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Parameter setting in language acquisition: A study of the acquisition of null objects and the *ba* construction in Chinese

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Abstract

To explain children's rapid mastery of the grammar of any natural language, in the Principle and Parameter approach (Chomsky, 1981, 1993), learning is reduced to parameter setting. However, a lot of controversial and unanswered questions still remain as to how this may work. The present study compares two language models of parameter setting, the triggering model advanced in Gibson and Wexler (1994) and Yang's (2002, 2004) variational model. To evaluate the two models, I examine the production of null objects and the occurrence of the *ba* construction with 47 monolingual Mandarin-speaking children (aged 1;2 - 6;5) and their caregivers through the CHILDES database (MacWhinney, 2000). The results indicate that whether measured by the acquisition of a null object grammar or by the *ba* construction, which implies the obligatoriness of an overt object, no gradual climb was found in the children's developmental pattern as anticipated by the variational model, rather parametric change was precipitous as expected on the triggering model. The frequency of null object use drops suddenly to adult level just over the span of six months (from 1;2 to 1;8) or even less. Moreover, children all produced overt objects in the *ba* construction, like adults, from the first occurrence, which demonstrates that children do not start with both parameter values as the variational model assumes. A default value may play a role in development and the setting of such value is independent from the frequency of the input received in the linguistic environment.

Keywords: the triggering model, the variational model, parameter setting, null object, the *ba* construction

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Abbreviations

BA	*ba* construction
CL	classifier
DE	pre-nominal modification marker or postverbal resultative marker *de*
EXP	experiential aspect
FEM	feminine
NEG	negation
PERF	perfective aspect
PL	plural (e.g. 3PL = 3rd person plural)
PROG	progressive aspect
Q	question particle
SFP	sentence-final particle
SG	singular (e.g. 3SG = 3rd person singular)
TOP	particle realizing the head of Topic Phrase

Chapter I Introduction

The question "how do children acquire their native language?" has prompted a lively theoretical debate and a great deal of empirical research. The complexity and relatively limited input make the acquisition of language wildly difficult. However, all children exposed to language, regardless of environmental factors and individual differences in intelligence and other talents, are able to acquire very complex grammars in 5 or 6 years. The search for a plausible explanation for this phenomenon has led to important theories in the literature. The claim that there is a Universal Grammar (UG), that is, an innate language faculty equipped with abstract linguistic principles and parameters, was offered as a possible answer (Chomsky, 1981, 1993). Such Principles and Parameters (P&P) framework perfectly solves tree major problems related to the language acquisition. First, the logical problem of language acquisition, that is, how children are able to acquire their first language (L1) so quickly and effortlessly. Second, the developmental problem of language acquisition, namely why children appear to go through stages of development on their way to fix the appropriate settings. Third, cross-linguistic variation (for a review, see Ayoun, 2003). Although parameter-setting theory has come under criticism (see Evans, 2014; Behme & Evans, 2015), it remains actively pursued because it has not been replaced by any other satisfactory proposal and hypotheses based on parameter-setting theory are testable by empirical studies (Adger, 2015).

However, with regard to examining how parameter setting may work there are still a lot of unanswered questions. There is controversy in, for example, whether children initially choose a parameter value or rather both values are operative. Several important reflections or hypotheses have appeared; among them the triggering model endorsed by Gibson and Wexler (1994) and Yang's (2002, 2004) variational model are two of the most influential ones.

The central claim of the triggering model is that all children start out with either parameter, and, based on certain information in the input data, children could eventually change this initial parameter setting or consistently apply the initial value if it allowed the child to parse sentences. Change is precipitous like setting a switch. In contrast to the analysis of the triggering model, the proposal of Yang assumes that learners do not need to select any values as their initial guess, since both values are available. Besides, Yang (2002, 2004) considers language acquisition as the consequence of a population of competing grammars, whose distribution changes in response to the input presented to the learner. Therefore if such model is at all relevant to the explanation of child language development, the following predictions are inevitable:

(1) a.   Learners should start with two parameter values.
    b.   The behavior pattern should take the shape of a gradual curve, that is, abrupt changes in linguistic expressions should not be observed.

To evaluate these two theoretical models, I compared their predictions against my findings from a longitudinal production study of the acquisition of Chinese null objects phenomena in transitive verbs and the *ba* construction. The reason for me to focus on the null object parameter is that to determine [±Null object] parameter is relatively clear in Chinese. As pointed out in Wexler (2011), one problem of Legate and Yang's (2007) cross-linguistic research is that how particular morphological patterns are considered to be [+Tense] or [-Tense] (since they focus on the [±Tense] parameter) remains unclear. Moreover, as a discourse oriented language (Li & Thompson, 1976; Tsao, 1977 as cited in Huang, 1984a), null objects are an outstanding phenomenon in Chinese.

Based on that, our joint goals are, on the one hand, to spell out how well each model stands up to empirical findings aiming to build and refine parameter-setting theory and, on the other hand, to describe a developmental pattern of the acquisition of null objects and the *ba* construction by monolingual, typically-developing Chinese children.

In order to achieve our goals, the present dissertation is organized as follows. Chapter II first considers the main differences between the triggering model and the variational model. At the same time I provide a background discussion of the Chinese null objects phenomenon, including an introduction to the *ba* construction. Then, I address the respective predictions of these two models on the acquisition of null objects and the *ba* construction. The objectives of the study are introduced in chapter III, and chapter IV deals with the data used in the research and presents the results of the analysis. Chapter V discusses the implications of the acquisition models. The summary of the main findings and limitations of the current research and its implications for future study are also presented in this chapter.

Chapter II Background

2.1 Two approaches to learnability

In the development of generative grammar, modern syntactic theory is usually associated with the Government and Binding theory and the subsequent development of Minimalism (Chomsky, 1981, 1995). Under this framework, it is assumed that linguistic theory is to be characterized by a set of principles defining Universal Grammar (UG), which is innately available to the learner, and a finite number of parameters, each of which has a binary value, say the value 0/1. In an attempt to achieve explanatory adequacy (i.e., to establish how the child acquires knowledge of language), generative linguists developed a Principles & Parameters (P&P) approach, according to which when the child acquires a particular language, s/he should select the grammar(s) used in her/his linguistic environment, or fix the values of the parameters at various points in her/his grammar. So, basically, learning is just selection. However, what children should select remains controversial. There are two influential models related to this question: the triggering model (Gibson & Wexler, 1994) and the variational model (Yang, 2002, 2004). Although they both admit that the UG-defined grammars are accessible to the learner from the start, they differ in the sense of whether there are default grammars and whether those grammars can be changed. To fully assess the plausibility of these two parameter-setting models, we will review them below.

2.1.1 The triggering model

To begin with, we focus on the triggering model developed by Gibson and Wexler (1994). It has been assumed that, at any time, the learner identifies a default grammar G, i.e., a string of 0's and 1's. When the learner hears a sentence S from the input, s/he will analyze this sentence with G; if S allows the learner to parse that sentence[1], then the target grammar is

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[1] The sentence which determines that a parameter is set to a certain value has often been called a *trigger* for that value of that parameter (Gibson & Wexler, 1994, p. 408).

left unchanged. If not, the learner changes the value associated with G, thus obtaining a new grammar G_n, and tries to reprocess S using the G_n. If analysis is now possible, the parameter value of G_n is adopted. Otherwise, G is retained. For the sake of clarity, I limit myself to putting forward the algorithmic formulation as follows:

(2) Given an initial set of values for n binary-valued parameters G, the learner,
    a. Upon receiving an incoming sentence S, analyzes S with G
    b. If successful, G remains unchanged; returns to a.
    c. If failure, then
        ● changes the value associated with G, obtaining a new grammar G_n
        ● analyzes S with G_n
        ● If successful, adopts G_n
        ● otherwise retains G; returns to a[2].

Following Gibson and Wexler (1994), the learner should have an initial hypothesis about the parameter settings; as stated by Wexler (2011) there is maybe some kind of biological mechanism which pushes "some parameters to be set first, refusing to let them change when other input comes in" (p.94-95). Furthermore, the triggering model is error-driven, in that "the learner does not attempt to change her hypothesis as long as the current input sentence can be syntactically analyzed" (Gibson & Wexler, 1994, p. 410). In addition, learning is online and conservative, in that the $G_n(s)$ are very close to the previous G, differing by only one parameter value.

2.1.2 The variational model

Note that, under the triggering model, the learner's grammar changes depending on its success or failure to parse the input, so "after a particular input sentence, the learner may actually end up farther from the target grammar than before" (Gibson & Wexler, 1994, p.

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[2] The triggering model also takes into account the effects of noise in the input data. As Gibson and Wexler (1994) pointed out, a variant of the triggering model might consider changing parameters based on only highly frequent kinds of input data.

410). This can be a main difference with Yang's variational model (2002, 2004), according to which "the learner is identified with a population of grammars whose probabilistic distribution changes in response to the input but the grammars don't" (Yang, 2011, p. 140). That is, Yang considers acquisition is a result of stochastic selection of competing grammars from a statistical perspective and even argues that a full explanation of children's grammar development must abandon triggering and similar models, in favor of probabilistic learning mechanisms (Yang, 2004).

So, according to his proposal, each parameter is associated with a probability and the task of acquisition is to select the grammar(s) used in the learner's linguistic environment; when a particular grammar succeeds in assigning an analysis it is rewarded, if it fails it is punished. As learning proceeds, the more successful grammar becomes stronger, eventually pushing out the competitors. The procedure can be summarized as follows (from Yang, 2002, p. 26-27):

(3) For an input sentence s, the child:
    (i) with probability P_i selects a grammar G_i,
    (ii) analyzes s with G_i,
    (iii)   ● if successful, reward G_i by increasing P_i,
           ● otherwise punish G_i by decreasing P_i.

Many variants of (3) have been spelled out, a more recent one is given in Yang (2011, p. 140):

(4) Suppose that there are n (binary) parameters α_1, α_2, … , α_n, each parameter α_i is associated with probability p_i, which denotes the probability of α_i set to, say, the value 1.
    a. Upon receiving an input sentence s, the learner uses P to probabilistically (and thus non-deterministically) generate a composite grammar G.
    b. If G can analyze s, reward all the parameter choices in G; i.e., increase/decrease p_i if α_i has been chosen the value 1/0.

c. If *G* fails to analyze *s*, punish all the parameter choices in *G*.

Hence, in this model, the rise of the target grammar is gradual which means that non-target grammars will stick around for a while before they are eliminated. Besides, the number of values that are in play when the learner first engages in setting a parameter are also different. According to the variational model, the learner entertains two values simultaneously; there should not be an initial or default value as the triggering model suggests.

As the main concern of this study is to examine how well the two accounts stand up to the empirical findings in relation to the acquisition of direct object omission and the *ba* construction by Chinese children, in what follows I briefly consider some basic facts concerning these two phenomena. The null object parameter is discussed first, and then the *ba* construction.

2.2 The null object parameter in Mandarin Chinese

We take it as our starting point that a canonical active sentence in Chinese is built around a transitive action verb with the unmarked SVO word order, as in (5).

(5) a. 我　洗　衣服。
　　　wo　xi　yi-fu.
　　　1SG　wash　cloth
　　　'I wash clothes.'
　　b. 他　　看　　电视。
　　　ta　　kan　　dian-shi.
　　　3SG　watch　TV
　　　'He watches TV.'

In (5) Agent is always assigned to the subject and Patient to the object. So, there is a one-to-one mapping between the number of noun phrases (NPs) and the number of a verb's arguments. However, as we will see below, this one-to-one correspondence is not always

overtly upheld, sometimes arguments may be phonetically null (in the sense of object drop). In this case, for each transitive verb in Chinese its complement could be coded in one of the following three categories: overt object (6), definite implicit object (7), or indefinite implicit object (8):

(6) 我　今天　吃　了　一　顿　大 餐。
    wo　jin-tian　chi　le　yi　dun　da can.
    1SG　today　eat　PERF　a　CL　big meal
    'I ate a great meal today.'

(7) Speaker A: 我　今天　吃　了　一　顿　大 餐。
            wo　jin-tian　chi　le　yi　dun　da can.
            1SG　today　eat　PERF　a　CL　big meal
            'I ate a great meal today.'
    Speaker B: 哇! 我　也　吃　了。
            wa!　wo　ye　chi　le　(Ø).
            oh　1SG　also　eat　PERF
            'Oh! I also ate (one).'

(8) 我　　今天　已经　吃　过　了。
    wo　　jin-tian　yi-jing　chi (Ø)　guo　le.
    1SG　today　already　eat　EXP　SFP
    'I have already eaten (Ø) today.'

(6) is a typical SVO sentence, since the object appears without any previous reference, and object-drop is ruled out in both Chinese and English. In (8), the object is assumed to be generic and nonreferential in the sense that the speaker does not try to convey the idea that something in particular has been eaten today, but something edible in general, and in this case both languages license object-drop. The difference between the two languages arises in a definite context such as (7), in which, unlike in its counterpart in English shown by the translation, Chinese permits object drop as long as the object can be recovered through discourse, even if the object is definite.

In this respect, the child acquiring such a system faces the intriguing task of figuring out when omissions are allowed. Therefore, in terms of language acquisition, it is also necessary to explain how each option is learned by children and under what circumstances each is used. Before going further into the language acquisition process, it is necessary to provide some background concerning the essentials of SVO structure in Chinese. In order to do so, we first introduce the distinction between SVO structure and VO formation words.

2.2.1 Verb-object phrase or verb-object word

The notion of 'word' is quite clear and intuitive in English; however, in Chinese the word can be reanalysed as a syntactic phrase. For example, the word *shui-jiao* ('sleep') consists of a verb (*shui* 'sleep') and a noun (*jiao* 'sleep') which can be grammatically described as [[shui]$_V$[jiao]$_N$]$_V$. But at the same time, the two morphemes *shui* and *jiao* can be separated by expressions of time like (9) and the noun *jiao* even can be topicalized as shown in (10).

(9) 他　　睡　　了　　两　　　小时　　　的　　觉。
    ta　　shui　le　　liang　xiao-shi　　de　　jiao.
    3SG　sleep　PERF　two　　hour　　　DE　　sleep
    'He slept for two hours.'

(10) 觉，　　我　　想　　他　　是　会　　睡　　　的。
    jiao,　wo　　xiang　ta　　shi　hui　shui　　de.
    sleep,　1SG　think　3SG　be　will　sleep　DE
    'Sleep, I think he will take.'

The problem here is how to determine if a 'word' like *shui-jiao* is a V-O phrase or a compound word. In the present dissertation, we follow the criteria of Huang (1984b) and Packard (2000). According to Huang's Phrase Structure Condition (PSC, 1984b), a Mandarin verb may be followed by at most one constituent, thus, if a V-O form is followed by an object, it should be analysed as a V-O word, but not a syntactic V-O phrase, since if it were a V-O phrase, it would violate the PSC by allowing the verb to be followed by two

constituents[3]. On the other side, when the object is either modified (e.g. by expressions of time or quantification) or moved (e.g. via topicalization), it can be identified as a syntactic phrase (Packard, 2000).

Therefore, following the criteria given above, *shui-jiao* ('sleep') in (11) is a word because it may not be followed by an object:

(11)　他　　　睡　　　觉　　　了。
　　　ta　　shui　　jiao　　le.
　　　3SG　sleep　　sleep　　PERF
　　　'He has slept.'

In contrast, *shui jiao* ('sleep') in (9) and (10) is a VO phrase, because the relation between the verb *shui* and object *jiao* is clearly syntactic as the object is modified by the expression of time or has been topicalized, none of which are lexical operations. So, it seems that Mandarin V-O formation forms can be analyzed as both words and phrases; if we want to count the ratio of sentences with null objects, we should not include the complement morpheme as an object in VO words (such as *jiao* in (11)). In the next section, we will describe some theoretical approaches to object omission in the adult grammar of Chinese from the syntactic point of view, and attempt to draw out the essentials of this phenomenon.

2.2.2 Generative approaches to object omission

Mandarin Chinese is considered a discourse-oriented language (Li & Thompson, 1976; Tsao, 1977 as cited in Huang, 1984a), that is, compared to the Indo-European languages, it uses fewer morphological resources, but more devices and strategies at the discourse level for the construction of text. One important piece of evidence for this parameter setting is the fact

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[3] As indicated by Packard (2000), although the presence of a second object may indeed determine the identify of a V-O form as a word in most cases, its absence by no means identifies the V-O form as a phrase, because it can also be an intransitive verb.

that Chinese has a rule of Topic NP Deletion (Tsao, 1977), which licenses a null object as long as the object referent can be recovered through discourse. An example of topicalized object drop is provided in (12).

(12) Speaker A: 你　　要　　来　　　看　　　泰坦尼克号　　吗？
　　　　　　　　ni　　yao　　lai　　kan　　　tai-tan-ni-ke-hao　　ma?
　　　　　　　　2SG　want　como　see　　　Titanic　　　　　SFP?
　　　　　　　　'Would you come along to the *Titanic*?'
　　　Speaker B: 我　　　已经　　　看　　　过　　　　了。
　　　　　　　　wo　　yi-jing　　kan　　guo (Ø)　le.
　　　　　　　　1SG　already　　see　　EXP　　SFP
　　　　　　　　'I have already seen (it).'

In (12), the direct object *tai-tan-ni-ke-hao* ('Titanic') can be dropped because its meaning is recoverable from the preceding context. By contrast, if a direct object has not been mentioned before (13a), or if it contrasts with another object (13b), then object omission is ruled out, as it would prevent the sentence from having any interpretation at all.

(13) a. *我　　很　　　喜欢　　看。
　　　　wo　　hen　　xi-huan　　kan (Ø).
　　　　1SG　very　　like　　　see
　　　　'I like seeing (Ø) very much.'
　　b. *我　　看　　过　　　泰坦尼克号，　　但　　没　　看　　　过。
　　　　wo　　kan　guo　　tai-tan-ni-ke-hao,　　dan　mei　kan　　guo (Ø).
　　　　1SG　see　EXP　　Titanic,　　　　but　NEG　see　　EXP
　　　　'I have seen Titanic, but I haven't seen (Ø).'

So far, various theoretical approaches have been proposed to capture the essentials of object omission. For instance, in performance proposals it has been argued that the use of overt and null arguments and their interpretation is determined at the discourse level (new or given information) rather than by grammatical parameter setting (Goldberg, 2001; Graf, Theakston, Lieven, & Tomasello, 2014; Greenfield & Smith, 1976). Specifically, research on discourse-pragmatic approaches consistently finds that new information comes last, i.e. new information is typically expressed in the predicate of the sentence and is normally realized

with a lexical NP (for an overview, see Arnold, Losongco, Wasow & Ginstrom, 2000) and, according to the Principle of Informativeness (Greenfield & Smith, 1976 as cited in Hyams & Wexler, 1993), children may omit from their utterances that information which is given. Therefore, if this type of accounts were correct, when placing the object in the position before the verb, as in OSV topicalizations, the omission rates for objects (in Chinese OSV structures) should be similar to those for subject (subject in the topicalized position).

However, the pragmatic accounts for argument drop have been showed to receive little empirical support from child language (Hyams & Wexler, 1993). For example, for the missing subject phenomenon, the pragmatic accounts (e.g. Informativeness approach) fail to explain the subject-object asymmetry[4] and the Processing approach (Bloom, 1990 as cited in Hyams & Wexler, 1993) cannot explain why null subjects typically occur alongside a range of other theoretically related grammatical properties, such as the development of inflection, verb second in Germanic or post verbal subjects in French (Hyams & Wexler, 1993). Due to the fact that pragmatic accounts of argument drop have been shown to be problematic, in the present paper we pay more attention to generative explanations for null objects.

First, let's return to the example of topicalized object drop in (12). According to Huang, Li & Li (2009), there are two types of topic structures in Chinese, namely "gapless topic sentences" and "gapped topic sentence". The former, illustrated in (14), involves an "aboutness" topic relation between the comment clause and the topic, which is base-generated as Xu & Langendoen (1985), Xu (2000), among others suggest (example from Huang, Li & Li, 2009, p. 203):

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[4] According to Hyams and Wexler (1993), the performance approach cannot explain why the information that is given is more often pronominalized when it occurs in object position, but dropped or pronominalized in about equal proportions when it occurs in subject position.

(14) 水果， 我　　 最　 喜欢 （水果　 中　 的） 香蕉。
　　shui-guo, wo　　 zui　　 xi-huan　(shui-guo zhong de) xiang-jiao.
　　　fruit, 1SG　　 most　　 like　　 (fruits　 among DE)　 banana
　　'(As for) fruits, I like bananas (among fruits) most.'

However, not all topic structures in Chinese are generated in the same manner. Huang (1984a) argues that gapped topic sentences like (12), which comprise a gap-antecedent relation, are derived by movement. According to him, the null object is locally bound by a sentence initial [$_{Top}$ Ø$_i$], which is in a nonthematic position; the status of the null object should be defined as a *variable* given the fact that "α is a *variable* if and only if it is locally A'-bound and in an A-position" (Chomsky, 1981, p. 330)[5]. The analysis of (12), according to Huang (1984a) is therefore as follows:

(15) Speaker B: [Top *e$_i$*], [wo　　 yi-jing　 kan　　 guo　 *e$_i$*　 le].
　　　　　　　　　　　 1SG　 already　 see　　 EXP　　　 SFP
　　　　　　'(It), I have already seen.'

In particular, the direct object (*it*) has been topicalized by an operator that is itself null and appears in the sentence-initial position, leaving a gap (empty category, *e*) in the base position. So, given this analysis, there is no genuine zero pronoun in Chinese object omission and what is really missing is the topic, that is, "an object is topicalized first before it is deleted from topic position" (Huang, 1984a, p. 542). As a consequence, we should expect that children acquiring Chinese will produce null-object structures at the point at which they develop *variables*, as evidenced, for example, by the emergence of quantification or the comprehension and production of *wh*-questions[6], etc.

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[5] Within the Government and Bingding (GB) framework of Chomsky (1981), α A-binds β iff α binds β and α is in an argument position (subjects, objects, etc.), and α A'-binds β iff α binds β and α is in an operator, nonargumental position (C, Top, etc).

[6] Tsai (1994, 1999) and Cole and Hermon (1998) proposed a binding model for *wh*-questions. In this model, Chinese wh-words are mostly variables, except adverbial *wh*-words (for a further review see Gao, 2009).

However, no consensus has been reached among researchers on the analysis of topic drop. While Huang (1984a) proposes that null objects in a "gapped topic sentence" show variable properties, other researchers suggest that null arguments in Chinese may be analysed as null pronominals (*pro),* which allow base-generation (Hu, 2014), so the analysis of (12) according to Hu (2014) is as in (16):

(16) Speaker B: [Top e_i], [wo$_j$ yi-jing   kan   guo   *pro$_i$*   le].
                               1SG   already   see   EXP   SFP
          '(It$_i$), I$_j$ have already seen (it$_i$).'

If we consider the null object a base-generated *pro,* then it should be free in its governing category[7] in accordance with Principle B of Binding Theory (Chomsky, 1981), thus it cannot refer to *wo* 'I', the subject of the comment clause. Therefore, Hu (2014) suggests that *pro* can only be bound outside its governing category by referring to an entity in a context which is salient, that is, the topic of the sentence *tai-tan-ni-ke-hao* 'Titanic'. Accordingly, the relation between the topic and *pro* is an anaphoric one, not a movement relation.

However, as mentioned by Lasnik (1976), Principle B only specifies what a pronoun cannot refer to, not what its reference must be. So, if the null object were really a *pro*, it should by default have two possible references, namely, i) *pro* is bound with the based-generated topic *tai-tan-ni-ke-hao* 'Titanic' as in Hu's (2014) analysis, or ii) need not be bound. Note that the second possibility is ill-formed in Chinese as shows below:

(17) * 泰坦尼克号，   我   已经   看   过   了。
      tai-tan-ni-ke-hao$_j$ wo$_j$ yi-jing   kan   guo   *pro$_i$*   le.
         Titanic   1SG   already   see   EXP   SFP
      'Titanic$_j$, I have already seen (it$_i$).'

So if we consider the null object as a *pro*, we should develop a theory to explain why (16) is

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[7] According to Chomsky (1981) as revised in Huang (1983), α is the governing category for β iff α is the minimal category containing β, a governor of β and a SUBJECT which, if β is an anaphor, is accessible to β.

acceptable and (17) is out, that is, why the null object should be always bound. Another construction that is also related to the [±Null object] parameter is the Chinese *ba* construction, which implies the obligatoriness of an overt object. I describe it in the next section.

2.3 The *ba* construction

The *ba* construction is used very commonly in Chinese people's daily speech (Xu, 2011). Previous research has provided us with detailed analyses of this construction (for a review see, Yang, 2013), however there have not been as adequate studies on the L1 acquisition of *ba*.

Ba was a lexical word, with the meaning of "take hold of" or "grasp" (Wang, 1957 as cited in Li, 2006); through a process of grammaticalization, *ba* has become an object marker, but it cannot be used to mark the object in a canonical SVO sentence (as in (18)), so structurally the *ba* construction is associated with SOV sentences.

The basic pattern of the *ba* construction is illustrated in (19) where the subject is in its canonical position[8]:

(18) *我   吃   把   蛋糕   了。

     wo   chi   ba   dan-gao   le.

     1SG   eat   BA   cake   PERF

     'I haven eaten the cake.'

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[8] The subject is not obligatory; there is the option of a null subject as long as it can be recovered through discourse.

(19)　我　把　蛋糕　　吃　　了。

　　　wo　ba　dan-gao　chi　le.

　　　1SG BA　cake　　eat　PERF

　　　'I have eaten the cake. '

Although *ba* has become grammaticalized and does not behave like a lexical verb, it still has a residual meaning of 'strong transitivity' in terms of Chao (1968). As illustrated in (19), the basic pattern of the *ba* construction could be [Subject + BA + NP + V + XP] which can be paraphrased as 'Subject take NP and does [V+XP] to it' (Huang et al., 2011). Although there is no consensus on the nature of the *ba* construction among linguists, it is agreed in the literature that there are several restrictions concerning this construction (Chao, 1968; Li, 2006).

First, the NP following *ba* – referred to as the post-*ba* NP – should be an affectee, that is, in our sentence (19), *dan-gao* 'cake' need be directly affected by the action *chi* 'eat'. Second, the post-*ba* NP is regulated by features of definiteness, so the sentence (20) is ungrammatical:

(20) *我　把　一　块　蛋糕　　吃　了。
　　　wo　ba　yi　kuai　dan-gao　chi　le
　　　1SG BA　one　CL　cake　　eat　PERF
　　　'I have eaten a cake. '

Third, the predicate in a *ba* construction cannot be a verb by itself (i.e. a bare verb), it must take another grammatical unit, that is, the VP must be morphologically complex. As shown the example of (19) above, the verb takes a perfective aspect marker *le*. Besides the aspect marker, the verb can take either a resultative verbal complement or a locative PP like (21) and (22) respectively. The ungrammatical counterparts are also given in (23) and (24).

(21) 我　　把　　黑板　　擦　　干净　了。
　　　wo　ba　hei-ban　ca　gan-jing　le.
　　　1SG　BA　blackboard　erase　clean　PERF
　　　'I erased the blackboard.'

(22) 我　　把　　苹果　　放　在　桌子　　上　　了。
　　　wo　ba　ping-guo　fang　zai　zhuo-zi　shang　le.
　　　1SG　BA　apple　put　on　table　above　PERF
　　　'I put the apple on the table.'

(23) *我　　把　　黑板　　擦。
　　　wo　ba　hei-ban　ca.
　　　1SG　BA　blackboard　erase
　　　'I erased the blackboard.'

(24) *我　　把　　苹果　　放。
　　　wo　ba　ping-guo　fang.
　　　1SG　BA　apple　put
　　　'I put the apple.'

The post-*ba* NPs in both (21) and (22) are definite, in which the speaker need bear the specific identity of the object (i.e. the blackboard and the apple) in mind. Moreover, in (21) *hei-ban* ('the blackboard') is affected in the sense that now it is clean, and *ping-guo* ('the apple') in (22) is affected in the sense that its location has changed by being on the table now. Finally, unlike a canonical SVO sentence like (25), when post-*ba* NP becomes a sentence topic it cannot be omitted (26):

(25) Speaker A: 我　　的　　蛋糕　　呢？
　　　　　　　　wo　　de　　dan-gao　　ne　？
　　　　　　　　1SG　DE　　cake　　Q
　　　　　　　'Where is my cake?'
　　Speaker B: 我　　吃　　了 (Ø)。
　　　　　　　wo　　chi　　le.
　　　　　　　1SG　eat　PERF
　　　　　　　'I have eaten (it). '

(26) Speaker A: 我　　的　　蛋糕　　呢？
　　　　　　　　wo　　de　　dan-gao　　ne　？
　　　　　　　　1SG　DE　　cake　　Q
　　　　　　　'Where is my cake?'
　　Speaker B: 我　把　　它　　吃　　了。
　　　　　　　wo　ba　　it　　chi　　le.
　　　　　　　1SG BA　　it　　eat　PERF
　　　　　　　'I have eaten it. '
　　Speaker B: *我　　把　　　　吃　　了。
　　　　　　　wo　　ba　(Ø)　chi　　le.
　　　　　　　1SG　BA　　　　eat　PERF
　　　　　　　'I have eaten (it). '

With the purpose of understanding how children acquire these structures, I take a close look at the predictions that the triggering model and the variational model make for the Chinese null object and the *ba* construction.

2.4 The triggering model and the variational model in the Chinese null object and the *ba* construction

The triggering model anticipates that the child consistently applies one parameter value, that is, either [+Null object] or [-Null object] unless parameter resetting is required. Suppose the child begins with an incorrect parameter setting, then following the triggering model we should expect a drastic change in the child's grammatical development at the point the child resets her parameter to the correct one.

On the other hand, the speed with which a parameter value rises to dominance correlates with the proportions of unambiguous forms (*signatures*, in Yang's term, 2002, p. 39) that appear in the input to the child. The signature for a parameter refers to "sentences that are analyzable only if that parameter takes on the correct value of the target language" (Yang, 2014, p. 142). Yang argues that many parameters are associated with signatures. With respect to the null object phenomenon, Yang (2002) considers that null objects in Chinese could be a positive signature for topic-drop. So, for the topic-drop parameter, if there are abundant signatures (i.e. null object instances and other null arguments) in the child input, we should expect that topic-drop would be learned very fast if we adopt Yang's model. If the inputs contain both overt and null objects, then we should expect that the child acquiring Chinese would show certain variability in the initial stage (at least).

Let us turn now to the *ba* construction. On the triggering model, when the presence of the *ba* construction in the input data becomes sufficiently high that it can be considered as possible triggering data, then we should expect the children to produce overtly post-*ba* NPs which are acceptable in the target grammar. Notice that, if we adopt this model, there is one case which should never occur, namely:

(27) In the triggering model, a new hypothesis is formed to replace the old, so if the children have established the value of the *ba* construction successfully, i.e. produce overt post-*ba* NP, then it should be impossible that we could still find some evidence of null post-*ba* NP in their productions.

With respect to the variational model, it is the distribution of grammars, not a single grammar itself, that changes upon exposure to linguistic evidence. Therefore, if the frequency of the *ba* construction is very high in the input, due to the fact that those constructions need an overt object, then Chinese children would move towards an English-like grammar where the objects in topicalized position need to be overt, although they could still produce null objects in the *ba* construction, given the presence of null objects

in the Chinese adult input. It would follow that:

(28) It is not possible that children just show one type of objects (i.e. overt or null) in
      their productions at least at the early age.

On the other hand, if the frequency of the *ba* construction is very low in the input, then Chinese children will speak a Chinese-like grammar where the objects in topicalized position could be null, and although they could still produce overt objects in the *ba* construction, the proportion might not be very high. Under this condition again:

(29) It is not possible that children just show one type of objects (i.e. overt or null) in
      their production at least at the early age.

To sum up, unlike in the triggering model, if we adopt Yang's model we should expect that, for an extended period of time, children would produce sentences that contain both overt and null objects, that is, Chinese children ought to use a Chinese grammar in coexistence with an English grammar. Besides, if a small number of *ba* constructions have been encountered in the input, then Chinese children should take some time to internalize that in the *ba* construction there should be an overt object even if it occupies a topicalized position. In addition, this process should be gradual and not set in an all-or-nothing manner, which means we could see the percentage of overt objects in the *ba* construction is increasing little by little.

With those predictions in mind, we turn to some previous work about how children acquire object omissions and production.

2.5 Previous studies assessing child language for object omission

First, null objects have not been a central issue in the study of early child grammar, while much research focuses on the more salient null subject (pro-drop) phenomenon. Previous

studies on English object omission find that null objects seldom occur in children's early production (Bloom, 1990; Wang, Lillo-Martin, Best, & Levitt, 1992). For the Chinese children, Wang et al. (1992) ran an experimental test in which the subject's task was to tell the story the experimenter just read by means of a role-playing game. The results, as shown in table 1, reveal that as their Mean Length of Utterance (MLU) increases, the mean percentage of sentences with null objects increases, too.

Age range	MLU	Mean percentage of object drop
2;0-2;5	3.41	20.121
3;1-3;5	4.41	21.376
4;1-4;4	5.28	26.031
Adults	/	40.142(in an adult-to-adult conversational setting)[9]/ 10.300(in children's story-telling)

Table 1: Mean Percentage of Sentences with Null Objects in Chinese child and adult subjects

As we can observe, in conversational settings, the Chinese children used null objects from as early as 2 years old, and at MLU 3.5 children produced more or less 20% of the transitive verb constructions with null objects; by MLU 5.28, their object-dropping rate is approaching the level of use by adults (in an adult-to-adult conversational setting).

Moreover, Wang et al. (1992) also demonstrated that both Chinese- and English-speaking children produced variables (through the comprehension and production of *wh*-questions for Chinese and the production of *wh*-movement for English) at the same time as these children showed null objects.

Hu (2014) tested the production of 125 Chinese children from age 3;0 to 8;0 in order to investigate what children do when they fail to produce relative clauses. She found that the typical answer for younger children were to answer with a declarative sentence with a null

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[9] The data are calculated based on appendices B and D in Wang et al. (1992, p. 253-254).

object or a null subject. Besides, the percentages of errors in declarative sentences with null objects are very low for each group tested (2.0% for age 3;0; 2.5% for age 4;0; 0.5% for age 5;0; and from age 6;0 there were no errors), which suggests that the null object parameter should be set early.

Moreover, all of these studies report a subject/object asymmetry in argument omissions. In fact, from a cross-linguistic point of view, it is widely acknowledged that subjects are omitted more often than objects (see Allen, 2000 for child Inuktitut; Hyams & Wexler, 1993 for child English; Serratrice, Sorace, & Paoli, 2004 for English-Italian bilingual and monolingual) even in the languages in which the omission of subjects is out. One of the ways to explain why English-speaking children also omit subjects is that children initially resort to topic-drop more often than adults (Hyams & Wexler, 1993). We can also find a less restrictive claim in Pérez-Leroux, Pirvulescu and Roberge (2008)'s proposal. According to them, children start out with null objects and by default extend this option wrongly to referential contexts. However, this proposal is not compatible with the variational model, since in this model the claim is that, at any one time, the learner has a number of different grammars that compete probabilistically.

Chapter III A study of spontaneous production

3.1 Research questions

On the basis of the existing literature, the main purpose of this study is to assess Gibson and Wexler's (1994) and Yang's (2002) proposals on L1 acquisition. In order to evaluate them, we focus on the acquisition of object omission by Chinese-speaking children, specifically, the *ba* construction as we have already pointed out in the previous section. Besides, we think it would also be interesting to investigate if we have evidence that variables (e.g. the emergence of wh-questions or quantification) cooccur with null objects in child Chinese. To that effect, the questions we address include the following:

(30) a. Is the developmental pattern of null objects compatible with Gibson and Wexler's model? How about Yang's?

   b. Is the developmental pattern of the Chinese *ba* construction compatible with Gibson and Wexler's model? How about Yang's?

(31)   Do we have evidence that variables develop simultaneously with null objects?

3.2 Methodology

3.2.1 Data

The present study is based on the speech of 47 Chinese-speaking children from the corpus of Zhou and, since there were no subjects of age six and above in the corpus of Zhou, 5 additional children from Chang's corpus were also included. Zhou's corpus includes children recruited in Nanjing, while Chang's data were collected in Taiwan. They were all from Mandarin speaking families as parents speak Mandarin Chinese to their children in everyday life. All can be found in the East Asian Language subset of the Child Language Data

Exchange System (CHILDES) database (MacWhinney, 2000).

All children in this combined corpus are between the ages of 1 year 2 months and 6 years 5 months and are typically developing children. I selected my samples randomly. The corpora include a total of 4624 child utterances.

For the purpose of this study, participants were divided into 9 age groups: the 1;2 age group, the 1;8 age group, the 2;2 age group, the 2;8 age group, the 3;0 age group, the 3;6 age group, the 4;0 age group, the 5;0 age group and the 5;5-6;5 age group (5 speakers of each age group, except for the last group ranging from 5;5 to 6;5, which has 7 speakers). Details on the child subjects can be found in table 2, which includes information about the age and the MLU of each subject. And adult data sources appear in table 3.

File	Subject	Age	MLU
cs14h.cha	Yangfan	1;2	1.357
cs14e.cha	Yijia	1;2	1.289
cs14b.cha	Liuxinyu	1;2	1.25
cs14g.cha	Xuyang	1;2	1.053
id14m.cha	Haohao	1;2	1.463
cs20i.cha	Xue'er	1;8	1.595
cs20c.cha	Wenwen	1;8	1.052
cs20g.cha	Jiangweiying	1;8	2.889
cs20d.cha	Qinlong	1;8	1.152
id20m.cha	Haohao	1;8	3.351
cs26i.cha	Majunhua	2;2.15	3.221
cs26b.cha	Liuzonghao	2;2.22	3.071
cs26j.cha	Shixintong	2;2.24	2.581
cs26c.cha	Shixuchen	2;2.26	1.466
id26m.cha	Haohao	2;2	3.558
cs32f.cha	Marui	2;8	3.514
cs32h.cha	Limanli	2;8	2.946
cs32c.cha	Chenzihui	2;8	2.574
cs32b.cha	Liyan	2;8	3.434
id32m.cha	Houhou	2;8	3.493
cs36fa07.cha	Wangyue	3;0	2.366
cs36fa08.cha	Zhouxinyuan	3;0	3.019
cs36fa09.cha	Hanjiaqi	3;0	2.293

cs36fb17.cha	Lishasha	3;0	2.12
cs36fb19.cha	Chenxixian	3;0	2.202
cs42mb12.cha	Zoushupeng	3;6	2.434
cs42ma03.cha	Zhangyuxuan	3;6	2.648
cs42fb20.cha	Caitianqi	3;6	2.317
cs42fb17.cha	Guohaohao	3;6	2.609
cs42fa10.cha	Chenziwei	3;6	2.747
cs48mb11.cha	Lijinghao	4;0	2.797
cs48fb16.cha	Chenxiaorong	4;0	3.213
cs48fa06.cha	Tangyi	4;0	2.377
cs48mb15.cha	Majunwei	4;0	2.722
id48m.cha	Haohao	4;0	4.278
cs60fa10.cha	Xuqucheng	5;0	2.325
cs60mb11.cha	Xuhao	5;0	3.736
cs60fb18.cha	Luohong	5;0	3.508
cs60fa09.cha	Yaoyifei	5;0	2.49
cs60fa06.cha	Dingyueying	5;0	3.46
cs66fa07.cha	Shikeyu	5;6	3.64
09.cha	Anxiang	5;7	4,761
10.cha	Xier	5;9	5,136
07.cha	Geli	5;11	7,092
cs72fa10.cha	Sunruiqi	6;0	3.573
05.cha	Lanxin	6;2	6,051
06.cha	Dezhi	6;5	7,810

Table 2: Child subjects

File	Identification
cs14h.cha	Mother
cs14e.cha	Mother
cs14b.cha	Mother
cs14g.cha	Mother
id14m.cha	Mother
cs20i.cha	Mother
cs20c.cha	Mother
cs20g.cha	Mother
cs20d.cha	Mother
id20m.cha	Mother
cs26i.cha	Mother
cs26b.cha	Mother
cs26j.cha	Mother
cs26c.cha	Mother

id26m.cha	Mother
cs32f.cha	Mother
cs32h.cha	Mother
cs32c.cha	Mother
cs32b.cha	Mother
id32m.cha	Mother
cs36fa07.cha	Mother
cs36fa08.cha	Mother
cs36fa09.cha	Mother
cs36fb17.cha	Mother
cs36fb19.cha	Mother
cs42mb12.cha	Mother
cs42ma03.cha	Mother
cs42fb20.cha	Mother
cs42fb17.cha	Mother
cs42fa10.cha	Mother
cs48mb11.cha	Mother
cs48fb16.cha	Mother
cs48fa06.cha	Mother
cs48mb15.cha	Mother
id48m.cha	Mother
cs60fa10.cha	Mother
cs60mb11.cha	Mother
cs60fb18.cha	Mother
cs60fa09.cha	Mother
cs60fa06.cha	Mother
cs66fa07.cha	Mother
09.cha	Observer/EXP
10.cha	Observer/EXP
07.cha	Observer/EXP
cs72fa10.cha	Observer/EXP
05.cha	Observer/EXP
06.cha	Observer/EXP

Table 3: Adult subjects

3.2.2 Data reduction

For the purpose of hypothesis testing, I calculated the raw number and mean percentage of
sentences with null objects for each speaker. Following the reasons and criteria detailed in

1.2, I did not include the VO words as V+O structures. Besides, when calculating null objects, I excluded any utterance that appears to be an immediate imitation, or an exact repetition from earlier in the same transcript. Such utterances were excluded on the grounds that they do not reliably indicate a novel use of the child's own grammatical knowledge (Demuth, 1996). The calculation was based on the ratios of the sentences with null objects over the sentences with a transitive verb.

Since efficient automated analysis tools are now readily available, I used CLAN tools (MacWhinney, 2015) for the calculation of MLU and the command ¨kwal +t*CHI +s"把" @¨ and ¨kwal +t*MOT +s"把" @¨ to cull all of the utterances that contain the *ba* construction in children and adults' spontaneous speech.

3.3 An overall view of the object omission results

First I focus on the overall percentage of object omission in the corpus; I turn to the *ba* construction in section 4.3. The mean percentage of sentences with null objects produced by Chinese child subjects is 33.19 (Standard Error mean, *SE* = 3.96), while it is 34.42 (*SE* = 2.24) for Chinese adults. I analyzed whether there were differences in the proportion of object omission by the child's age group and I found that initially (as early as age 1;2) all five children that I studied start by omitting objects 100% of the time (*M* = 100, *SE* = 0). Therefore, the initial grammar in Chinese is plausibly [+null object]. Examples for such sentences appear in (32).

(32) a MOT: 小　球　要　不　要　啦？
　　　　　　xiao qiu yao bu yao la
　　　　　　small ball   want NEG want   Q
　　　　'Do you want the small ball?'
　　　CHI: 要　　　　　　　　　　　(Liuxinyu, 1;2)
　　　　　yao (Ø)
　　　　　want
　　　　'I want it.'
　　b.　妈妈　　拿　　　　　　　(Xuyang, 1;2)
　　　　ma-ma　na (Ø)
　　　　mom　take
　　　'Mom, take it (it = robot).'

I adopted Wang et al. (1992)'s criteria in that the grammaticality of the Chinese null object sentences was judged with respect to the context in which the sentence in question was actually produced. Thus all the sentences in (32) are grammatical, since the objects can be recovered from the context. Besides, drawing on examples such as (33) we can assert that children show an early sensitivity to language-specific properties of the input data. Unlike English, verbal answers (which recover a form of the verb in the question) are one of the possible answer patterns to yes-no questions in Chinese.

(33) a. MOT: 要　喝　点　　水　啊？
　　　　　　yao he dian shui a ?
　　　　　　want drink little   water   Q
　　　　　'Do you want to drink some water?'
　　　CHI: 喝　　　　　　　　　　(Haohao, 1;2)
　　　　　drink (Ø)
　　　　　'I want.'
　　b. MOT:　喝　　水　　吧？
　　　　　　he　shui　ba?
　　　　　　drink water   Q
　　　　　'Do you drink water?'
　　　CHI: 不　　喝　　水。　　　(Haohao, 1;8)
　　　　　bu　he　shui.
　　　　　NEG　drink　water
　　　　　'I don't drink water.'

Interestingly, we find the same phenomenon in European Portuguese, which also allows verbal answers to yes-no questions[10]. Santos (2004) finds that European Portuguese children at 1;6.6 - 1;8.2 (her Stage I) only produce verbal answers (from Santos, 2004, p. 438):

(34)   MAE: Eu   posso?
                I   may
                'May I?'
        INI: Pô [: podes].   (Inês, 1;8.2)
                 may

Returning to Chinese, the results for children and child-directed speech in my corpus appear in table 4.

Age Group	Null object (Child)		Null object (Input)	
	%	N	%	N
1;2	100	14/14	43.05	65/151
1;8	42.86	15/35	38.67	87/225
2;2	34.57	28/81	26.73	50/187
2;8	41.77	33/79	32.93	54/164
3;0	30.59	26/85	31.87	109/342
3;6	31.31	31/99	28.21	110/390
4;0	28.66	45/157	40.36	134/332
5;0	31.67	57/180	37.35	121/324
5;5-6;5	29.80	59/198	32.26	30/93

Table 4: Percentage (%) and number (N) of null object produced by the child and input in each age group

[10] There are four main types of answer to yes-no question in European Portuguese: *Sim* (yes) answers, verbal answers, *ser* (be) answers and adverbial answers (Santos, 2004).

To illustrate the pattern and have a complete picture, I also drew a developmental curve of object omission for our 9 age groups of children (see Fig. 3). The results indicate that the omission of objects decreases very rapidly from 1;2 ($M = 100.00\%$, $SE = 0.00$) to 1;8 ($M = 51.57\%$, $SE = 13.56$), and then maintains at around 35% of object omission from 1;8 to 6;5 (the oldest age considered). At age 1;2, null objects are produced 100% of the time; by age 1;8, they have dropped to 42.86%, a change of 57.14%. I also ran an independent t-test to confirm if there is a significant difference between age 1;2 and 1;8 with respect to the percentage of null objects. I found that the difference was very significant $t(8) = 3.57$, $p < .05$ and it did represent a large-sized effect $r = .78$. However, the difference between 1;8 and 2;2 ($M = 41.76\%$, $SE = 10.15$) was not significant $t(8) = .58$, $p > .05$, $r = .20$. Thus the dramatic change in use of null objects takes place within 6 months.
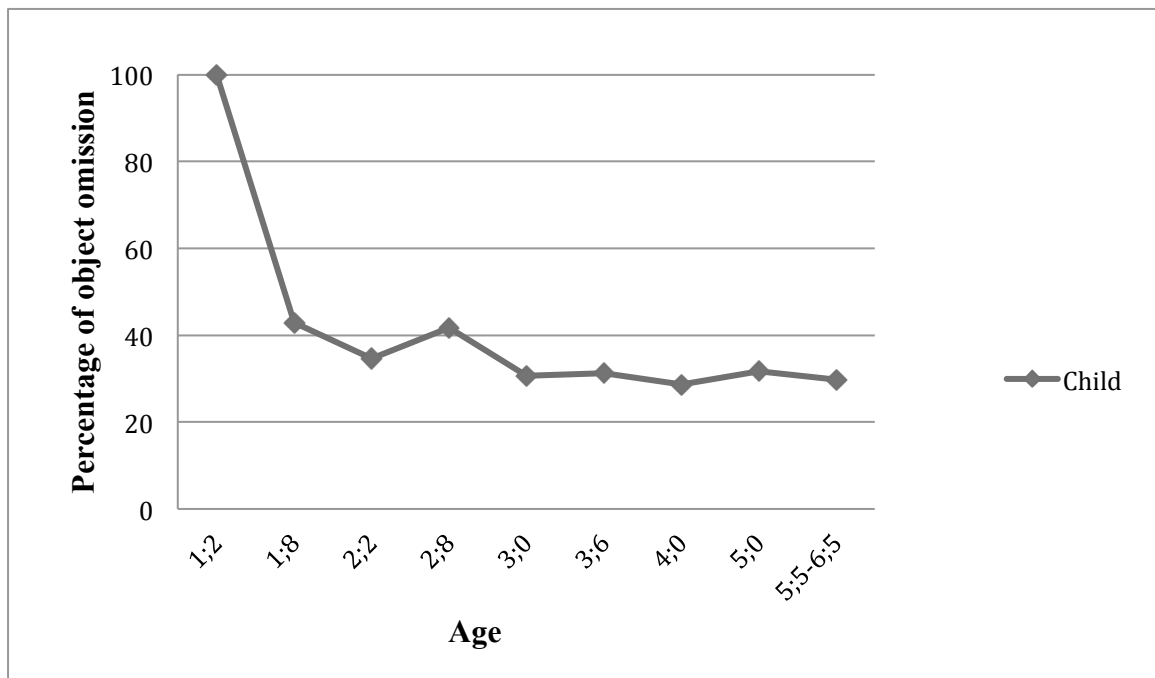

Fig. 3 Developmental curve of object omission for the Chinese children by age

It is possible that children omit objects because they are exposed to instances of null objects. Thus, I also examined the incidence of null objects in adult use at each point in the child's development as we can observe in table 3 above and figure 4: first there is no systematic decrease in the rate of null objects in adults' speech that parallels the decrease in the

children's use of null objects, as might be expected if children merely imitated the input. Second, the dependent t-test shows that there is no significant difference between children and adult performance at the age 1;8, $t(4) = -1.7$, $p > .05$, $r = .65$, that is, as early as age 1;8 the child performance of null objects has already become adult-like.
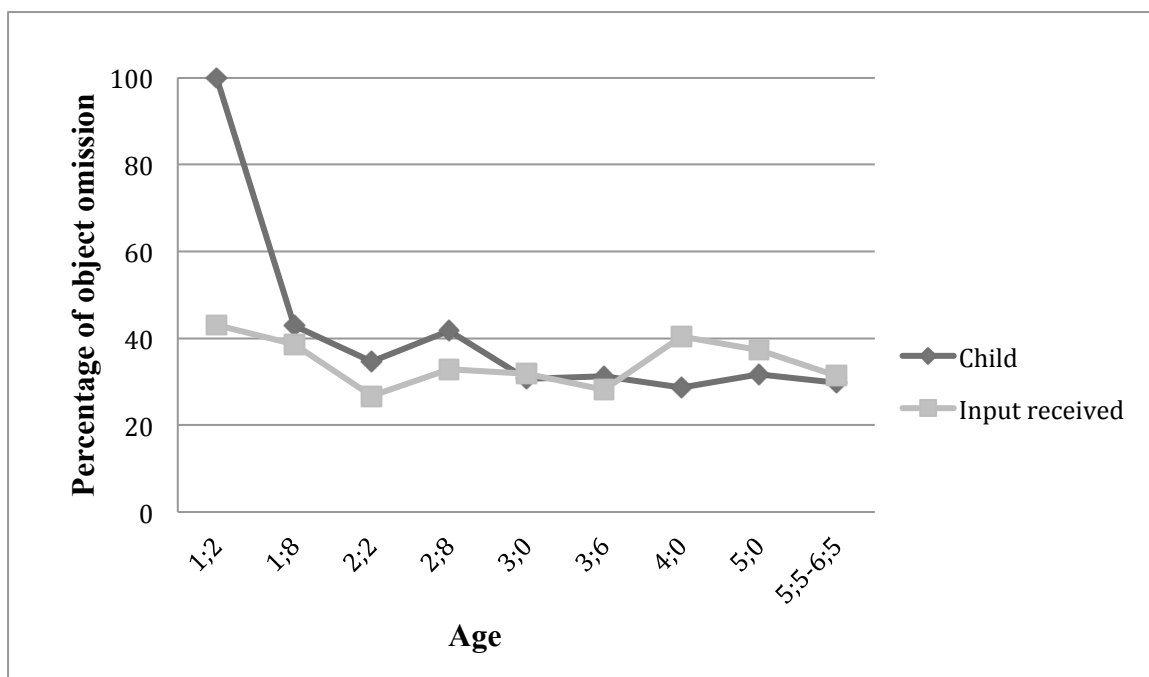

Fig. 4 Developmental curve of object omission for the Chinese children by age and percentages of object omission in child-directed speech

Since "by estimating the frequency of signatures in child-directed input, one can study the acquisition of parameters quantitatively and cross-linguistically" (Yang, 2011, p. 147), I also calculated the percentage of null objects in all sentences heard by children. Based on the CHILDES corpus, I estimated that such sentences (over the total number of sentences) constitute 8.2% ($SE = .69$) of all Chinese sentences heard by children

3.3.1 Results across MLU

In order to determine whether there is any relationship between the null object phenomenon and the child's linguistic maturation, the percentage of null object sentences was recalculated

on the basis of the children's MLU and chronological age. As expected, a strong positive correlation was found between age and MLU for our Chinese child subjects: r = .745, *p* < .01.

Then, I recalculated the null objects grouped by MLU. Based on Brown's stage of language development (Brown, 1973) and our data, I divided all the subjects into six stage groups across MLU, as in table 5:

Stage	MLU range	Mean age	Null object	*SE*
I	1.0-1.75	1;5	85.19%	7.58
II	1.75-2.25	3.0	34.33%	5.39
III	2.25-2.75	3;8	31.21%	2.82
IV	2.75-3.5	3;1	33.42%	3.52
V	3.5-4.0	5;3	26.93%	8.56
VI	4.0+	5;8	37.56%	14.06

Table 5: Percentage of null object sentences on the basis of MLU and standard error mean (*SE*) at each stage
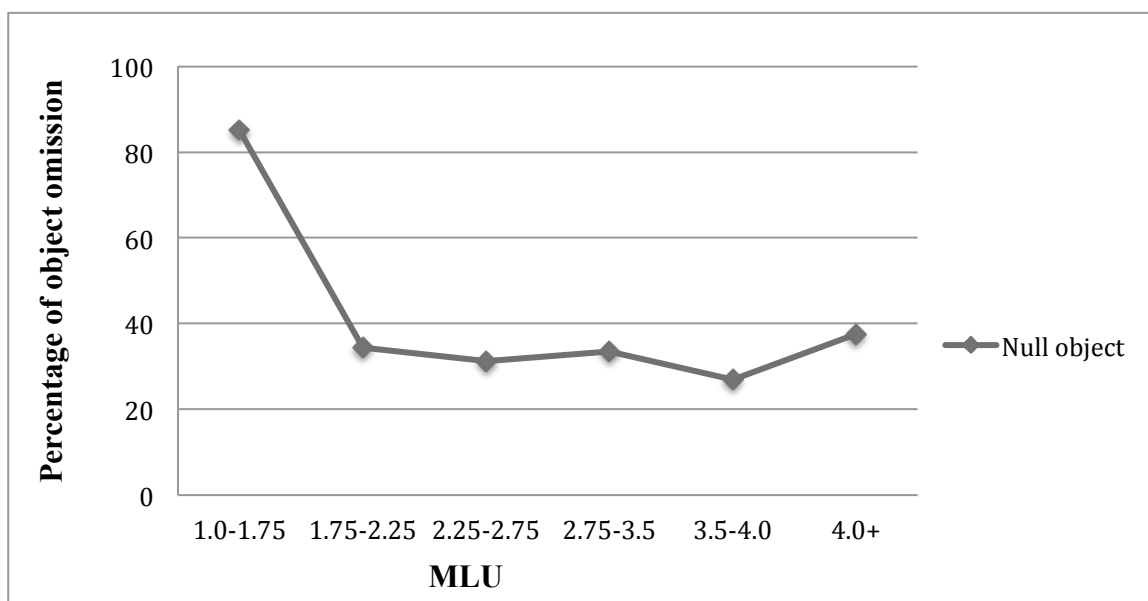

Fig. 4 Developmental curve of object omission for the Chinese children by MLU

The curve by MLU confirms what I have found when considering age. All children start by omitting objects very frequently. Then omission decreases for all children. Clearly, Chinese children experience a sharp drop in their use of null objects from MLU 1.0-1.75 (Stage I) to 1.75-2.25 (Stage II), and this finding is also corroborated statistically $t(10) = 3.68$, $p < .05$, which means there was a significant difference regarding the use of null objects between Stage I and Stage II and it also showed a large-sized effect $r = .78$. This result is hardly surprising, given that children at Stage 1 have an MLU below 2, and an overt object requires a two-word utterance at least.

In sum, whether divided by age or by MLU, Chinese children can set the correct parameter value at a very early age (before age 1.8 or at MLU 1.75). It seems unlikely that children omit objects 100% of the time at the beginning and then drop them to around 35% because they mimic the input. If this were the case, we should have found a systematic change in the input (adult's speech) parallel to the change in the output (children's speech). However, this was not the case. So, different performance among the nine age groups cannot be attributed to the different rate of object drop in the input that children hear.

3.4 Results of the use of the *ba* construction

Now consider the *ba* construction, both in young children and adult's speech; its frequency is significantly low according to our data. In young children, the overall percentage of the *ba* construction against transitive sentences is 4.9% (*SE* = 1.14), while in adult's speech is 12.9% (*SE* = 1.42). Table 6 reports the results of this analysis.

Age Group	The *ba* construction (Child)		The *ba* construction (Input)	
	%	N	%	N
1;2	0.00	0/14	17.88	27/151
1;8	2.86	1/35	22.22	50/225
2;2	2.47	2/81	22.99	43/187
2;8	2.53	2/79	9.76	16/164
3;0	3.53	3/85	12.87	44/342
3;6	2.02	2/99	12.56	49/390
4;0	10.19	16/157	11.14	37/332
5;0	9.44	17/180	6.79	22/324
5;5-6;5	10.10	20/198	10.75	10/93

Table 6: Percentage (%) and number (N) of *ba* constructions against transitive sentences produced by the child and input in each age group

As showed in the developmental curve, the *ba* construction appeared as early as 1;8 and reached adult levels of production by 4;0.
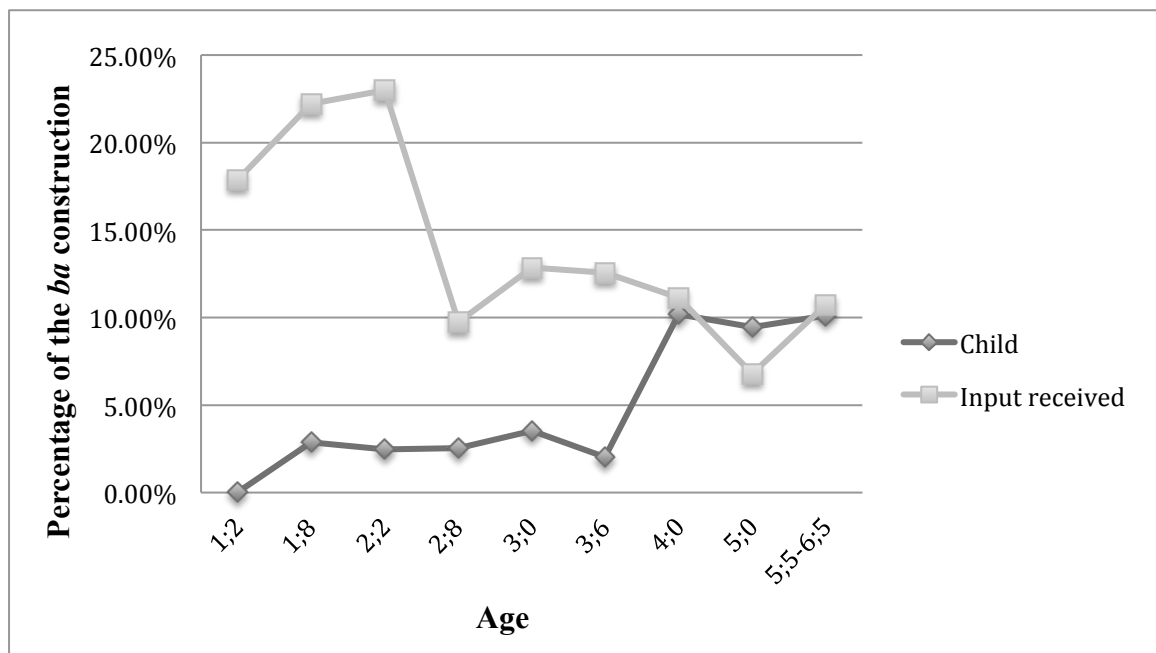

Fig. 5 Developmental curve of the *ba* construction by Chinese children by age and by adult speakers

Like with null objects, the shift is also drastic: there is a significant change between 3;6 and 4;0, $t(8) = -2.56$, $p < .05$, $r = .67$. However, the input received does not present a significant change, $t(8) = 1.07$, $p > .05$, $r = .35$, suggesting that the change could not be the result of the mimic of the input.

On the basis of MLU, the percentage of the *ba* construction against transitive sentences, and the result of the developmental curve are those in table 7 and figure 6:

Stage	MLU range	Mean age	The *ba* construction	*SE*
I	1.0-1.75	1;5	0.00%	0.00
II	1.75-2.25	3.0	0.00%	0.00
III	2.25-2.75	3;8	3.00%	1.29
IV	2.75-3.5	3;1	6.03%	1.71
V	3.5-4.0	5;3	10.91%	6.83
VI	4.0+	5;8	14.22%	5.71

Table 7: Percentage of the *ba* construction against transitive sentences on the basis of MLU and standard error mean (*SE*) at each stage
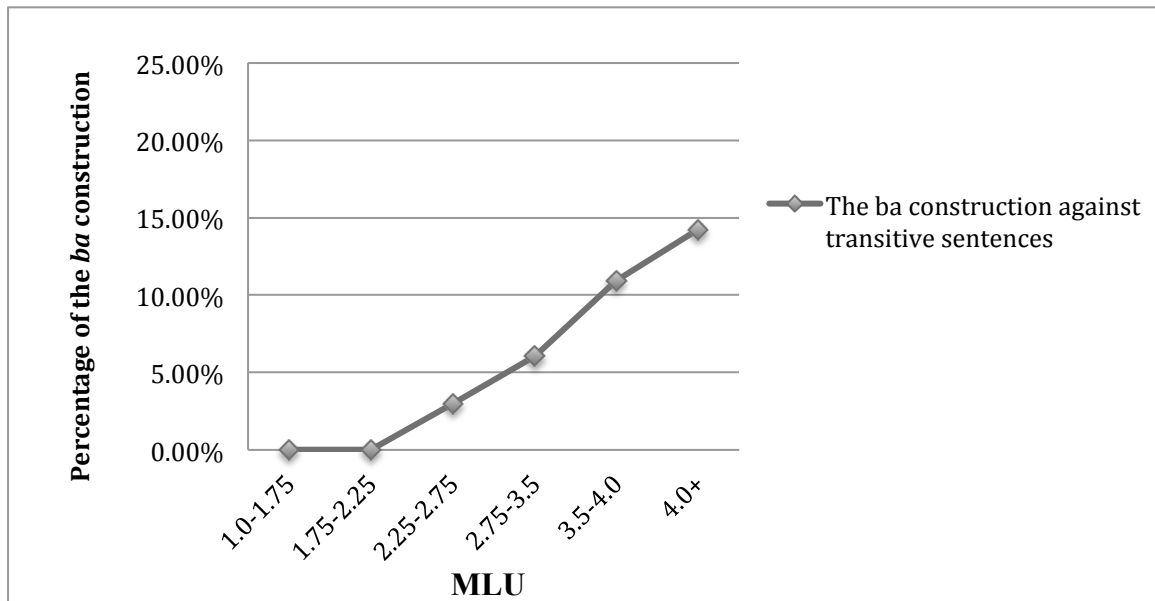
Fig. 6 Developmental curve of the *ba* construction against transitive sentences by MLU

As can be observed, although the Chinese-speaking children did not produce the *ba* construction at the first two stages tested (MLU 1.0-2.25), after the Stage II, as their MLU increased, the mean percentage of sentences with the *ba* construction increased. By MLU 3.5 their use of *ba* construction is approaching that of Chinese adults. Most importantly, all the children whose productions I analysed always produced an overt object in the *ba* construction (i.e. post-*ba* NP) from the first time. Examples from the corpus are provided in (35).

(35) a. CHI: 把　　大灰狼　　　赶　　走　　了。　　　　(Haohao, 1;8)
　　　　　　ba　da-hui-lang　　gan　zou　le.
　　　　　　BA　wolf　　　　drive　away　PERF.
　　　　　　'I drove the wolf away.'

　　　b. CHI: 帮　　我　把　它　拿　出来。　　　　　　(Liuzonghao, 2;2)
　　　　　　bang　wo　ba　ta　na　chu-lai.
　　　　　　help　1SG　BA　it　take　out.
　　　　　　'Help me to take it out.'

　　　c. CHI: 他　　把　苹果　　扔　　掉　　了。　　　(Marui, 2;8)
　　　　　　ta　ba　ping-guo　reng　diao　le.
　　　　　　3SG　BA　apple　throw　away　PERF
　　　　　　'He threw away the apple.'

The fact that all children produced post-*ba* NP just like adult shows that, if we adopt the standard criterion (e.g. Brown, 1973; Thornton & Tesan, 2007) that 90% "correct" adult-like usage in obligatory contexts indicates that a grammar structure has been acquired, the Chinese *ba* construction is an early acquisition (at 1;8), although the frequency of occurrence of this structure is low in our corpus.

Finally, in line with Yang (2002) and Legate and Yang (2007), I also calculated the adult usage frequency of the *ba* construction in the input, which constitutes 3.1% (*SE* = .31) of all the utterances.

3.5 Results of the use of structures exhibiting *variables*

In accordance with our third objective, I analysed whether children produced null object structures at the point when they developed *variables*. In our data, children produce some structures involving *variables* through the comprehension and production of *wh*-questions (Thornton, 1990; Wang et al., 1992), as can be seen in (36) and (37). These *variables* were produced and comprehended at the same time as these children showed evidence of using null objects.

(36) a. MOT: 猫　　怎么　　叫　的？
　　　　　　mao　zen-me　jiao　de?
　　　　　　cat　　how　　yowl　Q
　　　　　'How does a cat yowl?'
　　　CHI: 喵喵。　　　　　　　　　　　　　　　　(Haohao, 1;2)
　　　　　miao-miao.
　　　　　miaow-miaow
　　　　　'Miaow-miaow.'
　　b. MOT: 书　　上　　有　　个　什么　　人　　啊？
　　　　　　shu　shang　you　ge　shen-me　ren　　a?
　　　　　　book　above　have　CL　what　person　Q
　　　　　'Who's in the book?'

CHI: 阿姨。   (Haohao, 1;8)
a-yi
auntie
'Auntie.'

(37) a. CHI: 这   个   是   什么   呀?   (Jiangweiying, 1;8)
zhe ge   shi   shen-me ya?
this CL   is   what   Q
'What is this?'

b. CHI: 哪里   有   火车?   (Jiangweiying, 1;8)
na-li   you   huo-che?
where   have   train
'Where is the train?'

Our findings are consistent with Wang et al. (1992) who argued that Chinese children develop variables at the same time as they show evidence of using null arguments. However, the youngest age that Wang et al. observed is 2, our results indicate that the Chinese-speaking children used/comprehended *variables* from as early as 1;2. Since there is evidence that variables coexist with null objects, I can assume that null objects in Chinese are *variables* rather than *pro*s following Huang's (1984a) proposal.

Chapter IV Discussion and conclusion

4.1 Discussion

If verbal answers correlate with the default interpretation of a yes-no question, which is a topic-centered interpretation[11] (see Reinhart, 1982; Santos, 2004), the fact that verbal answers are available form the earliest stages on in both Chinese and European Portuguese may mean that children in both languages can correctly identify the topic in a question, namely by interpreting preverbal subjects as topics. However, different from the European Portuguese, in which the verbal answers may be instances of VP ellipsis (Santos, 2004), the two examples in (33), repeated here as (38) for convenience, reveal that children acquiring Chinese do not treat the verbal answers as VP ellipsis but null objects since VP is available in (38b).

(38) a. MOT: 要　喝　点　水　啊？
　　　　　　yao　he　dian　shui　a ?
　　　　　　want drink little　water　Q
　　　　　　'Do you want to drink some water?'
　　　CHI: 喝　　　　　　　　　　　　(Haohao, 1;2)
　　　　　　drink (Ø)
　　　　　　'I want.'
　　b. MOT: 喝　水　吧？
　　　　　　he　shui　ba?
　　　　　　drink water　Q
　　　　　　'Do you drink water?'
　　　CHI: 不　喝　水。　　　　　　(Haohao, 1;8)
　　　　　　bu　he　shui.
　　　　　　NEG　drink　water
　　　　　　'I don't drink water.'

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[11] A yes-no question is interpreted as a request to assess all the presented information about a given topic, this topic-centered character is a default interpretation of SVO yes-no questions (Reinhart, 1982).

As for the null object parameter setting, the children in our corpus seemed to choose [+Null object] as their starting point, which would reveal that the default option would be the [+Null object]. However, this statement needs to be qualified because we are referring to an age when children produce less than two-word per utterance on average, and more precise elicitation experiments need to be elaborated. Besides, individual differences should also be taken into account. The results of Thornton and Tesan (2007) by analysing the acquisition of the inflection parameter in English showed that "different children begin with different initial values, perhaps just leave the point about individual variation in final state, take different paths, and reach the 'final state' at different rates and at different times" (Thornton & Tesan, 2007, p. 86). Although our study did not evaluate the conformity in acquisition across children due to the limitation of the corpus, it is certainly our future work to analyze the trajectory for each child.

Nevertheless, there was no child for whom both values, namely [±Null object], seemed to be competing in the earliest stages of acquisition. Of course, this finding is not anticipated on the variational model. With respect to the *ba* construction, putting the question of brain's computational capability aside (see Wexler 2011), if the child initially has probabilistic access to both the + and the - value of the parameter, and then increases and decreases weights as in (3) or (4), thus there is a probability at least greater than zero that [+null object] parameter will be used as evidence for the child to produce the *ba* construction. In other words, the relatively high frequency of null objects in Chinese and the low frequency of the *ba* construction in the input should lead children to drop objects (i.e. post-*ba* NP) in this construction at least at the early stage of *ba* production. Following my discussion in 2.4, according to the variational model, Chinese children will have a Chinese-like grammar where the objects in topicalized position could be null, and although they could still produce overt objects in the *ba* construction, the proportion would not be very high because of the existence of a variational stage and the fact that parameter re-setting is gradual (under Yang's assumptions). However, this prediction is not fulfilled by our results: Even the child at age 1;8 produces post-*ba* NP in the *ba* construction (see (35)). Again, there is no variational stage such as the one expected in the variational model.

Although the incidence of null objects in adults' speech does not seem to be responsible for the children's object omission, it is possible that input factors are responsible for the different rates and patterns of omission as proposed by Yang (2002, 2004). Therefore, adopting the same methodology used by Legate and Yang (2007) to examine the Root Infinitive (RI) phenomenon in Spanish, French, and English acquisition, I compared the overall rate of [+Null object] and [-Null object] in the adults' production. The results of our counts are summarized in table 8.

Rewards [+Null object]	760/2208
Rewards [-Null object]	1448/2208
([+Null objects]-[-Null object])%	(34.42-65.58) = -31.16%

Table 8: Quantitative evidence in child-directed Chinese for [±Null objects] acquisition

I found 760/2208 (34.42%) of recorded sentences that unambiguously implicate a [+Null object] grammar. These are countered by 1448/2208 (65.58%) of sentences recorded that, by virtue of being consistent with the [-Null object] grammar, may impede the acquisition of the [+Null object] grammar. This means that the numerical advantage of the [+Overt object] is 31.16%.

I then found more or less the same numerical advantage in Yang and Legate (2007)'s work in the context of another parameter, namely the RI phenomenon in French. Since they argue that RIs are the result of a [-Tense] grammar in a language which is [+Tense], Yang and Legate (2007) counted the percentages of [+Tense] structures cross-linguistically. As for French, they used the future, conditional and imperfective past tense morphological markings as signatures for [+Tense] grammar. The table 9 presents their results.

Quantitative Comparisons of the Amount of Morphological Evidence in Favor of the [+Tense] Grammar and the Reported Duration of the RI Stage in Three Languages

Language	% for [+T]-% for [−T]	Duration of RI
Spanish	60.2%	~2;0
French	39.6%	~2;8
English	5.8%	>3;5

Table 9: Quantitative comparisons of the amount of morphological evidence in favor of the [+Tense] grammar and the reported duration of the RI stage in three languages
(from Legate & Yang, 2007, p. 336)

Because the numerical advantage of our [+Overt object] parameter (i.e. 31.16%) is comparable to that of the [+Tense] parameter in French (i.e. 39.6%), we could expect that the Root Infinitive phenomenon in the French child should be successfully acquired at roughly the same time that Chinese children have adult-levels of overt object use - at age 1;8[12]. On the contrary, as can be seen in table 8, RI in French last until around 2;8.

Moreover, on the variational model, quantitative data from input frequencies can also be used to estimate the learning trajectory, that is, whether a parameter setting will be consolidated early or late (Thornton & Tesan, 2007). For example, according to Pierce (1989, as cited in Yang, 2002), French speaking children learn that French is a verb raising language by 1;8. Yang (2002), based on the CHILDES database, estimated that signature sentences for verb raising, which is expressed by the form V_{FIN} Neg/Adv., constitute 7% of all sentences children acquiring French hear. Thus he concluded the frequency of signature of an early set parameter must be at least 7% of the input data. On the other hand, Yang

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[12] Although my data indicate that at age 1;8, Chinese children produce the null object sentences 42.86% of the time, which is adult-like (38.67%). On logical grounds, I may assume that at age 1;8, the use of the overt objects by Chinese children would be 57.14%, which also approaches that of the adult (61.33%).

(2002) assumes that expletive (*there*) subjects are signatures for overt subjects because such sentences cannot be parsed by the grammar that licenses null subjects. Yang (2002) counted from the CHILDES the frequency of expletive (*there*) sentences in the database and found that they comprise 1.2% of the adult input to children. Drawing on Valian's report (1991, as cited in Yang, 2002), which reveals null subjects not disappearing from children's productions until about 3 years of age, Yang (2002) concluded that 1.2% or less of a signature in the input is responsible for the late parameter setting.

Our findings seem to support the quantitative analysis of Yang at first sight. First, null object sentences constitute 8.2% of the input data, which means that the acquisition of null objects by Chinese children should be very early. Second, the presence of the *ba* construction, due to its correlation with the obligatoriness of an overt object, may cause a late acquisition, but fortunately the *ba* construction just comprises 3.1% of the input, which means that its presence cannot 'threaten' the correct setting of a null object type grammar. But here comes the problem. If the *ba* construction just appears 3.1% of the time, according to Yang's theory, this structure should be acquired late, because the frequency is less than the baseline for an early acquisition (i.e. 7%), contrary to fact: children are able to set correctly the post-*ba* NP in the *ba* construction from the first time[13]. Of course, I have to admit another possibility that the early acquisition of the *ba* construction by children is due to the overall amount of evidence for another object markers, such as passive marker *bei*, which also introduces an obligatoriness of object, even though the forms are not the *ba* per se. To confirm this hypothesis, I need to count the input frequency of those forms in the future work.

However, another serious problem of the variational model is that it is somewhat circular. In order to reward a null object grammar, the child has to realise that an object can be omitted

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[13] I readily concede that probably more than one parameter may be involved here: one for the *ba* construction, one for the null topic. For example, with respect to the position of subject, in a topicalized sentence (not the *ba* type), the subject is after the topic, a position different from that of the subject with the *ba* construction. However, I assume that this could not make the story change much for Yang and my critical view of it.

when the construction appears in the input. Presumably, the child does this by noticing that there exist relatively high numbers of null objects (34.42% in our corpus analysis) in child-directed speech. The problem is, as Ambridge and Lieven (2011) and Wexler (2011) have pointed out, that once the child has made this discovery, s/he already knows that his/her language permits null objects, and thus there is no need to entertain the possibility that s/he may be learning a [-null object] language. In other words, why does the child not set the null object parameter to [+Null object] as soon as s/he has encountered a null object?

Finally, the fact that certain parameters values can be fixed very early in spite of the contradictory input (31.16% advantage of the [+Overt object]) could favor the triggering model. The default value could play a role here. According to the triggering model, parameters are associated with a default value, and it is quite likely that the default value associated with the *ba* construction is related to [-Null object] rather than [+Null object] parameter setting.

4.2 Conclusion

The evidence is quite strong that Chinese-speaking children have a grammar that allows null objects at an early age. Our data also show that roughly between the ages of 1;2 and 1;8, or MLU stage I to stage II, a drastic change has taken place in their grammatical development. That is, during this period the Chinese children show a dramatic decline in the production of null objects and approach that of the adult subjects. Moreover, the analysis of the *ba* construction also shows that there is no variational stage as expected by the variational model because all the children that I observed produced overt objects in the *ba* construction, like adults, from the first occurrence.

The empirical findings from our corpus show, instead, that children set a parameter and when setting is initiated, it takes hold quickly, and is brought to closure at the latest by the time that two-word utterances are produced, which supports the triggering model, which

claims that parameter setting is precipitous. Second, I have shown that parameter setting cannot be explained simply by input frequency, at least not in a superficial sense.

In addition, I find that Chinese children display null objects at the same time they develop *variables* (as indicated by the production of *wh*-questions) during the time their production was recorded. This observation is consistent with Huang's (1984a) proposal that the status of the null object should be defined as a *variable* derived by movement.

Finally, it is worth pointing out, when I say, for example, that the frequency of the *ba* construction is very low in the input, this merely means that in the input I analysed there were few *ba* constructions. Of course this does not exclude the possibility that children have heard the *ba* construction in other contexts. A more extensive investigation or designed experimental tasks of different inputs would certainly be required in the future research. Besides, if the path of language development is in keeping with the triggering model, what constitutes triggering and what constitutes sharp learning will no doubt remains a question for future investigation, but what I am sure here is that this change is sensitive to the child's internal grammatical capacities, and do not directly input-driven.

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