Intervention effects and the acquisition of relativization and topicalization in Chinese

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PhD thesis

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Declaration

I hereby declare that this thesis has been written by me, that the work has been carried out by me, or principally by me in collaboration with others as acknowledged, and that the thesis has not been submitted in any previous application for other degrees.

HU Shenai

To Anna, Jan, Teresa and my parents

Acknowledgements

Abstract

This thesis is about the acquisition of relativization and topicalization in Chinese.

Through a series of experimental studies, I obtain the following results. First, a disadvantage of object relatives holds in comprehension and in production for children from three to seven years of age. Second, subject relatives are also difficult to comprehend and elicit a variety of errors from children up to six years of age. Third, a large use of resumptive NPs is observed in production across age groups (including adults); for many adult native speakers of Mandarin Chinese, relative clauses with resumptive NPs are acceptable in spoken Chinese. Fourth, children from three to six years of age understand sentences featuring object topicalization as well as those featuring subject topicalization; on both structures children perform at ceiling at five years of age.

The noted difficulty of object relatives is captured by the Relativized Minimality approach. I propose that structural intervention of the subject within the chain connecting the relative head and its copy is the source of the difficulty. With respect to topicalization, the results are interpreted by assuming that topicalization in Chinese does not involve A'-movement, but an anaphoric relation between the empty category *pro* and the base-generated topic.

Abstract (Catalan)

Aquesta tesi tracta l'adquisició de la relativització i la topicalització en xinès.

Mitjançant un sèrie d'experiments, obtinc els resultats següents. En primer lloc, les frases de relatiu d'objecte són més mal compreses i produïdes que les de subjecte en els nens de tres a set anys d'edat. En segon lloc, les relatives de subjecte també presenten unes certes dificultats de comprensió i donen lloc a diversos errors en els nens fins als sis anys. En tercer lloc, l'experiment d'elicitació va donar com a resultat molts SNs resumptius en tots els grups d'edat (inclosos els adults); per a molts parlants natius del xinès, les frases de relatiu amb SNs resumptius són acceptables en xinès parlat. En quart lloc, els nens de tres a sis anys entenen les frases amb topicalització d'objecte tan bé com entenen les frases amb topicalització de subjecte; en els dues estructures els nens assoleixen nivells adults als cinc anys.

La dificultat assenyalada amb les frases de relatiu d'objecte pot explicar-se mitjançant una anàlisi en termes de Minimitat Relativitzada. Proposo que la intervenció estructural del subjecte entre el nucli del relatiu i la seva còpia són la font de la dificultat. Pel que fa a la topicalització, els resultats indiquen que la topicalització en xinès no involucra el moviment A', sinó una relació anafòrica entre la categoria buida *pro* i un tòpic generat a la base.

Abstract (Italian)

In questa tesi, viene trattata l'acquisizione delle frasi relative e delle frasi con topicalizzazione nel Cinese.

Dai vari esperimenti condotti, è emerso (i) che le frasi relative sul soggetto sono più facili da comprendere e produrre delle frasi relative oggetto per bambini che hanno dai 3 ai 7 anni; (ii) le relative soggetto in cinese presentano alcune difficoltà per i bambini fino a 6 anni; (iii) si osserva un uso consistente di NP di ripresa in produzione in tutti i gruppi di partecipanti, inclusi gli adulti; inoltre, per molti adulti le frasi relative con NP di ripresa sono accettabili nella lingua orale; (iv) i bambini comprendono a partire dai 3 anni tanto le frasi in cui l'oggetto è topicalizzato quanto quelle in cui il soggetto è topicalizzato; inoltre, a 5 anni la loro prestazione è a soffitto.

La difficoltà che i bambini hanno con le frasi relative è spiegata in termini di minimalità relativizzata. Propongo che l'intervento strutturale del soggetto tra la testa della relativa oggetto e la sua copia è ciò che causa le difficoltà di comprensione. I risultati sulla comprensione della frasi con topicalizzazione suggeriscono che la topicalizzazione in cinese mandarino non mette in gioco il movimento, ma una relazione anaforica tra il topic che è generato in posizione iniziale della frase e una categoria vuota, *pro*.

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Abbreviations

+Cl   the feature of classifiers

+Dem   the feature of demonstratives

+NP   the lexical restriction feature

+R   the feature of relative heads

+Q   the interrogative feature

A-   Argumental

A'-   A-bar or nonargumental

ACC   accusative case

AP   adjective, adjectival phrase

ASP   aspect

BEI   passive marker *bei*

C, CP   complementizer, complementizer phrase

CL, ClP   classifier, noun phrase with classifier

D, DP   determiner, determiner phrase

DE   relative marker *de* 的, pre-nominal modification marker *de* 的,

                    postverbal resultative marker *de* 得

DLT   Dependency Locality Theory

e   empty category element

GCR   Generalized Control Rule

IP   inflectional phrase

LE   perfective marker or sentence-final particle

N, NP   noun, noun phrase

neg	negation
NOM	nominative case
Num, NumP	numeral, number phrase
O	object
OO	object relative clause modifying the matrix object
OOp	object relative clause modifying the matrix object (with a post-verbal subject)
OS	subject relative clause modifying the matrix object
PAST	past tense
PP	prep/postpositional phrase
PL	plural
PRO/pro	empty pronominal element
PROG	progressive aspect
Q	question particle
RC(s)	relative clause(s)
RM	Relativized Minimality
S	subject
SG	singular
SO	object relative clause modifying the matrix subject
Spec	specifier
SS	subject relative clause modifying the matrix subject
t	trace of moved element
TOP	topic
V, VP	verb, verb phrase

CHAPTER 1 Introduction

Over the last decades, a significant amount of research has been carried out on the acquisition of A'-dependencies. However, why some A'-movement structures are mastered by children only at a late age is still a puzzle today. The overarching aim of the present study is to assess how structures involving A'-movement are acquired in Chinese. To achieve this, two structures are examined. One is Chinese relative clauses; another is topicalization.

1.1   The importance of Chinese relative clauses in acquisition

Studies from many languages with head-initial relative clauses (henceforth RCs) consistently report that subject RCs are easier than object RCs in child acquisition (e.g., English: Brown, 1971; Goodluck & Tavakolian, 1982; Sheldon, 1974, 1977; Zukowski, 2009; French: Labelle, 1990, 1996; Spanish: Pérez-Leroux, 1995; Italian: Adani, 2011; Contemori & Belletti, 2013; Guasti & Cardinaletti, 2003; Hebrew: Arnon, 2005, 2010; Portuguese: Costa, Lobo, & Silva, 2011; Catalan: Gavarró, Cunill, Muntané, & Reguant, 2012; German: Adani, Shem, & Zukowski, 2013) and in adult processing (e.g., English: Ford, 1983; Warren & Gibson, 2002; French: Cohen & Mehler, 1996). Such a subject/object asymmetry has been also reported in the acquisition of *wh*-questions, namely object *which*-questions are more difficult than other types of *wh*-questions (e.g., English: Avrutin, 2000; Hebrew: Friedmann, Belletti, & Rizzi, 2009; Italian: Guasti, Branchini, & Arosio, 2012).

To explain children's difficulties, one proposal is the Relativized Minimality (RM; Rizzi, 1990, 2004) approach, according to which object RCs and object *which*-questions

are difficult because they feature the intervention of the subject between the head and its trace, as seen in (1).

(1) a. Show me the child$_i$ that the grandma draws t$_i$.

b. Which child$_i$ did the grandma draw t$_i$?

In essence, the featural specification of the intervening subject is included in the featural specification of the A'-moved element (Friedmann, Belletti, & Rizzi, 2009; Belletti & Rizzi, 2013). To consider them distinct, one has to compute the subset-superset relation, but by hypothesis, limited computational resources sometimes prevent younger children to do it. Accordingly, a RM violation arises. Along this line of explanation, a number of studies focus on how well the RM approach accounts for acquisition data (e.g., Adani, van der Lely, Forgiarini, & Guasti, 2010; Belletti, Friedmann, Brunato, & Rizzi, 2012; Contemori & Belletti, 2013; Guasti, Stavrakaki, & Arosio, 2012), although the RM approach also stirs a hot debate on its validity (e.g., Goodluck, 2010).

Turning now to head-final RCs such as those of Chinese (exemplified in (2)), Japanese and Korean, studies are not uncommon both in the field of acquisition and processing, but one of the intriguing facts is that results in these languages are mixed. Take Mandarin Chinese, an SVO language with head-final RCs, as an example.

(2) a. [t$_i$ hua   waipo   de] xiaopengyou$_i$ (subject RC)

draw   grandma DE child

'the child that draws the grandma'

b. [waipo   hua t$_i$ de] xiaopengyou$_i$ (object RC)

grandma   draw   DE   child

'the child that the grandma draws'

Indeed, the results on Mandarin are conflicting in previous studies on child comprehension (e.g., Cao, Goodluck, & Shan, 2005; Chang, 1984; Lee, 1992), on child production (e.g., Chen & Shirai, 2014; Hsu, Hermon, & Zukowski, 2009; Su, 2004) as well as on adult processing (e.g., Gibson & Wu, 2013; Hsiao & Gibson, 2003; Lin & Bever, 2006; Packard, Ye, & Zhou, 2011; Vasishth, Chen, Li, & Guo, 2013). Partly this is due to some confounding factors or weaknesses in the experiments, differences in material design (see Lin & Bever, 2006; Gibson & Wu, 2013), selection of participants and statistical problems (see Vasishth et al., 2013), but, more importantly, the typological properties of Chinese RCs appear to have an impact on their acquisition and processing (see Chan, Matthews, & Yip, 2011; Kidd, 2011). The questions of interest are: at what point the acquisition/processing of Chinese RCs are subject to language-specific properties? And if the formal principle, RM, is indeed operative, how does it deal with linguistic variation in acquisition?

1.2   The goals and outline of the thesis

The foremost goal of this thesis is to establish whether the object RC disadvantage holds in Chinese acquisition based on comprehension and production.

Second, I would like to fuel the cross-linguistic discussion on the acquisition of RCs, taking into account the typological differences between languages with head-initial RCs and those with head-final RCs.

The third goal is to assess how well the RM approach can be used to understand Chinese acquisition data and to see whether it can diagnose the acquisition path of A'-movement.

To that effect, the fourth goal is to consider topicalization (exemplified in (3)). If it involves A'-movement, under the RM approach children should show comprehension difficulties in object topicalization sentences (with the OSV order) as compared to subject topicalization sentences (with the SVO order).

(3)   a. Zhe-ge haizi$_i$ (ya),   e$_i$ zai   hua waipo.   (subject topicalization)

        this-CL child (TOP)   PROG draw grandma

        'As for this child, (he) is drawing the grandma.'

        b. Zhe-ge haizi$_i$ (ya), waipo   zai   hua e$_i$.   (object topicalization)

        this-CL child (TOP) grandma PROG draw

        'As for this child, the grandma is drawing (him).'

This thesis consists of a series of experimental studies carried out with typically developing Chinese children. Chapter 2 provides a background discussion that sets the foundation for the current research, including an introduction of the RM approach and a syntactic analysis of Chinese RCs and topic structures. Chapters 3 deals with experiments on the comprehension of Chinese RCs and chapter 4 with the production of Chinese RCs. In chapter 5, I present the study on the acquisition of topicalization sentences with the OSV order and those with the SVO order. Chapter 6 summarizes the main findings and considers the limitations of the current study and its implications for future research.

CHAPTER 2 Relativized Minimality and A'-movement in Chinese

This chapter outlines the theoretical motivation behind my experimental research and provides a syntactic analysis of Chinese RCs and topic structures that forms a foundation for the current research. Section 2.1 presents the Relativized Minimality (RM) approach and deals with how RM accounts for A'-movement in child grammar. Essentially, the formulation of RM, which applies to child acquisition, is that of Friedmann, Belletti, & Rizzi (2009). Section 2.2 describes some characteristics of Chinese which will appear to be of special relevance throughout this thesis. Section 2.3 is concerned with the typology of Chinese RCs and section 2.4 with the syntax of Chinese RCs. Section 2.5 deals with the syntax of topic structures. I also provide a brief analysis of Chinese RCs and topicalization within the RM framework.

2.1   Relativized Minimality and child acquisition

RM is a locality constraint on dependencies within sentences which was proposed by Rizzi (1990). Consider the classical configuration of the RM principle in (4).

(4)   a. X … Z … Y

      b. Z intervenes between X and Y iff Z c-commands Y and Z does not c-command X

    (from Rizzi, 2004: 225)

A local structural relation cannot hold between X and Y when Z intervenes as a potential candidate for the same local relation. In its original formulation, the concept of RM was

devised to account for the impossibility of extracting some *wh*-elements from islands. See the well-documented examples below, taken from Rizzi (2004).

    (5)   a. I wonder who could solve the problem in this way.

            b. * How$_i$ do you wonder [who could solve this problem t$_i$] ?

One cannot construct a *wh*-question with a manner adjunct in a sentence like (5b). More specifically, the *wh*-element *how* in (5b) cannot be linked to its trace due to intervention of another *wh*-element *who,* which qualifies as a closer candidate for the same relation.

    Let us further consider the example in (6), taken from Rizzi (2004).

    (6)   ? Which problem do you wonder how to solve <which problem>?

The moved element in (6) is not a simple *wh*-element, but is a complex *wh*-phrase involving a *wh*-element and a lexical noun phrase. Contrary to (5b), (6) is marginal but not ill-formed. The contrast between (5b) and (6) can be captured in a RM approach if one interprets the RM principle in terms of features (Rizzi, 2004; Starke, 2001). The configurations are given in (7), taken from Friedmann, Belletti, & Rizzi (2009), where A and B stand for abstract morphosyntactic features triggering movement.

    (7)   X   Z   Y

            a. +A …… +A …… <+A>   (identity)

            b. +A, +B……+A …… <+A, +B>   (inclusion)

            c. +A …… +B …… <+A>   (disjunction)

Three different types of relation between the target and the intervener are illustrated: identity, inclusion and disjunction. First of all, when the intervener's specification and the target's specification are identical as in (7a), RM rules out the sentence (5b). Second, according to Starke (2001)'s approach, the example in (6) can be captured by the schema (7b); when the intervener's featural specification is included in the target's featural specification, the structure is ruled in by RM (although some degradation is observed). Finally, when the featural specification of the intervener and that of the target are disjoint as in (7c), the RM principle rules sentences in. For example, in (8), taken from Rizzi (2004), the subject pronoun *you* has a disjoint specification with respect to the target *how* and therefore, the antecedent-trace relation between *how* and its trace holds in the sentence.

(8)   How$_i$ did you solve the problem t$_i$?

The featural approach was used by Grillo (2005, 2008, 2009) to capture locality effects linked to intervention in RCs, topicalization, control structures, passives and *wh*-questions by agrammatic Broca's aphasics (see also Garraffa & Grillo, 2008). Friedmann, Belletti, & Rizzi (2009) further extended RM to account for children's difficulty in acquiring object RCs and object *which*-questions. See also Adani, van der Lely, Forgiarini, & Guasti (2010), Belletti & Contemori (2010), Belletti, Friedmann, Brunato, & Rizzi (2012), Belletti & Rizzi (2013) and Contemori & Belletti (2013) for further extension of the RM approach to child acquisition; see Guasti, Branchini, & Arosio (2012), Guasti, Branchini, Arosio, & Vernice (2012) and Guasti, Stavrakaki, & Arosio (2012) for an approach which deals with object RCs and object *wh*-question featuring postverbal NP subjects.

RM holds similarly in adult and child grammar. For the sake of clarity, I would like to point out that Friedmann, Belletti, & Rizzi (2009) and their subsequent works (e.g., Belletti & Rizzi, 2013) did not express this point univocally. On the one hand, they say "we are led to conclude that children adhere to a somewhat strict version of RM, requiring not just a distinct featural specification of the target with respect to the intervener but imposing the stronger requirement of a disjoint specification" (Friedmann, Belltti, & Rizzi, 2009: 84). Here they seem to suggest that there are two versions of RM, one for adults and another (stricter) one for children. On the other hand, they say "under this approach, the same formal principle, RM, applies in a slightly stricter form in children than in adults" (Belletti & Rizzi, 2013: 120). Here they seem to suggest that there is only one RM, but it applies to adults and children in different ways. In this thesis I stick to the latter interpretation.

Given that RM holds similarly in adult and child grammar, so identity of feature specification as in (7a) leads to ungrammaticality and disjunction of feature specification as in (7c) results in grammaticality, but indeed some differences between the adult and the child system arise concerning the validity of (7b). According to Friedmann, Belletti, & Rizzi (2009), the adult system permits an A'-moved element to cross over an intervener as long as the intervener has a distinct feature specification, so both the configurations (7b) and (7c) leads to a grammatical output in adult system. In contrast, the child system allows movement only when the specification of the intervener is disjoint from that of the A'-moved element as in (7c), but does not admit (7b) because of the difficulty of computing subset-superset relation of features. The authors related it to a limitation in the operative syntactic memory:

(9)   "disjointness is easier to determine, as it can be calculated feature by feature, whereas calculating a subset-superset relation requires holding in operative memory and comparing the whole featural specifications associated to different positions, an operation which may exceed the capacity of the early systems…"

(from Friedmann, Belletti, & Rizzi, 2009: 84)

In sum, to consider the target and the intervener distinct as in (7b), one has to compute the subset relation, but children's supposed limited computational resources sometimes prevent them to do it. When they fail in computing them, a RM violation arises. Consequently, object extraction structures are not well understood.

These authors presented clear evidence from a series of acquisition experiments with Hebrew-speaking children (N = 22, aged 3;7-5;0, M = 4;6, SD = 0.5) that object RCs and object *which*-questions are challenging for children. First, object RCs, either when the RC contains a gap (10b) or when it contains a resumptive pronoun as in (10c), are harder than subject RCs as in (10a). Specifically, accuracy rates of object RCs with gaps and those with resumptive pronouns were 55% and 56% respectively, while those of subject RCs were 90%.

(10) a. Tare li   et   ha-para she-menasheket et ha-tarnegolet. (subject RC)
          show to-me ACC the-cow   that-kisses   ACC the-chicken
          'Show me the cow that is kissing the chicken.'
      b. Tare li   et   ha-pil   she-ha-arie martiv.   (object RC)
          show to-me ACC the-elephant that-the-lion wets
          'Show me the elephant that the lion is wetting.'

c. Tare   li   et   ha-kof   she-ha-yeled mexabek oto.   (object RC)

show to-me ACC the-monkey that-the-boy hugs   him

'Show me the monkey that the boy is hugging.'

Furthermore, they showed that the difficulty in comprehending object RCs was modulated by the nature of the relative head and of the embedded subject. In (10b-c), both the relative head and the subject in the RC are nominal phrases introduced by a determiner and the latter intervenes between the relative head and the gap, but in (10a) there is no such intervener. To account for this range of the facts, they assumed that, under the raising analysis of RCs (see Vergnaud 1974, Kayne 1994 and Bianchi 1999) and following Starke (2001)'s approach, the relative head is attracted by a complex attractor [+R, +NP], where "R" and "NP" express the relative feature and the lexical restriction feature respectively. The configurations are illustrated below, (11a) for subject RCs and (11b) for objects RC.

(11) a. D NP …… <D NP> …… D NP

   [+R, +NP]   [+NP]

   b. D NP …… D NP …… <D NP>

   [+R, +NP]   [+NP]

In the subject RC case (11a), the lexically restricted relative head does not cross over another lexically restricted element, whereas, in the object RC case (11b), the lexically restricted relative head has to cross over another lexically restricted element, i.e., the subject of the embedded clause. Thus, in object RCs, the relative head bears [+R, +NP] features and the subject of the embedded clause bears a [+NP] feature, i.e., the latter has a

subset of the features of the former. Since, according to the authors, children struggle in computing subset relations, they have greater trouble in understanding and producing object RCs than subject RCs. In fact, to understand an object RC, one has to compute a subset relation to establish that the relative head and the intervening subject are distinct. Failure to compute the subset relation leads children to incur in a RM violation, whereby the embedded subject and the relative head are similar because they show the NP feature (Belletti & Rizzi, 2013).

The same explanation carries over to object *which*-questions (12d), which were found to be more difficult than *who*-questions (12a-b) and subject *which*-questions (12c). Specifically, the accuracy rate of object *which*-questions was 58%, while that of subject *who*-questions, object *who*-questions and subject *which*-questions were 81%, 78% and 75% respectively.

(12) a. Mi   noshex et   ha-xatul?   (subject *who*-question)

      who bites   ACC the-cat

      'Who bites the cat?'

b. Et   mi   ha-xatul noshex?   (object *who*-question)

      ACC who the-cat   bites

      'Whom does the cat bite?'

c. Eize   kelev noshex et   ha-xatul?   (subject *which*-question)

      which dog   bites   ACC the-cat

      'Which dog bites the cat?'

d. Et   eize kelev ha-xatul noshex?   (object *which*-question)

      ACC which dog   the-cat   bites

      'Which dog does the cat bite?'

The configuration of object *who*-questions is in (13a) and of object *which*-questions in (13b).

(13)   a. Wh Q …… D NP …… < Wh >

      [+Q]   [+NP]

    b. Wh NP Q …… D NP …… <Wh NP>

      [+Q, +NP]   [+NP]

Following Starke (2001)'s approach, Friedmann et al. assumed that the bare *wh*-phrase is attracted by a pure attractor [+Q] and the complex phrase headed by *which* is attracted by a complex attractor [+Q, +NP], where "Q" stands for the interrogative feature. In (13a), the *wh*-element and the intervening subject do not share any feature and thus are considered as disjunction by children (as well as by adults). The configuration (7c) is satisfied and object *who*-questions were not problematic for children. Instead, in object *which*-questions as schematized in (13b), the subject intervener has a lexical NP restriction which is a subset of the features of *which*-phrase. This is exactly what we have seen in the object RCs. As in the case of object RCs, to properly understand object *which*-questions, a subset relation has to be computed to establish that the target and the intervener are distinct.

To summarize, according to these authors, children's difficulty in the processing of object RCs and object *which*-questions can be attributed to the same syntactic locality principle. More specifically, as shown in (14a-b), repeating (11b) and (13b) for convenience, the intervening subject shares part of the featural specification of the A'-moved element and children have difficulty computing the subset feature specification, so

the movement of the angle bracketed element fails. In the remainder of this thesis, I refer to this proposal as the RM approach.

(14) a. [+R, +NP] …… [+NP] …… < +R, +NP>

b. [+Q, +NP] …… [+NP] …… <+Q, +NP>

2.2   Some typological features of Chinese

Mandarin Chinese has SVO as its canonical word order, as illustrated in (15a). An object can be preposed either to a preverbal position as SOV in (15b) or to a sentence-initial position as OSV in (15c).

(15) a. Wo hen xihuan yinyue.   (SVO)

I   very like   music

'I like music.'

b. Wo yinyue hen xihuan.   (SOV)

I   music very like

'I, music, like.'

c. Yinyue, wo hen xihuan.   (OSV)

music   I   very like

'Music, I like.'

(from Huang, Li, & Li, 2009: 199)

As has been extensively stated in the literature (Li & Thompson, 1981; Huang 1982; Qu, 1994; Huang, Li, & Li, 2009; among others), the SVO order contrasts with the other two orders in several ways. For instance, a negative polarity item cannot be licensed

by the sentential negation *mei* when it occupies the object position in the SOV sentence (16b) and the OSV sentence (16c), but is licit in the SVO sentence (16a).

(16) a. Ta mei xie shenme/renhe shu.   (S neg VO)

        he not write what/any   book

    b. *Ta shenme/renhe shu   mei xie.   (SO neg V)

        he what/any   book not write

    c. *Shenme/renhe shu,   ta mei xie.   (OS neg V)

        what/any   book he not write

    'He did not write any book.'

(from Huang, Li, & Li, 2009: 200)

Although the SOV and the OSV orders share the same features, the two are not identical. According to Shyu (1995), the SOV structure is derived by A-movement and the OSV structure by A'-movement. Generally, the former is called "focalization", requiring a contrastive or a focus interpretation[1], and the latter is a topic structure, in

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[1] Without context, as shown in (i), the SOV order is not possible, because the subject and the object can switch their theta roles. In this case, the sentence is always interpreted as the OSV order (cited from Huang, Li, & Li (2009: 201)).

(i) Wo xiaonühai hen xihuan.
    me little girl   very like
    '?? I like the little girl.'   (SOV)
    'As for me, the little girl likes (me).'   (OSV)

With the context, as shown in (ii), the animate object *xiaonühai* 'little girl' is contrasted to *xiaonanhai* 'little boy', so the SOV order becomes possible.

which *yinyue* 'music' is the topic as in (15c). Topic structures have been widely discussed in the linguistic literature (Chao, 1968; Huang, 1982; Huang, Li & Li, 2009; Li, 2000; Li & Thompson, 1976, 1981; Shi, 2000; Xu, 2000; Xu & Langendoen, 1985). I dwell on this structure in section 2.5 and chapter 5.

In Mandarin Chinese, both subjects and objects can be phonologically null under appropriate discourse conditions (Huang, 1984, 1989). For example, as shown in (17), all the responses by Speaker B are correct. The subject is dropped in (17a), the object is dropped in (17b) and both the subject and the object are dropped in (17c).

(17) Speaker A: Zhang San zai   xie   shu ma?
          Zhang San PROG write book Q
          'Is Zhang San writing a book?'

   Speaker B: a. *e* zai   xie   shu.
              PROG write book
              '(He) is writing a book.'

          b. Ta zai   xie   *e*.
             he PROG write
             'He is writing (a book).'

          c. *e* zai   xie   *e*.
              PROG write
             '(He) is writing (a book).'

(ii) Speak A: Ni   hen xihuan zhe-ge   xiaonühai ma?
          you very like   this-CL little girl   Q
          'Do you like this little girl?'

   Speak B: Wo zhe-ge   xiaonühai$_i$ bu xihuan e$_i$, zhe-ge xiaonanhai$_j$ hen xihuan e$_j$.
          I   this-CL little girl   not like   this-CL   little boy very like
          'I don't like this little girl, (but) like this little boy very much.'

Although Mandarin allows null subjects, it is different from Italian. Italian has rich verb inflection as in (18) and this licenses null subjects. In contrast, Chinese is mono-morphemic. Words lack morphological complexity: there are no verb conjugations, no case-marking and no gender on nouns.

(18) a. io   scrivo

       b. tu   scrivi

       c. lui/lei scrive

       d. noi   scriviamo

       e. voi   scrivete

       f. loro   scrivono

2.3   The typology of Chinese relative clauses

Mandarin Chinese is an SVO language with head-final RCs. As exemplified in (19a) for subject RCs and in (19b) for object RCs, the RC linearly precedes the relative marker *de* and the relative head.

(19) a. [_$_i$ hua   waipo   de] xiaopengyou$_i$

          draw grandma DE child

      'the child that draws the grandma'

      b. [waipo   hua _$_i$ de] xiaopengyou$_i$

       grandma draw   DE child

      'the child that the grandma draws'

Such a type is extremely rare, according to Dryer (2013)'s observations. Dryer analyzed 879 languages and found that, among OV languages, head-initial and head-final RCs are roughly equally common; however, almost all VO languages have head-initial RCs and only five VO languages have head-final RCs. In Dryer's data, these are Mandarin Chinese, Cantonese, Hakka, Bai and Amis.[2]

Moreover, the modifier *de* 的 not only serves as a relative marker, but is also homophonous to other grammatical functions. An adjective phrase (AP) in (20a), a possessive phrase in (20b) and a prepositional phrase (PP) in (20c) illustrate this point (examples from Cheng & Sybesma, 2009: 124-125).

(20) a. feichang   da de yu   (AP)

   extraodinarily big DE fish

   'very big fish'

---

[2] To my knowledge, Wu, another language spoken in China, also belongs to this type. In this case, only six languages are recorded to have VO order and head-final RCs. I illustrate the Wu VO order in (i), subject RCs in (ii) and object RCs in (iii).

(i) ŋ 21 bo21 ɦo21 n 2 ŋ44   (VO order)
   grandma   draw child
   'The grandma draws the child.'
(ii) ɦo21 ŋ 2 bo21 kəʔ0 n 2 ŋ33   (subject RC)
   draw grandma   DE   child
   'the child that draws the grandma'
(iii) ŋ 3 3 bo21 ɦo342 kəʔ0 n 33 ŋ44   (object RC)
    grandma   draw DE child
   'the child that the grandma draws'

The above variety is spoken in Wencheng, Zhejiang. The transcripts are transliterated from the actual flow of speech of one native speaker (YCZ, aged 29). I thank SHI Jun for kindly transcribing the data.

b. Zhang San   de yifu   (possessor)

   Zhang San   DE clothes

   'Zhang San's clothes'

c. dui   erzi de taidu   (PP)

   regarding son DE attitude

   'the attitude towards his son'

In the literature, *de* has been referred to as "marker of explicit modification" (Chao 1968: 28) and as "associative" marker for associate phrase as (20a-c) (Li & Thompson 1981: 113). It has been analyzed in different ways: as a complementizer in RCs (Cheng 1986) and as D^0 (Simpson 2002, along the lines of Kayne, 1994). I will discuss the role of *de* in Chinese RCs in the next section.

The features of Chinese RCs sketched above raise a number of questions of interest to syntacticians and psycholinguists. For example, how does the hierarchical structure represent the linear order of Chinese RC? Does the relatively late occurrence of the relative marker make Chinese RCs more difficult to process and to acquire, in contrast to head-initial RCs such as English ones? In the next section, I am concerned with the syntax of Chinese RCs and provide a preliminary analysis of them under the RM framework.

2.4   The syntax of Chinese relative clauses

The RC is a complex modifier involving extraction from an internal position of the clause, i.e., the extraction site, and is associated to the constituent it modifies, i.e., the relative head. I assume a raising analysis of RCs (e.g., Bianchi, 1999; Donati & Cecchetto,

2011; Kayne, 1994; Vergnaud, 1974). The structures are sketched in (21a) for English and (21b) for Chinese.

(21) a. the child$_i$ that the grandma draws t$_i$
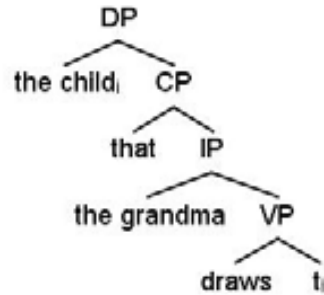
b. waipo   hua   t$_i$ de xiaopengyou$_i$

    grandma draw   DE child

    'the child that the grandma draws'
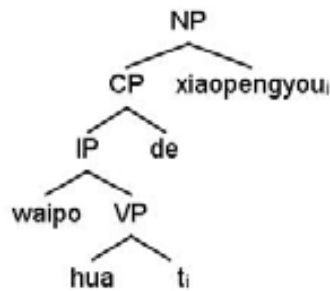
In (21a), the RC appears postnominally; in (21b), the RC appears prenominally[3]. However, in both cases, the relative head is moved from the object position of the embedded clause, leaving a gap in its original position. There is a referential relationship between the relative head and the gap within the clause; the former c-commands the latter.

Kayne (1994) proposed the Linear Correspondence Axiom (LCA) which establishes a rigid relation between hierarchical structure and linear order.

---

[3] In a moment, I will argue why the maximal node is a NP, not a DP, in Chinese.

(22)   Linear Correspondence Axiom (LCA)

d(A) is a linear ordering of T

(from Kayne, 1994: 5-6)

Here, A is the maximal set of ordered pairs $<X_j, Y_j>$ in which X_j and Y_j are nonterminals, and for each j, X_j asymmetrically c-commands Y_j. d(A) is the set of terminals that X_j and Y_j dominate, and T is the set of terminals.

Following LCA, right adjunction cannot be allowed and thus LCA forces the reanalysis of a number of constructions such as RCs. Regardless of whether the RC linearly follows its head (as in English) or precedes its head (as in Chinese), the complementation structure takes the relative clause (CP) to be the complement of the determiner (D), expressed as $[_{DP} D^0 CP]$.

(23) $[_{DP}$ the $[_{NP} [[_{NP}$ picture] $[_{CP}$ that [Bill saw [e]]]]]]

(adapted from Kayne, 1994: 87)

Within Kayne's framework and resorting to cross-linguistic and historical data, Simpson (2002) claimed that *de* in Chinese is actually an enclitic determiner and thus occupies the D head position. Chinese RCs have to be derived in two steps: the relative head is first raised to [Spec, CP] and then the remnant IP is moved to [Spec, DP]. More specifically, in the first step as shown in (24a), the relative head *xiaopengyou* 'child' is extracted from IP and moves to the [Spec, CP] position; in the second step as shown in (24b), the remnant IP *waipo hua* 'the grandma draws' is moved to the [Spec, DP] position.

Under this analysis, after the remnant movement takes place, the relative head does not c-command the gap within the RC anymore.

(24) a.
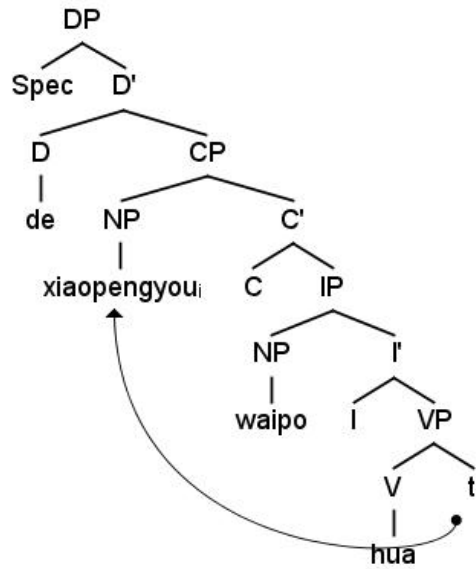
b.
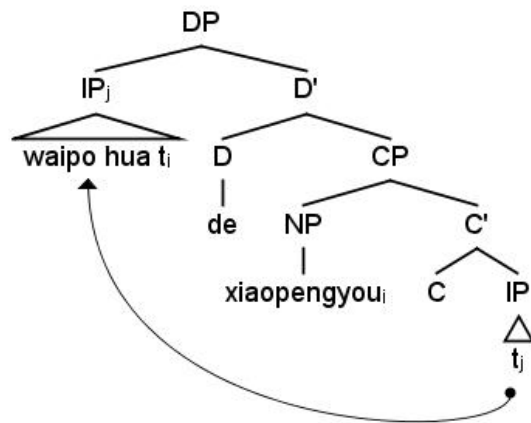
However, Aoun & Li (2003) argued against this analysis. Below, I review their arguments, beginning with the facts that support the necessity of a DP projection (in English), and later giving the Chinese facts which support the opposite.

Aoun & Li proposed that the complementation structure has the following properties *à la* Kayne (1994).

(25) a. Because the relative CP is the complement of D, the presence of a relative

   CP entails the presence of D.

   b. A selection relation exists between D and CP.

   c. D does not form a constituent with the Head NP, which is in the Spec of

   CP.

   (from Aoun & Li, 2003: 101)

Important empirical evidence to support these properties comes from coordination structures. In general, English allows *and* to conjoin DPs and conjoin NPs as shown in (26) (examples from Aoun & Li, 2003: 101).

(26) a. He saw [DP an actor] and [DP a producer].

   b. He is [DP an [NP actor] and [NP producer]].

   c. He is [DP a [NP great actor] and [NP brilliant producer]].

According to the complementation structure analysis, the relative head occupies the [Spec, CP] position and the CP is a complement to D. Thus, when RCs occur in coordinate relative constructions, a determiner must occur in each conjunct, as shown in (27a). If the determiner does not occur in the second conjunct, namely before *producer*, the sentence is ill-formed (cf. 27b). Moreover, when both conjuncts have the determiner, the RC modifies only the latter (27c), but when only one conjunct has a determiner, the

RC must modify both conjuncts (27d). See Donati & Cecchetto (2011) for related evidence.

(27) a. He is [[an actor that wants to do everything] and [a producer that wants to please everyone]].

b. *He is an [[actor that wants to do everything] and [producer that wants to please everyone]].

c. He is [[an actor] and [[a producer] that does not know how to produce]].

d. He is [an [[actor] and [producer]] that wants to please everyone].

(from Aoun & Li, 2003: 101)

However, this is not the case in Chinese. Unlike English, Chinese has several ways to express *and*, as summarized in (28) (from Aoun & Li, 2003: 143).

(28) a. *Jian* connects two properties of a single individual or two activities performed by one individual. In terms of categories, *jian* can connect NPs or VPs.

b. *He/gen* connects two individual-denoting expressions (i.e., two DPs), which can be proper names, pronouns, expressions containing demonstratives, or expressions containing number of classifier expressions.

c. *Erqie* connects two nonnominal categories, including clauses, adjective phrases, and VPs not expressing dual properties activities of one individual.

d. These connectives are not interchangeable.

If [$_{DP}$ D^0 CP] was an appropriate structure for Chinese RC, we would predict all sentences in (29a-c) to be acceptable. In (29a), the NP connective *jian* "and" is used to connect two complex nominals modified by RCs: *fuze yingwen de mishu* 'a secretary that takes care of English (matters)' and *jiao xiaohai de jiajiao* 'a tutor that teaches kids'. These two complex NPs are used to describe one person who is a secretary and tutor. In (29b), the DP connective *he/gen* is used to connect the two complex NPs and in (29c), the CP connective *erqie* is used.

(29) a. Wo xiang zhao [yi-ge [fuze   yingwen de   mishu]   jian [jiao xiaohai de

      I   want find one-CL charge English DE secretary and teach kid   DE

      jiajiao]].

      tutor

      'I want to find a secretary that takes care of English (matters) and tutor

      that teaches kids.' (I want to find one person.)

    b.*Wo xiang zhao [yi-ge [fuze yingwen de   mishu] he/gen [jiao xiaohai de

      I   want find one-CL charge English DE secretary and   teach kid   DE

      jiajiao]].

      tutor

      '*I want to find a secretary that takes care of English (matters) and tutor

      that teaches kids.'

c.*Wo xiang zhao [yi-ge [fuze   yingwen de   mishu] erqie [jiao xiaohai de

I want find one-CL charge English DE secretary and teach kid   DE

jiajiao]].

tutor

'*I want to find a secretary that takes care of English (matters) and tutor

that teaches kids.'

(from Aoun & Li, 2003: 144).

Given that only (29a) with the NP connective *jian* 'and' is grammatical, the prediction of

the [$_{DP}$ D^0 CP] assumption is not borne out. (29b) can be rescued, if we add a number and

a classifier such as *yi-ge* 'one' in the second conjunct in (30). The sentence turns to

include two individual-denoting expressions, rather than one individual-denoting

expression as in (29a). Given that *he/gen* is a DP connective, the acceptability of (30) is

expected.

(30) Wo xiang zhao [yi-ge fuze   yingwen de   mishu]   he/gen [yi-ge   jiao

I   want find one-CL charge English DE secretary and   one-CL teach

xiaohai de jiajiao].

kid   DE tutor

'I want to find a secretary that takes care of English (matters) and a tutor that

teaches kids.' (I want to find two persons.)

(from Aoun & Li, 2003: 145)

In brief, the contrast between the English example (27b) and the Chinese example

(29a) clearly indicates that a complex nominal in English is always a DP and the category

inside D is a CP, but a complex nominal in Chinese with the NP connective *jian* 'and' is an NP.

Summing up, the evidence above indicates that the projection of a RC and the relative head can itself be an NP, rejecting Kayne's [$_{DP}$ D^0 CP] analysis for Chinese RCs. In Chinese, relative construction is expressed as [$_{NP}$ CP NP] (Aoun & Li, 2003). The relative head occupies [Spec, CP], *de* occupies C^0, and the gap precedes the antecedent. The hierarchical structures of Chinese RCs are given in (31a) for subject RCs and (31b) for object RCs. In the remainder of the thesis, I will stick to this analysis.

(31) a. [t$_i$ hua   waipo   de] xiaopengyou$_i$ (subject RC)

        draw   grandma DE child

      'the child that draws the grandma'

```
                        NP
                    ┌────────┴────────┐
                   CP                 NP
                ┌───┴───┐          xiaopengyou_i
               IP       C
            ┌───┴──┐    │
           t_i     I'   de
               ┌───┴───┐
               I       VP
                    ┌───┴───┐
                    V       NP
                    │
                   hua    waipo
```

      b. [waipo   hua t$_i$ de] xiaopengyou$_i$ (object RC)

        grandma   draw   DE child

      'the child that the grandma draws'

NP
CP   NP
IP   C   xiaopengyou
NP   I'   de
waipo I VP
V   t_i
hua
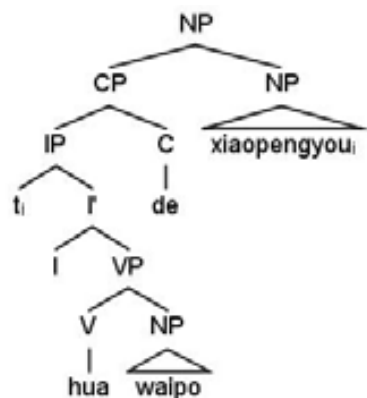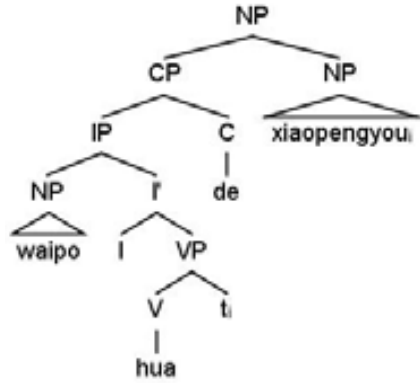
For subject RCs, as illustrated in (31a), the relative head (*xiaopengyou* 'child') c-commands the object of the RC (*waipo* 'grandma') and the gap. The object is structurally deeper than the gap and does not c-command it. Structural intervention is determined on the basis of c-command so that the relative head c-commands the gap with no intervention by the object. Namely, there is no structural intervention between the relative head and the gap.

In contrast, for object RCs, as illustrated in (31b), the relative head (*xiaopengyou* 'child') c-commands the subject of the RC (*waipo* 'grandma') and the gap. The subject c-commands the gap and intervenes in the relation between the relative head and the gap. Under the raising analysis, the relative head bears [+R, +NP] features and the subject bears a [+NP] feature. The latter has a subset of the features of the former. According to the RM approach, children have problems in computing the subset relation and, thus, object RCs should be more difficult to comprehend/produce than subject RCs in Chinese, consistent with the results of Hebrew (Friedmann et al., 2009) and other languages such as Italian (Adani, 2011).

2.5   The syntax of Chinese topic structures

In the previous sections, I have discussed the RC construction, an instantiation derived by A'-movement. In this section, I deal with topicalization which is also claimed

to be derived by A'-movement by some researchers (Huang, 1982; Huang, Li, & Li, 2009; Shyu, 1995). First, I introduce some general properties that both RCs and topic structures share with *wh*-constructions; second, I discuss two contrasting approaches for Chinese topic structures, one arguing for movement (Huang, 1982) and the other for base-generation (Xu & Langendoen, 1985; Xu, 2000).

It has been observed that topic structures are closely related to RCs, both being derived by A'-movement (e.g., Huang, Li & Li, 2009). For example, a gap exists in both structures and has an A'-antecedent, namely, the relative head in RCs or the topic element in topic structures. Such antecedent-gap relation can cross multiple clause boundaries. The English examples in (32a) for RCs and in (32b) for topic structures illustrate this point.

(32)   a. This is the girl [whom$_i$ I think [that John believes that [Bill likes t$_i$]]].

b. That girl$_i$, I think that John believes that Bill likes t$_i$.

(from Huang, Li, & Li, 2009: 198)

Another common property is that the dependency relation is sensitive to the Subjacency Condition (Chomsky, 1973, and his subsequent work). A violation of the Complex NP Constraint (Ross, 1967) in (33) and the impossibility of extraction from a subject island in (34) illustrate this point.

(33)   a. *the girl who$_i$ you bought [the books that criticize t$_i$]

b. *that girl$_i$, you bought [the books that criticize t$_i$]

(34)   a. *the girl whom$_i$ you said [[that John likes t$_i$] is important]

b. *that girl$_i$, you said [[that John likes t$_i$] is important]

(from Huang, Li, & Li, 2009: 198)

Let us turn to topic structures in Chinese. Chinese topic structures include three elements: a topic, a comment and a topic marker. A topic is typically a nominal, referring either to a specific entity (that the hearer already knows) or a class of entities, but other syntactic categories can also constitute a topic. Generally, a comment is a clause, but not obligatorily. A topic marker can be null as in (35a), or overt like *ya* in (35b). Not only *ya*, but also *a*, *me*, *ne* and *ba* can be used as topic markers (Li & Thompson, 1981).

(35) a. Zhe-ge   haizi,   waipo   zai   hua.
        this-CL child   grandma PROG   draw

     b. Zhe-ge   haizi ya,   waipo   zai   hua.
        this-CL child   TOP grandma PROG draw
        'As for this child, the grandma is drawing (him).'

The comparison between (35a) and (35b) shows that the topic marker does not need to be phonetically realized. Note that a comma can occur after the topic or the topic marker, but it does not always need to be interpreted as a pause when speaking (Xu, 2000). To my knowledge, whether an intonational break occurs after it largely depends on the individual.

Consider some other topic structures in (36).

(36) a. Zhe-ge haizi$_i$ (ya),   waipo   zai   hua   ta$_i$.
        this-CL child (TOP) grandma PROG draw him
        'As for this child, the grandma is drawing him.'

b. Changjinglu (ya),   bozi   chang.

   giraffe   (TOP) neck long

   'As for giraffes, their necks are long.'

c. Shuiguo (ya),   wo zui xihuan yingtao.

   fruit   (TOP) I most like   cherry

   'As for fruits, I like cherries best.'

d. Nei-chang huo (ya), xingkui   xiaofangdui lai de kuai.

   that-CL   fire (TOP) fortunately fire-brigade come DE quickly

   'As for that fire, fortunately the fire brigade came quickly.'

e. Yijiuliuba nian ba yue   ershi'er ri (ya), wo zhenghao ershiyi sui.

   1968   year 8 month 22   day (TOP) I exactly   21   age

   'As for August 22, 1968, I was exactly 21 years old.'

First, contrary to (35) in which the topic *zhe-ge haizi* 'this child' is related to an empty element in the comment clause, the topic in (36a) is coreferential with an overt pronoun *ta* 'him' in the comment clause. Second, double noun constructions (i.e., "double-subject sentences" in Li & Thompson, 1981) are also possible: two initial NPs *changjinglu* 'giraffe' and *bozi* 'neck' in (36b) are involved with a part-whole relation or the first NP *shuiguo* 'fruit' and the last NP *yingtao* 'cherry' in (36c) have an inclusive relation. Third, the comment as a whole is a predicate related to the topic as in (36d), without any indication of a gap in the comment. Fourth, the topic can also be an adverbial phrase like (36e). The sentence is assumed to derive from another sentence (37) in which the adverbial *yijiuliuba nian ba yue ershi'er ri* '(on) August 22, 1968' is located in the position after the subject *wo* 'I'. The adverbial fronting illustrated in (36e) is a special case of topicalization of (37) as argued by Xu & Langendoen (1985).

(37)　Wo yijiuliuba nian ba yue　ershi'er ri　zhenghao ershiyi sui.

　　　I　1968　year 8 month 22　　day exactly　21　age

　　　'I was exactly 21 years old on August 22, 1968.'

Two types of analyses of Chinese topic structures have been proposed in the literature (see Huang et al. (2009) for complete references). According to the first family of explanations, topic structures in Chinese do not involve movement; topics are generated in their surface position. A configuration of topic structures is given in (38), adapted from Xu (2000). Topic Phrase (TopP)[4] is the maximal projection of the Top head, as the topic occurs in the specifier position, followed by a functional category Top and the complement of Top, i.e., IP.

(38)
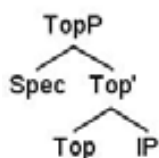
An important piece of evidence for the non-movement account comes from the "gapless" topic structures like (36b-d). There is no gap in all these sentences. An "aboutness" relation between the comment clause and the topic, rather than a gap-antecedent relation, exists. These "gapless" sentences have been noted by a number of linguists (e.g., Chao, 1968; Li & Thompson, 1976, 1981; Xu & Langendoen, 1985; Xu, 2000) and they further claim that all topic structures are based-generated and do not involve A'-movement, including topicalization sentences in (35).

_____

[4] Xu (2000) used TP as an abbreviation for Topic Phrase. I use TP for Tense Phrase (TP) and TopP as the abbreviation for Topic Phrase.

According to the second family of explanations, not all topic structures are derived in the same manner (Huang, 1982; Huang, Li, & Li, 2009). Some topics are base-generated according to an "aboutness" relation, such as the "gapless" sentences in (36b-d). Some topics are associated to gaps in the comment clause, and are derived by movement. Huang, Li, & Li (2009) refer to (35a), repeated in (39) for convenience, as a "gapped topic sentence", contrary to "gapless topic sentences" like (36b-d). Specifically, they argue, the object of the sentence *zhe-ge haizi* 'this child' has moved from the object position, leaving a gap there, and reaches the sentence-initial position.

(39) Zhe-ge haizi$_i$, waipo zai hua t_i.

this-CL child grandma PROG draw

'As for this child, the grandma is drawing (him).'

Thus, the authors assume that a gap exists in gapped topic structure and has an A'-antecedent. Such an antecedent-gap relation can cross multiple clause boundaries, as in (40b). The topic element *zhege haizi* 'this child' is deeply embedded and moves via intermediate CPs to reach the peripheral position.

(40) a. Zhe-ge haizi$_i$, Zhang San zhidao Li Si kanjian waipo zai hua t_i.

this-CL child Zhang San know Li Si see grandma PROG draw

'As for this child$_i$, Zhang San knows that Li Si saw that the grandma was drawing (him$_i$).'

b. Zhe-ge haizi$_i$, [$_{CP}$ Zhang San zhidao [$_{CP}$ Li Si kanjian [$_{IP}$ waipo zai hua t_i]]].

Indeed, the so-called gapped topic sentences are sensitive to some island conditions such as the Complex NP constraint. Consider (41) (example from Huang, Li, & Li, 2009: 210).

(41) *Li Si$_i$, wo hen xihuan [[[t$_i$ chang   ge] de] shengyin].

Li Si   I   very like   sing   song DE voice

'*As for Li Si$_i$, I like the voice with which t$_i$ sings.'

Specifically, in (41), the topic, *Li Si* 'Li Si', is extracted from inside a complex NP. Given that the topic element cannot be extracted from the complex NP island, the sentence is ill-formed. If a resumptive pronoun is inserted in the gap position, the sentence becomes acceptable as expressed in (42) below.

(42) Li Si$_i$, wo hen xihuan [[[ta$_i$ chang   ge] de] shengyin].

Li Si   I   very like   he sing   song DE voice

'As for Li Si$_i$, I like the voice with which he$_i$ sings.'

This is not surprising, if topic structures are derived by movement when a gap occurs and only then. However, what is intriguing is the grammatical sentence (43) in which the topicalization appears grammatical notwithstanding a violation of Complex NP constraint.

(43) Li Si$_i$, [[[t$_i$ chang   ge] de] shengyin] hen haoting.

Li Si   sing   song DE voice   very nice

'As for Li Si$_i$, the voice with which [t$_i$] sings is very nice.'

How to account for the ungrammaticality of (41) and the grammaticality of (43)? Huang (1982, 1989) proposed that it relates to the availability of an empty pronoun *pro* in Chinese.

Chinese has been argued to allow empty pronouns (both *pro* and PRO). The examples (from Huang, 1989: 192) are given in (44).

(44)   a. Zhangsan zhunbei [PRO gen   ni   qu].

Zhangsan prepare   with you go

'Zhangsan plans to go with you.'

b. Zhangsan qi   ma   qi   de [pro hen   lei].

Zhangsan ride horse ride till   very tired.

'Zhangsan rode a horse until (he) got very tired.'

Huang (1989) proposed that *pro* is limited to the subject position of finite clauses in Chinese. Consider (45) (examples from Huang, 1989: 187).

(45)   a. Zhang San shuo [e hen xihuan Li Si].

Zhang San say   very like   Li Si

Interpretation 1: 'Zhang San$_i$ said that (he$_i$) liked Li Si.'

Interpretation 2: 'Zhang San said that (Mary) liked Li Si.'

b. Zhang San shuo [Li Si hen xihuan e].

Zhang San say   Li Si very like

'Zhang San said that Li Si liked (Mary).'

In (45a), the null subject may refer to the matrix subject *Zhang San* or to a discourse topic such as *Mary*. In (45b), the null object only refers to the discourse topic. Huang claimed that the former is a null pronominal, since an overt pronoun such as *ta* 'him' in the same position functions in the same way; the latter is better analyzed as a variable, because it is free, as shown by the fact that it cannot be bound by any c-commanding antecedent.

(46) *Zhang San$_i$ shuo [Li Si hen xihuan e$_i$].

The comparison between (45a) and (45b) led Huang to conclude a subject/object asymmetry[5] with respect to empty categories in Chinese (for more examples, see Huang 1984, 1989). He further suggested that empty pronouns are governed by a Generalized Control Rule (GCR).

(47) Generalized Control Rule (GCR)

Coindex an empty pronominal with the closest nominal element.

(from Huang, 1984: 552)

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[5] Such a subject/object asymmetry has been opposed by a number of linguists (Xu, 1986; Xu & Langendoen, 1985). Consider (i) (example from Xu, 1986: 78).

(i) Xiaotou yiwei [meiren kanjian e].
   thief   think   nobody see
  Interpretation 1: 'The thief$_i$ thought nobody saw (him$_i$).'
  Interpretation 2: 'The thief thought nobody saw (Mary).'

The null object is naturally interpreted as the matrix subject *xiaotou* 'thief', but with a context it may refer to the discourse topic *Mary*. It seems that the empty pronoun is not limited to the subject position of finite clauses as Huang (1989) claimed, but may also be in the object position of finite clauses. For an alternative approach see Xu (1986).

Let us turn back (41) and (43). Consider (41). First, the empty category cannot be established as a trace by movement because that would lead to a violation of the Subjacency Condition. Second, it can be base-generated as a *pro*. However, according to GCR, the closest antecedent of the empty category is the subject of the comment clause, *wo* 'I', and therefore the empty category cannot be associated to the topic *Li Si* 'Li Si'. In either case, as a trace or as a *pro*, the sentence is ungrammatical.

In turn, consider (43). Using the Subjacency Condition as a diagnostic, a movement analysis is inappropriate for the sentence. Although the sentence violates the Complex NP constraint, the empty category is coreferential with the topic *Li Si* 'Li Si'. One way to explain this is saying that the empty category is a *pro*, i.e., an empty pronoun, which allows base-generation. According to the GCR, the empty pronominal is coindexed with the closest potential antecedent, which in (43) turns out to be *Li Si* 'Li Si'. Thus, the linking between the *pro* and the topic is created without violating any principle of grammar.

However, extraction of an object from a complex NP is also possible. In (48), there are two empty categories within the RC: one refers to the relative head, *ren* 'people', and the other refers to the topic, *Zhang San* 'Zhang San'.

(48) Zhang San$_i$, [[e$_j$ piping e$_i$ de] ren$_j$] henduo.

Zhang San   criticize DE people many

'As for Zhang San$_i$, people who criticize (him$_i$) are a lot.'

Huang (1984) suggested that topicalization of an object involves two steps, as shown in (49b) (from Huang, Li, & Li 2009: 211). The object empty category is moved to a topic

position within the RC, where it results in a *pro*. Then, according to GCR, the *pro* refers to the closest nominal element which is the topic *Zhang San*.

(49) a. Zhang San$_i$, [[pro$_i$ e$_j$ piping t$_i$ de]   ren$_j$] henduo.

b.

Topic$_i$, [$_{Clause}$ [$_{Subject}$ pro$_i$ . . .   t$_i$] . . .]
            └───── GCR ─────┘ └─ Move ─┘
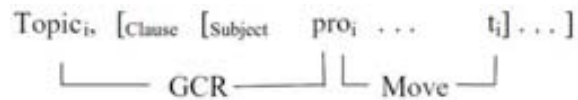
Intriguingly, for some Mandarin native speakers, the topic in (48) also can refer to the subject empty category, as shown in (50)[6].

(50) Zhang San$_i$, [[e$_i$ piping e$_j$ de] ren$_j$]   henduo.

Zhang San   criticize DE people many

'As for Zhang San$_i$, people who (he$_i$) criticizes are a lot.'

That is, for some speakers at least these sentences are ambiguous. The choice between the subject empty category and the object empty category for topic elements is at least partly determined by pragmatic factors. Thus, whether topicalization involves movement or not is still an open question at this stage.

Now I limit my attention to topicalization sentences like (39), repeated once again with a new numeration.

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[6] I questioned eight native speakers of Mandarin Chinese. Five participants thought topics only refer to the object empty category as shown in (48). The other three participants thought topics also can refer to the subject empty category, as shown in (50). I cannot explore the consequence of the existence of this variety in Chinese.

(51) Zhe-ge haizi$_i$, waipo   zai   hua t$_i$.

this-CL child   grandma PROG draw

'As for this child, the grandma is drawing (him).'

The sentence has an OSV order and I henceforth refer to this structure as object topicalization. As stated above, Huang claimed that the empty category in (51) is a variable and the sentence involves A'-movement. That is, the topicalized element is derived from the object position. A prediction of Huang's analysis can be tested by looking at child grammar. If we apply RM to the structure, (51) illustrates the configuration as (52) in which "D NP" designates a nominal expression[7]. Here, the topic phrase is triggered by a complex attracter endowed with [+TOP, +NP], where "TOP" stands for the topic feature and "NP" for the lexical restriction.

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[7] Bare nouns in Chinese can be the interpretative equivalents of the English definite or indefinite DPs. See the following examples (from Huang, Li, & Li, 2009: 283).

(i) Wo kandao gou.

   I   saw   dog

   'I saw a dog/dogs.'

(ii) Gou pao-zou-le.

    dog run-away-LE

   'The dog(s) ran away.'

In the literature, two lines of research have been proposed regarding Chinese bare nominals: they are taken to be embedded in a DP or in an NP structure (Chierchia, 1998; Huang, Li, & Li, 2009). In this thesis, I remain agnostic. For concreteness, I use "D NP" to indicate the internal constitution of the topic phrase. However, nothing crucial hinges on this. For advantages of adopting a DP structure in Chinese, see Huang, Li, & Li (2009).

(52) D NP   ......   D NP   ......   <D NP>

[+TOP, +NP]   [+NP]

This configuration should give rise to intervention effects in child grammar, according to the RM approach outlined in section 2.1. The object of the comment clause crosses over another lexically restricted position, the subject of the comment clause. To be more specific, the subject of the comment clause bears a [+NP] feature which is a subset of the features of the topic. According to Friedmann et al. (2009)'s analysis, children have trouble computing the subset relation; they would fail in detecting that the featural specification of the topic and that of the subject of the comment are distinct and thus would regard the configuration (52) as a violation of RM. Thus, a disadvantage of object topicalization sentence when compared to SVO sentences in acquisition is expected.

However, in principle, a non-movement analysis is also possible for topicalization sentences like (39). For convenience, the sentence is repeated once again in (53).

(53) Zhe-ge haizi$_i$, waipo   zai   hua e$_i$.

this-CL child   grandma PROG draw

'As for this child, the grandma is drawing.'

The empty category is a base-generated *pro*. This *pro* is coindexed with the nominal element like any overt pronoun. The closest element in (53) is the subject of the comment clause, *waipo* 'grandma'. However, the binding relation between two elements is not legitimate, because it violates Principle B of Binding Theory (Chomsky, 1981; among many others).

(54) Principle B

A pronoun must be free in its governing category.

The Generalized Control Rule in (47) was thought only for *pro* in subject position, but suppose that it can be interpreted as "coindex an empty pronominal with the closest nominal element *compatible with binding principles*" to subsume the *pro* in object position for object topicalization sentences. That is, if coindexing empty pronominals with the closest potential antecedent leads to a violation of a binding principle, *pro* is interpreted pragmatically by referring to an entity in a context which is salient. A topic is a salient category by definition, so *pro* refers back to *zhe-ge xiaopengyou* 'this child'. Accordingly, the relation between the topic and *pro* is an anaphoric, not a movement, relation. According to this analysis, movement is not the only possible source of object topicalization sentences. Notice that, in the non-movement analysis, no intervention effect is expected in child grammar, since RM only applies to movement chains.

Below, I summarize two contrasting analysis for topicalization:

(55) a. *The movement analysis*: topicalization involves A'-movement and the subject of the comment clause may bear a subset of the features of the topic.

b. *The non-movement analysis*: topicalization does not involve movement and the binding relation between the topic and the empty category is an anaphoric relation.

These two analyses lead to different predictions with regard to children's acquisition of topicalization. The issue is dealt with in chapter 5.

CHAPTER 3 The comprehension of Chinese relative clauses

Subject RCs elicit better performance than object RCs in children speaking a variety of languages. This subject/object asymmetry in comprehension was originally reported for English (Brown, 1971; Goodluck & Tavakolian, 1982; Sheldon, 1974, 1977) and has been replicated in many other languages with head-initial RCs: French (Labelle, 1990), Portuguese (Corrêa, 1995), Hebrew (Arnon, 2005, 2010; Friedmann & Novogrodsky, 2004), Italian (Adani, 2011; Arosio, Adani, & Guasti, 2009) and Catalan (Gavarró, Adani, Ramon, Rusiñol, & Sànchez, 2012). By contrast, previous studies on comprehension of head-final RCs such as Chinese RCs are mixed in results. Using an act-out task, Chang (1984) and Lee (1992) found a subject preference, whereas Chiu (1996) (cited in Su, 2006) observed better comprehension of object RCs in younger children. Given some methodological limitations of the act-out task and weaknesses in the experimental materials used in these studies, it is difficult to interpret their contrasting results.

This chapter examines the comprehension of RCs by administering a picture-sentence matching task (Experiment 1) and a character-sentence matching task (Experiment 2) to different age groups of Chinese children. I evaluate the validity of the predictions of the RM approach and the Dependency Locality Theory (DLT) which is hotly debated. The aims of the chapter are the following. First, I aim at disentangling whether the subject advantage holds for Chinese RC comprehension and in so doing I contrast the predictions of the RM approach and the DLT approach. Second, I wish to investigate if and to what extent this asymmetry emerges during development and how it is manifested in different age groups of children. Third, I attempt to compare the two

methods used in the literature and discuss the advantages and disadvantages of each. To overcome problems found in previous studies, particular attention is devoted to methodological issues, to experimental material and to the age range of participants.

The chapter is organized as follows. Section 3.1 discusses some methods used to study RC comprehension. Section 3.2 provides a review of previous studies on Chinese RCs and section 3.3 presents the predictions from the two approaches compared. Section 3.4 reports Experiment 1 and section 3.5 Experiment 2. A general discussion is offered in section 3.6 and the conclusion in section 3.7.

3.1   Methodological issues

Early studies on children's comprehension of RCs suggested that children at five years of age still have considerable difficulty comprehending RCs, whereas they begin to produce them at three years of age (Limber, 1973; Sheldon, 1974). These early comprehension studies mainly used act-out tasks where sentences like (56) were presented and children were asked to act the sentences out, using a set of toys which mapped onto the NPs in the sentences (e.g., a dog, a goat and a horse in (56)) (examples from Kidd, 2011:1).

(56)   a. Subject RC modifying the matrix subject (SS)

The dog_i that $\_i$ chased the goat jumped over the horse.

b. Object RC modifying the matrix subject (SO)

The dog_i that the goat chased $\_i$ jumped over the horse.

c. Subject RC modifying the matrix object (OS)

The horse jumped over the dog_i that $\_i$ chased the goat.

d. Object RC modifying the matrix object (OO)

The horse jumped over the dog_i that the goat chased $\_i$.

Further research has shown that this delay in comprehension is possibly due to methodological problems (Corrêa, 1995; Crain & Thornton, 1998; Goodluck & Tavakolian, 1982; Hamburger & Crain, 1982). For instance, only one object which was presented to children, e.g., one dog for acting out (56), violated the felicity conditions of the use of RCs, because RCs restricts the relative head over more than one object (Hamburger & Crain, 1982).

More recently, the picture-sentence matching task has been used in a number of experiments (Arosio, Adani, & Guasti, 2009; Belletti, Friedmann, Brunato, & Rizzi, 2012; Contemori & Belletti, 2013; Friedmann, Belletti, & Rizzi, 2009; Friedmann & Novogrodsky, 2004; Gutiérrez-Mangado, 2011; Suzuki, 2011). In these experiments, children were asked to choose one out of two pictures matching the sentence that they heard. Friedmann & Novogrodsky (2004) initially used this task to test comprehension of subject RCs modifying the main clause argument, as in (57a) and object RCs modifying the main clause argument, as in (57b), with a group of Hebrew-speaking children with SLI (N =10, aged 7;3-11;2, M = 9;0, SD = 1.2), a group of chronological age matched children (N =10, aged 5;11-6;5, M = 6;2) and a young group of normally developing children (N =10, aged 4;0-5;0, M = 4;7). A sample of experimental pictures is given in Figure 1.

(57) a. Zot ha-safta   she-menasheket et   ha-yalda.
         this the-grandmother that-kisses   ACC the-girl

         'This is the grandmother that is kissing the girl. '

      b. Zot ha-safta   she-ha-yalda   menasheket.
         this the-grandmother that-the-girl   kisses

         'This is the grandmother that the girl is kissing. '

Figure 1. A sample of experiment pictures (Friedmann & Novogrodsky, 2004).

A subject/object asymmetry was observed in every group (98.5% vs. 62%; 85.5% vs. 58%; 95% vs. 86%, respectively). Using a picture-sentence matching task has some limitations, as pointed out by Arnon (2005) and Adani (2011). The function of the RC is to single out a character whose relevant properties are described by the RC. However, the picture-sentence matching task requires children to choose a picture, rather than a character. Although children may choose the correct picture, it is unclear whether they do so because they recognize the correct referent of the RC in that picture or because they use some other strategies. For example, in order to choose the correct picture matching the sentence *this is the grandmother that the girl is kissing*, it is enough to rely on the embedded clause *the girl is kissing* and choose a picture that depicts a girl kissing.

Arnon (200) modified Friedmann & Novogrodsky's task by asking Hebrew-speaking children (N = 14, aged 4;5-5;2, M = 4;7) to choose a character. As in Friedmann & Novogrodsky (2004), she used two pictures, one displaying A kissing B and the other showing B kissing A, but instructed children to choose A or B in the relevant picture. In line with Friedmann & Novogrodsky (2004), children comprehended OS significantly better than OO (95% vs. 51%). In contrast to Friedmann & Novogrodsky in which only the reversal error (i.e., the wrong picture that children pointed to) could be observed, in

Arnon, a more fine-grained class of errors was detected. In comprehending object RCs (e.g., *the grandmother that the girl is kissing*), children not only made Reversal Error (i.e., they pointed to the character depicting *the grandmother that is kissing the girl* in the wrong picture) in 27% of the cases, but also made Embedded NP Error (i.e., they pointed to the character depicting *the girl that is kissing the grandmother* in the correct picture) in 22% of the cases. Crucially, the Embedded NP Error cannot be detected in the picture-sentence matching task. Since the correct picture is chosen, these responses fall among correct responses.

Results similar to Arnon were obtained by Adani (2011) with Italian-speaking children (N = 116, aged 3;4-7;9), using a different version of the character-sentence matching task. In this study, only one picture was used for each target sentence. All the pictures had the same structure as exemplified in Figure 2: character A on the left, a pair of characters B in the middle and another character A on the right. The examples which are associated to the picture are given in (58a) for OS and (58b) for OO.

(58) a. Indica   il cavallo che sta inseguendo i leoni.

          point to the horse that is chasing   the lions

          'Point to the horse that is chasing the lions.'

       b. Indica   il cavallo che i leoni   stanno inseguendo.

          point to the horse   that the lions   are chasing

          'Point to the horse that the lions are chasing.'

Figure 2. A sample of experiment pictures (Adani, 2011).

Consistent with the Hebrew studies, Italian-speaking children comprehended OS significantly better than OO (e.g., at age three, 91% vs. 53%), and importantly, Reversal Errors were the most common (e.g., at age three, 9% for OS and 34% for OO) and Middle Errors (including Embedded NP Errors; e.g., at age three, 13% for OO) were also found. These findings were corroborated in Catalan by Gavarró, Adani, Ramon, Rusiñol, & Sànchez (2012), using the same task as Adani (2011).

Although the main finding of both the picture-sentence matching and the character-sentence matching is the same, i.e., the subject/object asymmetry in head-initial RCs, the information gathered with the two tasks is slightly different and provides different clues on the course of development of RC comprehension. Therefore, in the current study, I used both tasks with the same experimental materials, but in two separate experiments. Beyond clarifying the validity and limits of the tasks, this move is important. As Chinese has head-final RCs, rather than head-initial RCs, and has topic drop, the choice of the task may matter. Foreshadowing slightly, I will claim that this is confirmed by the current study. The RC, which comes before the relative head in Chinese, can be misanalysed as a declarative sentence with the canonical SVO order (both in subject and object RCs). This is not possible in English, for example, where the head initial status of the RC immediately informs one that the sentence is not a declarative clause. In Experiment 1, I used a picture-sentence matching task, whereas in Experiment 2, I

employed a character-sentence matching task. By doing so, I am able to determine the consequences of using one task or the other.

3.2   A review of previous studies on Chinese relative clauses

Although several studies have been carried out on the acquisition of Chinese RCs, the results are confounded. Some studies observed a subject preference, whereas others observed the opposite pattern. Using an act-out task, Chang (1984) tested 48 school-aged children on the comprehension of subject-modifying RCs (SS and SO) and object-modifying RCs (OS and OO). Results showed that children in Grade 1, Grade 2 and Grade 6 (which corresponds roughly to six-, seven- and eleven-year-olds, respectively) comprehended SS and SO better than OS and OO, but no other preference was found (SS vs. SO; OS vs. OO). For children in Grade 4 (nine-year-olds), SS were comprehended better than all the other types, and no other significant difference was observed. Lee (1992) observed a subject preference with modulation depending on the age. He tested 61 children from four to eight years of age and observed that SS was the easiest of the four types and OO the most difficult for all ages. Correct responses in OO were below 20% from four to seven years of age and they increased to 45.8% at eight years of age. Interestingly, children at six and eight years of age comprehended OS better than SO, while the other age groups performed the reverse. Chiu (1996) (cited in Su, 2006) tested 65 children aged from 3;2 to 6;1 and found that the younger children comprehended OO better than OS (41% vs. 64%), but the older children comprehended OS better than OO (83% vs. 65%). The findings were again challenged by Cao, Goodluck, & Shan (2005). These authors tested 34 children aged from 4;1 to 6;1 and did not find the asymmetry between SS and SO, e.g., the younger group (N = 18, aged 4;1-5;2) comprehended SS correctly 83% of the time and SO 78% of the time.

These results are difficult to interpret due to the different ages of the groups tested and to some limitations in the materials and experimental designs. First, a sentence like (59), involving the passive morpheme *bei*, is a passive subject RC, but was regarded as an object RC in Chang (1984).

(59) Laoshu zhui [bei gou yao de] mao.

mouse chase BEI dog bite DE cat

'The mouse is chasing the cat that is bitten by the dog.'

Second, the experimental items were few in some studies, especially Chiu (1996) in which only one trial was tested for each sentence type. To my knowledge, in the literature there is not yet a general consensus about the minimum number of trials in a (comprehension) experiment. Note that with an adequate number of trials it would be possible to perform an individual analysis and thus to collect more information.

It is worth pointing out that OO were potentially the source of garden paths and this may obscure the results: in (60), taken from Lee (1992), the embedded subject, *houzi* 'monkey', can initially be mistaken as the object of the matrix clause, thus leading to reanalysis when the embedded verb *baozhe* 'hug +ASP' is encountered. Using a truth value judgment task, Su (2006) examined children's comprehension of OO (only OO, not OS in this study) and suggested that younger children (N = 15, aged 4;2-5;5, M = 4;9), compared with older children (N = 16, aged 5;6-6;9, M = 5;11), were likely to comprehend (60) as two simple sentences sharing an NP, namely, *xiaogou cai houzi* 'the puppy steps on the monkey' and *houzi bao baitu* 'the monkey hugs the rabbit'.

(60) Xiaogou cai   [houzi   bao zhe de] nei-ge   baitu.

puppy step-on monkey hug ASP DE that-CL rabbit

'The puppy steps on the rabbit that the monkey is hugging.'

However, this conclusion was compromised by the methodological limitations of the study. Each participant was tested in three trials and the correct answers of these trials were all positive. Since no control trial with a negative answer was included, it is difficult to evaluate children's positive answer (see Gordon, 1996, for advantages and pitfalls of this task).

The results from adult sentence processing studies are also controversial. Hsiao & Gibson (2003), Chen, Ning, Bi, & Dunlap (2008), Qiao, Shen, & Forster (2012) and Gibson & Wu (2013) found an object preference for Chinese RCs in subject-modifying position (i.e., SS vs. SO). This preference was also confirmed in an ERP study by Packard, Ye, & Zhou (2011). In contrast, Lin & Bever (2006, 2011) reported that subject RCs were processed faster than object RCs, as did Wu (2009) and Vasishth, Chen, Li, & Guo (2013). In a series of self-paced reading experiments, Vasishth et al. (2013)[8] presented adult participants with twenty sets of the single-embedded RCs in a null context as in Hsiao & Gibson, exemplified in (61). However, Vasishth et al. failed to replicate Hsiao & Gibson's results: in contrast to the original study, the new experiment showed a clear subject preference.

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[8] Vasishth et al. (2013) pointed out that the Hsiao & Gibson study and the Gibson & Wu study raised several questions, such as the places where the experiment was conducted (e.g., a wedding), the low accuracy rates in comprehension questions (e.g., Hsiao & Gibson, 2003, 75.7% in subject RCs and 70.5% in object RCs) and statistical problems.

(61) A null context condition (Hsiao & Gibson, 2003)

a. Subject RC

[_$_i$ yaoqing fuhao   de] guanyuan$_i$ xinhuaibugui…

    invite   tycoon DE official   have bad intentions

'The official who invited the tycoon has bad intentions…'

b. Object RC

[fuhao yaoqing _$_i$ de] guanyuan$_i$ xinhuaibugui…

tycoon invite   DE official   have bad intentions

'The official who the tycoon invited has bad intentions…'

Vasishth et al. further re-run the Gibson & Wu's experiment, which explored the processing of RCs in supportive contexts, exemplified in (62a). Interestingly, there was an object preference at the relative marker and at the relative head when Vasishth et al. combined their own data with Gibson & Wu's original experimental dataset and analyzed them.

(62) With context condition (Gibson & Wu, 2013)

a. Context

Zai kuaisudaolu yongsai de cheliu zhong, you yi-tai zhongxingjiche zhui-zhe yi-tai jiaoche. Lingwai yi-tai jiaoche kandao zhihou, jiu zhui-zhe na-tai   zhongxingjiche. Xiaoming shuo: wo tingshuo shi yi-ge gaozhongsheng kai-zhe qizhong yi-tai jiaoche, er lingwai yi-tai shi you yi-ge zhongnian funü kai-zhe. Na-ge gaozhongsheng shi kai-zhe na yi-tai che ne?

'On a highway, a motorcycle chased a car through heavy traffic. Another car saw (the situation), and then chased the motorcycle. Xiaoming said: I heard that a high school student was driving one of the cars and a middle-aged woman was driving the other. Which car was the high-school student driving?'

b. Target sentence (subject RC)

[_$_i$ Zhui zhongxingjiche de] che$_i$ shi gaozhongsheng   kai de che.

    chase motorcycle   DE car is high school student drive DE car

'The car which chased the motorcycle is the one that the high school student was driving.'

c. Target sentence (object RC)

[Zhongxingjiche zhui _$_i$ de] che$_i$ shi gaozhongsheng   kai de che.

 Motorcycle   chase DE car is   high school student drive DE car

'The car which the motorcycle chased is the one that the high school student was driving.'

On the other hand, most written corpus studies, regardless of the methods used, have found that subject RCs occur more frequently than object RCs (e.g., Hsiao, 2003; Wu, Kaiser, & Andersen, 2011). Wu et al. (2011) analyzed a corpus containing 824,983 Chinese characters (each Chinese character stands for a syllable) and found more subject RCs (86.6%, 676 out of 818 sentences) than object RCs (17.4%, 142 out of 818 sentences). The authors also calculated RCs with a transitive verb and found the same subject RC preference (60.8%, 211 out of 347 sentences; 39.2%, 136 out of 317 sentences). These results pointed toward a subject RC preference in spontaneous speech. Indeed, the subject preference was confirmed by a spoken (as well as written) study. Pu

(2007) conducted a narrative study in which native speakers (N = 30, aged 18-23) were asked to watch a four-minute silent color movie and then to recount the story in spoken and written language. The author calculated RCs and found more RCs in the oral database than in the written database (10 sentences vs. 53 sentences). Although RCs were not produced frequently, both databases showed a preference for subject RCs over object RCs: 80% (8 out of 10 sentences) vs. 20% (2 out of 10 sentences) in the oral database, 73.6% (39 out of 53 sentences) vs. 26.4 % (14 out of 53 sentences) in the written database. The author further examined the grammatical role of the relative head and found that the subject relative head tends to be animate and the object relative head tends to be inanimate. However, a recent study on spontaneous speech led to the opposite result. Chen & Shirai (2014) examined the occurrence of RCs with four monolingual Mandarin-speaking children (aged 0;11-3;5) and their caregivers. The results showed that subject RCs were produced less often than object RCs both in children and child-directed speech (children, 34 subject RCs vs. 78 object RCs; adults, 62 subject RCs vs. 191 object RCs). In this study, the authors did not differentiate headless RCs (63a) and headed RCs (63b), so the distribution of headed RCs in children's spontaneous speech is unspecified.

(63)   a. Zhe hui [shuijiao] de   hao   le. (MDY 2;0)

         this time   sleep   DE ready ASP

         '(The one) that slept is ready right now.'

      b. [Baba   mai] de ban. (MDY 1;10)

         daddy bought DE board

         '(It is) the board that daddy bought.'

In summary, data from children's and adults' comprehension display conflicting results in Chinese. As for child acquisition, I pointed out some methodological concerns as well as some problems with the experimental material used in previous studies which may be responsible for this situation.

3.3   Accounts on the comprehension of relative clauses

A number of hypotheses have been proposed to account for the difficulty in the acquisition of RCs by children and in their processing by adults. Some authors attribute this difficulty to the storage cost of grammatical dependencies (e.g., Gibson, 1998, 2000; Morrill, 2010), others to structural intervention (e.g., Belletti & Rizzi, 2013; Friedmann, Belletti, & Rizzi, 2009). Interestingly, these accounts make the same predictions for languages with head-initial RCs such as English, but make different predictions for Chinese which has head-final RCs. In this section, I compare the predictions of the two accounts.

The first account, namely the Dependency Locality Theory (DLT; Gibson, 1998, 2000), has been framed within the adult sentence processing literature, but it can be extended to acquisition data as well. According to this account, storage resources are required to keep track of syntactic dependencies, which are needed to complete the parse of a grammatical sentence. This theory predicts that object RCs (in languages like English or Italian) are more difficult than subject RCs due to a larger number of unresolved dependencies in the processing of object RCs at each given word. In particular, after processing *the dog that* in (64), to form a grammatical sentence one needs either two syntactic elements (if we hypothesize a subject RC), e.g., a subject trace and an intransitive verb as in *the dog that sleeps*, or three syntactic elements (if we hypothesize an object RC), e.g., a subject, a verb and an object trace as in *the dog that I love*. When

one encounters the verb *hits* in the subject RC (64a), one syntactic element is still needed: a noun as *the cat*. In contrast, after processing *the dog that the* in the object RC (64b), three syntactic elements are needed to form a grammatical sentence: a noun for the determiner *the*, a verb and an object trace. The noun *cat* satisfies the requirement of the determiner *the*, but two syntactic elements are still required: a verb and an object trace. When encountering the verb *hits*, the prediction is satisfied and the object trace can be connected to the relative head.

(64) a. English subject RCs

the dog$_i$ that __$_i$ hits the cat

b. English object RCs

the dog$_i$ that the cat hits __$_i$

DLT predicts that, in contrast to English, Chinese subject RCs are harder to process than object RCs. After processing the verb *da* 'hit' in (65a), three syntactic elements are needed: an NP object, the relative marker *de* and the relative head. Then, after the object *xiaomao* 'cat' is processed, two syntactic elements are still needed: the relative marker *de* and the relative head. Finally, at the relative marker *de*, only one element is missing: the relative head. In contrast, processing the object RCs in (65b) involves a less costly derivation. In particular, after processing the subject *xiaomao* 'cat', only a single element is expected, i.e., a verb for the clause, since this could be a declarative clause with the SV order. When the verb *da* 'hit' is processed, still only one syntactic element is expected: an NP object of the verb. When the relative marker *de* is

processed, the storage cost is the same as in subject RCs, namely, only the relative head is expected.[9]

(65)   a. Chinese subject RCs

[_$_i$ da xiaomao de] xiaogou$_i$

hit cat   DE dog

'the dog that hits the cat'

b. Chinese object RCs

[xiaomao da _$_i$ de] xiaogou$_i$

cat   hit DE dog

'the dog that the cat hits'

In summary, according to the DLT approach, subject RCs are easier than object RCs in English, because storage cost for the former is lower than that for the latter. The reverse holds in Chinese (see Hsiao & Gibson, 2003; Gavarró, Cunill, Muntané, & Reguant, 2012, for an implementation of this theory along the lines of Morrill 2010).

Now I turn to the RM approach which has been discussed in chapter 2. According to the RM account (Belletti & Rizzi, 2013; Friedmann, Belletti, & Rizzi, 2009), in the adult system the target can attract the goal if the potential intervener has distinct featural specification from the goal. Thus, an intervener does not block a locality relation between

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[9] In the DLT analysis, it is assumed that in Chinese there is no empty *wh*-pronoun (Hsiao & Gibson, 2003). This assumption is based on the observation that no integration cost is incurred at the relative marker or at the head of the RC, while an integration cost is observed in English (Warren & Gibson, 2002). Integration cost refers to the fact that a new referent needs to be combined with a verb, as the subject or the object of that verb, and a trace needs to be combined with the verb from which it depends.

a target and a goal if its featural specification is disjoint or has a subset of the features of the goal. RM applies in the same way in adult and child grammar. However, children have more limited computation resources and fail to compute subset relations. That is, they are unable to establish if the features of X and Z are in a superset-subset of relation and thus treat X and Z as similar. As such, a RM violation arises and children fail to understand object RCs. As the schematic representation of object RCs in (66) illustrates, the lexically restricted relative head crosses over another lexically restricted element, the subject. These elements have [+R, +NP] and [+NP] features, respectively. That is, the subject has a subset of the features of the relative head. Children have trouble computing the subset relation and thus, may fail to understand object RCs.

(66) D NP …… D NP …… <D NP>

   [+R, +NP]   [+NP]

In subject RCs like in the English example (67a), there is no structural intervener between the head of the RC (*the dog*) and its copy, whereas in object RCs (67b), the subject of the RC (*the cat*) [+NP] shares a subset of the featural specification of the relative head (*the dog*) [+R, +NP], causing comprehension problems.

(67)   a. The structure of English subject RCs
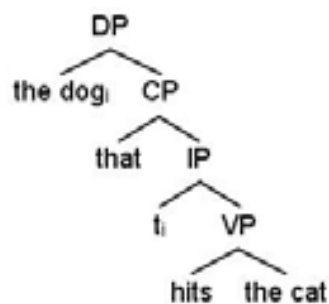
b. The structure of English object RCs
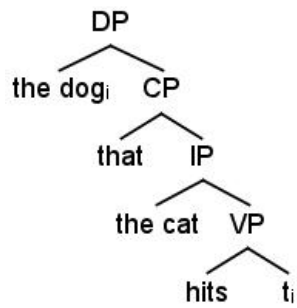
Let us now turn to Chinese RCs. As illustrated in (68), there is no intervener between the relative head and its copy in subject RCs, whereas in object RCs, the subject of the RC (*xiaomao* 'cat') structurally intervenes between the relative head (*xiaogou* 'dog') and its copy in object position and qualifies as a candidate for the same local relation as the object copy. Thus, this account predicts that object RCs are harder not only in English, but in Chinese as well.

(68)   a. The structure of Chinese subject RCs
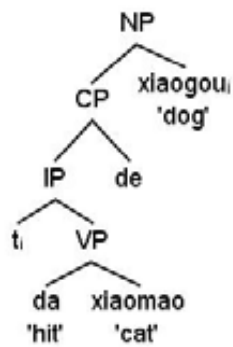
b. The structure of Chinese object RCs
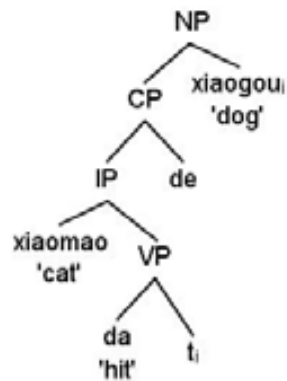
To sum up, the DLT account and the RM account make different predictions for the acquisition of Chinese RCs. The former predicts an object RC preference, while the latter predicts the opposite. I test these predictions through two experiments presented below with children from three to eight years of age.

3.4   Experiment 1

3.4.1   Method

3.4.1.1 Participants

Eighty children aged from 3;0 to 6;11 participated in this study. They were divided into four groups: the three-year-old group (N = 20, aged 3;0-3;11, M = 3;4, SD = .28, 11 males), the four-year-old group (N = 20, aged 4;0-4;10, M = 4;4, SD = .30, 9 males), the five-year-old group (N = 20, aged 5;0-5;11, M = 5;5, SD = .34, 10 males) and the six-year-old group (N = 20, aged 6;0-6;11, M = 6;5, SD = .26, 13 males). All the children were native speakers of Mandarin Chinese living in Zhejiang, China, and were developing normally. An additional adult group (N = 10, aged 22;1-29;9, M = 26;4, SD = 2.27, 5 males) served as control.

3.4.1.2 Materials and design

The stimuli consisted of 16 object-modifying RCs, 8 subject RCs (i.e., OS) like (69a) and 8 object RCs (i.e., OO) like (69b). To build up the stimuli, I employed 8 transitive verbs: *da* 'hit', *yao* 'bite', *gai* 'cover', *hua* 'draw', *tui* 'push', *zhui* 'chase', *kan* 'look at' and *bang* 'help'. All the sentences in the experiment were semantically reversible and unambiguous.

(69) a. Zhichu da   xiaogou de xiaomao.

     point to hit   dog   DE cat

     'Point to the cat that hits the dog.'

    b. Zhichu waipo   hua   de xiaohai.

     point to grandma draw DE child

     'Point to the child that the grandma draws.'

All the experimental sentences were matched with 16 sets of experimental pictures. Each set of experimental pictures consisted of two black and white drawings. On each set of pictures there were four characters. These characters participated in the same event, but with reversed thematic roles. Below, I provide an example of a set of experimental pictures used in this and in the next experiment (Figure 3). Additionally, there were 8 filler sentences involving an actional irreversible verb (e.g., *point to the girl that wears a skirt*) or an intransitive verb (e.g., *point to the girl that is sitting*). A list of the experimental sentences is provided in Appendix A.
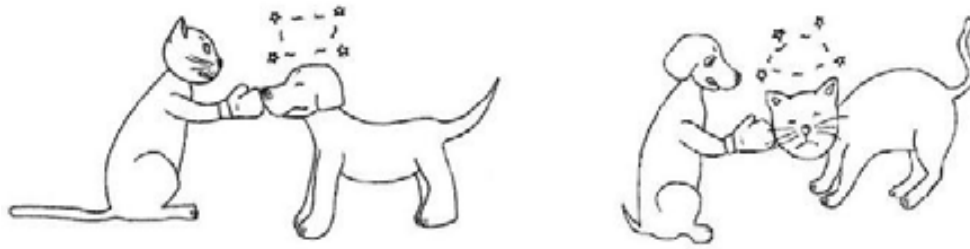
Figure 3. A set of experimental pictures used in Experiments 1 and 2. [10]

The independent variable, sentence type (i.e., OS vs. OO), was manipulated between items. That is, each set of pictures (i.e., Figure 3) was associated with an experimental sentence that could only occur as an OS or an OO. For instance, Figure 3 was associated exclusively to the Chinese equivalent of an OS sentence such as *Point to the cat that hits the dog*. The experimental sentences and the fillers were presented to each participant in pseudo-random order.

3.4.1.3 Procedure

Participants were tested individually. The pictures were presented on an iPad to participants. At the beginning of the task, each participant was told to look at the experimental pictures on the iPad screen and to point to the picture (out of two) that the experimenter described. Then, three practice items were presented to make sure that participants understood the task.

Before each experimental sentence was presented, the experimenter asked children (only to 3- and 4-year-olds) *Tamen zai ganshenme* 'What are they doing?' and children had to tell the experimenter *Xiaogou da xiaomao* 'The dog is hitting the cat' or *Xiaomao*

da xiaogou 'The cat is hitting the dog'. Through this procedure I made sure that children comprehended the actions depicted.

3.4.1.4 Scoring and error coding

The dependent variable was the proportion of accurate responses, namely the accuracy in identifying the correct picture (out of two). When participants pointed to the other one, I coded the response as Error.

3.4.1.5 Statistical analysis

In this experiment and all the further experiments, I mainly used R (R Development Core Team, 2013) and *lme4* (Bates, Maechler & Bolker, 2012) to perform linear mixed effects analyses of the relationship between different fixed factors. All the models included a number of fixed factors such as sentence type (e.g., subject RC vs. object RC) and age (e.g., 3-, 4-, 5- and 6-year-olds). As random effects, the models presented a by-subjects and a by-items intercept. The details will be given in each analysis.

3.4.2 Results

The experiment yielded a total of 1280 responses from children and 160 from adults (excluding responses to fillers). In both cases, half resulted from the subject RC comprehension and the other half from the object RC comprehension. The descriptive data indicate that children's comprehension of RCs improved from three to six years of age, but no age group displayed a clear subject/object asymmetry, as can been seen in Table 1.

Table 1. *Percentages (%), raw scores (N), means (M) and standard deviation (SD) of correct responses in each age group*

Groups	Subject RCs				Object RCs			
	%	N	M	SD	%	N	M	SD
3 y.o.	73	117/160	5.85	1.73	70.6	113/160	5.65	1.46
4 y.o.	80.6	129/160	6.45	1.57	80	128/160	6.40	1.50
5 y.o.	90	144/160	7.20	1.54	92.5	148/160	7.40	0.88
6 y.o.	97	155/160	7.75	0.64	100	160/160	8.00	0.00
Adult	100	80/80	8.00	0.00	100	80/80	8.00	0.00

I fitted accurate responses to a mixed-effects model with sentence type (i.e., OS vs. OO) and age (i.e., 3-, 4-, 5- and 6-year-olds) as fixed factors and subjects and items as random factors using the R package. The reference categories were object RCs for the sentence type factor and three-year-olds for the age factor. Sentence type factor did not predict the ability to comprehend RCs (χ^2 (1) = 0.06, p = .81), whereas crucially age yielded a significant effect. By changing the reference categories, I compared each age group with other age groups. From age three to age four, accurate responses did not significantly increase (χ^2 (3) = 48.43, p < .001; Wald Z = 1.51, p = .13)[11], while they did from age four to age five (Wald Z = 2.86, p < .01) and from age five to age six (Wald Z = 2.72, p < .01). Accordingly, accurate responses increased between age three and age five (Wald Z = 4.27, p < .001).

I further performed an individual analysis by counting the number of children performing above chance in each condition. In the picture-sentence matching task, chance level is 50%; each child was tested on 8 items in each condition. According to the

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[11] SD of subjects = 0.99; SD of items = 0.46; N = 1280; log-likelihood = -446.92; Estimate = 30.56; SE of age = 0.37.

binominal distribution, a performance was considered as above chance when there were seven correct responses (out of eight) in each condition. The pattern of results of individual performance to this task is consistent with the descriptive findings. Crucially, Table 2 shows that the number of children by age group performing above chance in the comprehension of OS vs. OO did not differ at four and five years of age. I contrasted the proportions of children performing above chance across age groups using a Chi-square test. At age three, there were descriptively more children performing above chance in the comprehension of OS as compared to OO, but the difference was not significant ($\chi^2(1) =$ 1.03, p = .25). At age six, fewer children performed above chance in the comprehension of OS as compared to OO, but again the difference was not significant ($\chi^2(1) = 2.11$, p = .10). As expected, adults performed at ceiling, with 100% correct responses in both sentence type conditions.

Table 2. *Percentages (%) and number (N) of participants who performed above chance in each age group*

Groups	Subject RCs		Object RCs	
	%	N	%	N
3 y.o.	40	8/20	25	5/20
4 y.o.	55	11/20	55	11/20
5 y.o.	85	17/20	85	17/20
6 y.o.	90	18/20	100	20/20
Adults	100	10/10	100	10/10

In conclusion, Experiment 1 reveals that Chinese-speaking children perform relatively well from three years of age, but an improvement is evident from three to six years of age. In addition, no subject/object asymmetry is evident at any age. I should

point out that accurate responses in the current experiment were substantially higher than in previous studies (Chang, 1984; Lee, 1992). For instance, Lee (1992) observed that 14.6% of the responses in OS and 2.1% of the responses in OO were correct at four years of age and the figures became 8.3% and 6.3% at five years of age. In contrast, in the current experiment, children at three years of age responded correctly to 73% of OS sentences and to 70.6% after OOs. I think that this discrepancy is due to the aforementioned experimental materials that they used and to the different tasks employed. Recall that I employed a picture-sentence matching task, while Chang (1984), Lee (1992) and Chiu (1996) used an act-out task, which requires not just an understanding of the sentence, but the planning of relevant actions.

The lack of any subject/object asymmetry is at odds with the prediction of both theories outlined above. Moreover, it depicts for Chinese a very different picture than the one for other languages. Typically, in acquisition studies, an asymmetry between subject and object RCs is found in children, where it is manifested through accurate responses. In processing studies, the same asymmetry is observed in adults, where it is manifested through longer reaction times or different ERP responses. Chinese adults display an asymmetry in the processing of RCs, although the direction is different depending on the study (a subject or an object advantage is observed). In the current results, no asymmetry is found in children. In the light of these results and observations, I suspected that the use of a picture-sentence matching task could overestimate children's comprehension. Recall that Chinese has head-final RCs, while other languages, in which this method was used, have head-initial RCs. In Chinese, the RC precedes the relative marker and the head of the RC. Moreover, Chinese has topic drop. Consequently, Chinese-speaking children could simply rely on the linear order of the embedded clause to find a matching picture. For instance, in Chinese, the embedded clause in a subject RC (70a) can be parsed as a

declarative sentence containing a dropped topic (70b), while an object RC (71a) has the same SVO word order of a declarative clause (71b), once the relative marker is ignored. Thus, in both cases, Chinese-speaking children could find the matching picture by ignoring the relative marker and possibly the relative head.

(70) a. t_i da   xiaomao de   xiaogou$_i$

hit   cat   DE   dog

'the dog that hits the cat'

b. *pro* da   xiaomao.

hit   cat

'(The dog) hits the cat.'

(71) a. xiaomao da t_i de   xiaogou$_i$

cat   hit   DE   dog

'the dog that the cat hits'

b. Xiaomao da   xiaogou.

cat   hit   dog

'The cat hits the dog.'

Crucially, this strategy cannot be adopted for head-initial RCs. To find the matching picture, English-speaking children could ignore the relative marker in subject RCs and rely on the SVO order and thus, in this condition, they should not have problems to find out the correct picture. And indeed, we know that, in languages like English, subject RCs are comprehended very well from around four years of age. In contrast, to understand an object RC, the whole sentence has to be analyzed first and the correct thematic roles have to be assigned to the characters partaking the transitive event. Indeed,

as found in many studies on head-initial RCs (see above for references), children still fail to comprehend object RCs at seven years of age.

Therefore, to assess Chinese-speaking children's comprehension of RCs, I devised a second experiment with the same materials, but asked children to choose a character instead of a picture. In doing this, I capitalized on the fact that a RC is used to single out a character through the description expressed by the embedded clause and made sure that children appropriately compute the structure of RCs.

3.5   Experiment 2

3.5.1   Method

3.5.1.1 Participants

One hundred and twenty children participated in the study. They were divided into six groups: the three-year-old group (N = 20, aged 3;0-3;11, M = 3;7, SD = .28, 10 males), the four-year-old group (N = 20, aged 4;1-4;10, M = 4;6, SD = .22, 10 males), the five-year-old group (N = 20, aged 5;0-5;11, M = 5;5, SD = .30, 10 males), the six-year-old group (N = 20, aged 6;1-6;11, M = 6;5, SD = .26, 10 males), the seven-year-old group (N = 20, aged 7;0-7;11, M = 7;5, SD = .29, 10 males) and the eight-year-old group (N = 20, aged 8;0-8;11, M = 8;5, SD = .23, 10 males). They were all native speakers of Mandarin Chinese, living in Zhejiang, China. An additional adult group (N = 20, aged 22;0-30;0, M = 26.8, SD = 2.26, 10 males) served as control.

3.5.1.2 Materials and design

All the sentences and the pictures were the same of those in Experiment 1 except that matrix sentences in this experiment started with *na yi-ge* 'which one' instead of *zhichu* 'point to' as in Experiment 1. Note that *ge* is a general classifier in Chinese, which

is typically used to single out a character and is one of the first classifiers used by children at an early age (Erbaugh, 1986). As illustrated in (72), classifiers are always used in conjunction with demonstratives or with numerals to identify specific objects.

(72) Demonstrative + Number + Classifier + Noun

zhe/na   yi   ge   xiaohai

this/that   one   CL   child

'this/that child'

Thus, when *ge* is present in the sentence, children should be discouraged from pointing to the picture because *ge* cannot be used as a classifier for a picture. In contrast to languages such as English and Italian, the presence of the classifier *ge* in Chinese could improve children's willingness to point to a character. Below I exemplify the subject RC (i.e., OS) (73a) and the object RC (i.e., OO) (73b) used in the experiment.

(73) a. Na   yi-ge   shi da   xiaogou de xiaomao?

        which one-CL   is   hit   dog   DE   cat

        'Which one is the cat that hits the dog?'

     b. Na   yi-ge   shi waipo   hua   de xiaohai?

        which one-CL   is   grandma   draw   DE   child

        'Which one is the child that the grandma draws?'

Again, recall that all the experimental sentences were matched with an experimental material made out of two pictures with two characters each (see Figure 3).

3.5.1.3 Procedure

The procedure was identical to that of Experiment 1, with the only difference that we asked participants to point to a character rather than to a picture.

3.5.1.4 Scoring and error coding

The dependent variable was the proportion of accurate responses, namely the accuracy in identifying the correct character (out of four). When participants did not choose the correct one, I coded the response as Error.

Errors were labeled as Embedded NP Error, Reversal Error and Other Error. To be qualified as an Embedded NP Error, the participant had to point to the wrong character in the right picture, that is, to the patient of the embedded clause in an OS and to the agent of the embedded clause in an OO. To be qualified as a Reversal Error, the participant had to point to the right character in the wrong picture; this is assigned a patient role, instead of an agent role, in an OS and it is assigned an agent role, instead of a patient role, in an OO. To be qualified as an Other Error, the participant had to point to the wrong character in the wrong picture. For example, instead of pointing to the character depicting *the cat that hits the dog*, they pointed to the one depicting *the dog that hits the cat*. This may indicate that the participant assigns the thematic role randomly.

3.5.2   Results

The experiment yielded a total of 1914 responses from children (excluding responses to fillers); half resulted from the subject RC comprehension and the half from the object RC comprehension. From adults, 320 responses were given. Section 3.5.2.1 lays out the analysis of correct responses. Section 3.5.2.2 provides error analysis.

3.5.2.1 The analysis of correct responses

The descriptive results in Table 3 indicate that children comprehended subject RCs more accurately than object RCs in each age group and that accuracy rates increased with age.

Table 3. *Percentages (%), raw scores (N), means (M) and standard deviation (SD) of correct responses in each age group*

Groups	Subject RCs				Object RCs			
	%	N	M	SD	%	N	M	SD
3 y.o.	47.8	75/157	3.75	1.89	24.8	39/157	1.95	1.73
4 y.o.	61.3	98/160	4.90	1.83	23	37/160	1.85	1.69
5 y.o.	72.5	116/160	5.80	1.99	20.6	33/160	1.65	1.35
6 y.o.	76.3	122/160	6.10	1.52	45	72/160	3.60	2.41
7 y.o.	99.4	159/160	7.95	0.22	45.6	73/160	3.65	2.90
8 y.o.	100	160/160	8.00	0.00	95.6	153/160	7.65	1.35
Adult	100	160/160	8.00	0.00	100	160/160	8.00	0.00

The statistical analysis confirms the descriptive results. I fitted responses to a mixed-effects model with sentence type (i.e., OS vs. OO) and age (i.e., 3-, 4-, 5-, 6-, 7- and 8-year-olds) as fixed factors and subjects and items as random factors. The reference categories were object RCs for the sentence type factor and three-year-olds for the age factor. I found a significant effect of sentences type ($\chi^2(1) = 50.41$, $p < .001$; Wald $Z = 16.88$, $p < .001$)[12] and a significant effect of age. By changing the reference categories, each age group was compared with other age groups. There was a significant increase

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[12] SD of subjects = 1.84; SD of items = 0, which means that items are quite homogenous; N = 1914; log-likelihood = -974.72; Estimate = 2.13; SE of condition = 0.13.

between age three and age six ($\chi^2(5) = 145.78$, $p < .001$; Wald $Z = 4.08$, $p < .001$)[13] and

between age four and age six (Wald $Z = 3.08$, $p < .01$). Accuracy also increased from age

five to age six (Wald $Z = 2.37$, $p < .05$), from age six to age seven (Wald $Z = 2.22$, $p < .05$)

and from age seven to age eight (Wald $Z = 6.01$, $p < .001$). In contrast, accurate responses

did not significantly increase either from age three to age four (Wald $Z = 1.03$, $p = .30$) or

from age four to age five (Wald $Z = 0.72$, $p = .47$).

I analyzed the rates of comprehension accuracy by age group from age three to

age eight in OS and OO sentences. Table 4 reports a summary of the results of the

statistical analysis for OS sentences, whereas Table 5 reports the results for OO ones. In

both datasets age provided significant fit to the models (OS: $\chi^2(5) = 121.81$, $p < .001$; OO:

$\chi^2(5) = 100.76$, $p < .001$). When I considered only accurate responses in the OS sentence

type, there was a significant development in accuracy rates between age three and age

five, between age four and age six, between age five and age seven, from age six to age

seven and between age six and age eight. When I considered only OO sentences, I

observed a robust increase in accuracy at six years of age and then at eight years of age.

Six-year-olds differed with respect to three-, four- and five-year-olds. In contrast, at three,

four and five years of age they did not show any difference in accuracy. At eight years of

age, there was an increase in accuracy such that the performance of children was almost

adult-like and significantly diverged from that of six- and seven-year-olds.

Again, I performed an individual analysis. I counted the number of children by

age group performing above chance in each condition. In the character-sentence matching

task, where participants have to choose one character in two pictures, chance level is 25%;

_____

[13] SD of subjects = 0.89; SD of items = 1.07; N = 1914; log-likelihood = -927.03; Estimate = 1.38;
SE of age = 0.34.

Table 4. *Summary of the fixed effects in the mixed-effects model (N = 957, SD of subjects = 0.82, SD of items = 0.13, log-likelihood = -393.29) for subject RC comprehension*

Age groups	Estimate	SE	Wald Z	p
3 y.o. vs. 4 y.o.	0.63	.35	1.80	=.07
3 y.o. vs. 5 y.o.	1.24	.36	3.43	<.001
4 y.o. vs. 5 y.o.	0.60	.36	1.67	=.10
4 y.o. vs. 6 y.o.	0.80	.37	2.19	<.05
5 y.o. vs. 6 y.o.	0.19	.37	0.52	=.60
5 y.o. vs. 7 y.o.	4.24	1.19	3.55	<.001
6 y.o. vs. 7 y.o.	4.04	1.19	3.39	<.001
6 y.o. vs. 8 y.o.	4.04	1.19	3.38	<.001
7 y.o. vs. 8 y.o.	13.50	984.19	0.01	=.99

Table 5. *Summary of the fixed effects in the mixed-effects model (N = 957, SD of subjects = 1.34, SD of items = 0.001, log-likelihood = -460.73) for object RC comprehension*

Age groups	Estimate	SE	Wald Z	p
3 y.o. vs. 4 y.o.	-0.12	.52	-0.23	=.82
3 y.o. vs. 5 y.o.	-0.24	.52	-0.46	=.64
3 y.o. vs. 6 y.o.	1.19	.50	2.34	<.05
4 y.o. vs. 5 y.o.	-0.12	.52	-0.23	=.82
4 y.o. vs. 6 y.o.	1.31	.50	2.57	<.01
5 y.o. vs. 6 y.o.	1.43	.51	2.81	<.01
5 y.o. vs. 7 y.o.	1.46	.51	2.85	<.01
6 y.o. vs. 7 y.o.	0.04	.50	0.07	=.94
6 y.o. vs. 8 y.o.	4.47	.77	5.79	<.001
7 y.o. vs. 8 y.o.	4.44	.77	5.72	<.001

the task involved eight trials in each condition. An above chance performance is at least five correct responses (out of eight), as predicted by the binominal distribution. Table 6 shows that the number of children performing above chance in the comprehension of OS vs. OO did differ. At age three, there were descriptively more children performing above chance in the comprehension of OS as compared to OO, but the difference was not significant ($\chi^2(1) = 1.29$, $p = .25$). In contrast, I observed a significant difference at age four ($\chi^2(1) = 9.23$, $p < .01$), at age five ($\chi^2(1) = 20.42$, $p < .001$), at age six ($\chi^2(1) = 8.29$, $p < .01$) as well as at age seven ($\chi^2(1) = 19.26$, $p < .001$). There was no difference at age eight ($\chi^2(1) = 1.03$, $p = .25$). Note that all of the children at age seven comprehended OS above chance, whereas many children were still below chance in the comprehension of OO. Adults performed again at ceiling.

Table 6. *Percentages (%) and number (N) of participants who performed above chance in each age group*

Groups	Subject RCs		Object RCs	
	%	N	%	N
3 y.o.	30	6/20	15	3/20
4 y.o.	55	11/20	10	2/20
5 y.o.	75	15/20	5	1/20
6 y.o.	80	16/20	35	7/20
7 y.o.	100	20/20	35	7/20
8 y.o.	100	20/20	95	19/20
Adults	100	20/20	100	20/20

To sum up, I observed that when children were asked to choose a character instead of a picture, a subject preference is evident in Chinese, as it is in studies on other

languages and in some previous studies on Chinese acquisition. I also noted that subject RCs are still not yet well comprehended at six years of age. In this experiment, I prevented children from using the strategy that they could possibly have used in Experiment 1. Recall that in Experiment 1 children could possibly have chosen the picture by ignoring the relative marker and the relative head. This is not possible in the present experiment, as children have to choose the relevant character that is described by means of the RC. This suggests that the character-sentence matching task used in Experiment 2 is certainly more informative, especially for Chinese. It is worth pointing out that the percentages of accuracy in Experiment 2 (and largely in Experiment 1) are still much higher than those reported in Lee (1992)'s study, in which an act-out task was used.

3.5.2.2 The analysis of errors

To investigate what children do when they fail to understand a sentence, I examined the distribution of errors. Tables 7 and 8 summarize percentages of error types (i.e., Embedded NP Error, Reversal Error and Other Error) for each group in OS and OO sentences respectively. Error types were equally distributed in the comprehension of OS, whereas Embedded NP Error was more common than Reversal Error and Other Error in the comprehension of OO.

Table 7. *Percentages (%) and number (N) of errors as a function of Error Type in the subject RC comprehension*

Groups	Embedded NP Error		Reversal Error		Other Error	
	%	N	%	N	%	N
3 y.o.	19.1	30/157	15.3	24/157	17.8	28/157
4 y.o.	15	24/160	10	16/160	13.7	22/160
5 y.o.	8.7	14/160	7.5	12/160	11.3	18/160
6 y.o.	11.8	19/160	3.1	5/160	8.8	14/160
7 y.o.	0.6	1/160	0	0/160	0	0/160
8 y.o.	0	0/160	0	0/160	0	0/160

Table 8. *Percentages (%) and number (N) of errors as a function of Error Type in the object RC comprehension*

Groups	Embedded NP Error		Reversal Error		Other Error	
	%	N	%	N	%	N
3 y.o.	37	58/157	22.9	36/157	15.3	24/157
4 y.o.	47.5	76/160	23.1	37/160	6.3	10/160
5 y.o.	73.1	117/160	3.8	6/160	2.5	4/160
6 y.o.	53.1	85/160	1.3	2/160	0.6	1/160)
7 y.o.	53.1	85/160	1.3	2/160	0	0/160
8 y.o.	4.4	7/160	0	0/160	0	0/160

As I was dealing with a count variable (e.g., number of errors), I ran a Poisson regression model. I limited the factor age from three to six years of age, since Other Error was not observed at seven and eight years of age.

Results indicate that, in OS sentences, Embedded NP Error was not more frequent than Other Error at age three (Wald Z = -0.13, p = .89), at age four (Wald Z = -0.30, p = .77), at age five (Wald Z = 0.71, p = .48) and at age six (Wald Z = 0.87, p = .39). Similarly, proportions of Embedded NP Error did not differ from rates of Reversal Error at age three (Wald Z = -0.69, p = .49), at age four (Wald Z = -1.26, p = .21) and at age five (Wald Z = -0.39, p = .70). There were significantly more Embedded NP Error than Reversal Error at age six (Wald Z = - 2.66, p < .01). Again, proportions of Reversal Error and Other Error did not differ at age three (Wald Z = 0.56, p = .58), at age four (Wald Z = 0.97, p = .33) and at age five (Wald Z = -1.09, p = .28), but differed at age six (Wald Z = 1.98, p < .05). Children did not show a tendency to make a specific mistake when they failed to understand OS, and this was true at least from three to five years of age.

In OO sentences, Embedded NP Error was significantly more common than Reversal Error at age three (Wald Z = -2.25, p < .05), at age four (Wald Z = - 3.59, p < .001), at age five (Wald Z = -7.10, p < .001) and at age six (Wald Z = -5.24, p < .001). Embedded NP Error was also more frequent as compared to Other Error at age three (Wald Z = -3.64, p < .001), at age four (Wald Z = -6.03, p < .001), at age five (Wald Z = -6.64, p < .001) and at age six (Wald Z = -4.42, p < .001). Proportions of Reversal Error and Other Error differed only at age four (Wald Z = 3.67, p < .001), with Reversal Error being more common. The two error types did not differ in any other age group (at age three [Wald Z = 1.54, p = .13], at age five [Wald Z = 0.63, p = .53] and at age six [Wald Z = 0.57, p = .57]). The analysis confirmed that children were more likely to make an Embedded NP Error as compared to any other type of error when they were not able to accurately comprehend an OO sentence.

In order to examine how the tendency to make a specific error evolved along with age, I ran an additional analysis involving the three types of errors as dependent variables

(i.e., Embedded NP Error, Reversal Error and Other Error), using a series of mixed-effects models with age as fixed factor and subjects and items as random factors.

In OS sentences no significant effect was found, i.e., in none of the error types was there a difference across ages (all $p > .11$). In OO sentences, children were more likely to make an Embedded NP Error ($\chi^2(5) = 80.61$, $p < .001$) from age four to age five (Wald $Z = 2.91$, $p < .01$) and from age five to age six (Wald $Z = -2.29$, $p < .05$), and were less likely to make such error from age seven to age eight (Wald $Z = -5.87$, $p < .001$). As for Reversal Error ($\chi^2(5) = 85.00$, $p < .001$), there was a significant decrease from age four to age five (Wald $Z = -4.20$, $p < .001$). As for Other Error ($\chi^2(5) = 51.34$, $p < .001$), the probability to make such an error decreased from age three to age four (Wald $Z = -2.44$, $p < .05$). No other significant effect was found across age groups.

The results of the current study appear to be novel in two ways. First, Chinese children made three different errors in OS and all of them were common, in contrast to what was found in Hebrew, Italian and Catalan, where errors in OS were rare (Adani, 2011; Arnon, 2005, 2010; Gavarró, Adani, Ramon, Rusiñol, & Sànchez, 2012). The error pattern thus differs from that reported in the literature on head-initial RCs. In the Italian study (Adani, 2011), for instance, Reversal Error was observed from age three to age seven, whereas Middle Error (including Embedded NP Error and Other Error) was only observed at age five with an error rate of 1%. It is important to note in addition that Hebrew, Italian and Catalan children performed over 90% correctly at age six, while their Chinese peers only performed 76.3% correctly.

Second, I observed that the most common error in OO for Chinese children was the Embedded NP Error, whereas the most common one in Italian and Catalan was the Reversal Error in both OO and OOp. An Italian OO and an OOp are given in (74a) and

(74b) respectively, in which the former is with a preverbal RC subject and the latter is with a post-verbal RC subject.

(74) a. Indica   il cavallo [che i leoni   stanno inseguendo].

   point to the horse   that the lions   are chasing

   'Point to the horse that the lions are chasing.'

   b. Indica   il cavallo [che stanno inseguendo i leoni].

   Point to the horse   that are chasing   the lions

   'Point to the horse that the lions are chasing.'

For instance, Italian children at three years of age were more likely to make a Reversal Error as compared to a Middle Error (34% vs. 13% in OO; 60% vs. 3% in OOp). Accordingly, Catalan children (aged 3;5-6;2) displayed the same asymmetry (22% vs. 7.5% in OO; 83% vs. 2.5% in OOp). In Hebrew children from three to five years of age, the Reversal Error and the Embedded NP Error were equally likely to occur (Arnon, 2005: 27% vs. 22% in OO; Arnon, 2010: 15% vs. 15% in OO). Thus, the distinct behavior of the participants must be attributed to the structural differences between Chinese RCs and RCs in languages like Italian, Hebrew and Catalan.

3.6   General discussion

In this study, I used a picture-sentence matching task (Experiment 1) and a character-sentence matching task (Experiment 2) to examine children's comprehension of Chinese RCs. Experiment 1 revealed high rates of accuracy in both RC types and no subject/object asymmetry. In contrast, Experiment 2 provided quite a different picture: overall I obtained lower accuracy rates and, most importantly, children were more

accurate in subject RCs as compared to object RCs. As in Experiment 1 high accuracy rates could be attributed to the reliance on the linear order of the RC and not to the processing of the RC structure, I claim that the results of Experiment 2 are more reliable in characterizing the ability of Chinese children to comprehend RCs.

Three main findings emerge from the current study: first, Chinese children do comprehend subject RCs better than object RCs, in line with the findings from other cross-linguistic studies on head-initial RCs; second, in contrast to what has been found in other studies on Hebrew, Italian and Catalan, subject RCs in Chinese are also difficult to comprehend and elicit a variety of errors; third, there was a discrepancy between Experiment 1 and Experiment 2, which suggests an interplay between methodological and typological aspects that deserves further discussion.

The developmental data in Experiment 2 showed that at least from four years of age on, children comprehended OS more accurately than OO. Note that at six years of age, 80% of children performed above chance in the comprehension of OS, whereas only 35% of them performed above chance in the comprehension of OO. Again, at seven years of age, all of the children performed above chance in OS sentences, but only 35% of them performed above chance in OO. These contrasting results between OS and OO suggest that the mastery of object RCs emerges later than that of subject RCs, as predicted by the RM approach. As illustrated earlier in (68b), the subject of the RC (*xiaomao* 'cat') intervenes in the connection between the head of the RC (*xiaogou* 'dog') and its copy in the hierarchical structure of object RCs. In contrast, there is no structural intervener between the head of the RC (*xiaogou* 'dog') and its copy in the hierarchical structure of subject RCs (see (68a)). The subject/object asymmetry in Chinese RCs goes against the prediction made by the DLT and favors the RM approach. Following Friedmann et al. (2009), Adani et al. (2010) and Belletti et al. (2012), I maintain that structural

intervention of the subject is at the root of the difficulty in comprehending object RCs. Chinese object RCs are more taxing than subject RCs, given that they violate a strict form of locality.

As the experimental results indicate, the DLT approach was problematic. It would predict an object advantage for Chinese RCs that I did not find. DLT was also challenged by the recent adult sentence processing study of Vasishth et al. (2013). As I mentioned earlier, Vasishth et al. attempted to replicate the Hsiao & Gibson's null context condition and the Gibson & Wu's context condition studies. In the null context condition, Vasishth et al. found a subject preference, in contrast to Hsiao & Gibson's results. In the context condition, they found an object advantage, but only at the relative marker and at the relative head. However, the authors argued that, since the context is supposed to make it clear that a RC is elicited, no effect due to integration cost or storage cost is predicted by DLT at the relative marker. Thus, they proposed that the object advantage found at the relative head could be regarded as a spillover effect from the preceding region. As suggested by Lin (2014) and Vasishth et al. (2013), one explanation of the object advantage in the context condition, but not in the null context condition, is that the preceding context (NP_1 V NP_2) involves the same thematic roles as the object RC (NP_1 V de NP_2), but differs from the subject RC (V NP_2 de NP_1). That is to say, the object advantage in the context condition may have nothing to do with integration cost or storage cost, nor with locality, but is probably an effect of thematic role order priming because sentences in the preceding context and object RCs have the same SVO order.

Although children's comprehension of OS was better than that of OO in the current study, from a comparative perspective we cannot disregard the fact that Chinese subject RCs were difficult up to six years of age, while this is not so in other languages, like Hebrew, Italian and Catalan. In addition, the comprehension of these RCs elicited a

variety of errors. As stated in the literature (Arnon, 2005), the errors reflect different sources of difficulty. The Embedded NP Error and the Other Error seem to reflect children's confusion about the syntactic role of the relative head. They indicate that children are not sensitive to the fact that the RC adds information to the relative head and they only use the information in the embedded clause to select the referent of the relative head. In contrast, the Reversal Error seems to reflect a misunderstanding of the thematic assignment. The results in Experiment 2 showed that all the error types were equally distributed in the OS condition and, crucially, none of them showed significant differences across ages. The results on subject RCs lead me to conjecture that also linear intervention is taxing for Chinese children, although to a lesser extent. Contrary to structural intervention, which is established in terms of c-command, linear intervention depends on precedence. Consider Chinese subject RCs in (65a) and its hierarchical structure in (68a), repeated in (75) below.

(75)   a. [_i da xiaomao de] xiaogou_i

   hit cat   DE dog

    'the dog that hits the cat'

   b.
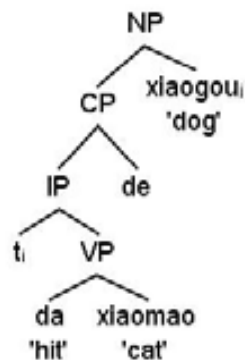
As shown in (75a), the object of the RC (*xiaomao* 'cat') linearly intervenes between the head of the RC (*xiaogou* 'dog') and its copy. As shown in (75b), the object does not structurally intervene between the relative head and its copy. This is not the case in the subject RCs with prenominal RC, e.g., English. Consider (76), repeating (64a) and its hierarchical structure (67a).

(76)   a. the dog$_i$ that ___$_i$ hits the cat

b.
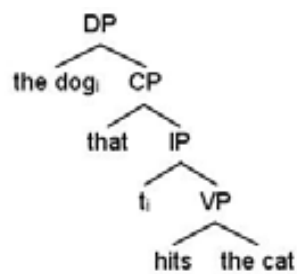
In (76), the object *the cat* does not intervene between the relative head *the dog* and its copy either linearly or hierarchically. If only structural intervention matters, we would not expect Chinese subject RCs to be problematic for children. Therefore, I propose that linear intervention does matter in comprehending Chinese subject RCs. Given that Chinese-speaking children comprehended object RCs much worse than subject RCs, I propose that structural intervention is stronger than linear intervention.

The proposal that linear intervention may also affect children's comprehension is in line with findings from Franck, Lassi, Frauenfelder, & Rizzi (2006). In a study on the production of structures involving subject-verb agreement by adults, these authors found that linear intervention led to the production of agreement errors, but to a lesser extent than structural intervention. In one experiment, they tested 60 Italian native speakers (aged 18-28) with structures like (77). In declarative SV sentences (77a), a subject

modifier *vicini* 'neighbours' linearly intervenes on the subject-verb agreement relation; in free inverted VS sentences (77b), the same noun does not intervene.

(77) a. L'amica   dei vicini   telefonerà.

        the friend-SG of the neighbour-PL   will phone-SG

        'The friend of the neighbours will phone.'

      b. Telefonerà   l'amica   dei vicini.

        will phone-SG the friend-SG of the neighbour-PL

        'The friend of the neighbours will phone.'

These authors found that agreement errors were significantly more frequent in SV sentences than in VS sentences (4.6% vs. 2%). This finding indicates that linear intervention triggers attraction effects. That is, the local noun in the linear word chain attracts the agreement with the verb. The verb *telefonare* 'phone' erroneously agrees with the local noun *vicini* 'neighbours', resulting in *telefoneranno* 'will phone-PL', as shown in (78).

(78) *L'amica   dei   vicini   telefoneranno.

        the friend-SG of the neighbour-PL will phone-PL

        'The friend of the neighbours will phone.'

In another experiment, they tested 40 native French speakers (aged 18-25) with structures in (79).

(79)   a. Le professeur   les   lit.

the professor-SG   them read-SG

'The professor reads them.'

b. Le professeur   des élèves   lit.

the professor-SG of the student-PL read-SG

'The professor of the students reads.'

The two structures have same surface orders: in (79a), an object clitic *les* 'them' linearly intervenes between the subject and the inflected verb; in (79b), a subject modifier *élèves* 'students' intervenes between them. But they differ from each other hierarchically: in (79a), the subject c-commands the clitic and the clitic c-commands the inflected verb; in (79b), the subject modifier does not c-command the inflected verb. The experimental results showed that agreement errors were significantly more frequent in sentences with clitic pronoun than with subject modifiers (9.5% vs. 3.4%). To sum up, the results supported that both hierarchical and linear intervention create interference, and the former is stronger than the latter.

In the current study, additional evidence for the role played by linear order in the early stages of development comes from the error analysis in OO sentences. Recall that the most common error in OO was the Embedded NP Error, whereas the most common one in Italian and Catalan was the Reversal Error. The fact that the error pattern is different in Chinese than in the other languages may indicate that children are really misinterpreting the RC as the main clause, as this comes before the relative head.

Importantly, although a cross-experiment comparison has to be done with caution as participants were not the same and chance performance was established differently, I tentatively would like to discuss the discrepancy between Experiment 1 and Experiment 2

in the light of the role of the linear order in comprehending RCs. In Experiment 1 I observed high accuracy rates as compared to the low accuracy ones found in Experiment 2 and, more intriguingly, there was no subject/object asymmetry in Experiment 1, whereas this emerged clearly in Experiment 2. However, I claim that the different tasks are responsible for it. Since we do not know whether children are pointing to a correct or an incorrect referent by using a picture-sentence matching task (Arnon, 2005), one possible way to explain the accuracy in Experiment 1 is that the reliance on the linear order of the RC is sufficient to choose the correct picture. Recall that word order of object RCs is SVO, the same of the declarative clause (see (71)). It is possible that children could match the picture and the sentence based on the linear order of the sentence, without knowledge of the RC function. In addition, Chinese is a topic drop language, that is, the embedded clause in subject RCs can be regarded as a declarative sentence with a topic-dropped subject (see (70)). Therefore, children could also find the corresponding picture of the subject RC relying on the VO order of the embedded clause, with no need to analyze the whole RC.

Based on the comparison between Experiment 1 and Experiment 2, another point that I would like to debate is the validity of the object advantage found in Basque children by Gutiérrez-Mangado (2011). Unlike Chinese, Basque is a highly inflected, ergative-absolutive, SOV language. However, like Chinese, RCs are head-final. Gutiérrez-Mangado (2011) used a picture-sentence matching task, like in the first experiment, and reported an object advantage in comprehension. In contrast, in a production study, Gutiérrez-Mangado & Ezeizabarrena (2012) observed a subject advantage. Although a comparison between comprehension and production should be done with caution for the reasons already outlined above, I think that these contrasting findings cannot be disregarded in the light of my criticisms leveled to the picture-sentence matching task. In

fact, Basque is like Chinese as far as the head-final status of the relative head is concerned. It is very likely that the results overestimate children's comprehension, as I thought they did for Chinese. Future research on Basque should attempt to find out whether the object advantage is still observed with a character-sentence matching task. If it is, then Basque would be unlike Chinese. In any event, the subject advantage in production would remain mysterious.

The results of Japanese RCs are also controversial. Japanese, like Basque, is a verb final language with head-final RCs. Using a picture-sentence matching task, Suzuki (2011) found that subject RCs were harder than object RCs in comprehension for children aged 5;1-6;8 (N = 30, M = 5;10). But the subject RC disadvantage disappeared for the children (N = 11, M = 5;11) who were able to use both the nominative and accusative case markers as cues for comprehending canonical SOV sentences with transitive verbs. Ozeki & Shirai (2007) examined the frequency of RCs in spontaneous speech of five Japanese-speaking children and found no subject/object asymmetry (subject RCs vs. Object RCs, 35.6% vs. 34.7%). Given the picture-sentence matching task used in Suzuki's study and the comparison between this task and the character-sentence matching task reported in the current study, I also suggest that it is necessary to reconsider the Japanese RC comprehension.

A final point that I would like to briefly discuss is input frequency. As I have indicated earlier, several corpus studies have shown that (headed) subject RCs are more frequent than (headed) object RCs (e.g., Pu, 2007; Wu, Kaiser, & Andersen, 2011). This input frequency is exactly what Chinese children followed: children comprehended subject RCs better than object RCs in the current study. According to the results of corpus studies, object RCs with inanimate heads were much more frequent than those with animate heads in Chinese. If frequency matters, we would expect that children should

comprehend object RCs with inanimate heads better than those with animate heads. However, this issue is complex (see, Arosio, Guasti, & Stucchi, 2011; Guasti, Branchini, Arosio, & Vernice, 2012). I will discuss it in the last chapter.

3.7   Summary

To conclude, the results of the current study indicate that the choice of the experimental method may interact with the structure of clauses in a language, as revealed by the contrast between Experiment 1 and 2. In addition, I have provided an important insight about the processing of RCs in Chinese children: I observed a subject/object asymmetry in the course of development of RC comprehension as predicted by the RM approach, contrary to the DLT approach, and I demonstrated a peculiar pattern of errors in comparison with that of children speaking languages with head-initial RCs. Such a pattern suggests that the linear order also affects the comprehension of RCs, even if it does not account for the overall great difficulty of RCs.

CHAPTER 4 The production of Chinese relative clauses

This chapter examines the production of Chinese RCs by children and adults with several goals: (i) to test whether the subject vs. object RC asymmetry holds in production, (ii) if it does, to examine how the asymmetry develops across ages, and (iii) to characterize children's difficulties, if any, by looking at the pattern of non-target structures and errors. In addition, as reported in chapter 3, the typological properties of Chinese RCs have an impact on their comprehension: a unique pattern of errors and an uncommon difficulty in comprehending subject RC up to six years of age were found, contrary to the findings on head-initial RCs. Thus, I also hope to contribute to the understanding of the impact of the head-final status of RCs in their production. To this purpose, I ran an elicitation experiment with children and adults (Experiment 3) and a grammaticality judgment experiment with adults (Experiment 4). The latter experiment is the first grammaticality study focusing on Chinese RCs with resumptive NPs designed to tease apart prescriptive grammar from the grammar of spoken Chinese in the domain of RCs.

The chapter is organized as follows. In section 4.1, I briefly review previous production studies and the resumptive strategy across languages. In section 4.2, I provide a review of previous production studies on Chinese RCs and a brief restatement of the predictions about Chinese RCs in terms of the RM approach. Section 4.3 presents Experiment 3; section 4.4, Experiment 4. In section 4.5, I tentatively compare the results of comprehension (Experiment 2) with those of production (Experiment 3). I discuss the results within the RM framework in section 4.6 and finally give a summary in section 4.7.

4.1   A resumptive strategy in the production of relative clauses

Studies from many languages consistently report that subject RCs are produced by children in an adult-like manner more often than object RCs (e.g., French: Labelle, 1990, 1996; Spanish: Pérez-Leroux, 1995; Italian: Contemori & Belletti, 2013; Guasti & Cardinaletti, 2003; English: Zukowski, 2009; Hebrew: Arnon, 2010; Portuguese: Costa, Lobo, & Silva, 2011; Catalan: Gavarró, Cunill, Muntané, & Reguant, 2012; German: Adani, Shem, & Zukowski, 2013). These studies observed that children often produce RCs with resumptives (e.g., Labelle, 1990, 1996) and passive RCs at an older age. Below, I provide a brief discussion of the resumptive strategy across languages.

Several studies show that children adopt a resumptive strategy, mostly involving resumptive pronouns and less frequently resumptive NPs. A resumptive pronoun is a pronoun occurring inside the RC, which is related to the relative head and encodes its grammatical function inside the RC, as in (80a) (example from Labelle, 1990); a resumptive NP is a copy of the relative head and occupies the extraction site, as in (80b). Both options are ungrammatical in the standard language, here French. However, in French-speaking children's production data (N = 108, aged 3-6), resumptive pronouns are well-attested and resumptive NPs are also found, although less frequent than resumptive pronouns (Labelle, 1990). In (80c), the adult version is given.

(80)   a. sur la balle qu'i(l)   l'attrape (LE 3;08)

on the ball that he it catches

'on the ball that he catches it'

b. sur la balle qu'i(l) lance   la balle (M 5;00)

on the ball that he throws the ball

'on the ball that he throws the ball'

c. sur la balle qu'i(l) rattrape

on the ball that he catches

'on the ball that he catches'

Resumptive pronouns in RCs are often found in substandard varieties of French and Italian (Guasti & Cardinaletti, 2003) and are optional in some languages. For instance, in Hebrew a resumptive pronoun is allowed in the object position, as shown in (81).

(81) Tare li   et   ha-kof   she-ha-yeled mexabek oto.
     show to-me ACC the-monkey that-the-boy hugs   him
     'Show me the monkey that the boy is hugging.'

The use of resumptive pronouns in RCs in child grammar has been widely discussed for, e.g., Spanish (Pérez-Leroux, 1995), English (McKee & McDaniel, 2001), French and Italian (Guasti & Cardinaletti, 2003). To account for it, some scholars propose that children's initial relatives do not involve movement, but feature the syntax of a predicative construction (Labelle, 1990, 1996); some other scholars propose a movement account, but suggest that children lack the relative operator until six years of age (Guasti & Shlonsky, 1995). Still others propose that children have an adult-like system and resumptive pronouns are the Spell-Outs of traces (McKee & McDaniel, 2001).

In contrast, the occurrence of resumptive NPs has not been widely discussed, although it has been attested in child's early production of RCs (e.g., French: Labelle, 1990, 1996; Italian: Utzeri, 2007; Catalan: Gavarró, Cunill, Muntané, & Reguant, 2012; Mandarin Chinese: Hsu, Hermon, & Zukowski, 2009). It has been suggested that the use

of resumptive NPs is an option in child grammar, but not allowed in adult grammar (Utzeri, 2007).

4.2   Previous production studies on Chinese relative clauses

There are several studies on the production of Mandarin RCs. In Cheng (1995) (cited in Su, 2004), 27 children aged from 3;6 to 6;3 were tested and a subject preference was observed (42% vs. 19%). In contrast, Su (2004) tested 40 children aged from 5;0 to 6;5 and 31 adults and did not find any preference (subject vs. object RCs, 84% vs. 88%, for children aged 5;0-5;6; 78% vs. 83%, for children aged 5;7-6;5; 98% vs. 89%, for adults). The author used an elicitation methodology similar to Hamburger & Crain (1982) and Crain, McKee, & Emiliani (1990). That is, one experimenter acted out a short story with toys to each child and another experimenter manipulated a puppet whose name was Big Bird; next, Big Bird was turned around and the first experimenter pointed to one of the toys; then, Big Bird was turned back and the child described the toy that was pointed to. It has been stated that four tokens of each sentence type is the minimum acceptable in elicited production (Thornton, 1996). These different results were obtained with only one trial and two trials for each sentence type in Cheng and in Su, respectively, and thus they should be considered with some caution.

Hsu, Hermon, & Zukowski (2009) tested 23 children (aged 4;0-6;5, M = 4;8) and 10 adults, using an elicited production task with the help of picture presentations modeled after Hamburger & Crain (1982) and developed by Zukowski (2001, 2009). They found that both children and adults produced more subject RCs than object RCs (children, 83.5% vs. 38.9%; adults, 95% vs. 79.5%). However, some of their materials were arguably problematic due to the properties of the verbs: in the subject RC elicitation task, some verbs could be used intransitively, and thus could inflate the subject advantage. For

instance, (82a) was used to depict two girls in the experimental picture: one girl is singing and another girl is drawing. Then, a mouse appeared in front of one of the two girls and the experimenter asked "Which girl is the mouse watching?" to elicit a subject RC (82b). Here, *changge* and *huahua* can either be used transitively to describe a generic activity, like "sing a song" and "draw a painting", or intransitively as in "sing" and "draw". The use of an optionally intransitive verb enhances the production of subject RCs, since the elicitation of object RCs always involved transitive verbs. In view of this weakness, it is hard to conclude that a subject preference holds in the production of Chinese RCs.

(82) a. Na-ge   nühai zai   changge/huahua.

　　　that-CL girl PROG sing/draw

　　　'That girl is singing/drawing.'

　　 b. Laoshu zai   kan   changge/huahua de nühai.

　　　mouse PROG   watch sing/draw   DE girl

　　　'The mouse is watching the girl that is singing/drawing.'

Chen & Shirai (2014) reported an object preference for Chinese RCs in early Mandarin-speaking children's speech, as mentioned in section 3.2. These authors analyzed the spontaneous production of four monolingual Mandarin-speaking children (aged 0;11-3;5) and their interlocutors. 145 sentences were observed in child production. Among them, 34 sentences (23.4%) were subject RCs and 78 sentences (53.8%) were object RCs (for details of other types of RCs, see the original paper). Examples of subject RCs are given in (83a) and object RCs in (83b-c).

(83) a. Peng-dao   yi-ge [wa   tu]   de   ren. (JIA, 2;8)

   meet-arrive one-CL dig earth DE person

   'I met a person who was digging the earth.'

 b. Zhe hui [shuijiao] de   hao   le. (MDY 2;0)

   this time   sleep   DE ready ASP

   '(The one) that slept is ready right now.'

 c. [Baba   mai] de ban. (MDY 1;10)

   daddy bought DE board

   '(It is) the board that daddy bought.'

The fact that object RCs emerge early and remain the preference in Mandarin-learning children's speech is different from early production of English-speaking children (a subject RC preference found in Diessel & Tomasello (2000)) and that of Japanese-speaking children (no asymmetry reported in Ozeki & Shirai (2007)). The finding uncovers the early stage of Chinese children's RC production, but there are still some limitations. For example, the authors did not examine the complexity of the clause. (83b) is a headless RC with an intransitive verb, much less complex than (83a) with the animate relative head and the transitive verb.

To sum up, the aforementioned studies on the production of Chinese RCs are problematic in some respects and, therefore, in the current study I aim at establishing whether the object RC disadvantage found in comprehension holds also in production. As I have stated in previous chapters, considering the acquisition of Chinese RCs in terms of the RM approach, the prediction is that object RCs should be harder than subject RCs and this has been confirmed in the comprehension study reported in chapter 3. Below,

whether this prediction is valid in production is investigated through Experiment 3, an elicitation task conducted with children from three to eight years of age and adults.

4.3   Experiment 3

4.3.1   Method

4.3.1.1 Participants

One hundred and twenty-five children and twenty adults participated in this experiment. I divided children into six groups: the three-year-old group (N = 20, aged 3;0-3;11, M = 3;7, SD = .29, 10 males), the four-year-old group (N = 24, aged 4;0-4;11, M = 4;7, SD = .31, 11 males), the five-year-old group (N = 21, aged 5;0-5;11, M = 5;6, SD = .32, 12 males), the six-year-old group (N = 20, aged 6;1-6;11, M = 6;6, SD = .29, 10 males), the seven-year-old group (N = 20, aged 7;0-7;11, M = 7;5, SD = .30, 10 males) and the eight-year-old group (N = 20, aged 8;0-8;11, M = 8;5, SD = .26, 10 males). All the children were native speakers of Mandarin Chinese who lived in Zhejiang, China. They were typically developing children without language impairment or hearing deficits. All the adults (N = 20, aged 22;0-30;0, M = 26.8, SD = 2.26, 10 males) were native speakers of Mandarin Chinese who studied at the Universitat Autònoma de Barcelona.

4.3.1.2 Materials and design

RCs were elicited using a preference task modeled after Novogrodsky & Friedmann (2006). The experimenter presented two options and asked participants to respond with his/her preference. The method is exemplified in (84a) for subject RCs and in (84b) for object RCs.

(84) a. You liang-ge xiaopengyou. Yi-ge xiaopengyou qin mama. Yi-ge

xiaopengyou qin baba. Ni xiang dang na-ge xiaopengyou?

'There are two children. One child kisses the mother. Another child kisses

the father. Which child do you want to be?'

b. You liang-ge xiaopengyou. Baba qin xiaopengyou. Mama qin

xiaopengyou. Ni xiang dang na-ge xiaopengyou?

'There are two children. The father kisses one child. The mother kisses

another child. Which child do you want to be?'

There were 20 items, half aimed at eliciting subject RCs and half aimed at eliciting object RCs. To build up the stimuli, I employed fifteen verbs. Five verbs were used in both conditions, i.e., *bao* 'hug', *hua* 'draw', *qin* 'kiss', *bang* 'help' and *la* 'hold hands'. Five verbs were only used in the subject RC condition, i.e., *he* 'drink', *chi* 'eat', *mai* 'buy', *xi* 'wash' and *da* 'play' and five verbs only in the object RC condition, i.e., *zhui* 'chase', *han* 'call', *deng* 'wait', *bei* 'carry' and *jie* 'pick up'. All verbs were used transitively, with two noun phrases very familiar to children, including *laoshi* 'teacher', *tongxue* 'classmate' and family members, e.g., *yeye* 'grandpa on father's side', *nainai* 'grandma on father's side', *waigong* 'grandpa on mother's side', *waipo* 'grandma on mother's side', *baba* 'father' and *mama* 'mother'. A list of all experimental items is provided in Appendix B.

4.3.1.3 Procedure

Participants were tested individually in a quiet room in the school. The experimental items were randomized and the whole procedure was recorded on an iPad.

4.3.1.4 Scoring

Responses were classified into three categories: target RC responses, non-target RC responses and Other responses. The target responses included subject RCs like those exemplified in (85a) and object RCs like those exemplified in (85b). The non-target responses included passive RCs in (86a), RCs with resumptive pronouns in (86b) and RCs with resumptive NPs in (86c). Note that, with the passive marker *bei*, the object RC in (86a) is turned into a subject RC. RCs with resumptive NPs (86c) were not considered as errors here in contrast to other studies (Hsu et al., 2009), for reasons that will become clear in section 4.4.

(85) a. qin   mama   de xiaopengyou

      kiss mother DE child

      'the child that kisses the mother'

   b. mama   qin   de xiaopengyou

      mother kiss DE child

      'the child that the mother kisses'

(86) a. bei   mama qin   de   xiaopengyou

      BEI mother kiss DE   child

      'the child that is kissed by the mother'

   b. mama   qin   wo de xiaopengyou

      mother kiss me DE child

      'the child that the mother kisses me'

   c. mama   qin xiaopengyou de xiaopengyou

      mother kiss child   DE child

      'the child that the mother kisses the child'

In (86c), relative heads and resumptive NPs are identical, with the same noun *xiaopengyou* 'child'. Note that relative heads and resumptive NPs are not always identical. In (87a), a demonstrative *na* 'that' and a classifer *ge* precede the relative head *xiaopengyou* 'child'. In (87b), the relative head involves a demonstrative *na*, a classifer *ge* and a NP *ren* 'people', instead of *xiaopengyou* 'child' in (86c) and *na-ge xiaopengyou* 'that child' in (87a)[14]. In (87c), the relative head, i.e., *xiaopengyou* 'child', is omitted. I coded (86c) and (87a-b) as headed RCs with resumptive NPs and (87c) as headless RCs with resumptive NPs.

(87) a. mama   qin xiaopengyou de na-ge   xiaopengyou

       mother kiss child   DE that-CL child

       'the child that the mother kisses the child'

   b. mama   qin xiaopengyou de na-ge   (ren)

       mother kiss child   DE that-CL person

       'the person that the mother kisses the child'

   c. mama   qin xiaopengyou de

       mother kiss child   DE

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

As for Other responses, I further divided them into five types: (i) NP responses, (ii) NP *de* NP responses, (iii) declaratives, (iv) *de* omission responses and (v) reversal RCs.

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[14] Contemori & Belletti (2013, footnote 17) also observed that the resumptive DP is not always a full copy of the relative head in Italian.

The first type represents a simplification, frequently occurring in the younger children. For instance, *mama* 'mother' or *mama xiaopengyou* 'mother child' was used to express "the child that kisses the mother" or "the child that the mother kisses".

The second type included utterances with omission of the verbs, resulting in the phrase NP *de* NP. For example, instead of producing an object RC *mama qin de xiaopengyou* 'the child that the mother kisses', they produced *mama de xiaopengyou* (literally, the child *de* mother), corresponding to a possessive construction "the child of the mother", since *de* in Chinese can also correspond to a possessive marker. In the phrase *mama de xiaopengyou*, the verb, *qin* 'kiss', is omitted.

The third type was a declarative response as exemplified in (88). As a subject RC was elicited, children produced a declarative sentence with a null subject like (88a); as an object RC was elicited, they produced a declarative sentence with a null object like (88b); in both elicitation conditions, an SVO declarative sentence like (88c) was produced. This type of responses is inappropriate because the experiment was designed to answer *Ni xiang dang na-ge xiaopengyou* 'Which child do you want to be'. The sentence started with *wo xiangdang* 'I want to be' requires an NP object. Given that all the sentences in (88d-f) do not satisfy the requirement, they are errors.

(88) a. qin   mama

         kiss mother

         '(the child) kisses the mother'

      b. mama   qin

         mother kiss

         'the mother kisses (the child)'

c. mama   qin   xiaopengyou

   mother kiss   child

   'the mother kisses the child'

d. *Wo xiang dang   qin mama.

   I   want to be   kiss mother

   '*I want to be kisses the mother.'

e. *Wo xiang dang mama   qin.

   I   want   to be mother kiss

   '*I want to be the mother kisses.'

f. *Wo xiang dang   mama qin   xiaopengyou.

   I   want to be mother kiss child

   '*I want to be the mother kisses the child.'

   The fourth type of Other responses is illustrated in (89a), which only occurred
when a subject RC was elicited and was only produced by children. The word order of the
sentence differs from the word order in a declarative sentence in (88c), repeated here as
(89b) for convenience. Given its word order, we could attain the same meaning of a
subject RC and might interpret it as a subject RC with *de* omission, but, importantly,
eliminating *de* makes the sentence ungrammatical as shown in (89c). [15]

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[15] *De* omission responses might also occur when an object RC was elicited. However, we cannot
detect them because the word order of the sentence (NP$_1$-V-(*de*)-NP$_2$) is identical to the word
order of a declarative sentence (NP$_1$-V- NP$_2$). In short, if *de* is omitted in object RCs, the sentence
is identical to (88f) and it is ungrammatical.

(89) a. qin   mama   xiaopengyou

    V NP_1 NP_2

    kiss   mother   child

    'the child *(that) kisses the mother'

b. Mama   qin   xiaopengyou.

   NP_1 V NP_2

   mother   kiss   child

   'The mother kisses the child.'

c. *Wo xiang dang   qin   mama   xiaopengyou.

   I   want   to be   kiss mother child

   'I want to be the child *(that) kisses the mother.'

The final type of Other responses consisted in reversing the thematic role so that a subject RC rather than an object RC was produced. That is, instead of producing the object RC (85b), they produced the subject RC (85a). It was an obvious error and only occurred when an object RC was elicited.

4.3.2   Results

The experiment yielded a total of 2500 responses from children and 400 responses from adults. In both cases, half resulted from the elicitation of subject RCs and the half from the elicitation of object RCs. Section 4.3.2.1 lays out the analysis of target RC responses. Section 4.3.2.2 briefly describes non-target RC responses and then reports the analysis of RCs with resumptive NPs, followed by a comparison with the results in previous studies. Section 4.3.2.3 briefly reports Other responses and section 4.3.2.4 is a summary.

4.3.2.1 The analysis of target responses

Of the 1480 target responses from children, 985 were subject RCs and 495 object RCs. Of the 320 target responses from adults, 200 were subject RCs and 120 object RCs. Table 9 shows the percentages, the raw scores, the means and the standard deviation of target responses in both conditions for all groups. Subject RCs were more frequently produced than object RCs by both children and adults and the proportion of target responses increased with age, at least from three to six years of age.

Table 9. *Percentages (%), raw scores (N), means (M) and standard deviation (SD) of target RC responses in each age group*

Groups	Subject RCs				Object RCs			
	%	N	M	SD	%	N	M	SD
3 y.o.	22	44/200	2.20	2.63	2	4/200	0.20	0.41
4 y.o.	78	186/240	7.75	3.40	33	79/240	3.29	3.29
5 y.o.	89	186/210	8.86	2.33	28	59/210	2.81	4.01
6 y.o.	91	182/200	9.10	2.05	58	116/200	5.80	3.91
7 y.o.	95	189/200	9.45	1.57	56	111/200	5.55	3.80
8 y.o.	99	198/200	9.90	0.48	63	126/200	6.30	3.87
Adult	100	200/200	10.00	0.00	60	120/200	6.00	4.07

These observations are confirmed by the statistical analysis. I fitted responses to a mixed-effects model with sentence type (i.e., subject RC vs. object RC) and age (i.e., 3-, 4-, 5-, 6-, 7- and 8-year-olds and adults) as fixed factors and subjects and items as random factors. The reference categories were object RCs for the sentence type factor and three-year-olds for the age factor. The sentence type factor predicted the ability to produce RCs,

i.e., object RCs were significantly less likely to be produced than subject RCs (χ^2 (1) = 50.87, $p < .001$; Wald $Z = 14.62$, $p < .001$)[16].

As expected, age yielded a significant effect (χ^2 (6) = 97.55, $p < .001$). By changing the reference categories, I compared each age group with other age groups. Table 10 summarizes the results of the statistical analysis. I observed a robust increase in the production of target responses at age four and at age six. Four-year-olds' performance significantly differed from three-year-olds', but did not significantly differ from five-year-olds'. The performance of five-year-olds significantly differed from that of adults, while six-year-olds' performance did not show a significant difference from the adults'. Crucially, given that the eldest child that previous studies tested was six years and five months of age (e.g., Hsu et al., 2009; Su, 2004), and they did not distinguish those of six years of age from those of five years of age, the current study reports for the first time that the production of target-responses does not differ from the adults' from age six.[17]

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[16] SD of subjects = 3.49; SD of items = 0.50; N = 2900; log-likelihood = -983.52; Estimate = 4.14; SE of sentence type = 0.28.

[17] In the subject RC elicitation, five (out of ten) experimental items involved inanimate NPs; but in the object RC elicitation, all the experiment items included animate NPs. Thus, to examine whether the animacy affects the subject RC preference, I additionally ran a statistical analysis which only involved items with animate NPs, namely the five verbs used in the subject RC elicitation as well as in the object RC elicitation. I fitted responses to the mixed-effects model with sentence type (i.e., subject RC vs. object RC) and age (i.e., 3-, 4-, 5-, 6-, 7- and 8-year-olds and adults) as fixed factors and subjects and items as random factors. Again, object RCs were produced significantly less than subject RCs (χ^2 (1) = 53.40, $p < .001$; Wald $Z = 12.07$, $p < .001$; SD of subjects = 3.01; SD of items = 0.34; N = 1450; log-likelihood = -606.44; Estimate = 3.51; SE of sentence type = 0.29). Age yielded a significant effect (χ^2 (6) = 102.37, $p < .001$). By changing the reference categories, each age group was compared with other age groups. Here I only report the detail between age three to age four as an example: SD of subjects = 1.91; SD of items = 1.72; N = 1450; log-likelihood = -581.95; Estimate = -4.56; SE of age = 0.74; Wald Z = 6.17, $p < .001$. The results of these statistical analyses were in line with the results which were analyzed with all the responses of experimental items and have been reported in the body of text.

Table 10. *Summary of the age factor in the mixed-effects model (N = 2900, SD of subjects = 2.41, SD of item= 2.21, log-likelihood = -960.19) for producing target RC*

Groups	Estimate	SE	Wald Z	p
3 y.o. vs. 4 y.o.	4.98	.81	6.14	<.001
4 y.o. vs. 5 y.o.	0.43	.75	0.56	=.57
4 y.o. vs. 6 y.o.	2.10	.77	2.72	<.01
5 y.o. vs. 6 y.o.	1.68	.80	2.01	<.05
6 y.o. vs. 7 y.o.	0.16	.82	0.20	=.84
6 y.o. vs. 8 y.o.	0.82	.82	0.99	=.32
7 y.o. vs. 8 y.o.	0.66	.83	0.80	=.42
5 y.o. vs. adults	2.42	.81	3,00	<.01
6 y.o. vs. adults	0.75	.82	0.91	=.36
7 y.o. vs. adults	0.59	.83	0.72	=.47
8 y.o. vs. adults	-0.07	.83	-0.08	=.93

4.3.2.2 The analysis of non-target responses

Of the 196 non-target RC responses from children, 62 were passive RCs, 41 RCs with resumptive pronouns and 93 RCs with resumptive NPs. Of the 80 non-target RC responses from adults, 35 were passive RCs and 45 RCs with resumptive NPs. Note that all non-target RC responses from adults were obtained in the object RC elicitation task.

Passive RCs were only observed in the object RC elicitation: 4 passive RCs were produced by five-year-old children and 58 were produced by eight-year-old children. This is consistent with the cross-linguistic finding that children master passives at a relatively

This indicates that inanimate NPs in the subject RC elicitation did not significantly affect the object RC disadvantage.

late age (Hirsch & Wexler, 2006; Manetti, 2013). Adults produced 35 passive RCs. Given that the amount of passive sentences was not abundant, I only conducted a Chi-square test to contrast the proportions of passive RCs produced by 8-year-old children and by adults. Although there were descriptively more passives produced by 8-year-olds than by adults, the difference was not significant ($\chi^2(1) = 3.15$, $p > .05$).

Similarly, RCs with resumptive pronouns were only observed in the object RC elicitation. 15 such sentences were produced by four-year-olds, 21 sentences by five-year-olds and 5 sentences by eight-year-olds. This is in line with what has been found across languages (see Contemori & Belletti, 2013; Gavarró, Cunill, Muntané, & Reguant, 2012; Guasti & Cardinaletti, 2003; Labelle, 1990, 1996; Pérez-Leroux, 1995). Note that in the current study the only resumptive pronoun that children produced was *wo* "me", contrary to these aforementioned studies. For instance, in Contemori & Belletti (2013)'s study, both a third person clitic pronoun and a first person clitic pronoun were produced by Italian-speaking children. Following Contemori & Belletti, I think that the first person pronoun used by Chinese-speaking children may refer to an identification of the child refered to in the task.

RCs with resumptive NPs were produced both in the subject RC and in the object RC elicitation by children, but only in the object RC elicitation by adults. Table 11 provides the percentages and number of RCs with resumptive NPs produced by children and adults over the total number of RCs (including target RCs, passive RCs and RCs with resumptives). Of the 93 sentences with resumptive NPs produced by children, 13 were subject RCs and 80 were object RCs. They were observed in every age group, but the majority was produced by younger children: 31 by four-year-olds and 37 by five-year-olds.

Table 11. *Percentages (%) and number (N) of RCs with resumptive NPs in each age group (* stands for "with resumptive NPs" in this and further tables)*

Groups	Subject RCs*		Object RCs*	
	%	N	%	N
3 y.o.	0	0/44	20	1/5
4 y.o.	1.1	2/199	23.6	29/123
5 y.o.	0	0/186	30.6	37/121
6 y.o.	0.5	1/183	0.9	1/117
7 y.o.	4.1	8/197	5.9	7/118
8 y.o.	1	2/200	2.6	5/194
Adults	0	0/200	22.5	45/200

I ran a statistical analysis to see which factors contributed to the fit of the model. I used extraction site (i.e., subject vs. object) and group (i.e., children vs. adults) as fixed factors and subjects and items as random factors. The reference categories were object RCs with resumptive NPs for the extraction site factor and children for the group factor. I found a significant effect of extraction site: object RCs with resumptive NPs were significantly more common than subject RCs with resumptive NPs (χ^2 (1) = 53.63, p < .001; Wald Z = -9.38, p < .001)[18]. No significant effect of age was found (χ^2 (1) = 1.51, p = .22).

The data are in agreement with previous studies as far as children's production is concerned, e.g., in Hsu et al. (2009), children (N = 23, aged 4;0-6;5, M = 4;8) produced 3.3% resumptive NPs in the subject condition (10 out of 296 utterances) and 18.2% in the object condition (38 out of 208 utterances). However, they differed with respect to the

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[18] SD of subjects = 4.84; SD of items = 0, which means that items are quite homogenous; N = 2900; log-likelihood = -319.59; Estimate = -3.45; SE of extraction site = 0.37.

adults' production. In the current study, adults produced 22.5% object RCs with resumptive NPs (45 out of their 200 utterances in the object RC elicitation), while in Hsu et al.'s study, they did so 1.9% (3 out of 169 utterances). I argue that this discrepancy is partly due to the different tasks employed[19] and the smaller number of participants in Hsu et al.'s study (10 adults vs. 20 adults in the current study).

I also examined the individual performance to see if every participant consistently produced resumptive NPs. Table 12 shows the percentages and number of participants who produced subject and object RCs with resumptive NPs at least once in each age group. The number of children at four and five years of age was higher than that in the older groups and the number of adults was also high. In addition, I counted the number of participants who produced them at least five times (out of 10). Regarding subject RCs with resumptive NPs, 1 (out of 20) seven-year-olds produced them more than five times. Regarding object RCs with resumptive NPs, 3 (out of 24) four-year-olds, 4 (out of 21) five-year-olds and 4 (out of 20) adults produced them at least five times. This observation indicated that some individuals allow resumptive NPs freely, at least in object RC elicitation.

As mentioned earlier, relative heads and resumptive NPs are not always identical. In the current data, of the 93 sentences produced by children, 45 were headed RCs with resumptive NPs and 58 headless RCs with resumptive NPs. Among the headed RCs with resumptive NPs, 42.2% (19 out of 45 utterances) were sentences in which resumptive

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[19] Contemori & Belletti (2013) elicited RCs by using two tasks: a picture description task and the preference task that I used here. Italian children produced more RCs with resumptive NPs in the latter than in the former ($p = .054$). They interpreted the difference as a task-related effect. In their study, only children produced resumptive NPs, but not adults, the same as in Catalan (Gavarró, Cunill, Muntané, & Reguant, 2012).

Table 12. *Percentages (%) and number (N) of participants who produced RCs with resumptive NPs in each age group*

Groups	Subject RCs*		Object RCs*	
	%	N	%	N
3 y.o.	0	0	5	1/20
4 y.o.	8.3	2/24	37.5	9/24
5 y.o.	0	0	38.1	8/21
6 y.o.	5	1/20	5	1/20
7 y.o.	10	2/20	25	5/20
8 y.o.	5	1/20	20	4/20
Adults	0	0	45	9/20

NPs are identical to relative heads; 57.8 % (26 out of 45 utterances) were those in which resumptive NPs are not identical to their relative heads. Of the 45 sentences produced by adults, all were headed RCs with resumptive NPs; 71.1% (32 out of 45 utterances) were identical and 28.9% (13 out of 45 utterances) were not. It is interesting that only children produced headless RCs with resumptive NPs and importantly, *na + classifier* 'that' (e.g., *na-ge*) often occurred before relative heads in children's and adults' production.

4.3.2.3 The analysis of Other responses

To investigate what children do when they fail to produce RCs, I examined the different types of responses (including errors). The experiment yielded 824 sentences in the category of Other responses from children. Adults did not produce any sentence in this category. Table 13 and Table 14 provide the percentages and number of Other responses in each age group.

Table 13. *Percentages (%) and number (N) of different errors in each age group in the subject RC elicitation (V-NP, NP-V-NP and Reduced RCs stand for a declarative sentence with a null subject, a declarative sentence and subject RCs with de omission respectively, in this and further tables)*

	NP		NP *de* NP		V-NP		NP-V-NP		Reduced RCs	
	%	N	%	N	%	N	%	N	%	N
3 y.o.	25	50/200	4.5	9/200	38	76/200	10.5	21/200	0	0
4 y.o.	8.8	21/240	2.5	6/240	10	24/240	0.4	1/240	0	0
5 y.o.	1.4	3/210	0.5	1/210	4.3	9/210	2.4	5/210	2.9	6/210
6 y.o.	0	0	1	2/200	0	0	7.5	15/200	1	2/200
7 y.o.	0	0	0	0	0	0	1.5	3/200	0	0
8 y.o.	0	0	0	0	0	0	0	0	0	0
Adults	0	0	0	0	0	0	0	0	0	0

Table 14. *Percentages (%) and number (N) of different errors in each age group in the object RC elicitation (NP-V stands for a declarative sentence with a null object)*

	NP		NP *de* NP		NP-V		NP-V-NP		Reversal RCs	
	%	N	%	N	%	N	%	N	%	N
3 y.o.	53	106/200	7	14/200	2	4/200	34	68/200	1.5	3/200
4 y.o.	9.2	22/240	9.2	22/240	2.5	6/240	26.3	63/240	1.7	4/240
5 y.o.	1.9	4/210	6.2	13/210	0.5	1/210	31.4	66/210	2.4	5/210
6 y.o.	0	0	0	0	0	0	39.5	79/200	1.5	3/200
7 y.o.	0	0	0.5	1/200	0	0	36	72/200	4.5	9/200
8 y.o.	0	0	0	0	0	0	2.5	5/200	0.5	1/200
Adults	0	0	0	0	0	0	0	0	0	0

First, the typical responses for younger children were to answer with an NP[20], an NP *de* NP and a declarative sentence with a null subject or a null object (V-NP and NP-V respectively). As we can see in the two tables, the NP and NP *de* NP responses were more common in the object RC elicitation than in the subject RC elicitation (e.g., for three-year-olds, NP, 53% vs. 25%; NP *de* NP, 7% vs. 4.5%). In contrast, the NP-V responses in the object RC elicitation were less frequent than the V-NP responses in the subject RC elicitation (e.g., for three-year-olds, 2% vs. 38%).

The statistical analysis confirmed this observation for the age groups from three- to five-year-olds. I fitted responses to a mixed-effects model with condition (i.e., subject vs. object RC elicitation) and age (i.e., 3-, 4- and 5-year-olds) as fixed factors and subjects and items as random factors. As for the NP responses, I found a significant effect of condition ($\chi^2(1) = 19.09$, $p < .001$; Wald $Z = -4.59$, $p < .001$)[21] and age. There was a significant decrease from age three to age four ($\chi^2(2) = 38.15$, $p < .001$; Wald $Z = -4.16$, $p < .001$)[22], but not from age four to age five (Wald $Z = -0.63$, $p = .53$). As for the NP *de* NP responses, a significant effect of condition was found ($\chi^2(1) = 13.29$, $p < .001$; Wald $Z = -3.97$, $p < .001$)[23], but not of age ($\chi^2(2) = 0.86$, $p = .65$). As for the V-NP and NP-V responses, a significant effect of condition ($\chi^2(1) = 35.21$, $p < .001$; Wald $Z = 7.12$, p

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[20] Contemori & Belletti (2013) also observed that 3-year-old Italian children produced a high number of DPs in the plural head condition. In the current study, Chinese children were much more likely to produce them than their Italian peers (53% vs. 27%, in the object RC elicitation task). This pattern was not observed in the older children neither in Chinese nor in Italian.

[21] SD of subjects = 6.78; SD of items = 0.50; N = 1300; log-likelihood = -277.75; Estimate = -1.60; SE of condition = 0.35.

[22] SD of subjects = 3.24; SD of items = 0.94; N = 1300; log-likelihood = -268.22; Estimate = -5.71; SE of age = 0.78.

[23] SD of subjects = 3.87; SD of items = 0.41; N = 1300; log-likelihood = -188.29; Estimate = -1.56; SE of condition = 0.39.

$< .001)^{24}$ and age were found. There was a significant decrease from age three to age four ($\chi^2(2) = 30.57$, $p < .001$; Wald $Z = -3.90$, $p < .001)^{25}$, but not from age four to age five (Wald $Z = -1.07$, $p = .29$).

Second, declarative sentences (NP-V-NP) were very common, especially when object RCs were elicited, and especially in children from three to seven years of age. The statistical analysis supported this observation. I fitted responses to a mixed-effects model with condition (i.e., subject vs. object RC elicitation) and age (i.e., 3-, 4-, 5-, 6-, 7- and 8-year-olds) as fixed factors and subjects and items as random factors. Children were significantly more likely to use declarative sentences when they failed to produce object RCs than subject RCs ($\chi^2(1) = 55.91$, $p < .001$; Wald $Z = -13.58$, $p < .001)^{26}$. As for the age factor, the only significant decrease was observed from age seven to age eight ($\chi^2(5) = 29.68$, $p < .001$; Wald $Z = -3.09$, $p < .01)^{27}$. No significant decrease was observed across other age groups[28].

In addition, as shown in Table 13, reduced RCs, namely, subject RCs with *de* omission were very rare, with only 8 sentences being observed in the subject RC elicitation and only being produced by children at five and six years of age.

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[24] SD of subjects = 3.13; SD of items = 0.53; N = 1300; log-likelihood = -249.45; Estimate = 3.66; SE of condition = 0.51.

[25] SD of subjects = 2.62; SD of items = 1.98; N = 1300; log-likelihood = -251.77; Estimate = 3.80; SE of age = 0.98.

[26] SD of subjects = 3.41; SD of items = 0.38; N = 2500; log-likelihood = -568.60; Estimate = -4.41; SE of condition = 0.32.

[27] SD of subjects = 3.15; SD of items = 2.33; N = 2500; log-likelihood = -581.72; Estimate = -5.42; SE of age = 1.76.

[28] From age three to age four (Wald $Z = -1.48$, $p = .14$), from age four to age five (Wald $Z = 0.53$, $p = .60$), from age five to age six (Wald $Z = 1.31$, $p = .19$) and from age six to age seven (Wald $Z = -0.63$, $p = .53$).

Finally, as shown in Table 14, reversal RCs were observed in every age group, but was very rare in contrast to what is reported in research on other languages (e.g., Gavarró, Cunill, Muntané, & Reguant, 2012; Guasti & Cardinaletti, 2003).

To sum up, the results suggest that subject RCs are adult-like sooner than object RCs and, importantly, the response pattern of the six- and seven-year-olds differed from that of the eight-year-olds (e.g., the declarative response was still common in the former age groups, but not in the latter age group), although their production of what I have termed target RCs did not differ.

4.3.2.4 Summary

The findings of the current study can be summarized as follows. First, the subject/object asymmetry was observed in children and in adults, with an advantage for subject RCs. Second, object RCs were transformed into subject RCs through passive from eight-year-old children and adults, in a similar way. Third, children used resumptive pronouns, while adults did not. Although this is in line with what has been found in other studies, I must stress that the amount of resumptive pronouns in Chinese seems to be lower than in other languages. Fourth, both children and adults produced RCs with resumptive NPs and no difference was observed between children and adults (in clear contrast with what has been found in other languages). Children showed the same pattern as in previous studies: they produced more resumptive NPs in the object extraction site than that in the subject extraction site. In contrast, adults produced them only in the object extraction site, but their occurrence was much more frequent than that in previous studies. The use of resumptive NPs may be the result of an error that adults inadvertently made or an option in the spoken language. Since RCs with resumptive NPs are forbidden in

prescriptive grammar, I ran a grammaticality judgment task with adults to establish whether resumptive NPs are an option in their grammars.

4.4   Experiment 4

The data in Experiment 3 showed the surprising outcome that adults produced RCs with resumptive NPs. Although this possibility is banned in written Chinese (Hsu et al., 2009), the data suggest that they may be licit in spoken Chinese. I also observed that resumptive NPs and relative heads are not always identical: *na + classifier* 'that' (e.g., *na-ge*) often occurred before relative heads. In Experiment 4, what I set out to do is to investigate the acceptability of RCs with resumptive NPs and then to see the impact of *na + classifier* 'that'.

In Chinese, the basic component of a nominal phrase is a noun as *xiaopengyou* 'child' in (90), and a demonstrative *na* 'that', a number *yi* 'one' and a classifier *ge* may occur before the noun, as I mentioned earlier. A classifier can come after a demonstrative directly (90b), with the same interpretation as in (90a). I illustrate the structure of a full nominal phrase in (90c): a noun is generated in N, a classifier in Cl, a number in Num and a demonstrative in D (for a review of alternative approaches, see Tang, 2007).

(90) a. na   yi   ge   xiaopengyou

          that   one   CL   child

          'that child'

       b. na   ge   xiaopengyou

          that CL   child

          'that child'

c.

```
          DP
         /  \
        D   NumP
            /  \
          Num  ClP
               /  \
              Cl   NP
```
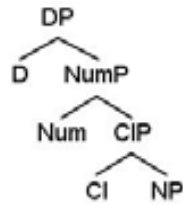
Classifiers interact in interesting ways with the comprehension of RCs (Lin & Bever, 2011). The classifiers can be used to indicate the potential phrasal boundaries, since there is a semantic agreement between classifiers and noun phrases. For instance, the classifier *pian* in (91a) denotes the relative head *wenzhang* 'article', while the classifier *wei* in (91b) denotes *xuesheng* 'student' which is the subject of the embedded clause.

(91) a. Laoshi xihuan na-si-pian$_i$ xuesheng xie   de wenzhang$_i$.

      teacher like   that-four-CL (article) student   write DE article

      'The teacher likes the four articles that the students wrote.'

    b. Laoshi xihuan na-si-wei$_i$ xuesheng$_i$ xie   de wenzhang.

      teacher like   that-four-CL (human) student   write DE article

      'The teacher likes the article that the four students wrote.'

In the current study, I do not discuss the semantic agreement between classifiers and noun phrases, since all the noun phrases I used were human and the classifiers directly precede the relative heads. What concerns me here is the relation between the relative head and its copy and the impact of the demonstrative plus the classifier (i.e., *na + classifier*) as they come before the relative head.

4.4.1   Method

4.4.1.1 Participants

Eighty undergraduate students (aged 18;1-23;0, M = 20;9, SD = .92, 16 males) volunteered to participate in the experiment. All were native speakers of Mandarin Chinese and studied in Zhejiang, China.

4.4.1.2 Materials and design

Experiment 4 consisted of Task A and Task B. In Task A, relative heads and resumptive NPs were identical, as exemplified in (92); in Task B, they were not identical, namely, *na + classifier* "that" precedes relative heads, as exemplified in (93). Briefly, the difference between two tasks was whether there is a *na + classifier* "that" prior to relative heads or not.

(92)   a. Subject RCs

Wo xiang dang [_i qin   nainai   de] piaoliang sunnü_i.

I   want to be   kiss grandma   DE pretty granddaughter

'I want to be the pretty granddaughter that kisses the grandma.'

b. Subject RCs with resumptive NPs

Wo xiang dang [sunnü_i   qin nainai   de] sunnü_i.

I   want to be   granddaughter kiss grandma DE granddaughter

'I want to be the granddaughter that (the granddaughter) kisses the grandma.'

c. Object RCs

Wo xiang dang [nainai   qin _i de] piaoliang sunnü_i.

I   want to be grandma kiss   DE pretty granddaughter

'I want to be the pretty granddaughter that the grandma kisses.'

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d. Object RCs with resumptive NPs

Wo xiang dang [nainai   qin sunnü$_i$ de] sunnü$_i$.

I   want to be grandma kiss granddaughter DE granddaughter

'I want to be the granddaughter that the grandma kisses (the

granddaughter).'

(93) a. Subject RCs

Wo xiang dang [_$_i$ qin   nainai   de] na-ge   piaoliang sunnü$_i$.

I want to be   kiss grandma DE that-CL pretty   granddaughter

'I want to be the pretty granddaughter that kisses the grandma.'

b. Subject RCs with resumptive NPs

Wo xiang dang [sunnü$_i$ qin nainai   de] na-ge   sunnü$_i$.

I   want to be granddaughter kiss grandma DE that-CL granddaughter

'I want to be the granddaughter that (the granddaughter) kisses the

grandma.'

c. Object RCs

Wo xiang dang [nainai   qin   _$_i$ de] na-ge   piaoliang sunnü$_i$.

I want to be   grandma kiss   DE that-CL pretty   granddaughter

'I want to be the pretty granddaughter that the grandma kisses.'

d. Object RCs with resumptive NPs

Wo xiang dang [nainai   qin sunnü$_i$ de] na-ge   sunnü$_i$.

I want to be   grandma kiss granddaughter DE that-CL granddaughter

'I want to be the granddaughter that the grandma kisses (the

granddaughter).'

For each task, I prepared 12 sets of sentences including four variants for a total of 48 sentences. Each set included subject and object RCs with or without resumptive NPs, as exemplified in (92) for Task A and in (93) for Task B. To build up the stimuli, I employed 12 reversible verbs: *bao* 'hug', *hua* 'draw', *qin* 'kiss', *bang* 'help', *zhui* 'chase', *bei* 'carry', *han* 'call', *jiao* 'teach', *kan* 'look at', *xuan* 'choose', *pai* 'photograph' and *qian* 'hold hands'. Of these, seven verbs appeared also in Experiment 3.

In each task, the target sentences were split into four lists, with each list including one sentence from each of the 12 sets using a Latin square design. All sentences had an identical length of Chinese characters (each character corresponding to a syllable). In order to make sentences of the same length, an adjective, for instance *piaoliang* 'pretty' in (92a), was added before the head noun, namely, *sunnü* 'granddaughter'. A complete list of the stimuli is presented in Appendix C.

In addition, each list was combined with 12 filler sentences. Among filler sentences, 3 were subject RCs with resumptive pronouns as in (94a) and 3 were object RCs with resumptive pronouns as in (94b).

(94) a. Subject RCs with resumptive pronouns

Wo xiang dang [ta$_i$ chang erge   de] nühushi$_i$.

I   want to be   she sing   child's song DE female nurse

'I want to be the female nurse that she sings child's songs.'

b. Object RCs with resumptive pronouns

Wo xiang dang [yeye   jie   ta$_i$ de] xiaoguniang$_i$.

I   want to be   grandpa pick up her DE   little girl

'I want to be the little girl that the grandpa picks her up.'

The filler sentences were randomly interspersed between items. Therefore, each list contained one version of each experimental set, along with 12 filler sentences, for a total of 24 experimental sentences.

Each sentence was judged by the subjects on a five-category scale, with 1 as "completely acceptable", 2 as "acceptable", 3 as "I am not sure", as "unacceptable" and as "completely unacceptable". In order to avoid an influence of the order of the scale, half of the participants were asked to judge sentences with a reversed order, namely with 1 meaning "completely unacceptable" rather than "completely acceptable".

4.4.1.3 Procedure

Stimuli were presented in a randomized order. The participants were tested orally (also to avoid the impact of the standard writing conventions) and they recorded their responses on an answer sheet.

4.4.1.4 Scoring

I assigned the response of "completely acceptable" and "acceptable" a "1", the response of "unacceptable" and "completely unacceptable" a "0" and coded the response of "I am not sure" as "other" to run statistical analyses.

4.4.2   Results

In this section, I compare the results of different structures as judged by adults. I also take into account the possible variability in grammaticality judgment across speakers by examining individual performance. Section 4.4.2.1 lays out the analysis of Task A;

section 4.4.2.2 the analysis of Task B. In section 4.4.2.3, I compare the results of Task A

and Task B. Finally, I give a summary in section 4.4.2.4.

4.4.2.1 The analysis of Task A

Adults accepted RCs with gaps 70% of the time (SD = 0.46) in the subject

condition and 67% of the time (SD = 0.47) in the object condition. As for RCs with

resumptive NPs, they accepted them 48% of the time (SD = 0.50) in the subject condition

and 38% of the time (SD = 0.48) in the object condition. Clearly, the acceptance rates of

RCs with gaps were higher than those of RCs with resumptive NPs and this was

confirmed by the statistical analysis. However, adults accepted RCs with resumptive NPs

to some extent.

I fitted responses to the model with resumption (i.e., RCs with gaps vs. RCs with

resumptive NPs) and extraction site (i.e., subject vs. object) as fixed factors and subjects

and items as random factors. The reference categories were RCs with gaps for the

resumption factor and object for the extraction site factor. I found a significant effect of

resumption (χ^2 (1) = 45.56, p < .001; Wald Z= -6.94, p < .001)[29], which indicates that

RCs with resumptive NPs were less likely to be accepted as compared to RCs with gaps.

As for the extraction site, I did not find a significant difference (χ^2 (1) = 1.26, p = .26).

Therefore, when I considered the individual performance, I did not distinguish between

subject RCs and object RCs, but only between a gap and a resumptive NP.

Next, I counted the number of participants who accepted each structure six times

(out of 6), and the number of participants who rejected each structure six times (out of 6).

There were 18 (out of 80, i.e., 22.9%) participants who accepted RCs with gaps all the

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[29] SD of the subject = 1.47; SD of items = 0.32; N = 819; log-likelihood = -447.48; Estimate = -1.26; SE of resumption = 0.18.

time. One participant rejected all RCs with gaps all the time, but he also rejected RCs with resumptive NPs five times (out of 6) and was discarded from further analysis. As for RCs with resumptive NPs, there were 8 (out of 79, i.e. 10.1 %) participants who accepted it all the time, and 10 (out of 79, i.e., 12.7%) participants who rejected it all the time. Among these 18 participants, 3 also accepted RCs with gaps all the time. Thus, there remain 46 (out of 79, i.e., 58.2%) participants who accepted RCs both with and without resumptive NPs from one to five times. This seems to suggest that Mandarin-speaking adults do accept RCs with resumptive NPs. That is, these RCs are not ruled out as ungrammatical by the majority of the participants interviewed. Thus, it is not surprising that they emerged in the spoken language.

4.4.2.2 The analysis of Task B

In the second task, as for RCs with gaps and *na + classifier* "that", adults accepted them 73% of the time (*SD* = 0.44) in the subject condition and 73% of the time (*SD* = 0.44) in the object condition. As for RCs with resumptive NPs and *na + classifier* "that", they accepted them 61% of the time (*SD* = 0.49) in the subject condition and 57% of the time (*SD* = 0.50) in the object condition. In line with the results of Task A, the acceptance rates of RCs with gaps were higher than those of RCs with resumptive NPs.

The model was fitted to the data that included resumption (i.e., RCs with gaps vs. RCs with resumptive NPs) and extraction site (i.e., subject vs. object) as fixed factors, and subjects and items as random factors. The reference categories were RCs with gaps for the resumption factor and object for the extraction site factor. As expected, RCs with resumptive NPs were significantly less acceptable than RCs with gaps (χ^2 (1) = 21.56, *p*

< .001; Wald Z = -4.67, p < .001)[30]. As for extraction site, again, I did not find a significant difference (χ^2 (1) = 0.02, p = .89).

I also examined the individual performance in Task B. One participant was discarded from further analysis, because he rejected all RCs with gaps and also RCs with resumptive NPs five times (out of 6). For the remaining 79 participants, there were 23 (or 29.1%) participants who accepted RCs with gaps all the time. As for RCs with resumptive NPs, there were 15 (out of 79, i.e. 19 %) participants who accepted them all the time, and 6 (out of 79, i.e., 7.6%) participants who rejected them all the time. Among these 21 participants, 9 also accepted RCs with gaps all the time. Thus, there remain 44 (out of 79, i.e., 55.7%) participants who accepted RCs both with and without resumptive NPs from one to five times. In line with the results of Task A, Mandarin-speaking adults do accept RCs with resumptive NPs.

4.4.2.3 The comparison of Task A and Task B

In this section, I compare the results of Task A (without *na + classifier*) and Task B (with *na + classifier*) in order to investigate the role of the factor *na + classifier* 'that'. As shown in Table 15, the proportion of acceptability of resumption in Task A is much lower than that in Task B, but that of RCs with gaps in Task A is similar to that in Task B.

Table 15. Percentages (%) of acceptability (* stands for "with resumptive NPs")

Sentence types	Subject RCs	Object RCs	Subject RCs*	Object RCs*
Task A	70	67	47	38
Task B	73	73	61	57

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[30] SD of the subject = 1.69; SD of items = 0.41; N = 833; log-likelihood = -375.61; Estimate = -0.98; SE of resumption = 0.21.

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The statistical analysis confirmed the descriptive observation. I combined the original dataset of the two tasks. The fixed factor was *na + classifier* (i.e., without *na + classifier* in Task A vs. with *na + classifier* in Task B) and the reference category was without *na + classifier*. I found a significant effect of *na + classifier* (χ^2 (1) = 36.89, *p* < .001; Wald *Z* = 6.11, *p* < .001)[31]. In addition, I compared the subset data of RCs with resumptive NPs in the two tasks. Crucially, there was a significant effect of *na + classifier* in RCs with resumptive NPs (χ^2 (1) = 35.04, *p* < .001; Wald *Z* = 5.99, *p* < .001)[32]. This suggests that RCs with resumptive NPs are significantly more acceptable when the *na + classifier* precedes the relative head.

I also compared the number of participants who accepted or rejected RCs with resumptive NPs at least six times (out of 6) in two tasks. As reported earlier, in task A, there were 8 (out of 79) participants who accepted RCs with resumptive NPs and 10 (out of 79) participants who rejected them. In task B, there were 15 (out of 79) participants who accepted RCs with resumptive NPs and 6 (out of 79) participants who rejected them. Clearly, more participants in Task B accepted resumptive NPs than in Task A, and less participants in the former rejected them than in the latter.

In addition, I investigated the acceptability of RCs with resumptive pronouns. The proportion of acceptability of subject RCs with resumptive pronouns was 40%, while that of object RCs with resumptive pronouns was 42%. Given that there were only 3 sentences in each condition, I cannot run a comparative statistical analysis with resumptive NPs and

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[31] SD of the subject = 1.55; SD of items = 0.45; N = 1652; log-likelihood = -817.70; Estimate = -0.79; SE of *na + classifier* = 0.13.

[32] SD of the subject = 2.21; SD of items = 0.37; N = 788; log-likelihood = - 397.13; Estimate = -1.19; SE of *na + classifier* = 0.20.

discuss this issue further. What I can suggest at this point is that resumptive pronouns are also accepted by some Mandarin-speaking individuals like resumptive NPs[33].

4.4.2.4 Summary

To sum up, at the group level, the gap strategy was preferred as shown by the statistical analysis. At the individual level analysis, there is variation and, importantly, there are many participants who accept the two structures and thus accept both options. In addition, I found that the presence of the *na + classifier* enhances the acceptance of RCs with resumptive NPs. Together with the results of Experiment 3, I therefore suggest that RCs with resumptive NPs are an option available in the spoken language, inconsistent with the prescriptive grammar.

4.5   Comprehension vs. Production

Given that the experimental design and the participants were different, a cross-experiment comparison has to be done cautiously. Nevertheless, I report a tentative and descriptive comparison between the results from the comprehension and production experiments (Experiment 2 vs. Experiment 3). Table 16 shows the percentages and the raw scores of the correct responses for each sentence type in each experiment. Note that the correct responses of production in the table include target RCs, passive RCs and RCs with resumptives (given the conclusions of section 4.4).

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[33] It is well-documented that a pronoun must occur in the indirect object position of the embedded clause (Li & Thompson, 1981, among others, for a rich literature), as exemplified below.

(i) Wo song gei *(ta)   yi-ben xiaoshuo de   ren

  I give   to   (him) one-CL novel   DE person

  'the person to whom I gave a novel'

Table 16. *Percentages (%) and raw scores (N) of correct responses in comprehension (Experiment 2) and production (Experiment 3) in each age group*

Groups	Comprehension				Production			
	Subject RCs		Object RCs		Subject RCs		Object RCs	
	%	N	%	N	%	N	%	N
3 y.o.	47.8	75/157	24.8	39/157	22	44/200	3	5/200
4 y.o.	61.3	98/160	23	37/160	78	188/240	51	123/240
5 y.o.	72.5	116/160	20.6	33/160	89	186/210	58	121/210
6 y.o.	76.3	122/160	45	72/160	92	183/200	59	117/200
7 y.o.	99.4	159/160	45.6	73/160	99	197/200	59	118/200
8 y.o.	100	160/160	95.6	153/160	100	200/200	97	194/200
Adult	100	160/160	100	160/160	100	200/200	100	200/200

Table 16 shows a clear asymmetry between subject RC and object RC condition for children from age three to age seven and, importantly, children at eight years of age performed at ceiling.

The table also shows a difference between comprehension and production. In the course of development of subject RC acquisition, children at six years of age still have some difficulties in comprehension, but they can produce these sentences at ceiling. For object RC acquisition, there is a robust increase in comprehension from age five to age six, but no increase at the same ages in production.

The comparison also shows that children from four to seven years of age scored higher on production than on comprehension, subject RC comprehension catching up subject RC production at seven years of age. This observation is contrary to the almost unanimous assumption that language comprehension precedes language production. However, the relation between comprehension and production is difficult to pin down. As

found in many previous studies, the different tasks used can lead to conclude that either comprehension is better than production or not (e.g., Fraser, Bellugi, & Brown, 1963; Håkansson & Hansson, 2000). In the present study, the complexity in the character-sentence matching task may be used to explain the delay of comprehension. This view is supported by the fact that children, no matter which languages they speak, did much better in a picture-sentence matching task than in a character-sentence matching task.

To sum up, on the one hand, the comprehension study and the production study both show a subject RC preference for children up to seven years of age and an adult-like performance at age eight, suggesting a parallel development. On the other hand, the two studies also reveal differences in the course of development of RC acquisition, which implies that production and comprehension may involve different additional mechanisms.

4.6   General discussion

Using an elicitation task (Experiment 3), I found a clear subject advantage for RCs in children that persists as children grow older, in line with the comprehension findings reported in chapter 3. The same asymmetry in production was found amongst adults. Unlike what happens in other languages, RCs with resumptive NPs were produced by children in each age group and by adults. Using a grammaticality judgment task (Experiment 4), I found that, for many native speakers of Mandarin Chinese, RCs with resumptive NPs are well-formed in spoken Chinese, inconsistent with the prescriptive grammar. In this section, I first discuss the subject/object asymmetry and then turn to the finding on Mandarin RCs with resumptive NPs.

As predicted by the RM approach children produced more subject RCs than object RCs. In fact, there is no intervention between the relative head and its trace in subject RCs, while there is a structural intervener in object RCs between the relative head and its

trace, i.e., the subject of the embedded clause. In particular, as illustrated earlier, repeated in (95) for convenience, the relative head bears [+R, +NP] features and the embedded subject bears the [+NP] feature, i.e., a subset of the features of the relative head.

(95) a. Object RCs

[waipo   hua t$_i$ de] xiaopengyou$_i$

grandma   draw   DE child

'the child that the grandma draws'

b.
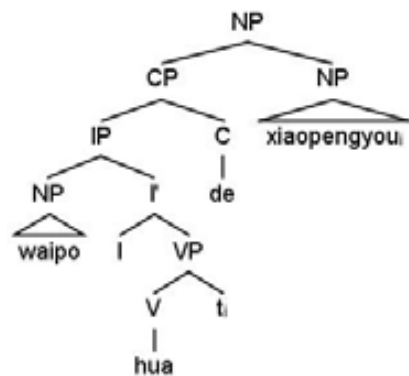
In adult grammar, RM applies when the intervener is identical in features with the target. In order to establish that the relative head and the embedded subject are not identical, one needs to compute a subset relation in the case of RCs. However, this computation is argued to be too demanding for children, which sometimes fail and treat the intervener as sufficiently similar to the target. Being similar, RM applies and the structure is not produced or is simplified. As children grow older, their computational resources increase and they become able to compute the subset relation. As a consequence, object RCs become more accessible to them (see also Belletti & Rizzi, 2013).

In line with what has been found in studies in other languages, I can argue that Chinese children circumvent the intervention problem with different strategies depending

on their age and on the syntactic resources they are endowed with, e.g., the younger children mainly resort to the simplification strategy (the NP, NP *de* NP, NP-V and V-NP responses), while the older children adopt passive RCs as adults.

Importantly, resumptives were produced by children across all age groups. Four- and five-year-olds showed a similar preference for resumptive pronouns and resumptive NPs. From age six on, children's resumptive responses decreased; this change may be related to the exposure to formal instruction, which starts at six years. Note that with respect to resumptive NPs, although the proportion of responses decreased, many older children still produced them. Given that adults produced them as well, this is not unexpected. As for the adoption of the resumptive strategy, I assume with McKee & McDaniel (2001) that it stems for the production system's inability to keep track of the antecedent-trace relation. This happens in Mandarin RCs as the trace occurs before the relative head and more frequently in the object than in the subject condition, because the trace in the former is structurally deeper than that in the latter. Notice that a linear account would predict just the opposite, as the trace is linearly closer to the relative head in object RC than in subject RC. Similar findings are reported in recent research on *wh*-questions in Italian Sign Language (LIS; Branchini, Cardinaletti, Cecchetto, Donati, & Geraci, 2013). In their corpus data, they found 13% samples in which the *wh*-phrase moves to the right and the trace in situ is also pronounced (notice that Italian Sign Language is SOV).

Regarding adult production (Experiment 3) and grammaticality judgments (Experiment 4), I found a coherent picture: adults produced RCs with resumptive NPs and, expectedly, they accepted them, with variability across participants being observed and showing a certain tension between prescriptive grammar and their internalized grammar. All in all, I propose that RCs with resumptive NPs are target-like, inconsistent with the prescriptive grammar which claims that they are errors.

RCs with resumptive NPs are rare cross-linguistically in adult grammar (Cinque, 2013). In addition, Mandarin Chinese is an SVO language with pre-nominal RCs, which is extremely rare as mentioned in section 2.3. The RC being prenominal in Chinese, both the relative marker and the relative head are linearized to the right of the relative clause. In production, when the structure of the sentence is planned and the relative head has not been pronounced yet, the relative head must be kept in working memory until the sentence planning is completed. This may introduce a heavy computational burden. In order to decrease this memory burden, the production system is looking for the gap as soon as possible and when it encounters the gap, it may be spelt out. In comprehension, under the incremental parsing model (Stevenson, 1998, among others), the arguments are interpreted incrementally and united into the structure of the sentence by means of the use of language-specific grammatical information. Let us consider the step-by-step parsing of the type of sentence under scrutiny. Take (93d), repeated here in (96) for convenience.

(96) Wo xiang dang [nainai   qin sunnü$_i$ de] na-ge   sunnü$_i$.

 I   want to be grandma kiss granddaughter DE that-CL   granddaughter

 'I   want   to   be   the   granddaughter   that   the   grandma   kisses   (the granddaughter).'

When the first NP *nainai* 'grandma' reaches the parser, the parser constructs the NP as the object of the matrix sentence, namely, *wo xiangdang nainai* 'I want to be the grandma'. However, the verb *qin* 'kiss' rejects this parse. As the parser receives *de*, it takes it as the relative marker and meanwhile waits for the relative head. As soon as the relative head, *na-ge sunnü* 'that granddaughter', is spelled out by the speaker, the parser assigns a theta role to it and reconstructs the sentence.

Another finding in Experiment 4 was the enhancing role played by *na + classifier* in the acceptance rates of RCs with resumptive NPs. In order to explain this, I offer the following speculation in adult grammar: featural specification of relative heads with *na + classifier* is much richer than that without *na + classifier* and the richer featural specification of relative heads make it more easily distinct from the copy. I take resumptive NPs in the object extraction site as examples. As illustrated in (97), structurally, featural specifications of the relative head and its copy are distinct because the relative head has an additional [+R] feature under a raising analysis. However, if we disregard the [+R] feature, their featural specifications are identical, both only holding a [+NP] feature.

(97) RC with resumptive NPs and without *na+ classifier* (Task A)

nainai   qin sunnü$_i$ de   sunnü$_i$

               [+NP]   [+R, +NP]

grandma kiss granddaughter DE granddaughter

'the granddaughter that the grandma kisses (the granddaughter)'

In contrast, in (98), the copy of the relative head has a [+NP] feature, whereas the relative head has [+R], [+Dem], [+Cl] and [+NP] features, where [+Dem] represents the demonstrative and [+Cl] represents the classifier. Here, the featural specification of the relative head is much richer than that of the copy. Structurally, their featural specifications are distinct because the relative head has an additional [+R], [+Dem] and [+Cl] feature. Moreover, if we disregard the [+R] feature, their featural specification are still distinct because the relative head still has [+Dem] and [+Cl] features which are not shared by the features of the copy.

(98) RCs with resumptive NPs and *na+ classifier* (Task B)

nainai   qin   sunnü$_i$ de   na-ge   sunnü$_i$

             [+NP]   [+R, +Dem, +Cl, +NP]

grandma   kiss   granddaughter   DE   that-CL   granddaughter

'the granddaughter that the grandma kisses (the granddaughter)'

Building upon this line of thought, a follow-up question might be interesting to address in future research. Consider (99).

(99) ?nainai   qin   na-ge   sunnü$_i$ de   sunnü$_i$

               +Dem, +Cl, +NP   +R, +NP

 grandma kiss   that-CL   granddaughter   DE   granddaughter

'the granddaughter that the grandma kisses (that granddaughter)'

In (99), *na+classifier* precedes the copy of the relative head. Structurally, featural specification of the relative head and its copy are distinct because the relative head has an additional [+R] feature and the copy has additional [+Dem] and [+Cl] features; if we disregard the [+R] feature, they are still distinct. It is possible that acceptability of (99) might be also higher than for the RC without *na+classifier* in (97). In addition, it is worth pointing out that (98) and (99) are different. In (98), the copy only has a [+NP] feature which is a subset of features of the relative head, whereas in (99), the copy has not only a [+NP] feature but also [+Dem] and [+Cl] features which are distinct from the relative head's.

Another open question is the status of resumptive NPs, although there is some straightforward evidence for analyzing it as a copy of a moved element. Consider (100).

(100) a. *Wo xiang kan [na-ge   [ni [yinwei t_i bu hui lai] hen shengqi de]

   I   want see   that-CL you because   not will come very angry DE

xuesheng$_i$].

student

'*I want to see [the student [that you are angry [because t_i would not

come]]].'

b. Wo xiang kan [na-ge   [ni [yinwei ta$_i$ bu hui   lai] hen shengqi de]

   I   want see   that-CL you because he not will come very angry DE

xuesheng$_i$].

student

'I want to see [the student$_i$ [that you are angry [because he$_i$ would not

come]]].'

c. *Wo xiang kan [na-ge [ni   [yinwei xuesheng$_i$ bu hui   lai]   hen shengqi

   I   want see   that-CL you because student   not will come very angry

de] xuesheng$_i$].

DE student

'*I want to see [the student$_i$ [that you are angry [because the student$_i$

would not come]]].'

In (100a), relativization leaves a gap within island and the sentence is unacceptable. The sentence can be made acceptable by the use of a resumptive pronoun *ta* 'him', as shown in (100b) (example from Aoun & Li, 2003: 170). In contrast, if replacing the resumptive

pronoun with a resumptive noun *xuesheng* 'student', the sentence is not acceptable, as shown in (100c). The contrast shows that the relative head can be related to a resumptive pronoun in a position inaccessible to movement, e.g., inside an island, but not to a resumptive NP. According to these observations, we might think that the resumptive NP is a copy of movement, but a resumptive pronoun is not. Is this proposal tenable? Let us further consider (101).

(101) a. *[[Wo [wei le rang t_i gaoxing] mai-le yi-ben shu de] na-ge laoshi$_i$]

    I in order to make   happy buy-LE one-CL book DE that-CL teacher

    ziji$_i$ mai-le shi-ben shu.

    self buy-LE ten-CL book

    '*[The teacher$_i$ [that I bought a book in order to make t_i happy]]] bought ten books.'

  b. [[Wo [wei le rang ta$_i$ gaoxing] mai-le yi-ben shu de] na-ge laoshi$_i$]

    I in order to make him happy buy-LE one-CL book DE that-CL teacher

    ziji$_i$ mai-le shi-ben shu.

    self buy-LE ten-CL book

    '[The teacher$_i$ [that I bought a book in order to make him$_i$ happy]]] bought ten books.'

  c. ? [[Wo [wei le rang laoshi$_i$ gaoxing] mai-le yi-ben shu de] na-ge

    I in order to make teacher happy buy-LE one-CL book DE that-CL

    laoshi$_i$] ziji$_i$ mai-le shi-ben shu.

    teacher self buy-LE ten-CL book

    '?[The teacher$_i$ [that I bought a book [in order to make the teacher$_i$ happy]]] bought ten books.'

The sentence (101a) is ill-formed because the relative head cannot be related to the gap inside an island; (101b) is well-formed as there is a resumptive pronoun *ta* 'him' which associates to the relative head. The comparison between (101a) and (101b) is parallel to that between (100a) and (100b). When we use a resumptive NP *laoshi* 'teacher', instead of the resumptive pronoun, the sentence (101c) is degraded. For some native speakers, (101c) is acceptable, although less so than (101b). To sum up, the status of resumptive NPs is not clear. Is it truly a trace of movement? I leave it open for future research. This issue might be addressed by looking at the acceptability of pronoun and (resumptive) nouns within different islands using a grammaticality judgment task.

4.7   Summary

To conclude, the main results in this chapter are twofold. First, I have observed a clear subject RC advantage in the production of Chinese RCs in line with other cross-linguistic findings and the Chinese RC comprehension finding presented in chapter 3, as predicted by the RM approach. Second, in contrast to the literature that claims that RCs with resumptive NPs are only a strategy used by children, I found that, due to specific characteristics of Mandarin Chinese, namely, that the trace precedes the antecedent, resumptive NPs are an option in Mandarin RCs for adults as well. I confirmed this through a grammaticality judgment task, in which adults were observed to accept resumptive RCs to a certain extent. In addition, I found that RCs with resumptive NPs and with *na+classifier* 'that' are generally more acceptable.

CHAPTER 5 The comprehension of Chinese topicalization

So far I have looked at the acquisition of Chinese RCs and have hypothesized that structural intervention plays an important role in child grammar. This chapter presents experimental data on the acquisition of topic structures by children from three to six years of age. As we have seen, Chinese topic structures have been widely discussed in the linguistic literature. However, little is known on how children acquire (especially, comprehend) this structure. As outlined in chapter 1, this thesis attempts to answer whether and how RM affects the acquisition of A'-movement structures. In this chapter, the question is addressed by examining the comprehension of topicalization. The results demonstrate that children have good comprehension of object topicalization sentences (with the OSV order) as they have of subject topicalization sentences (with the SVO order) and their performance is at ceiling at five years of age. The results bear on RM and on the adequate analyses of topic structures. There is a debate as to whether topic structures in Chinese involve A'-movement or result from based generation of the topic in the left periphery. Children have trouble with structures that unequivocally involve A'-movement, if an intervener with the relevant features is closer to the target than the real goal. This is the case of object RCs discussed in chapter 3 and 4. Object topicalization sentences structurally present a configuration similar to that of object RCs, with an intervener closer to the target than the goal. If topicalization was derived by movement as RCs, we would expect children's comprehension of the two structures to be similar. The results of the current study do not support this hypothesis. Thus, based on the analysis of experimental data of Chinese topicalization, I propose that Chinese topicalization does not involve A'-movement.

The chapter is organized as follows. In section 5.1, I briefly review previous studies on topicalization cross-linguistically as a point of departure, and then in section 5.2 I summarize previous acquisition studies on Chinese topic structures. Section 5.3 restates the movement vs. non-movement analysis of topicalization sentences and the predictions for the acquisition of these structures. Section 5.4 presents the details of experimental method I used here and the results. In section 5.5, I discuss the results. Finally, in section 5.6, a brief summary is given.

5.1   A review of previous studies on topicalization acquisition

How children acquire topicalization has been studied in some languages since the 1960s (e.g., Gruber, 1967; Pérez-Leroux, Pirvulescu, & Roberge, 2011; Sano, 2005, 2012; Spinner & Grinstead, 2006). In the past decade, this issue has received further attention from researchers investigating hearing-impaired children (e.g., Friedmann & Szterman, 2006; Friedmann & Haddad-Hanna, 2014) as well as aphasic patients (e.g., Friedmann & Shapiro, 2003; Grillo, 2005, 2008, 2009). I briefly review some of this recent literature below.

Friedmann & Szterman (2006) examined the comprehension of sentences with object topicalization and of SVO sentences by Hebrew-speaking children with hearing impairment (aged 6;0-7;3, M = 6;4) and typically developing children (aged 5;11-6;5, M = 6;2). They used a sentence-picture matching task. Materials included sentences like (102a) with the SVO order and (102b) with the OSV order.

(102) a. Ha-yalda mecayeret et   ha-isha   ha-zo.   (canonical SVO)

the-girl   draws   ACC the-woman   the-this

'The girl draws the woman.'

b. Et   ha-isha   ha-zo$_i$ ha-yalda mecayeret t$_i$.   (OSV topicalization)

ACC the-woman the-this the-girl   draws

'As for the woman$_i$, the girl draws (her$_i$).'

The results showed that the accuracy rates of the OSV topicalization sentences were lower than those of the canonical sentences. At the group level, the OSV structures were more difficult to comprehend than the SVO structures; within the hearing-impaired group, comprehension of OSV structures was significantly worse than that of SVO structures (p = .04). At the individual level, all the participants performed above chance level (using binomial test) on both sentence types.

The asymmetry between OSV and SVO structures can be explained by assuming Shlonsky (1997)'s analysis of topicalization. The OSV structure in Hebrew involves the movement of the object (with its accusative case marker) to the initial position of the sentence. That is, the topicalized element *et ha-isha ha-zo* 'the woman' in (102b) crosses over another lexically restricted element *ha-yalda* 'the girl'. If we assume the RM approach, the configuration of the OSV topicalization structure can be illustrated in (103).

(103) D NP   ......   D NP   ......   <D NP>

[+TOP, +NP]   [+NP]

In object topicalization, the subject has a subset of features of the topicalized object and thus is a potential intervener in the A'-chain connecting the moved topic and its copy. Since children may fail to establish that the topicalized object and the subject are distinct, they occasionally treat (103) as a violation of RM and fail to comprehend it.

Although object topicalization elicited lower scores than SVO structures, they were understood better than object RCs (object topicalization, about 90% in Friedmann & Szterman (2006); object RCs, 70% in Friedmann et al. (2009)). This comparison has to be taken with caution, however. In this study, children (M = 6;4 for deaf children; M = 6;2 for typically developing children) were at least one and half year older than those in Friedmann et al. (2009)'s study (aged 3;7-5;0, M = 4;6, SD = 0.5). Thus, the better performance on topic structures than on RCs may be attributed to age. However, the point is that (103) has the same configuration of object RCs and if both are derived by movement, children should understand or fail to understand them in a similar way.

In two papers, Sano (2005, 2012) argued that Japanese-speaking children have acquired topicalization at four and five years of age. Japanese is a verb-final language, with the SOV canonical order. In a comprehension study, using an act-out task, Sano (2005) tested children (N = 50, aged 3-6) with canonical SOV sentences and OSV topicalization sentences in two conditions: without the definite marker *sono* in (104a-b) and with *sono* in (104c-d).

(104) a. Canonical SOV

    Zou-ga   buta-o   ketobashi-masi-ta.

    elephant-NOM pig-ACC kick-Polite-PAST

    'The elephant kicked the pig.'

  b. OSV topicalization

    Buta-wa   zou-ga   ketobashi-masi-ta.

    pig-TOP elephant-NOM kick-Polite-PAST

    'As for the pig_i, the elephant kicked (it_i).'

c. Canonical SOV with *sono*

Sono zou-ga buta-o ketobashi-masi-ta.

the elephant-NOM pig-ACC kick-Polite-PAST

'The elephant kicked the pig.'

d. OSV topicalization with *sono*

Sono buta-wa zou-ga ketobashi-masi-ta.

the pig-TOP elephant-NOM kick-Polite-PAST

'As for the pig$_i$, the elephant kicked (it$_i$).'

The results displayed a discrepancy between two conditions. In the condition without *sono*, an asymmetry between OSV topicalization sentences and canonical SOV sentences was found in each age group (at age three, 37.5% vs. 100%; at age four, 28.6% vs. 78.6%; at age five, 57.2% vs. 96.4%; at age six, 61.1% vs. 94.3%). In the condition with *sono*, the asymmetry disappeared from age four to age six (e.g., at age four, 82.1% vs. 89.3%). Children at three years of age showed some difficulty in comprehending OSV topicalization sentences as compared to canonical SOV sentences (75% vs. 87.5%), but performed much better than in those without *sono*. At five and six years of age, they performed at ceiling in both structures (e.g., at age five, 100% vs. 100%). The author argued that the presence of topic marker *wa* is not sufficient for children's successful comprehension of OSV topicalization, the definite marker *sono* is necessary. That is, non-canonical OSV structure has NP$_1$ NP$_2$ V order which is same as the canonical SOV structure on the surface level; adding *sono* makes it clear that the preposed object phrase is old information which refers to preceding discourse.

This explanation is partly in line with the explanation for the acquisition of Japanese RCs. Both subject RCs and object RCs take a NP_1 V NP_2 superficial order in Japanese, as shown in (105) (from Suzuki, 2011: 1087).

(105) a. [_$_i$ kuma-o   hikkaita]   panda$_i$ (subject RC)

   bear-ACC scratch-PAST panda

'the panda which scratched a bear'

   b. [kuma-ga   _$_i$ hikkaita]   panda$_i$ (object RC)

   bear-NOM   scratch-PAST panda

'the panda which a bear scratched'

Suzuki (2011) did not find any subject/object asymmetry in the acquisition of Japanese RCs, when children (N = 11, M = 5;11) could use case markers as cues for the comprehension of canonical SVO sentences. The fact that morphological cues are relevant to the comprehension of RCs has also been shown in the comprehension of German RCs (Arosio, Yatsushiro, Forgiarini, & Guasti, 2012).

In this chapter, I attempt to decide whether topic structures pose the same difficulty as RCs to children by carrying out a comprehension study on Chinese topicalization with children from age three to age six. The age range is comparable to that in Chinese RC acquisition studies and, thus, it is possible to decide whether they experience difficulties with topicalized structures at the age in which they have difficulty in comprehending object RCs.

5.2   A review of previous studies on the acquisition of Chinese topic structures

Generally, the topic in Chinese refers either to a specific entity (what the hearer already knows) or a class of entities, followed by an optional topic marker such as *ya*. The sentence is a comment on or a prediction about the topic (Li & Thompson, 1976, 1981; Shi, 2000). In Chinese, there are "gapless topic sentences" and "gapped topic sentences", as discussed in section 2.5, and this fact partly obscures the possibility of distinguishing between the subject and the topic. Consider (106).

(106) a. Li xiansheng$_i$ (ya)   wo renshi e$_i$.   (OSV topicalization)

        Li Mr.   (TOP)   I   know

        'As for Mr. Li, I know (him).'

    b. Li xiansheng (ya)   renshi wo.

        Li Mr.   (TOP) know   me

        Interpretation 1: 'As for Mr. Li, (he) knows me.'   (SVO topicalization)

        Interpretation 2: 'Mr Li knows me.'   (canonical SVO)

In the literature, not only (106a) but also (106b) have been regarded as topic structures (Li & Thompson, 1976, 1981). In object topicalization sentences (with the OSV order), the topic and the subject are distinct, whereas in the SVO sentences the topic and the subject share the same position, at least superficially. In (106a), we can identify the topic and the subject regardless of the presence of the topic marker (e.g., *ya*). The topic is *Li xiansheng* 'Mr. Li' which occurs in sentence-initial position and is related to an empty element in the comment clause, and the subject is *wo* 'I'. However, in (106b), the topic and the subject are identical. With the topic marker, the sentence receives the topic interpretation (Interpretation 1); without the topic marker, the sentence can be regarded as a canonical

SVO sentence (Interpretation 2) or as a topicalization sentence with the subject being the topic given the proper context (Interpretation 1)[34]. Consider (107).

(107) Speaker A: Li xiansheng shi women   xinlai   de   jingli.

Mr. Li   is we   new-coming DE manager

'Mr Li is our new-coming manager.'

Speaker B: *Li xiansheng (ya),   renshi wo*. Women shi   daxue   tongxue.

Mr. Li   (TOP) know me   we   are university classmate

'As for Mr Li, (he) knows me. We were classmates of the university.'

In the sentence by speaker B (107)*, Li xiansheng* 'Mr. Li' has been mentioned in the previous discourse (Speaker A) and is being discussed again (Speaker B). It can be followed by an optional topic marker such as *ya*, and the remaining clause *renshi wo* "know me" is about this specific person. Given that the phrase satisfies the conditions for being the topic, I consider the sentence as a topic structure.

To examine whether young children were sensitive to the topic-subject distinction, Chien & Lust (1985) tested 95 children aged from 2;6 to 5;0 by using an elicited imitation task. They asked children to imitate coordinate sentences like (108a) and control-sentences like (108b).

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[34] There might be an intonational difference between the two structures. To my knowledge, it is optional and subject to large variation among individuals.

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(108) a. *Baobao*, jiao hen xiao; *baobao* ye hen   ke'ai.

baby   feet very small baby   also very cute

'As for the baby, the feet are small; as for the baby, (he) is also very

cute.'

b. *Xiaohua*, jiejie   xihuan *Xiaohua* dai   maozi.

Xiaohua older sister like   Xiaohua wear hat

'As for Xiaohua, (his) older sister likes Xiaohua to wear a hat.'

In (108a), the first NP *baobao* 'baby' is the topic and *jiao hen xiao* 'the feet are small' is the comment. *Ye hen ke'ai* 'also very cute' can either be a comment of the second NP *baobao* 'baby' or be a comment which refers to the first NP without the need of repeating the topic element. The second NP, however, was added in the experiment intentionally. The logic was that if children took the first NP as the topic, they should delete the second NP, as shown in (109a). Such a reduction is perfectly grammatical in Chinese and gives rise to a sentence with the same interpretation as (108a).

In (108b), the first NP *Xiaohua* 'Xiaohua' is the topic and the comment clause is a control structure. The second NP *Xiaohua* 'Xiaohua' controls the PRO subject in the clause *dai maozi* 'to wear a hat'. If it were omitted, the phrase *jiejie* 'old sister' would control PRO as in (109b). The sentence (109b) is well-formed, but does not have the same meaning as (108b).

(109) a. Baobao$_i$, jiao hen xiao; e$_i$ ye   hen   ke'ai.

baby   feet very small   also very cute

'As for the baby, the feet are small; (he) is also very cute.'

b. Xiaohua, jiejie$_i$ xihuan PRO$_i$ dai maozi.

Xiaohua older sister like   wear hat

'As for Xiaohua, (his) older sister likes to wear a hat.'

Through the experiment, Chien & Lust found that children dropped the first NP in a coordinate construction like (108a) less than in a control-construction like (108b) (2.02% vs. 43.16%), and were more likely to omit the second NP in the former than in the latter (21.71% vs. 2.49%). Thus, they suggested that children, at least from age three, were able to distinguish the concepts of topic and subject.

Erbaugh (1992) conducted a longitudinal study with 4 children aged 1;10 to 3;10. Based on 64 hours of spontaneous speech data, the author found that topicalization was not frequent in the early stage of development and in many observed sentences the comment was truncated or anaphorically unclear.

Furthermore, Chen (2009) analyzed the speech of 44 children from the CHILDES database (MacWhinney, 2000). She divided them in four age groups: the 2;2 age group (N =10), the 2;8 age group (N = 10), the 4;0 age group (N =12) and the 6;0 group (N =12). Different types of topic structures were found, exemplified in (110) (from Chen, 2009: 167-168). To clarify, these sentences were not produced by the children in the database and they are used to exemplify the different types of topic structures by the author.

(110) a. Li xiansheng$_i$ wo renshi e$_i$.

Li Mr.   I   know

'As for Mr. Li, I know (him).'

b. Li xiansheng$_i$ wo renshi ta$_i$.

  Li Mr.   I   know he

  'As for Mr. Li, I know him.'

c. Changjinglu bozi chang.

  giraffe   neck long

  'As for giraffes, their necks are long.'

d. Shuiguo wo zui xihuan yingtao.

  fruit   I most like   cherry

  'As for fruits, I like cherries best.'

e. Zuotian wanshang wo mei shuijiao.

  yesterday evening   I   not sleep

  'As for last night, I did not sleep.'

The data showed that children began to produce topic structures of the kind in (110a) as early as age 2;2, but only 5 sentences (1.3%, out of 387 utterances) were found. The 2;8 age group produced only 8 sentences (3.5%, out of 227 utterances), including 7 object topicalization sentences like (110a) and 1 adverbial phrase like (110e). In the age group 4;0 and 6;0, more topic sentences were found, 34 sentences (3.9%, out of 875 utterances) and 35 sentences (3.5%, out of 1009 utterances) respectively. Of them, only 5 sentences were object topicalizations in each age group. The author also examined a small sample of adult data, represented by four TV talks. The percentage of topic sentences produced by adults ranged from 2.02% to 5.17% across four talks. Thus, although topic structures are produced from a very early age, they are not abundant in the spontaneous speech of Chinese children and adults.

To sum up, previous studies have shown that topic structures are produced by children from their first multiword combinations. In addition, among the topic structures produced by children up to three years of age, the majority were object topicalizations. Recall that in the current RC comprehension studies, discussed in chapter 3, I found that object RCs were harder to comprehend than subject RCs. The corpus analysis revealed that object RCs are less frequent than subject RCs (e.g., Pu, 2007; Wu, Kaiser, & Andersen, 2011). Given that object topicalizations are rare in spontaneous speech and they have been claimed to involve A'-movement the same as RCs, it is possible that children fail to comprehend them as they do in the case of RCs. In addition, if frequency of occurrence influences the course of acquisition significantly, I expect topicalization and relative clauses to display a similar development. In other words, one could claim that children have trouble with object RCs because these are infrequent in the input that children hear. If this point is valid, I would expect that object topicalization sentences would be difficult because they are also infrequent in the input (adult speech). For subject topicalization sentences, children should not have any problems because, even if they are infrequent, children could treat them as simple declarative clauses. In order to investigate this issue, I conducted a picture-sentence matching task, which is reported in section 5.4.

5.3   Analyses of topicalization and their predictions for acquisition

In this section, I reconsider the two different accounts of topicalization and discuss their predictions for acquisition within the RM framework I am assuming. Consider the following sentences.

(111) a. Zhe-ge   haizi   (ya),   waipo   zai   hua.

　　　this-CL   child   (TOP)   grandma   PROG   draw

　　　'As for this child, the grandma is drawing (him).'

　　b. zhe-ge   haizi   (ya),   zai   hua   waipo.

　　　this-CL   child   (TOP)   PROG   draw   grandma

　　　Interpretation 1: 'As for this child, (he) is drawing the grandma.'

　　　Interpretation 2: 'This child is drawing the grandma.'

Regarding the examples (106) that have been discussed in the previous section, I analyze (111) in the following way. No matter whether the topic maker is overt or covert, (111a) is an object topicalization sentence with the OSV order, as *zhe-ge haizi* 'this child' serves as a topic with a definite interpretation and *waipo* 'grandma' is the subject of the verb *hua* 'draw'. With the topic marker, (111b) is a subject topicalization sentence with the SVO order; without the overt topic marker, it can be analyzed either as a canonical SVO sentence or as a subject topicalization sentence. That is, *zhe-ge haizi* 'this child' can be the subject because it relates to the verb *hua* 'draw', but in appropriate discourse conditions, it can also be the topic. Thus, with the appropriate context, the two structures (111a) and (111b) can be regarded as a minimal pair of topicalization sentences.

Two contrasting analyses of topicalization were presented in section 2.5, namely, the movement analysis and the non-movement analysis. Under the movement analysis, the topic phrase is attracted by a complex attractor endowed with the [+TOP, +NP] features, where "TOP" designates the overt or covert topic marker and "NP" designates a nominal expression. The configurations are given in (112).

(112) a. D NP   ......   D NP   ......   <D NP>   (OSV topicalization)

  [+TOP, +NP]   [+NP]

b. D NP   ......   <D NP>   ......   D NP   (SVO topicalization)[35]

  [+TOP, +NP]   [+NP]

RM holds similarly in children and adults. As evident in (112a), the subject of the comment bears a [+NP] feature and intervenes between the topic and its gap. According to Friedmann et al.'s analysis, in the configuration (112a), a RM violation may be detected by children because they may not consider the topic and the subject distinct. In order to consider them distinct, a subset relation has to be computed, but children's limited computational resources sometimes prevent them to do it. When this happens, object extraction structures are not well understood. This is precisely what I noticed for object RCs, whose configuration repeated in (113) is similar to that of OSV topicalization sentences given in (112a). No problem arises in SVO topicalization sentences as illustrated in (112b), because there is no intervener between the topic and it copy.

(113) D NP   ......   D NP   ......   <D NP>

  [+R, +NP]   [+NP]

In summary, given the parallel between (112a) and (113) and the contrast between (112a) and (112b), I expect children to display difficulties in comprehending OSV topicalization

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[35] As I have discussed, there are two ways to look at SVO topicalization sentences without overt topic marker. One is to think that there is a movement of the subject, but it cannot be seen, since there is no overt topic marker. The other way is to think that the subject sits in the canonical position, but can receive a topic interpretation in that position. For convenience, I illustrate the structure as in (112b).

sentences compared with SVO topicalization sentences, if topicalized structures are derived by movement as RCs.

An alternative analysis is that the topic is merged in the topic position in the left periphery of the clause and it entertains a binding relation with base-generated *pro* as in (114).

(114) a. Zhe-ge   haizi$_i$ (ya),   waipo   zai   hua   pro$_i$.

      this-CL child (TOP) grandma PROG draw

      'As for this child, the grandma is drawing (him).'

   b. Zhe-ge   haizi$_i$ (ya),   pro$_i$ zai   hua   waipo.

      this-CL child (TOP)   PROG draw grandma

      'As for this child, (he) is drawing the grandma.'

As I have discussed in section 2.5, a Generalized Control Rule (GCR; Huang 1984, 1989) governs the distribution of *pro* in subject position. In order to explain the empty category in object position for object topicalization, I further proposed that the GCR can be interpreted as "coindex an empty pronominal with the closest nominal element *compatible with binding principles*". In (114a), a binding relation between *pro* and the subject *waipo* 'grandma' is not legitimate because of a violation of Principle B, namely, the pronoun cannot be bound to an NP in an A-position within the local domain. Accordingly, *pro* is interpreted pragmatically by referring to a salient entity in a context which is *zhe-ge haizi* 'this child'. In (114b), *pro* is in the subject position. According to Huang's GCR, the closest nominal element to *pro* is the topic, *zhe-ge haizi* 'this child'. Under these assumptions, there is no movement and RM does not apply. Therefore, I do

not expect any difference in the comprehension of OSV topicalization sentences and SVO topicalization sentences.

Summarizing, two contrasting hypotheses are proposed below.

(115) *Hypothesis 1*: Under the movement analysis, topicalization involves A'-movement like RCs and the usual locality principles apply, in particular, RM does. Thus, OSV topicalization sentences are predicted to be harder than SVO topicalization sentences.

(116) *Hypothesis 2*: Under the non-movement analysis, the binding relation between the topic and the empty category *pro* is an anaphoric relation whereby *pro* looks for an antecedent. RM does not apply in this case as there is no movement. Thus, no asymmetry between OSV topicalization sentences and SVO topicalization sentences is expected.

5.4   Experiment 5

5.4.1   Method

5.4.1.1 Participants

Eighty Chinese-speaking children aged from 3;0 to 6;11 participated in this experiment. They were divided into four groups: the three-year-old group (N = 20, aged 3;0-3;9, M = 3;3, SD = .26, 10 males), the four-year-old group (N = 20, aged 4;0-4;11, M = 4;4, SD = .31, 8 males), the five-year-old group (N = 20, aged 5;0-5;11, M = 5;5, SD = .32, 9 males) and the six-year-old group (N = 20, aged 6;0-6;11, M = 6;6, SD = .29, 11 males). They lived in Zhejiang, China and were developing normally. An additional adult group (N = 10, aged 25;7-28;11, M = 26;7, SD = 1.11, 5 males) served as control.

5.4.1.2 Materials and design

The stimuli consisted of 8 OSV topicalization sentences like (117a) and 8 SVO topicalization sentences like (117b). No overt topic marker was used. I used 8 transitive verbs: *da* 'hit', *yao* 'bite', *gai* 'cover', *hua* 'draw', *tui* 'push', *zhui* 'chase', *kan* 'look at' and *bang* 'help'. These verbs were identical to those used in Experiment 1 and Experiment 2.

(117) a. Zhe-zhi qingwa, laoshu   zai   da.

　　　　this-CL   frog   mouse PROG hit

　　　　'As for this frog, the mouse is hitting (it).'

　　　b. Zhe-zhi xiaogou, zai   da xiaomao.

　　　　this-CL   dog   PROG hit   cat

　　　　'As for this dog, (it) is hitting the cat.'

All of the experimental sentences were semantically reversible, and the noun phrases were animate. In addition, there were 8 filler sentences including verbs which were not semantically reversible. A list of the experimental sentences is provided in the Appendix D.

Each experimental sentence was associated with a set of experimental pictures as exemplified in Figure 4. More specifically, Figure 4 was associated to the Chinese equivalent of a topicalization sentence, i.e., 'As for this frog, the mouse is hitting (it)'. In total, there were 24 sets of experimental pictures. The stimuli and the fillers were presented to each participant in pseudo-random order.

Figure 4. A set of experimental pictures used in Experiment 5.

To make the use of topicalization felicitous, I created an appropriate context. The experimenter asked participants to describe the picture first, e.g., to name the agent, *qingwa* 'frog' and *laoshu* 'mouse' in Figure 4, or to calculate the numbers of the agents, *liang-zhi qingwa* 'two frogs' and *liang-zhi laoshu* 'two mice' in Figure 4. Then, the experimenter told children: *Wo zai kan yi-zhi qingwa* 'I am looking at a frog'. By doing this, I provided a context for topicalization. Next, the experimenter presented the experimental sentence, e.g., an OSV sentence *Zhe-zhi qingwa, laoshu zai da* 'As for this frog, the mouse is hitting (it)' or an SVO sentence *Zhe-zhi qingwa, zai da laoshu* 'As for this frog, (it) is hitting the mouse', and the participant was asked to point to the picture matching the sentence. Given that the initial phrase is a topic, both structures regardless of the OSV order or the SVO order are topicalizations.

5.4.1.3 Procedure

Participants were tested individually. Each participant was asked to look at the experimental pictures on the iPad screen and to answer the question which was used to provide an appropriate context for topicalizations. Then, the experimenter presented the

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target sentence and the participant pointed to the picture (out of two). Two practice items were presented to ensure that participants understood the task.

5.4.1.4 Scoring and error coding

The dependent variable was the proportion of correct responses, i.e., the accuracy in selecting the correct picture (out of two). When participants pointed to the other one, the response was coded as an error.

5.4.2   Results

The experiment yielded a total of 1280 responses from children and 160 from adults (excluding responses to fillers). Half were from comprehending OSV topicalizations and the half from SVO topicalizations.

Table 17 shows the detail of responses in each condition across age groups. The percentages, the raw scores, the means and the standard deviation were calculated by group and by sentence type. The descriptive analysis showed that children's comprehension of topicalization improved from three to six years of age. Adults performed at ceiling, with 100% correct responses in both sentence type conditions.

I performed a linear mixed effects analysis with sentence type (OSV vs. SVO) and age (3-, 4-, 5- and 6-year-olds) as fixed factors and subjects and items as random factors. The reference categories were the SVO sentences for the sentence type factor and three-year-olds for the age factor.

First of all, the sentence type factor did not predict the comprehension ability (χ^2 (1) = 2.71, p = .10). As I changed the random slopes for sentence type by subjects and by items, the p-value from likelihood ratio test was also not significant (χ^2 (1) = 2.65, p

= .10). The results indicate that comprehension of topicalization sentences with the OSV order and those with the SVO order did not differ.

Table 17. *Percentages (%), raw scores (N), means (M) and standard deviation (SD) of correct responses in each age group*

Groups	OSV topicalization sentences				SVO topicalization sentences			
	%	N	M	SD	%	N	M	SD
3 y.o.	76	121/160	6.05	1.50	88	141/160	7.05	0.89
4 y.o.	84	134/160	6. 70	1.26	89	142/160	7.10	1.02
5 y.o.	93	149/160	7.45	0.10	96	154/160	7.70	0.57
6 y.o.	98	156/160	7.80	0.52	100	160/160	8.00	0.00
Adult	100	80/80	8.00	0.00	100	80/80	8.00	0.00

Table 18. *Summary of the age factor in the mixed-effects model (N = 1280, SD of subjects = 0.95, SD of items = 1.04, log-likelihood = -335.56) for comprehending two structures*

Age groups	Estimate	SE	Wald Z	p
3 y.o. vs. 4 y.o.	0.39	.39	1.02	=.31
3 y.o. vs. 5 y.o.	1.66	.45	3.73	<.001
3 y.o. vs. 6 y.o.	3.22	.67	4.80	<.001
4 y.o. vs. 5 y.o.	1.26	.45	2.80	<.01
4 y.o. vs. 6 y.o.	2.82	.67	4.19	<.001
5 y.o. vs. 6 y.o.	1.56	.71	2.20	=.03

Second, age yielded a significant effect (χ^2 (3) = 38.03, p < .001). By changing the reference categories, I compared each age group with the other age groups. Table 18 reports the output of the analysis. There was no significant improvement in accurate

responses from age three to age four. Crucially, a robust improvement occurred at five years of age, namely, the performance of five-year-olds significantly differed from those of three- and four-year-olds. There was no significant difference between age five and age six.

I further examined individual performance by calculating the number of children who performed above chance in each sentence type. Choosing one picture out of two pictures, chance level is 50%; since each child was tested on 8 items in each condition, I considered an above chance performance when there were seven correct responses (out of eight) in each sentence type as predicted by the binominal distribution. As shown in Table 19, there are descriptively more children performing above chance in the comprehension of the SVO sentences as compared to the OSV sentences. However, this difference is not statistically significant. I contrasted the proportions of children performing above chance across age groups using a Chi-square test and did not observe any significant difference: at age three ($\chi^2 (1) = 1.62$, $p = .2$), at age four ($\chi^2 (1) = 1.03$, $p = .25$), at age five ($\chi^2 (1) = 0.36$, $p = .2$) a nd at age six ($\chi^2 (1) = 1.03$, $p = .25$).

Table 19. *Percentages (%) and number (N) of participants who performed above chance*

Groups	OSV topicalization sentences		SVO topicalization sentences	
	%	N	%	N
3 y.o.	45	9/20	65	13/20
4 y.o.	60	12/20	75	15/20
5 y.o.	90	18/20	95	19/20
6 y.o.	95	19/20	100	20/20
Adult	100	10/10	100	10/10

To summarize, children comprehended OSV and SVO topicalization sentences equally well from age three and there was no significant difference between the comprehension of two structures at any age, neither at the group level nor at the individual level. Improvement in both structures was observed and almost ceiling performance was observed at five years of age.

5.5   General discussion

Children comprehended OSV topicalization sentences as well as SVO topicalization sentences as predicted by the non-movement analysis. In this section, I first discuss the developmental pattern of the two structures and then the two aforementioned hypotheses. I also comment on some objections and put forth some follow-up questions.

The experimental results show that, although the accurate rates of OSV topicalization sentences were numerically lower than SVO topicalization sentences (e.g., at age three, 88% vs. 76%; at age four 89% vs. 84%), no difference between the two structures reached significance in any age group. This finding suggests that children master the topic-prominent property at a very early age. The only robust improvement in comprehending the two structures occurs at five years of age, while three-year-olds and four-year-olds do not differ from each other. In these two age groups, accuracy was already high. As mentioned earlier, OSV topicalization sentences are rare compared to SVO sentences. If frequency matters, it would have predicted an asymmetry. But I did not find it. Frequency does not seem to play a big role in the comprehension of topicalization.

Two analyses are offered in the literature of topic structures: the movement analysis and the base generation analysis. They make different predictions for acquisition when combined with the RM approach, as we discussed before. According to the RM principle, a local relation between X and Y cannot be established if Z, having the same

feature as Y, acts as a potential candidate for the same relation as in (118a). If topicalization involves A'-movement, RM applies as in (118b). Since I assume that children have trouble computing the subset relation, they may not consider the topic and the subject distinct and may detect (118b) as a RM violation. In this case, I predicted that OSV topicalization sentences would have been harder than SVO topicalization sentences.

(118) a. X   ......   Y   ......   Z

b. D NP   ......   D NP   ......   <D NP>

[+TOP, +NP]   [+NP]

The present result goes against this analysis, but supports the base generation analysis, as children do not seem to have trouble establishing the relation between the topic and the empty category in the comment clause, in spite of the presence of the subject. Further support comes from a recent on-line adult processing study. Using a cross-modal priming lexical decision task, Cai & Dong (2010) examined 7 adults' comprehension of topicalization. They observed that the filler was not activated at the gap position, namely, the gap seems to have no psychological reality in Chinese topicalization. This result is strikingly similar to the current results from children's offline comprehension[36].

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[36] Yang & Liu (2014) used ERP to examine the processing of topicalized structures and tentatively proposed that their results indicated a syntactic dependency between the topic and the trace position. However, the experimental design was problematic and the relation between the observed waves and the trace was largely a speculation.

They tested three conditions: (i) for grammatical topicalized sentences, (ii) for ungrammatical topicalized sentences and (iii) for SVO sentences as controls. In fact, as we discussed in section 2.5, in the linguistic literature (iii) is regarded as a topic structure in which *zuotian* 'yesterday' is a moved element. Thus, (iii) is not a simple SVO sentence which can serve as control.

The current results raise a couple of objections. One may claim that children's good comprehension of topicalization is not unexpected, as compared to that of RCs, because topicalization is semantically easier than the RC construction. The semantic meaning of (119a) involves two entities, namely a frog and a mouse. In contrast, the semantic relation in RCs is much more complex. For example, in (119b), it involves a set of frogs from which one is singled out.

(119) a. Qingwa, laoshi   zai   da.

　　　　frog,   mouse   PROG hit

　　　　 O　　　 S　　　　V

　　　　'As for the frog, the mouse is hitting (it).'

　　　b. laoshu   zai   da   de   qingwa

　　　　mouse PROG   hit   DE   frog

　　　　 S　　　 V　　　　　 O

　　　　'the frog that the mouse is hitting'

(i) Zhuozi jingli　　ti-le　　　　　liang-jiao.
　　table　manager kick-PAST two-feet.
　　'As for the table, the manager kicked (it) twice.'
(ii) *Zhuozi jingli　　ti-le　　　　Wang Wu.
　　　table　manage kick-PAST Wang Wu
　　'*As for the table, the manager kicked Wang Wu.'
(iii) Zuotian　jingli　　da-le　　　Wang Wu.
　　　yesterday manager hit-PAST Wang Wu
　　'As for yesterday, the manager hit Wang Wu.'

They reported that an enhanced N400 in the sentence-initial NP was observed in (i) and (ii), but not in (iii). As the authors noticed themselves, the first NPs in (i) and (ii) are inanimate, but the first NP in (iii) is a temporal noun. Thus, the N400 might associate with the animacy, and not the topic.

c. the frog that the mouse is hitting

        O   S   V

However, when we turn to the syntax of two structures, topicalization turns out not to be easy. The word order of object RCs like (119b) is SVO, which is same as the canonical SVO sentence in Chinese. In the case of object topicalization, instead, it is an OSV structure as in (119a) which is the same as found in head-initial object RCs such as in (119c). A number of RC comprehension studies have established that this OSV order is difficult for young children (e.g., Friedmann et al., 2009). Thus, based on cross-linguistic data, we would expect OSV order in Chinese to be difficult as well, especially if it involves movement.

One also may argue that the picture-sentence matching task I used is not good enough to examine the comprehension of topicalization structures, since the accuracy rates in this study were as good as the results of the comprehension of Chinese RCs in Experiment 1 in which the same task was used. As we discussed in chapter 3, the picture-sentence matching task (Experiment 1) does not display the same result as the character-sentence matching task (Experiment 2), because Chinese RCs are head-final. To choose the right picture, children could simply rely on the embedded clause which comes before the relative head. However, we also notice that the discrepancy between two tasks in head-initial RCs is much less sharp. A number of studies using the picture-sentence matching task gave the same results as that using the character-sentence matching task (e.g., Adani, 2011; Arosio, Adani, & Guasti, 2009). Thus, in languages with head-initial RCs, the former task could be as valid as the latter one. It is only for Chinese RCs that the picture-sentence matching task is particularly problematic because of their head-final status. Second, as mentioned above, RCs and topicalization have different discourse

conditions, one to single out a referent and another to describe a situation. The linear order of topicalization in Chinese is like that of head-initial object RCs, both holding an OSV order. Thus, if the picture-selection is good for the head-initial RCs, it should be also appropriate for topicalization. To sum up, even if the picture-sentence matching task is not appropriate for RCs in Chinese, it is good for topicalization as this has the same order as head-initial RCs in other languages.

Several questions remain to be addressed in future research. First, as mentioned earlier, previous corpus studies (Chen, 2009; Erbaugh, 1992) examined children's spontaneous speech and observed that OSV topicalization sentences are not frequent. Thus, it would be interesting to investigate the frequency of SVO topicalization sentences and to see whether it is frequent or not. Second, both Chinese and Japanese are topic-prominent languages, but topic markers are optional in Chinese, while they are obligatory in Japanese (Xu, 2006). In the current study, I did not manipulate the experimental items with overt topic markers and it would be important to test the structures with them. Third, although acquisition data from children argue that they have the non-movement analysis, it is necessary to test whether this explanation can be extended to other gapped topic structures like (40), repeated here as (120). As pointed out in chapter 2, to establish the relation between the topic element *zhe-ge haizi* 'this child' and the empty category, multiple clause boundaries have to be crossed.

(120) Zhe-ge haizi$_i$, [$_{CP}$ Zhang San zhidao [$_{CP}$ Li Si kanjian [$_{IP}$ waipo zai hua t$_i$]]].

this-CL child   Zhang San know   Li Si see   grandma PROG draw

'As for this child$_i$, Zhang San knows that Li Si saw that the grandma was drawing (him$_i$).'

5.6   Summary

This study used a picture-sentence matching task to investigate the comprehension of topicalization with two different orders in Chinese by testing Chinese young children. The results showed that children from age three to age six performed quite well on both structures. Critically, these results demonstrated that there was nothing intrinsically hard about topicalization with the OSV order as compared to those with the SVO order. Therefore, I propose that RM applies to A'-movement chains, but topicalization in Chinese does not involve A'-movement, rejecting the movement analysis.

CHAPTER 6 Conclusion

The preceding chapters have presented four experiments designed to explore the acquisition of Chinese RCs and one experiment aimed at exploring the acquisition of topicalization. In the concluding chapter, I briefly summarize the major findings of the current study, discuss the potential limitations of the Relativized Minimality (RM) approach in capturing the acquisition of A'-movement structures, and discuss the implications for future study.

6.1   Summary of main findings

The overarching goal of the present research is to investigate the acquisition of RCs and topicalization in Chinese and to establish whether and how RM plays a role in the acquisition of A'-movement structures. In chapter 2, the RM approach was illustrated: I assume that RM applies in the same way in child and adult grammar; however, due to the limited computational resources, children have difficulties in computing the subset relation between the target and the intervener. Consequently, the child system may allow movement only when the features of the intervener are disjoint from that of the A'-moved element. By contrast, in the adult system, where subset relations can be computed, an A'-moved element can cross over an intervener provided that the intervener has distinct feature specification.

In addition, in that chapter, I discussed the syntax of Chinese RCs and of topicalization and the prediction of RM for the acquisition of these structures. First, with respect to Chinese RCs, for subject RCs, the object of the embedded clause is structurally deeper than the subject trace, so there is no structural intervention between the relative

head and its trace; for object RCs, the subject of the embedded clause intervenes in the relation between the relative head and its copy. Given that the subject has a subset of the features of the relative head and children have problems in computing the subset relation, object RCs should be more difficult to comprehend than subject RCs in Chinese. Second, with respect to topicalization, if we assume that the structure involves A'-movement as RCs, we expect children to display difficulties in comprehending object topicalization sentences (with OSV order) compared with subject topicalization sentences (with SVO order).

Chapter 3 examined the comprehension of Chinese RCs and evaluated the validity of the predictions of the RM approach. I also discussed Dependency Locality Theory (DLT), which predicts an object RC preference in comprehension. Experiment 1, involving a picture-sentence matching task, showed that both subject and object RCs were very well comprehended and no subject/object asymmetry in any age group was found. I proposed that such high accuracy could be attributed to the reliance on the linear order of the RC and not to the computing of the RC structure. Experiment 2, involving a character-sentence matching task, provided a more complex picture: children were less accurate in both RC types and a clear subject/object asymmetry was observed. The comparison between the two tasks has implications for psycholinguistic studies. Given that the task used in Experiment 2 requires children to compute the complete sentence, I claimed that the results of Experiment 2 are more reliable in characterizing the ability of Chinese children to comprehend RCs. Such a subject/object asymmetry in Chinese RCs goes against the predictions made by the DLT approach and supports the RM approach. Another important finding is that Chinese subject RCs are also difficult to comprehend and elicit a variety of errors in contrast to what has been found in other studies (e.g., Hebrew, Italian and Catalan). I proposed that linear intervention in terms of precedence

may also affect children's comprehension, but to a lesser extent than structural intervention in terms of c-command.

Chapter 4 explored the issue of an asymmetric preference in the production of Chinese RCs. The results of Chinese RCs in previous studies were mixed, some arguing for a subject RC preference, some for no preference. In Experiment 3, using an elicitation task, I found a clear subject RC advantage with children from age three to age eight and adults; children at eight years of age performed in an adult-like way. The object RC disadvantage in production supports the prediction of the RM approach, in line with the comprehension findings. Moreover, in Experiment 3, a large use of resumptive NPs was observed across age groups (including adults). In the follow-up experiment (Experiment 4), I used a grammaticality judgment task and found that, for many adult native speakers of Mandarin Chinese, RCs with resumptive NPs are acceptable in spoken language. I assumed McKee & McDaniel (2001)'s analysis in which it is claimed that an occurrence of a resumptive NP is due to the inability to keep track of the antecedent-trace relation in the production system. Moreover, the presence of the *na + classifier* 'that' before relative heads enhances the acceptability of RCs with resumptive NPs. Furthermore, I tentatively provided a comparison between comprehension (results of Experiment 2) and production (results of Experiment 3) and suggested a parallel development between comprehension and production.

The study of Chinese RCs is consistent with the idea that structural intervention plays an important role in child grammar and the difficulty of object RCs in Chinese is correctly predicted by the RM approach. Chapter 5 further examined the comprehension of object topicalization (with the OSV order) and subject topicalization (with SVO order). The results of Experiment 5 demonstrated that children from three to six years of age showed good comprehension of object topicalization on a par with their comprehension

of subject topicalization and the performance was at ceiling at five years of age. The results are interpreted as meaning that topicalization does not involve A'-movement and the empty category in the object position is not a gap, but a *pro*. Thus, the binding relation between the topic and the empty category is an anaphoric dependency between a base-generated topic and a *pro*.

Taken together, the present research has disentangled the confounding in Chinese acquisition and has provided evidence about how universal principle and language-specific properties interact.

6.2   Limitation of the present study and implication for future research

In the course of the present study, some potential problems became obvious and a number of questions were raised that need to be addressed and call for further investigation.

The RM approach was criticized by Goodluck (2010) based on results from experiments on comprehension of *which-N*-questions. Similarly to RCs, *which-N*-questions are introduced by a *wh*-phrase and involve A'-movement of the *wh*-phrase to a clause-peripheral position. In addition, *which* is accompanied by a nominal part, whose counterpart is the relative head in RCs, as in (121).

(121) a. Which lion did the zebra kiss <which lion>?

+Q +NP   +NP

b. the lion that the zebra kissed <the lion>

+R +NP   +NP

The schematic featural representation of the two clauses in (121) is given below each clause. We can see that object *which*-questions like (121a) and object RCs (121b) display the presence of an intervener with the [+NP] feature between the target (endowed with the [+Q] or [+R] feature and the [+NP] feature) and its trace. According to Friedmann et al. (2009), children's failure to understand (121a) has the same source as children's failure to understand (121b), i.e., intervention of an element with a subset of the features of the target. Goodluck acknowledged that object *which*-questions like (121a) are challenging for children, but she pointed out that when *which lion* was changed into *which animal* as in (122a), children's performance was as good as for questions like (122b).

       (122) a. Which animal did the zebra kiss?

             b. Who did the lion kiss?

On the one hand, in (122a) the intervener has the [+NP] feature and this should elicit a similar violation of RM as in (121a). On the other hand, *animal* and *zebra* in (122a) are in a superset/subset relation and this should be challenging for children, as the RM approach holds that children fail in understanding object RCs and object *which*-questions when the intervener has a subset of the features of the moved element. As Goodluck recognized, the superset relations in the case of *animal/zebra* and in the cases discussed by Friedmann et al. (2009) are different. In the former case, it is a semantic relation and in the latter it involves grammatical features. This difference may be responsible for the different results. Be that as it may, RM does not account for the improvement obtained with (122a). Although this effect deserves further research, we need to know more about its nature. One may wonder whether the facilitatory effect is simply due to the fact the more

general term (*animal*) comes before the more specific one (*lion*) in (122a) or whether the effect persists in questions like (123).

(123) Which lion did the animal kiss?

This would be crucial for two reasons. First, not only questions like (122b) are well understood by Hebrew speaking children, but also RCs like (124) in which the intervening subject is a null arbitrary subject are not problematic. That is, RM is not at issue if the target and the intervener are distinct or do not share any feature.

(124) Tare li   et   ha-sus   she-mesarkim oto.

      show to-me ACC the-horse that-brush-pl   him

      'Show me the horse that someone is brushing.'

We also need to know whether the facilitatory effect extends to RCs, i.e., if (125) is easier than (121b).

(125) the animal that the zebra kissed <the animal>

Second, related to the preceding point, in Chinese the relative head comes after the RC. Therefore, it would be important to know whether the facilitatory effect of (122a) follows from structural constraints or from linear order. If improvement is brought about by the general constituent coming before the more specific one linearly, we would not expect such an improvement in Chinese object RCs as in (126a). If, on the contrary,

improvement depends on structural constraints, due to the more general constituent c-commanding the more specific, (126a) should elicit more correct answers than (126b).

(126) a. banma qin   de dongwu

zebra   kiss DE animal

'the animal that the zebra kisses'

b. dongwu qin   de   banma

animal   kiss DE zebra

'the zebra that the animal kisses'

Thus, I think that the point raised by Goodluck has the potential to initiate a line of research where different facilitatory effects can be distinguished and whose sources can vary. I leave these issues for future research.

Another point raised by Goodluck was that subject *which*-questions in (127) have been found to be mildly problematic for children, although not to the same extent as object *which*-questions.

(127) Which lion kissed the zebra?

This also does not follow from the RM approach, as no intervener is present in subject questions. As I said above, there may be different factors that can alleviate or hinder the comprehension of a given structure whose source is of a different nature. Thus, it is not expected that they all be explained by the RM approach. I conjecture that the difficulty observed in subject *which*-questions is of a different nature of that typically found in object *which*-questions. First, object *which*-questions are more difficult than subject

which-questions. This would be surprising if there was a unique source of difficulty. It is possible that moving a *wh*-operator that pied-pipes a nominal is challenging for children and this has an impact also in subject *which*-questions as suggested by Guasti, Branchini, & Arosio (2012). In fact, in a production study on Italian questions, these authors found that subject *which*-questions were more problematic for children than subject *who*-questions. Interestingly for my point is that children sometimes omitted the nominal part or splitted the *wh*-element and the nominal part, suggesting that movement of the complex *which-N* is challenging. But this effect is likely to add up to the challenges created by intervention (see also Adani et al., 2010 for a discussion within the RM approach of a facilitatory effect in Italian subject RCs).

In the present study, I mainly examined the RCs with animate NPs, but not the RCs with inanimate NPs. Some studies have showed that animacy may facilitate children's comprehension (e.g., Kidd, Brandt, Lieven, & Tomasello, 2007) as well as adults' processing (e.g., Mak, Vonk, & Schriefers, 2006; Traxler, Morris, & Seely, 2002). This animacy effect is also hard to account for in a system like RM, as noticed by Goodluck (2010). Although Goodluck is right, data are more complex on this issue. Arosio, Guasti, & Stucchi (2011) tested the comprehension of Italian RCs by nine-year-old children, using a self-paced listening task with a final comprehension question. They found that children comprehended subject RCs with great accuracy regardless of the animate or inanimate status of the object. They comprehended object RCs with inanimate heads better than those with animate heads, but less well than subject RCs. In short, animacy plays a role, but some penalty is observed also in object RCs with inanimate heads. However, in a production study on Italian RCs, Guasti, Branchini, Arosio, & Vernice (2012) did not find any difference between object RCs with animate heads and those with inanimate heads in children of the same age as Arosio et al. (2011). In the

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same study, animacy did matter for five-year-old children, with object RCs with animate heads being harder than those with inanimate heads. Thus, although animacy may play a role in the children's use of object RCs, it is important to establish its role among the various factors that facilitate comprehension and its source, something that I leave open for future research.

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Appendices

Appendix A

List of experimental items in Experiment 1

(1) *Zhi chu da xiaogou de xiaomao.*

'Point to the cat that hits the dog.'

(2) *Zhichu waipo hua de xiaohai.*

'Point to the child that the grandma draws.'

(3) *Zhichu chuan qunzi de nühai.*

'Point to the girl that wears a skirt.'

(4) *Zhichu kan xiaomao de xiaogou.*

'Point to the dog that looks at the cat.'

(5) *Zhichu nanhai tui de xiaogou.*

'Point to the dog that the boy pushes.'

(6) *Zhichu wan yao de nanhai.*

'Point to the boy that bows.'

(7) *Zhichu gai waipo de nühai.*

'Point to the girl that covers the grandma.'

(8) *Zhichu yao xiaogou de xiaomao.*

'Point to the cat that bites the dog.'

(9) *Zhichu qi zixingche de nanhai.*

'Point to the boy that rides a bike.'

(10) *Zhichu waipo bang de nühai.*

'Point to the girl that the grandma helps.'

(11) *Zhichu zhui xiaogou de houzi.*

'Point to the monkey that chases the dog.'

(12) *Zhichu pai shou de nühai.*

'Point to the girl that applauds.'

(13) *Zhichu laoshu kan de houzi.*

'Point to the monkey that the mouse looks at.'

(14) *Zhichu zuozhe de nühai.*

'Point to the girl that is sitting.'

(15) *Zichu hua qingwa de gongzhu.*

'Point to the princess that draws the frog.'

(16) *Zhichu qingwa da de laoshu.*

'Point to the mouse that the frog hits.'

(17) *Zhichu ti qiu de nanhai.*

'Point to the boy that plays football.'

(18) *Zhichu tui daxiang de xiaomao.*

'Point to the cat that pushes the elephant.'

(19) *Zhichu nanhai gai de daxiang.*

'Point to the elephant that the boy covers.'

(20) *Zhichu chang ge de laoshu.*

'Point to the mouse that sings.'

(21) *Zhichu laoshu zhui de daxiang.*

'Point to the elephant that the mouse chases.'

(22) *Zhichu na taozi de houzi.*

'Point to the monkey that holds a peach.'

(23) *Zhichu bang daxiang de nanhai.*

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'Point to the boy that helps the elephant.'

(24) *Zhichu laoshu yao de xiaogou.*

'Point to the dog that the mouse bites.'

Appendix B

List of experimental sentences used in Experiment 3

(1) *Yi-ge xiaopengyou he kele. Yi-ge xiaopengyou he niunai.*

'One child drinks cola. Another child drinks milk.'

(2) *Yi-ge xiaopengyou chi pingguo. Yi-ge xiaopengyou chi xiangjiao.*

'One child eats an apple. Another child eats a banana.'

(3) *Yi-ge xiaopengyou mai qiqiu. Yi-ge xiaopengyou mai wanju.*

'One child buys a balloon. Another child buys a toy.'

(4) *Yi-ge xiaopengyou xi kuaizi. Yi-ge xiaopengyou xi shaozi.*

'One child washes chopsticks. Another child washes spoons.'

(5) *Yi-ge xiaopengyou da lanqiu. Yi-ge xiaopengyou da paiqiu.*

'One child plays basketball. Another child plays volleyball.'

(6) *Yi-ge xiaopengyou bao xiaomao. Yi-ge xiaopengyou bao xiaogou.*

'One child hugs a little cat. Another child hugs a little dog.'

(7) *Yi-ge xiaopengyou la tongxue. Yi-ge xiaopengyou la laoshi.*

'One child holds hands with a classmate. Another child holds hands with a teacher.'

(8) *Yi-ge xiaopengyou bang laoshi. Yi-ge xiaopengyou bang tongxue.*

'One child helps a teacher. Another child helps a classmate.'

(9) *Yi-ge xiaopengyou hua waigong. Yi-ge xiaopengyou hua waipo.*

'One child draws the grandpa. Another child draws the grandma.'

(10) *Yi-ge xiaopengyou qin mama. Yi-ge xiaopengyou qin baba.*

'One child kisses the mother. Another child kisses the father.'

(11) *Baba zhui xiaopengyou. Mama zhui xiaopengyou.*

'The father chases a child. The mother chases another child.'

(12) *Waigong han xiaopengyou. Waipo han xiaopengyou.*

'The grandpa calls a child. The grandma calls another child.'

(13) *Baba jie xiaopengyou. Mama jie xiaopengyou.*

'The father picks up a child. The mother picks up another child.'

(14) *Waigong deng xiaopengyou. Waipo deng xiaopengyou.*

'The grandpa waits for a child. The grandma waits for another child.'

(15) *Baba bei xiaopengyou. Yeye bei xiaopengyou.*

'The father carries a child. The grandpa carries another child.'

(16) *Mama bao xiaopengyou. Nainai bao xiaopengyou.*

'The mother hugs a child. The grandma hugs another child.'

(17) *Mama la xiaopengyou. Baba la xiaopengyou.*

'The mother holds hands with a child. The father holds hand with another child.'

(18) *Laoshi bang xiaopengyou. Tongxue bang xiaopengyou.*

'The teacher helps a child. The classmate helps another child.'

(19) *Laoshi hua xiaopengyou. Tongxue hua xiaopengyou.*

'The teacher draws a child. The classmate draws another child.'

(20) *Mama qin xiaopengyou. Baba qin xiaopengyou.*

'The mother kisses a child. The father kisses another child.'

Appendix C

List of experimental sentences used for Task A in Experiment 4

(1) *xuan* 'choose'

Wo xiangdang xuan tongxue de linglei banzhang.

'I want to be the distinctive class monitor that chooses the classmates.'

Wo xiangdang banzhang xuan tongxue de banzhang.

'I want to be the class monitor that (the class monitor) chooses the classmates.'

Wo xiangdang tongxue xuan de linglei banzhang.

'I want to be the distinctive class monitor that the classmates choose.'

Wo xiangdang tongxue xuan banzhang de banzhang.

'I want to be the class monitor that the classmates choose (the class monitor).'

(2) *pai* 'photograph'

Wo xiangdang pai yingmi de zhiming daoyan.

'I want to be the famous director that takes a photo of (his) fans.'

Wo xiangdang daoyan pai yingmi de daoyan.

'I want to be the director that (the director) takes a photo of (his) fans.'

Wo xiangdang yingmi pai de zhiming daoyan.

'I want to be the famous director that the fans take a photo of.'

Wo xiangdang yingmi pai daoyan de daoyan.

'I want to be the director that the fans take a photo of (the director).'

(3) *zhui* 'chase'

Wo xiangdang zhui nüsheng de shuaiqi nansheng.

'I want to be the handsome boy that chases the girl.'

Wo xiangdang nansheng zhui nüsheng de nansheng.

'I want to be the boy that (the boy) chases the girl.'

Wo xiangdang nüsheng zhui de shuaiqi nansheng.

'I want to be the handsome boy that the girl chases.'

Wo xiangdang nüsheng zhui nansheng de nansheng.

'I want to be the boy that the girl chases (the boy).'

(4) *hua* 'draw'

Wo xiangdang hua yeye de huopo haizi.

'I want to be the lovely child that draws the grandpa.'

Wo xiangdang haizi hua yeye de haizi.

'I want to be the child that (the child) draws the grandpa.'

Wo xiangdang yeye hua de huopo haizi.

'I want to be the lovely child that the grandpa draws.'

Wo xiangdang yeye hua haizi de haizi.

'I want to be the child that the grandpa draws (the child).'

(5) *bang* 'help'

Wo xiangdang bang baixing de miaoshou shenyi.

'I want to be the excellent doctor that helps people.'

Wo xiangdang shenyi bang baixing de shenyi.

'I want to be the doctor that (the doctor) helps people.'

Wo xiangdang baixing bang de miaoshou shenyi.

'I want to be the excellent doctor that people help.'

Wo xiangdang baixing bang shenyi de shenyi.

'I want to be the doctor that people help (the doctor).'

(6) *jiao* 'teach'

Wo xiangdang jiao laoshi de congming xuesheng.

'I want to be the clever student that teaches the teacher.'

Wo xiangdang xuesheng jiao laoshi de xuesheng.

'I want to be the student that (the student) teaches the teacher.'

Wo xiangdang laoshi jiao de congming xuesheng.

'I want to be the clever student that the teacher teaches.'

Wo xiangdang laoshi jiao xuesheng de xuesheng.

'I want to be the student that the teacher teaches (the student).'

(7) *bei* 'carry'

Wo xiangdang bei erzi de gexing fuqin.

'I want to be the characteristic father that carries the son.'

Wo xiangdang fuqin bei erzi de fuqin.

'I want to be the father that (the father) carries the son.'

Wo xiangdang erzi bei de gexing fuqin.

'I want to be the characteristic father that the son carries.'

Wo xiangdang erzi bei fuqin de fuqin.

'I want to be the father that the son carries (the father).'

(8) *kan* 'look at'

Wo xiangdang kan guanzhong de youxiu yanyuan.

'I want to be the excellent actor that looks at the audience.'

Wo xiangdang yanyuan kan guanzhong de yanyuan.

'I want to be the actor that (the actor) looks at the audience.'

Wo xiangdang guanzhong kan de youxiu yanyuan.

'I want to be the excellent actor that the audience looks at.'

Wo xiangdang guanzhong kan yanyuan de yanyuan.

'I want to be the actor that the audience looks at (the actor).'

(9) *qian* 'hold hands'

Wo xiangdang qian laoren de ke'ai haizi.

'I want to be the lovely child that holds hands with the old.'

Wo xiangdang haizi qian laoren de haizi.

'I want to be the child that (the child) holds hand with the old.'

Wo xiangdang laoren qian de ke'ai haizi.

'I want to be the lovely child that the old holds hand with.'

Wo xiangdang laoren qian haizi de haizi.

'I want to be the child that the old holds hand with (the child).'

(10) *bao* 'hug'

Wo xiangdang bao nü'er de meili mama.

'I want to be the charming mother that hugs the daughter.'

Wo xiangdang mama bao nü'er de mama.

'I want to be the mother that (the mother) hugs the daughter.'

Wo xiangdang nü'er bao de meili mama.

'I want to be the charming mother that the daughter hugs.'

Wo xiangdang nü'er bao mama de mama.

'I want to be the mother that the daughter hugs (the mother).'

(11) *han* 'call'

Wo xiangdang han qiuyuan de yanli jiaolian.

'I want to be the strict trainer that calls the football player.'

Wo xiangdang jiaolian han qiuyuan de jiaolian.

'I want to be the trainer that (the trainer) calls the football player.'

Wo xiangdang qiuyuan han de yanli jiaolian.

'I want to be the strict trainer that the football player calls.'

Wo xiangdang qiuyuan han jiaolian de jiaolian.

'I want to be the trainer that the football player calls (the trainer).'

(12) *qin* 'kiss'

Wo xiangdang qin nainai de piaoliang sunnü.

'I want to be the pretty granddaughter that kisses the grandma.'

Wo xiangdang sunnü qin nainai de sunnü.

'I want to be the granddaughter that (the granddaughter) kisses the grandma.'

Wo xiangdang nainai qin de piaoliang sunnü.

'I want to be the pretty granddaughter that the grandma kisses.'

Wo xiangdang nainai qin sunnü de sunnü.

'I want to be the granddaughter that the grandma kisses (the granddaughter).'

Appendix D

List of experimental items in Experiment 5

(1) *Zhezhi xiaogou, zai da xiaomao.*

   'As for this dog, (it) is hitting the cat.'

(2) *Zhege haizi, waipo zai hua.*

   'As for this child, the grandma is drawing (him).'

(3) *Zhege nanhai, zai kan shu.*

   'As for this boy, (he) is reading a book.'

(4) *Zhezhi xiaogou, zai kan xiaomao.*

   'As for this dog, (it) is looking at the cat.'

(5) *Zhege nanhai, xiaogou zai tui.*

   'As for this boy, the dog is pushing (him).'

(6) *Zhege nanhai, zai qi zixingche.*

   'As for this boy, (he) is riding a bike.'

(7) *Zhege nanhai, daxiang zai gai.*

   'As for this boy, the elephant is covering (him).'

(8) *Zhezhi xiaomao, xiaogou zai yao.*

   'As for this cat, the dog is biting (it).'

(9) *Zhege nühai, zai chuan qünzi.*

   'As for this girl, (she) is wearing a skirt.'

(10) *Zhege nanhai, zai tui daxiang.*

   'As for this boy, (he) is helping the elephant.'

(11) *Zhezhi houzi, zai zhui xiaogou.*

   'As for this monkey, (it) is chasing the dog.'

(12) *Zhege yeye, zai jiao hua.*

'As for this grandpa, (he) is watering flowers.'

(13) *Zhezhi houzi, laoshu zai kan.*

'As for this monkey, the mouse is looking at (it).'

(14) *Zhege nanhai, zai ti qiu.*

'As for this boy, (he) is playing football.'

(15) *Zhezhi qingwa, zai hua gongzhu.*

'As for this frog, (it) is drawing the princess.'

(16) *Zhege nühai, zai cui lazhu.*

'As for this girl, (she) is blowing out candles.'

(17) *Zhezhi qingwa, laoshu zai da.*

'As for this frog, the mouse is hitting (it).'

(18) *Zhezhi xiaomao, zai tui daxiang.*

'As for this cat, (it) is pushing the elephant.'

(19) *Zhege nühai, zai tiao sheng.*

'As for this girl, (she) is jumping rope.'

(20) *Zhege nühai, zai gai waipo.*

'As for this girl, (she) is covering the grandma.'

(21) *Zhezhi laoshu, daxiang zai zhui.*

'As for this mouse, the elephant is chasing (it).'

(22) *Zhege nanhai, zai zhai yingtao.*

'As for this boy, (he) is picking up cherries.'

(23) *Zhege nühai, waipo zai bang.*

'As for this girl, the grandma is helping (her).'

(24) *Zhezhi laoshu, zai yao xiaomao.*

'As for this mouse, (it) is biting the cat.'