞狗熊的老虎

   Zhuang4 gou3xiong2 de lao3hu3
   Bump bear de tiger
   'the tiger that bumps the bear'

3. 咬小牛的小象

   Yao3 xiao3niu2 de xiao3xiang4
   Bite cow de elephant
   'the elephant that bites the cow'

4. 推长颈鹿的老虎

   Tui1 chang2jing3lu4 de lao3hu3
   Push giraffe de tiger
   'the tiger that pushes the giraffe'

Object DE RCs

1. 熊猫舔的狮子

   Xiong2mao1 tian3 de shi1zi
   Panda lick de lion
   'the lion that the panda licks'

2. 大象追的老虎

   Da4xiang4 zhui1 de lao3hu3
   Elephant chase de tiger
   'the tiger that the elephant chases'

3. 小猪踢的小牛

   Xiao3zhu1 ti1 de xiao3niu2
   Pig kick de cow
   'the cow that the pig kicks'

4. 大象撞的长颈鹿

   Da4xiang4 zhuang4 de chang2jing3lu4
   Elephant bump de giraffe
   'the giraffe that the elephant bumps'

Appendix C Mandarin RC stimuli-Picture pointing task

哪一個是。。。？

Which one is [RC] de head noun?

Subject

1. 親公雞的老鼠

   qin1 gong1ji1 de lao3shu3

   kiss rooster de mouse

   'the mouse that kisses the rooster'

2. 推獅子的小熊

   Tui1 shi1zi de xiao3xiong2

   Push lion de bear

   'the bear that pushes the lion'

3. 喂小狗的猴子

   Wei4 xiao3gou3 de hou2zi

   Feed dog de monkey

   'the monkey that feeds the dog'

4. 親老鼠的大象

   Qin1 lao3shu3 de da4xiang4

   Kiss mouse de elephant

   'the elephant that kisses the mouse'

5. 推小鴨子的老鼠

   Tui1 xiao3ya1zi de lao3shu3

   Push duck de mouse

   'the mouse that pushes the duck'

6. 喂白兔的公雞

   Wei4 bai2tu4 de gong1ji1

   Feed rabbit de rooster

   ‘the rooster that feeds the rabbit’

7. 推老虎的小馬

   Tui1 lao3hu3 de xiao3ma3

   Push tiger de horse

   ‘the horse that pushes the tiger’

8. 親小豬的小狗

   Qin1 xiao3zhu1 de xiao3gou3

   Kiss pig de dog

   ‘the dog that kisses the pig’

Object

1. 小羊推的兔子

   Xiao2yang2 tui1 de tu4zi

   Sheep push de rabbit

   ‘The rabbit that the sheep pushes’

2. 小貓喂的小鴨子

   Xiao3mao1 wei4 de xiao3ya1zi

   Cat feed de duck

   ‘the duck that the cat feeds’

3. 小豬抱的小馬

   Xiao3zhu1 bao4 de xiao3ma3

   Pig hug de horse

   ‘the horse that the pig hugs’

4. 奶牛抱的長頸鹿

   Nai33niu2 bao4 de chang2jing3lu4

   Cow hug de giraffe

   ‘the giraffe that the cow hugs’

5. 小羊抱的小貓

   Xiao3yang2 bao4 de xiao3mao1

   Sheep hug de cat

   ‘the cat that the sheep hugs’

6. 長頸鹿抱的獅子

   Chang2jing3lu4 bao4 de shi1zi

   Giraffe hug de lion

   ‘the lion that the giraffe hugs’

7. 大象喂的小熊

   Da4xiang4 wei4 de xiao3xiong2

   Elephant feed de bear

   ‘the bear that the elephant feeds’

8. 奶牛親的猴子

   Nai3niu2 qin1 de hou2zi

   Cow kiss de monkey

   ‘the monkey that the cow kisses’

Appendix D Kam RC stimuli-Picture pointing task

tɕia nəu ɕi [RC] li head noun?

Which one is [RC] li head noun?

Subject

1. pu suɪ-kaɪ li nuo
   kiss rooster li mouse
   'the mouse that kisses the rooster'

2. tʰoŋ ʃì- tsi li ɕioŋ
   push lion li bear
   'the bear that pushes the lion'

3. wa la-kʷʰa li məm
   feed dog li monkey
   'the monkey that feeds the dog'

4. pu mom li ɕiaŋ
   kiss tiger li elephant
   'the elephant that kisses the mouse'

5. tʰoŋ la-pən li nuo
   push duck li mouse
   'the mouse that pushes the duck'

6. wa tʰu-tsi li suɪ-kaɪ
   feed rabbit li rooster
   'the rooster that feeds the rabbit'

7. pu la-mu li la-kʷʰa
   kiss pig li dog
   ‘the dog that kisses the pig’

8. tʰoŋ mom li la-ma
   push tiger li horse
   ‘the horse that pushes the tiger’

Object

1. la-nie tʰoŋ li tʰu-tsi
   sheep push li rabbit
   ‘The rabbit that the sheep pushes’

2. la-miaʊ wa li la-pən
   cat feed li duck
   ‘the duck that the cat feeds’

3. la-mu pu li la-ma
   pig hug li horse
   ‘the horse that the pig hugs’

4. tuo pu li tʃʰaŋ-tɕin-lu
   cow hug li giraffe
   ‘the giraffe that the cow hugs’

5. la-nie pu li la-miaʊ
   sheep hug li cat
   ‘the cat that the sheep hugs’

6. tʃʰaŋ-tɕin-lu bu li ʃi- tsi
   giraffe hug li lion
   ‘the lion that the giraffe hugs’

7. ɕiaŋ wa li ɕioŋ
   elephant feed li bear
   ‘the bear that the elephant feeds’

8. tuo pu li məm
   cow kiss li monkey
   ‘the monkey that the cow kisses’

Appendix E Language Background Questionnaire

儿童语言背景调查问卷

儿童姓名：_____ 性别：_____

出生日期：____年___月___日 填写日期：____年___月___日

1. 贵子女在哪里出生？_____
2. 贵子女曾在平等乡外的其他地方生活过吗？

   是/否 如果是，请说明在那里生活时的年龄及生活了多长时间？

   _____

3. 贵子女出生后第一个恒常大量接触的语言是：侗语☐ 普通话☐ 侗语及普通话 ☐
4. 请问贵子女在家中会接触到什么语言？(可多于一种)

   侗语☐ 普通话☐ 其他_____

5. 贵子女从何时开始**恒常大量**接触侗语?

   从_____岁通过_____（家庭、学校、电视等）接触侗语。

   补充说明：

   _____

6. 贵子女从何时开始**恒常大量**接触普通话?

   从_____岁通过_____（家庭、学校、电视等）接触普通话。

   补充说明：

   _____

7. 贵子女平均每天处于**侗语**环境中（如：学校、家人、亲戚等）的时间是多长？

   _____小时/天

8. 贵子女平均每天处于**普通话**环境中的时间是多长？

_____小时/天

9. 贵子女在家说**侗语**的时间是多少？

从不☐ 很少☐ 一半时间☐ 大部分时间☐ 全部时间☐

10. 贵子女在家说**普通话**的时间是多少？

从不☐ 很少☐ 一半时间☐ 大部分时间☐ 全部时间☐

11. 从 1 到 8，请您对贵子女的语言能力进行评估，在相应的方格内打✓。

1	无实际进行有效交流的能力。需要花费大量的时间和提示才有可能进行问候，说出自己的个人信息及说出一些熟悉的物品。不能参与真正的对话。	侗语	普通话
2	只能进行很小程度的交流，表达有很大困难，只能使用一些单独的词语及所记住的固定短语。		
3	只能就一些简单的话题进行交流。严重依赖熟记短语或者对话人所提供的词语。能说短而不完整的句子，沟通障碍及误解经常发生。		
4	能通过组合及重新组合短句，表达他们已知的事实和对话人说的话，成功进行有限的简单对话。		
5	能对一些不同的简单话题（如：食物、家庭、日常生活和个人喜好等）进行简单的对话。说话人大部分使用完整的句子但很少使用连接词或复杂句。语法错误仍很常见。若没有听话人参与帮助，能独自清楚描述事件的能力仍然很有限。		
6	能成功处理及应付很多简单对话，及与学校、娱乐、休闲活动和喜好相关，需要交换基本信息的社交场合。 有一些不流畅及错误，交流中断仍有可能发生。能讲述一些不完整或不连贯的简短个人故事。		

7	能主动参与大部分和学校、家庭及休闲活动相关的对话。能讲述完整及连贯的个人故事，仍会出现少量错误。能使用很多复杂句。		
8	能轻松自信地处理大量的沟通任务，如各种和学校、家庭、休闲活动相关的具体话题，能自然有效地讲述个人及虚构性的故事。使用多种不同的词汇及句子结构，包括连接词及复杂句。		

12. 请问贵子女平日主要由谁照顾（可多于一人）？他们会以什么语言跟您的孩子沟通？

照顾孩子的人	使用的语言或方言

----------完----------

谢谢！

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