Default *ne* in Child Mandarin Chinese*

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Transcripts of children acquiring Mandarin Chinese reveal errors in the morphological realization of inchoative aspect. Where an adult would use a sentence-final particle *le*, children will often either omit it, or substitute a different marker (*ne*). We analyze the overuse of *ne* in child Mandarin as a retreat to a default form that results from an impoverished syntactic representation.

We compare the actual proportions of S-*le* successes, *ne* errors, and omission errors across fine-grained developmental stages by estimating the number of inchoative "attempts," based on the frequency of adult usage of S-*le* from the same transcripts. We propose an Optimality Theoretic account in which constraints requiring syntactic realization of the features of the intended meaning "float" in the ranking over constraints that require economy of syntactic structure. These partial rankings characterize a set of alternative grammars that the child uses in production. Finally, we compare these results to similar results from the acquisition of French and of Catalan, all of which display a coexistence of competing grammars, retreats to a default form, and constraints requiring economy of structure, despite obvious differences in the morphological richness of the three languages.

1. Introduction

This paper reports an examination of the acquisition of tense-aspect markers in three children acquiring Mandarin Chinese as their first language. Focusing on the earliest markers acquired—*ne* and *le*—we argue that *ne* is primarily used as a default tense-aspect marker in early spontaneous speech production.

This is an important result for a number of reasons. To the best of our knowledge, this pattern had not been established through any detailed analysis of early child data (around the age of 2) before. In addition, the Mandarin pattern confirms the existence of default strategies during acquisition of functional morphology cross-linguistically, independently of

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the classification of the specific language as "morphologically rich" or "morphologically poor."

We apply an approach that has been successful in explaining the course of acquisition of functional morphology in several other languages; to the extent that this approach is successful in capturing the Mandarin pattern as well, its viability as a crosslinguistically valid explanation of morphosyntactic acquisition is increased. Specifically, we propose a model of acquisition rooted in Optimality Theory (OT), a model of knowledge of language based on the idea that linguistic representations are fundamentally optimal resolutions of conflicts between ranked well-formedness constraints (Prince & Smolensky, 1993). In this paper, we argue that the variation seen in progressive stages of first-language acquisition is fundamentally the same kind of variation found in adult language, both with respect to cross-linguistic typology and intralinguistic variation.

Our framework in fact allows us to proceed one step further, not only predicting the *existence* and *options* for variation at each stage, but also making predictions about the *frequencies* of different grammatical and ungrammatical variants at different stages, and even across children. When considered together with the previous success of this model in predicting the properties of morphological acquisition in French and Catalan, the Mandarin results serve as a strong confirmation of our proposed "partial ranking" model of acquisition crosslinguistically.

2. Mandarin Chinese Tense/Aspect

The ability to use functional categories correctly is an important step in the process of learning a language because it involves acquiring the specific structural properties of a language (as opposed to expanding the lexicon). The present empirical investigation concerns linguistic forms that mark temporal properties of an event in Mandarin Chinese.

While all languages encode temporal properties of events, they differ with respect to which properties are grammaticalized and how these properties are expressed. Traditionally, Mandarin particles have been taken to encode aspectual distinctions such as perfective, inchoative, or progressive (Li & Thompson, 1981; Li, 1990) but the precise classification of these particles has been the subject of some debate.

The literature to date has concentrated on six such markers in Mandarin, verb final *le* (V-*le*), sentence final *le* (S-*le*), *ne*, *zhe*, *zai*, and *guo*. A brief elaboration on the meaning of these markers follows below, including both examples from the literature and from the child data we examined. The child data was originally collected by Tardif (1993, 1996) and contributed to CHILDES (MacWhinney & Snow 1985).

Following Chan (1980), Chao (1968), and Sybesma (2001) (but contra Li, 1990; Klein et al., 2000) we distinguish two *le*s, each encoding different temporal/aspectual properties and allowed to co-occur, in distinct syntactic positions. S-*le* (which appears at the end of a sentence) often called an inchoative marker, emphasizes the inception of a situation (Chan, 1980:52–3), implying that the situation did not hold prior, and indicates a relevance of that situation to the moment of current concern (Li & Thompson, 1981:240–290; Sybesma, 2001:60–2).[1]

(1) (a) wǒ míngbái nèi-jiàn shì **le**.
I understand that-cl thing le
'Now I understand it' (Sybesma, 2001:60)

(b) wǒ bù xiǎng mǎi nèi-běn shū **le**.
I not want buy that-cl book le
'I don't want to buy that book anymore' (Sybesma, 2001:60)

(c) FA–CH: bú huà **le**!
Neg draw le
'(We/Let's) stop drawing now.' (BBvis5:10)[2]

V-*le* (which appears after a verb) is a perfective marker, indicating the termination of a bounded event, temporally, spatially or conceptually (Chan, 1980:47; Chao, 1968:246; Li & Thompson, 1981:185).

[1] We cannot do justice here to the intricacies of the meaning contributed by S-*le*; see Chan (1980), Sybesma (2001) for more extensive discussion.

[2] References such as "BBvis5" are references to data from the CHILDES database; in this case, from the transcript of the fifth visit with child BB, page 10. Page numbers are assigned based on our hard copies of the files, printed in 13 point Courier.

(2) (a) BM–CH: hái mǎi le yí-ge dà qìqiú.[3]
in.addition buy le one-cl big balloon
'(Your mom) also bought a big balloon.'
(YYvis1:2)

(b) MO–CH: dǎ bài -**le** zhàng le.
Fight lose-le battle le
'You lost your battle.' (YYvis6:1)

It is worth pointing out that in a sentence with an intransitive verb (hence, in many child utterances), the same morpheme *le* is observationally both postverbal and at the end of the utterance. In such cases, it seems to be interpretable as if it were either S-*le* or V-*le* (or even both simultaneously).

(3) tā lái **le**.
he come le
'He has come' *or* 'He is coming' (Sybesma, 2001:65)

Ne is a sentence-final durative marker. *Ne* suggests the continuation of the process around the reference time. It often co-occurs with the preverbal *zai* with process verbs, or with postverbal *zhe* with transitory states, both of which themselves contribute a similar durative/progressive meaning. For permanent states, *ne* occurs alone or with *hai* 'still' (Chan, 1980:61–65).

(4) (a) tā **zài** jiǎng gùshì **ne**.
3sg zai tell story ne
'He is telling a story.' (Chan 1980:65)

(b) tā (hái) méiyou kànwán zhèiběn shū **ne**.
3sg (still) not read this-cl book ne
'He (still) hasn't finished reading this book (yet).'
(Chan, 1980:64)

[3] BM (Bǎomǔ) is the baby-sitter or the nanny (an adult).

(c) BM–CH: yángyang nǐ xīn-lǐ **zài** xiǎng shénme **ne**?
YangYang 2sg heart-in zai think what ne
'What are you thinking about, Yangyang?'
(YYvis1:3)

Both *le* and *ne* are productively used by 2-year-olds acquiring Mandarin Chinese. With respect to counting, however, the homophony of V-*le* and S-*le* complicates the analysis of the corpus somewhat; there are cases in which it is very difficult to know for certain which was intended by the child.

The other aspectual markers, *zhe* and *guo*, are very uncommon in 2-year-old child speech. ***Zhe*** is a postverbal durative marker. *Zhe* suggests durativity of a state (Chan, 1980:65), or an on-going posture or physical disposition (Li & Thompson, 1981:221).

(5) (a) tā chuān-**zhe** píxié.
3sg wear- zhe leather-shoe
'S/He is wearing his/her leather shoes.'
(Li & Thompson, 1981:221)

(b) BM–CH: zài jiā dāi-**zhe** yǒu shénme jìn ne?
at home stay-zhe have what fun Q
'What fun is staying at home?' (YYvis1:3)

Guo occurs postverbally and marks indefinite past aspect or past experience. *Guo* suggests something "happened at least once in the past—ever" (Chao 1968:251).

(6) (a) nǐ chī-**guò** yúchì méiyou?
2sg eat-guo fish-fin Neg
Have you ever eaten shark's fin? (Chao, 1968:251)

(b) MO–HY: dōu méi jiàn-**guò** shì-bú-shì a ?
all Neg see-guo be-Neg-be Q
'(We) haven't seen (any of these types of cars)
before, right?' (HYvis1:4)

There is much debate in the literature as to whether these particles mark aspect or tense. Sybesma (1997) argues that S-*le* functions in the same way as tense, having a deictic function that anchors a specific event to a particular point on the time axis.[4] Zhang (2000) uses distributional patterns to argue that *ne*, like S-*le*, should be considered to realize tense, structurally higher than the non-deictic (less controversially aspectual) markers like V-*le*, postverbal *guo,* and *zhe*. For our purposes, we need not enter the debate as to the proper characterization of the semantic contribution of these particles; we need only the conclusion that these morphemes occupy distinct structural positions, taken (following Pollock, 1989, and much subsequent literature) to be the realizations of separate functional projections, both of which occur structurally below the projection housing interrogative particles (CP). We will refer to the projections as TP (for S-*le* and *ne*) and AspP (for V-*le*, *guo*, and *zhe*).

Based partly on the properties that we observed in the child transcripts, we take S-*le* to be a more specific T morpheme than *ne*; that is, *ne* is a default realization of T (that is, a "prototypical sentence particle"). We formalize this in the vocabulary of Distributed Morphology (Halle & Marantz, 1993) as follows:

(7) Relevant morphological realization rules

le	↔	T [deictic] / in env. Asp
ne	↔	T

The Asp node of a syntactic structure will be spelled out, depending on its content, as *zhe*, *guo*, *le*, or Ø (when inchoative). According to the rules in (7), T (when it has the features of adult S-*le*, indicated in (7) as "[deictic]" without any further attempt at its precise meaning) is spelled out as *le* only when an AspP is present in the structure (which we might at least informally think of as a requirement that the event referred to by the

[4] An anonymous reviewer observed that this view of S-*le* is perhaps not the consensus view in the literature, but we find Sybesma's (2001) arguments and conclusions to be compelling. He demonstrates that the patterns of ambiguity in sentences containing *le* cannot be accounted without separating S-*le* and V-*le*. Further, he shows that there are actually two types of "V-*le*" ("endpoint *le*" and "realization *le*"), and discusses how this has lent spurious support to the "one *le*" view.

sentence is bounded in a way that allows reference to at least one endpoint). Otherwise T is spelled out as *ne*.[5]

To foreshadow our analysis, we will adopt the view that syntactic representations in child speech, when they differ from adult representations, might lack one or both of the TP and AspP projections. If the AspP projection is missing, the default pronunciation of T in (7) (i.e. *ne*) will apply; only if both TP and AspP are present will the morpheme *le* appear.

In section 4 we show how incorporating this syntactic representation of Asp and T to an optimality-theoretic analysis of development stages yields novel insight into the course of acquisition.

3. Stages of acquisition of *le* and *ne*

It is impossible to explain the course of acquisition over several stages without an adequate and explicit characterization of the notion of developmental stage. To this end, we make use of a metric developed in Vainikka et al. (1999) that formalizes and links two traditional observations about language development. The first is that children go through a one-word stage, a two-word stage, etc.; the other is that the appearance of verbs marks an important milestone in the acquisition of language. The Predominant Length of Utterance (PLU) is a metric that takes into account both the relative length of the child utterances and the proportion of verbal utterances. It was developed as an alternative to the Mean Length of Utterance (MLU; Brown, 1973). Although very commonly used in the acquisition literature, the MLU has proven to be an unreliable means of measuring a child's syntactic development (see, e.g., Klee & Fitzgerald, 1985). Vainikka et al. (1999) provide significant cross-linguistic evidence that a change in PLU stage corresponds to specific syntactic developments in individual languages. Moreover, the PLU metric has been instrumental to detailed analyses of acquisition of tense

[5] Of course a full account of the morphological system of Mandarin would have many more morphological rules and probably more complex conditions, but we assume that the marked–unmarked relationship between *le* and *ne* would be preserved in the more completely spelled-out system. The rules in (7) are formulated so as to allow for the fact that both *le* and *ne* can co-occur with overt realizations of Asp (that is, *ne* frequently occurs with *zhe* and *zai*, and *le* can occur with *guo* and also, somewhat less naturally, with *zhe* and *zai*).

and person agreement in French and Catalan (Legendre et al., 2000; Davidson & Legendre, to appear).

The PLU stages that occur in Tardif's early Mandarin transcripts are 3b and 4b. The relevant definitions for these stages are given in Table 1 below.

Table 1. Relevant Predominant Length of Utterance (PLU) stages

Stage number (number of words per utterance):

Stage 3 *"Two word stage"*: Fewer than 60% of utterances are single word utterances and utterances with three or more words do not predominate.

Stage 4 *"Predominantly multi-word stage*": Utterances with three or more words are more common than either one- or two-word utterances.

Secondary stage letter (percentage of utterances with a verb):

Secondary stage b: 60% or fewer utterances contain a verb.

Secondary stage c: More than 60% of utterances contain a verb.

The guidelines developed for determining PLU stages in Mandarin combine the original PLU guidelines (Vainikka et al., 1999) with Tardif's (1993) guidelines for determining MLU in Mandarin (for specific details, see Appendix 1). We examined transcripts of three Mandarin speaking children from the CHILDES database (MacWhinney & Snow, 1985). These data were collected in Beijing by Tardif (1993, 1996) from firstborn, only children whose parents were both native speakers of Mandarin with at least a college education.

Our study focused specifically on the children's use of S-*le* (inchoative), and errors made where S-*le* would be expected in the corresponding adult utterances. We found only one clear instance of V-*le* produced by one child (YY, file 5). We do not present figures for the production of experiential *guo*, durative *zhe*, or progressive *zai* here since the children only used these forms rarely, if at all.

We also included the colloquial variants *na* and *la* in our counts. Two native speakers evaluated all instances of *le* and *ne* in the child speech and in the adult speech and categorized each instance into one of the groups listed in Table 2. Further details on our coding procedures are outlined in Appendix 2.

Table 2: Categories into which child utterances were coded

1)	Instances of (unambiguous) V-*le* (perfective).
2)	Instances of inchoative S-*le*. Where S-*le* emphasizes the beginning of a new situation, even in case where *le* happens also to follow the verb and where the sentence might arguably *also* be perfective (i.e. as if containing V-*le* as well as S-*le*), it was counted as S-*le*.
3)	Truly ambiguous instances of *le* were excluded from our counts.
4)	Instances of progressive *ne* that were correctly used.
5)	Instances of *ne* that were used where an S-*le* should have been used.
6)	Omissions of S-*le*, counted by one of the native speaker authors. Credibly identifying omissions is difficult and it is possible that the conservative criteria left some omission errors uncounted.

We coded the first and last visits of BaoBao (male), YangYang (male), and BingBing (female) from this corpus (Table 3).[6]

[6] Tardif (1993) provides MLUs modified for Mandarin, but averaged over all of her subjects. In the first files we examined, the average MLU is 2.03, and in the last files, the average MLU is 2.78.

Table 3: Subjects from CHILDES Database (MacWhinney & Snow, 1985; originally from Tardif, 1993)

BaoBao (BB)				
File	Age	PLU	Utterances	Verbal Utterances
1	1;10.12	3b	287	81
5	2;02.07	4b	706	414
YangYang (YY)				
File	Age	PLU	Utterances	Verbal Utterances
1	1;10.20	3b	269	161
5	2;02.18	4b	278	163
BingBing (LXB)				
File	Age	PLU	Utterances	Verbal Utterances
1	1;09.03	3b	221	126
4	2;01.08	4b	206	79

PLU: Predominant Length of Utterance (Vainikka, Legendre & Todorova, 1999)
Utterances = Total number of Utterances
Verbal Utterances = Utterances with verbs

In Tables 4–6, we give these counts as a proportion of the child's total number of utterances containing a verb, compared to the corresponding proportion derived from the child-directed adult utterances in the same transcript.[7] We take the adult proportion to be the target, which, for example, these three children appear to have attained for S-*le* at stage 4b.

[7] For each file, we coded the first 400 utterances of child-directed adult speech from one parent. The files BB4b and YY4b included slightly less than 400 such utterances.

Tables 4, 5, 6: Summary: Correct forms, out of total verbal utterances

BB	3b	Adult	4b	Adult
V-*le*	—	(3/266) 1.1%	—	(1/272) 0.4%
S-*le*	(4/81) 4.9%	(54/266) 20.3%	(69/414) 16.7%	(49/272) 18.0%
Prog. *ne*	(4/81) 4.9%	(4/266) 1.5%	(1/414) 0.2%	(7/272) 2.6%

YY	3b	Adult	4b	Adult
V-*le*	—	(2/267) 0.7%	(1/163) 0.6%	(3/319) 0.9%
S-*le*	(3/161) 1.9%	(76/267) 28.5%	(28/163) 17.2%	(76/319) 23.8%
Prog. *ne*	(12/161) 7.5%	(4/267) 1.5%	(2/163) 1.2%	(9/319) 2.8%

LXB	3b	Adult	4b	Adult
V-*le*	—	(4/302) 1.3%	—	(4/311) 1.3%
S-*le*	(8/126) 6.3%	(83/302) 27.5%	(15/79) 19.0%	(58/311) 18.6%
Prog. *ne*	(2/126) 1.6%	(3/302) 1.0%	(2/79) 2.5%	(3/311) 1.0%

Several generalizations hold of the data above. First, the children fail to use perfective aspect (V-*le*) during both stages. This is not surprising, given how uniformly low the proportions are in adult speech.[8] Secondly, the children's production of S-

le starts off noticeably lower than that of their adult counterpart. For example, at the earlier stage, BB produces a quarter as many S-*le* forms as his adult counterpart (BB: 4.9% vs. adult: 20.3%), as does LXB (LXB:

[8] While *ne* most frequently occurs with imperfective aspect in adult speech, imperfective aspect itself does not occur that frequently. In a 1987 study conducted by one co-author (Tao), about 90 minutes of Beijing Mandarin conversation (over 8 hours, between six individuals ranging in age from early 20s to 70s) was analyzed; only two instances of the imperfective were observed.

6.3% vs. adult: 27.5%). Thirdly, children appear to overproduce *ne* at the earlier stage. While the adult targets for *ne* are very low and roughly the same as for V-*le*, the child proportions of *ne* are systematically higher than their adult counterparts. For example, 7.5% of YY's utterances with verbs contain progressive *ne* vs. 1.5% for his adult counterpart. Note that the pattern holds for all three children.

It is clear from the data above that the children are not simply imitating what they hear, since they overproduce *ne* and underproduce S-*le*. Moreover, it is not a phonological issue, as *zhe* and *guo* are basically absent, though children produce other words starting with [zh] and [g]. This is in line with one of the main findings in Tardif (1993), who found an absence of any direct effect of the frequencies in adult input. Rather, there is systematicity in the data that we attempt to account for here.

One of the underlying assumptions we make in our analysis is that it is not children's intentions that develop, but rather their grammatical system. More perspicuously, we assume that the children will want to say inchoative sentences at roughly the same frequency as adults in the same situations, but as this intention is filtered through the child's grammar at early stages, these distinctions are not always realized in the actual utterance. These "rates of success" will be important for the formal analysis developed in the next section.

We found several relatively clear cases in which *ne* appeared in place of S-*le* (see Table 7).[9] To get an estimate of how often the default *ne* is appearing in error, we started by computing the overall average adult proportion of S-*le*; this *target percentage* was 22.5% (514/2281) of verbal utterances. We then looked at the number of verbal utterances produced by each child, and hypothesized that the child *attempted* to use S-*le* in that percentage of their verbal utterances (since we assume that adults realize S-*le*, when attempting to express the relevant meaning, at a rate of 100%). We then compared what we observed to the number of S-*le*'s and of S-*ne*'s that this predicts. These figures are reported in Table 7.

So, for example, BB–3b produced 81 verbal utterances, and if 22.5% of those were attempted S-*le*'s, we would have expected to see 18 (actually 18.2, on average). We actually saw 4, indicating that 14 of BB's attempts yielded something other than S-*le*; BB–3b was successful only 22% of the

[9] Impressionistically, there was no reason to think that the children in the transcripts we analyzed failed to understand tense/aspect distinctions; rather, they only seem to fail to produce them properly.

time in producing S-*le*. Twice (of 18.2 attempts, 11% of the time), we find BB–3b producing *ne* with a (non-adult) inchoative meaning. Given these, we arrive at the percentage of attempts still unaccounted for (100%–22%–11%=67%), which are putative attempts to use inchoative meaning but without any overt reflex. These, we list as "other errors."

Figures 1–2 summarize the observed data graphically.

Table 7: Determining error percentages

Adult S-*le* target: 22.5% (514/2281)	BB 3b	BB 4b	YY 3b	YY 4b	LXB 3b	LXB 4b
1. Verbal utts.	81	414	161	163	126	79
2. Attempts	18.2	93.2	36.2	36.7	28.4	17.8
3. S- *le*	4	69	3	28	8	15
4. Successes	21.9 %	74.1 %	8.3%	76.3%	28.2%	84.4%
5. *ne* subst.	2	1	21	8	14	2
6. *ne* errs	**11.0%**	**1.1%**	**58.0%**	**21.8%**	**49.4%**	**11.3%**
7. Other errs	**67.1%**	**24.9%**	**33.7%**	**1.8%**	**22.4%**	**4.4%**

Key to rows:
1. verbal utterances made by the child
2. predicted attempts (R.1 * 22.5)
3: number of S-*le*'s actually observed
4: % success in producing S-*le*'s (R.3 / R.2)
5. number of inchoative *ne*'s observed.
6. % *ne* errors (R.5 / R.2)
7. Other errors (1–R.4–R.6).

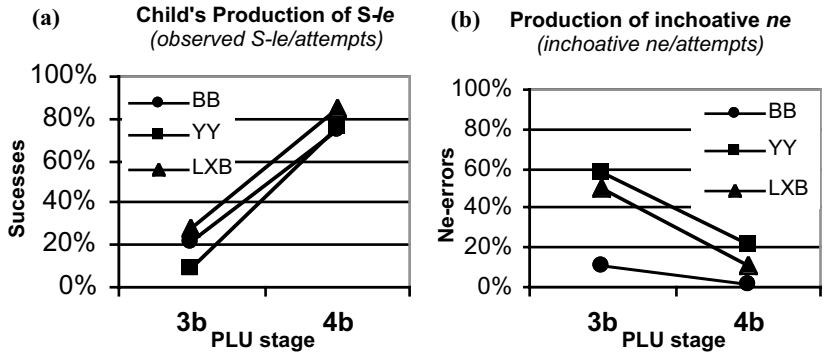

Figure 1: Development by stage of (a) S-*le* and (b) *ne* used inchoatively.

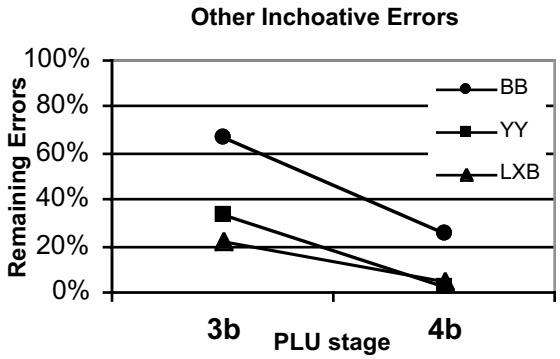

Figure 2: Development Across Stages of other inchoative errors

Another word is in order concerning the correct use of "progressive *ne*", previously given in Tables 4–6. Even considering only utterances where *ne* seemed to be appropriate from the perspective of the adult grammar (correct uses), we again seem to see an "overproduction" of *ne*. The children at the early stages are using *ne* quite a bit more often than adults do. A preliminary scan of the child data indicates that at the same time, children are using *zhe* (also used in sentences with progressive meaning) quite a bit less often than adults. Although this remains at the level of speculation, pending further systematic study, this observation suggests that *ne* is serving as a default marker not only for S-*le* but also in utterances that would have contained *zhe* if generated by the adult grammar.

4. A formal analysis

We propose to explain the course of acquisition in terms of changing outcomes in a competition between two types of conflicting constraints: those requiring expression of intended meaning vs. those requiring minimal syntactic representations. As acquisition proceeds through different stages, the constraints requiring relatively minimal structure become less important than constraints requiring expression of intended meaning (in a specific way, outlined below).

Optimality Theory (Prince & Smolensky, 1993) is a framework for formalizing the resolution of constraint conflict in linguistic systems; the grammatical system is given an "input" (an intended meaning), and in light of the relative ranking of the constraints on grammatical outputs, the computational system chooses an optimal realization of this intended meaning, one that violates the fewest important constraints. The different possible realizations of an input are "candidates," which are evaluated for well-formedness with respect to each of the constraints until the candidate that minimally violates the highest-ranked constraints (compared to the other candidates) is revealed. Because faithfulness constraints, which require the output to be faithful to the input (where by "input" we will consistently be referring to the "intended meaning"), often stand in conflict with markedness constraints, which impose certain structural requirements on the output (e.g., minimize structure), the ranking is crucial for selecting the optimal candidate.

We assume that the input to a child's grammatical system (the intended meaning) is the same as it would be for an adult—only the relative ranking of the constraints, which determine how the input will be realized, differ.

Language acquisition in an OT model amounts to learning the ranking of constraints in the language being acquired (Tesar & Smolensky, 2000). As argued by Smolensky (1996), the initial state (that is, the initial ranking) must be one in which the faithfulness constraints dominate the markedness constraints they could conflict with. Under OT as formulated by Prince & Smolensky (1993), the evaluation of candidate output structures for a given input takes place with respect to constraints that are strictly ranked with respect to one another: for any two constraints C_1 and C_2, either C_1 is strictly more important than C_2, or vice-versa, and no matter how egregious the violation of the lower-ranked constraint would be, it would not justify a violation of the higher-ranked constraint in the optimal candidate. We make the further assumption (following Legendre et al.,

2000; see also Reynolds, 1994; Anttila, 1994; Boersma, 1997) that as the child re-ranks constraints, there are points at which several grammars are being entertained. If in the adult language a faithfulness constraint F outranks a markedness constraint M with which it conflicts, the child's ranking may move from the initial state (where M outranks F) to a state in which both rankings are contemplated (either M outranks F or F outranks M). This is a partial ranking, which specifies two different strict rankings, and we can think of F metaphorically as "floating over" M.[10] For each utterance the child produces at such a stage, we assume that one of the currently contemplated grammars is selected essentially at random, which makes a prediction: We should see forms generated by the grammar in which M outranks F (M>>F) with the same frequency as forms generated by the grammar in which F outranks M (F>>M). Where the grammar in which M>>F results in an utterance which is not grammatical in the adult language, this gives us a way to interpret the fact that children will produce both adult-like and non-adult-like utterances at the same stage. With more complex partial rankings (e.g., where F floats over several markedness constraints), the frequency predictions become more fine-grained, particularly given that certain output structures will be optimal under more than one possible ranking. This is explored in more detail below with respect to the Mandarin child data.

Based on our first observation—the lack of V-*le* in the child utterances—we propose that the children are compelled to violate the faithfulness constraint requiring overt realization of a [perfective] feature in the input. In the terminology of Prince & Smolensky (1993), this is a failure to "parse" in the output a feature contained in the input, a violation of one of the PARSE family of faithfulness constraints. This interpretation of the missing V-*le* in child Mandarin mirrors the analysis of missing person agreement in French and tense marking in Catalan put forth in Legendre et al. (2000), Davidson & Legendre (to appear). Because realizing the [perfective] feature would entail additional syntactic structure, the lack of V-*le* in child Mandarin indicates that a constraint prohibiting structure outranks the constraint calling for [perfective] to be realized.

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[10] This is one of the places in which our proposal diverges from that made by Tesar & Smolensky (2000). The system we are proposing here is one in which Faithfulness constraints are promoted in the constraint ranking, rather than Markedness constraints being demoted.

Given our assumption that in the relevant context child and adult inputs (intended meanings) are the same, containing whatever features (e.g., [perfective], or [inchoative]) would be appropriate for the adult, we can take the low rate of production for inchoative *le* in child speech as an indication that the children fail to parse the intended [inchoative] feature some percentage of the time. That is, they intend an inchoative utterance but the grammar used (some percentage of the time) to produce the utterance obscures it. For example, in BB's stage 3, he produces S-*le* approximately 25% as often as his adult counterpart. We interpret this as a result of BB having one grammar that ranks the constraint requiring the [inchoative] feature to be parsed (realized) above the constraint requiring the structure not to have the additional functional projection needed to parse the [inchoative] feature, and another grammar in which that ranking is reversed. For any utterance produced by BB, either grammar may be used, which (given the specific partial ranking proposed below) results in the correct form (with S-*le*) being produced 25% of the time, and an incorrect form (without S-*le*) being produced the other 75% of the time.

Our interpretation of the overproduction of progressive *ne* is that *ne* is used as a default aspectual marker in the children's speech, appearing in place of an intended S-*le*. In support the view of *ne* as a default, note that there are several instances where (a non-adult) *ne* seems to substitute for S-*le* (the category we label "inchoative *ne*"), but we found no cases where *le* was erroneously used for durative *ne*. Moreover, the frequency of "inchoative *ne*" is inversely proportional to the correct S-*le* forms over the course of development.

The fact that S-*le* and imperfective *ne* have essentially opposite meanings (Chan, 1980:62) is taken to indicate a default form, rather than an extension of the meaning of S-*ne*. In the adult language, the morpheme *ne* covers a wide range of functions that is not easy to define concisely; Chan (1980) maintains that among imperfective markers, *ne* has the broadest function, covering the meanings of progressive *zai* and durative *zhe*. *Ne* is also a question marker and emphatic marker in the spoken Beijing dialect.

To formalize our analysis of the Mandarin data, we appeal to the four constraints listed below, based on constraints originally motivated for the acquisition of French and Catalan:

(8)

PARSEASP	Aspect features must be realized.
PARSET	Tense features must be realized.
***F**	No functional heads are allowed.
***F^2**	No pairs of functional heads are allowed.

Four candidate output structures for an input underlying an adult S-*le* form are possible. Example realizations are given for the verb *lái* 'to come, arrive'.

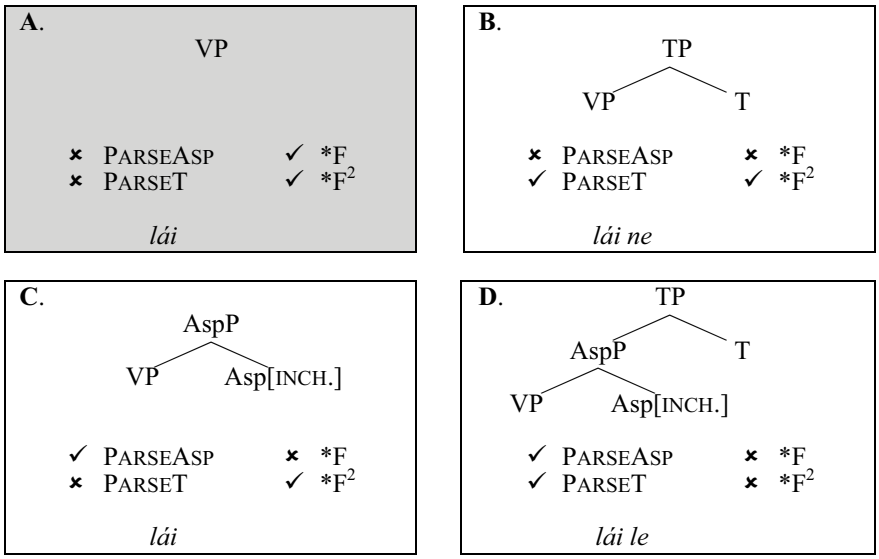

Figure 3: Candidate structures

Although candidate (a) above is in principle possible, the proposal we make immediately below predicts that it never wins in the child transcripts that we analyzed; it is on the surface indistinguishable from candidate (c). It is probable that candidate (a) would have been the optimal output for utterances at an earlier stage, however.

We propose that at stage 3b (for BB), the faithfulness constraint PARSEASP floats over *F^2 while PARSET floats over both *F^2 and *F (the relative ranking between the structural markedness constraints *F^2 and *F is universally fixed). This yields eight possible rankings (that is, eight grammars under consideration by the child), which are listed below Figure 4. Note that each of the eight rankings picks a candidate from those listed

above in Figure 3, but a single candidate may be optimal with respect to several different rankings.[11]

3b–BB

Markedness		$*F^2$ >> *F
Faithfulness	PARSET	———————————
	PARSEASP	————————

Possible rankings and results:

a. PARSET >> PARSEASP >> $*F^2$ >> *F ⇒ TP+AspP (*le*)
b. PARSEASP >> PARSET >> $*F^2$ >> *F ⇒ TP+AspP (*le*)
c. PARSEASP >> $*F^2$ >> PARSET >> *F ⇒ AspP (*Ø*)
d. PARSEASP >> $*F^2$ >> *F >> PARSET ⇒ AspP (*Ø*)
e. PARSET >> $*F^2$ >> PARSEASP >> *F ⇒ TP (*ne*)
f. $*F^2$ >> PARSET >> PARSEASP >> *F ⇒ TP (*ne*)
g. $*F^2$ >> PARSEASP >> PARSET >> *F ⇒ AspP (*Ø*)
h. $*F^2$ >> PARSEASP >> *F >> PARSET ⇒ AspP (*Ø*)

Figure 4: A partial ranking for Stage 3b (BB)

Given an [inchoative] feature in the input, the probability of producing *le* is 2 out of 8, the probability of producing no realization (*Ø*) is 4 out of 8, and the probability of producing a *ne* is 2 out of 8. We compare our predicted and observed proportions below:

[11] One can also work out simple frequencies for TP and AspP individually. The results from BB3b (Table 8) would arise if TP is present in the representation 33% of the time and AspP is present in the representation 66% of the time (thus, both together, resulting in *le*, would be expected 33% × 66% = 22% of the time, and so forth). Running through the others, BB4b (Table 10) shows TP:75% AspP:99%; LXB3b (Table 9) TP:77%, Asp:36%; LXB4b (Table 11) TP: 95%, AspP:88%; YY3b (fn. 12) TP:66%, AspP:12%. Simply assigning such frequencies to each stage (without making use of the system of partially ranked constraints) is not really a viable alternative approach, as it leaves the frequencies essentially unexplained, arbitrary. The proposed system of partially ranked constraints is more explanatory and also more restrictive: a case in point is YY3b's data, which is easily cast in terms of (arbitrary) percentages for TP and AspP, yet requires some additional explanation if we take these percentages to arise from a system of partially ranked constraints (see fn. 12 below).

Table 8: Predicted vs. observed morphology (3b–BB)

	Predicted	**Observed**
le	25%	22%
ne	25%	11%
Ø	50%	67%

The observed frequencies for LXB's stage 3b were qualitatively different, indicating a different partial ranking. The partial ranking we propose for LXB stage 3b is given below, along with a comparison of predicted and observed proportions.[12]

Table 9: Predicted vs. observed morphology (3b–LXB)

	Predicted	**Observed**
le	25%	28%
ne	50%	49%
Ø	25%	22%

[12] The stage 3b data from YY (observed: *le* 8%, *ne* 58%, *Ø* 34%) are not analyzed in the text. They fit the general pattern of LXB's data, but match the predictions (in Table 9) less well. In fact, YY's data matches quite well the predictions of a superimposition of two rankings: the ranking given in Figure 5 for LXB 3b, and another in which PARSEASP is ranked below all of the other constraints and PARSET floats over both *F and $*F^2$. This second ranking would be expected of an earlier stage, and perhaps the data from YY 3b actually represents a *transition* into stage 3b. It is worth pointing out that apart from the possibility of this superimposition (predicting 13% *le*, 58% *ne*, and 29% *Ø*, a close match), none of the possible partial rankings alone can predict this pattern very accurately. In a sense, this reveals a positive aspect of the general proposal: Floating constraints are not so powerful as to guarantee a match for any distribution of data. We leave the resolution of this issue to future research, but two other possible strategies to accommodate this data are available as well. The first would be to introduce another, lower constraint that PARSET and PARSEASP float over; the second would be to abandon the assumption that the rankings are chosen with equal probability (for an approach of this second type to Catalan acquisition data, see Davidson & Legendre, to appear).

3b–LXB

Markedness		$*F^2$	>>	*F
Faithfulness	PARSET	————		
	PARSEASP	————————————		

Possible rankings and their results:

a. PARSEASP >> PARSET >> $*F^2$ >> *F ⇒ TP+AspP (*le*)
b. PARSET >> PARSEASP >> $*F^2$ >> *F ⇒ TP+AspP (*le*)
c. PARSET >> $*F^2$ >> PARSEASP >> *F ⇒ TP (*ne*)
d. PARSET >> $*F^2$ >> *F >> PARSEASP ⇒ TP (*ne*)
e. PARSEASP >> $*F^2$ >> PARSET >> *F ⇒ AspP (*Ø*)
f. $*F^2$ >> PARSEASP >> PARSET >> *F ⇒ AspP (*Ø*)
g. $*F^2$ >> PARSET >> PARSEASP >> *F ⇒ TP (*ne*)
h. $*F^2$ >> PARSET >> *F >> PARSEASP ⇒ TP (*ne*)

Figure 5: A partial ranking for Stage 3b (LXB)

Before proceeding to stage 4b, we will need to introduce an additional constraint. We assume that just as there are constraints forbidding functional projections (*F) and two functional projections ($*F^2$, itself considered to a self-conjunction of *F), there are also further conjunctions that are still higher-ranked. For our purposes here, we will only need to refer to $*F^3$, given below.

(9) **$*F^3$** No triads of functional heads are allowed.

In the adult language, $*F^3$ is violated by any structure which includes a CP projection (and all lower projections); for example, utterances including a question particles such as *ma* in Mandarin. In the earliest stages in our data, the children do not use *ma* or show any other evidence of a CP projection, supporting the interpretation that faithfulness to CP-related PARSE constraints (e.g., PARSEQ) are outranked by $*F^3$. By the time the children acquire an adult-like ranking, however, all the PARSE-X constraints (e.g. PARSEASP, PARSET, PARSEQ) must ultimately outrank even $*F^3$.

We can now present partial rankings for stage 4b, which we do below. As before, the frequency patterns for BB differ from those of the other two children, indicating different partial rankings.

Table 10: Predicted vs. observed morphology (4b–BB)

	Predicted	**Observed (BB)**
le	75%	74%
ne	0%	1%
Ø	25%	25%

4b–BB

Markedness		$*F^3$ >> $*F^2$ >> *F
Faithfulness	PARSET	————————
	PARSEASP	————

Possible rankings and their results:

a. PARSEASP >> PARSET >> $*F^3$ >> $*F^2$ ⇒ AspP+TP (*le*)
b. PARSET >> PARSEASP >> $*F^3$ >> $*F^2$ ⇒ AspP+TP (*le*)
c. PARSET >> $*F^3$ >> PARSEASP >> $*F^2$ ⇒ AspP+TP (*le*)
d. PARSEASP >> $*F^3$ >> PARSET >> $*F^2$ ⇒ AspP+TP (*le*)
e. $*F^3$ >> PARSEASP >> PARSET >> $*F^2$ ⇒ AspP+TP (*le*)
f. $*F^3$ >> PARSET >> PARSEASP >> $*F^2$ ⇒ AspP+TP (*le*)
g. PARSEASP >> $*F^3$ >> $*F^2$ >> PARSET ⇒ AspP (*Ø*)
h. $*F^3$ >> PARSEASP >> $*F^2$ >> PARSET ⇒ AspP (*Ø*)

Figure 6: A partial ordering for Stage 4b (BB)

		4b–YY, LXB
Markedness		$*F^3$ >> $*F^2$ >> *F
Faithfulness	PARSET	————
	PARSEASP	————————

Possible rankings and their results:

a. PARSET >> PARSEASP >> $*F^3$ >> $*F^2$ ⇒ AspP+TP (*le*)
b. PARSEASP >> PARSET >> $*F^3$ >> $*F^2$ ⇒ AspP+TP (*le*)
c. PARSEASP >> $*F^3$ >> PARSET >> $*F^2$ ⇒ AspP+TP (*le*)
d. PARSET >> $*F^3$ >> PARSEASP >> $*F^2$ ⇒ AspP+TP (*le*)
e. $*F^3$ >> PARSET >> PARSEASP >> $*F^2$ ⇒ AspP+TP (*le*)
f. $*F^3$ >> PARSEASP >> PARSET >> $*F^2$ ⇒ AspP+TP (*le*)
g. PARSET >> $*F^3$ >> $*F^2$ >> PARSEASP ⇒ TP (*ne*)
h. $*F^3$ >> PARSET >> $*F^2$ >> PARSEASP ⇒ TP (*ne*)

Figure 7: A partial ranking for Stage 4b (YY, LXB)

Table 11: Predicted vs. observed morphology (4b–YY,LXB)

	Predicted	**Observed (YY, LXB)**	
le	75%	76%	84%
ne	25%	22%	11%
Ø	0%	2%	4%

Our analysis can be summarized as follows. Acquisition of tense/aspect categories in Mandarin involves the coexistence of grammars at individual stages of development. Some of these grammars yield adult-like utterances, while others yield non-adult-like utterances. The process of acquisition amounts to weeding out the non-adult grammars from the child's 'repertoire' by raising faithfulness constraints in the rankings above structural markedness constraints.[13] For grammars in which faithfulness constraints are low-ranked, we see overgeneralization (neutralization of contrast), resulting in an overuse of *ne*.

We close this section by showing graphically a comparison between the observed data and the predictions of our model.

[13] For a related discussion, see Yang (1999).

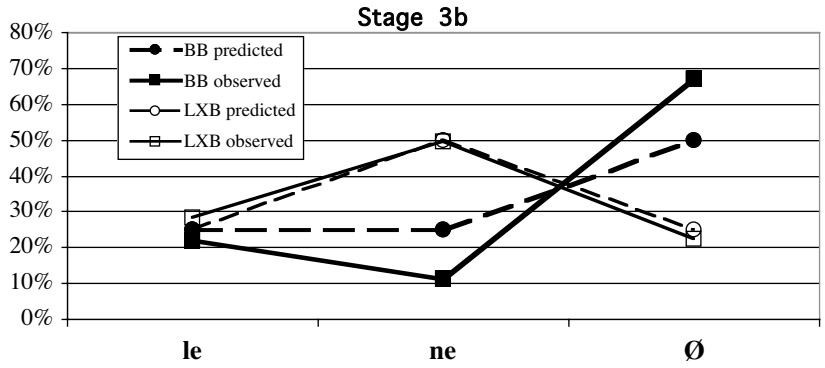

Figure 8. Predicted vs. observed values for stage 3b

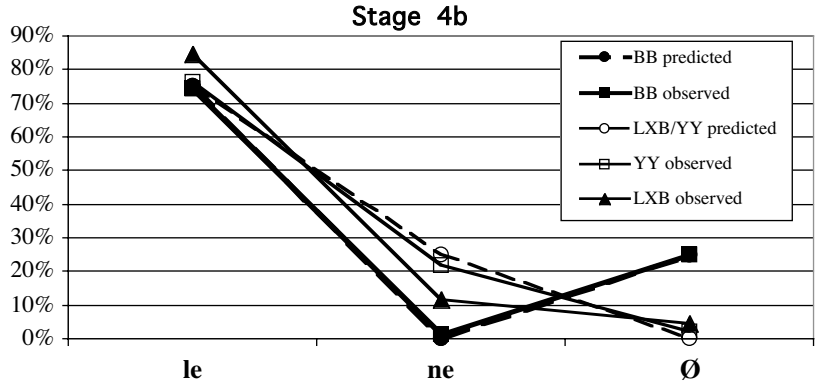

Figure 9. Predicted vs. observed values for stage 4b.

5. Consideration of a phonological alternative

One alternative account that should be considered before accepting the syntactic account above locates the cause of the observed overproduction of *ne* in an incompletely developed phonological system. That is, an account according to which the children merely substitute [*n*] for [*l*] sometimes. There were, in fact, a few instances apart from *le* where such substitutions were found. We looked at the children's overall productions of the sounds [*l*] and [*n*] (tokens of *le* and *ne* were excluded from this count) to see what proportion were [*l*], the results graphed below. There is

a slight increase in the proportion of [*l*] for BB and LXB, but a decrease for YY. Overall, the children are not clearly favoring [*n*] over [*l*], certainly not to the extent necessary to explain the substitutions of *ne* for *le*. We plotted this against children's productions of *le* and *ne* overall, and we see that the change in the use of *ne* vs. *le* is much steeper and, in the case of YY, even in the opposite direction. Thus, a simple phonological substitution would be insufficient to account for the child productions of *ne* for *le*.

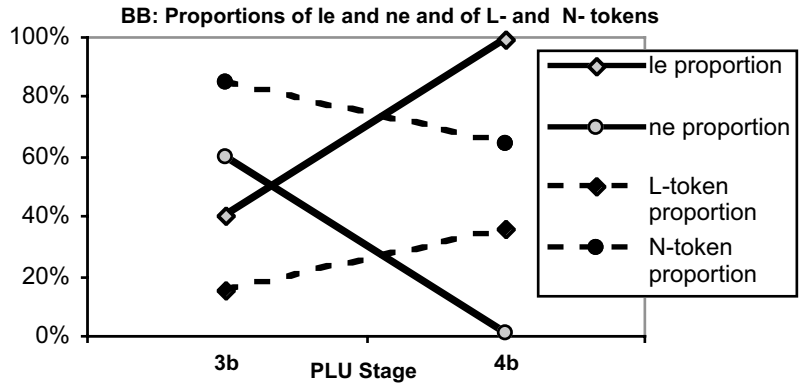

Figure 10. Proportions of *le* and *ne* vs. [*l*] and [*n*] for BB

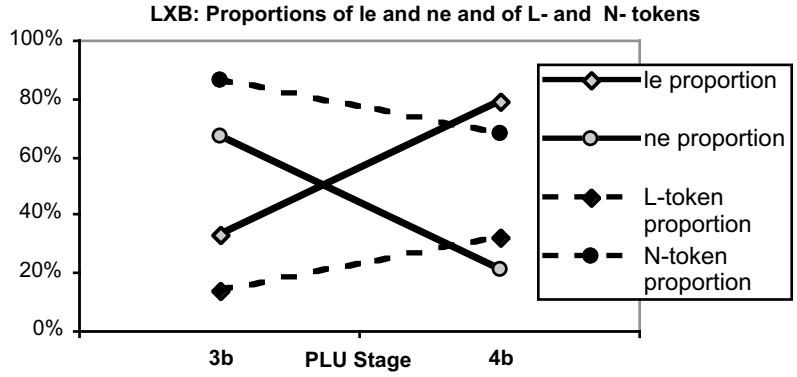

Figure 11. Proportions of *le* and *ne* vs. [*l*] and [*n*] for LXB

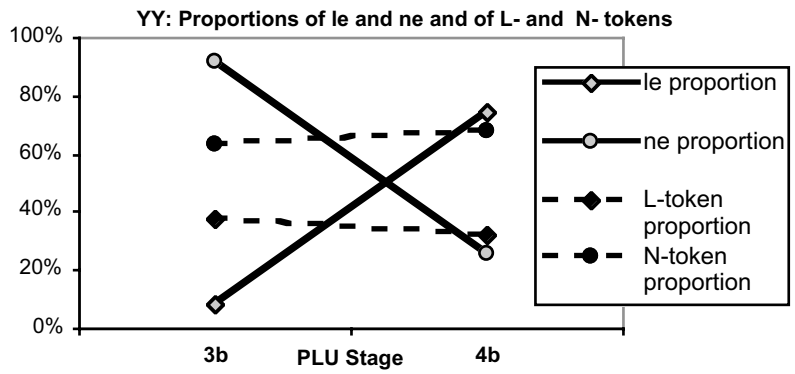

Figure 12. Proportions of *le* and *ne* vs. [*l*] and [*n*] for YY

6. Concluding remarks

The early stages of acquisition of Mandarin temporal categories appear highly similar to those previously identified in two unrelated languages, French and Catalan. While the specific categories are different, the pattern is the same at the same PLU stages despite a significant difference in overall inflectional richness of the target languages. In all three languages, the process of acquisition involves a default form and coexisting grammars: A specific form for a specific functional category appears very early, but it is also frequently substituted for by a default form that gradually disappears over time. In Mandarin the categories present in early speech are the inchoative *le* and the progressive *ne*, the latter also serving as the default form. Other temporal categories appear later, in particular perfective V-*le* and other aspect markers such as *guo* and *zhe*.[14] Using violable and re-rankable constraints in OT, with partial rankings of those constraints, we arrived at a model that accounts for both variation and frequency of use for the tense/aspect morphology through the course of development in children acquiring Mandarin Chinese (as was done previously for French and Catalan).

[14] Erbaugh (1992) observes that *le* appears relatively early in child speech, but she does not differentiate S-*le* from V-*le* (in fact, she observes that they cannot be distinguished in the early transcripts she was studying, since *le* always appeared at the end of a sentence, immediately postverbally). Thus, Erbaugh's claims are consistent with our conclusion that S-*le* appears earlier than V-*le*.

A desirable attribute of the present proposal is its correspondence to accounts put forth for French and Catalan functional categories (Legendre et al., 2000; Davidson & Legendre, to appear). The summary in Table 12 makes it clear that acquisition of functional categories (tense, aspect, person agreement) follows the same general course in the three languages via overgeneralization of a default form, independent of the richness of the morphology and the actual default used.

Table 12. Cross-linguistic patterns of early acquisition of syntax

	Inflectional Morphology	Default at early stage
Chinese	Poor	Yes: *ne*
French	Relatively poor	Yes: 3rd singular present
Catalan	Rich	Yes: participle

APPENDIX 1. Chinese PLU guidelines

Determining PLU stages in a given language involves several steps. First, one must decide what counts as an utterance in that language and what does not. The specific guidelines listed below summarize how the general PLU guidelines were modified into specific guidelines for Mandarin Chinese.

We counted as "utterances" anything that was not a direct repetition, with the exception of responses to questions that an adult would answer with a direct repetition. More specifically:

1. An imitation of a contiguous piece of an adult utterance were not counted as an utterance, except when:
   a. the utterance is a response to a question which would be answered by an adult with a direct repetition,
   b. the imitation includes a discontinuity (i.e. a failed direct imitation),
   c. there is a phonological change in the imitation.
2. A self-repetition was not counted as an utterance, except when:
   a. the repetition follows a different utterance made by the child,
   b. the repetition follows an adult utterance which was not ignored by the child,
   b. the repetition is addressed to a different hearer.

3. Syllables that are interjections such as *ou* (‘oh’), *em* ,*eng*, or *heng* were never counted as utterances. Included as utterances, however, were words such as *aiyou* (roughly ‘oh no!’ or ‘oops!’) that have a more specific meaning, as were question prompts such as *a?*.
4. If the child’s repetition either of himself/herself or of an adult is separated from the repeated utterance only by one or more interjections (3), it was considered an immediate repetition and evaluated under (1–2).
5. Unintelligible babble (of the type transcribed in CHILDES as “xxx”), except where such fragments could be confidently coded as interjections (3), were counted as utterances.
6. Sound effects, onomatopoeia, and vocalizations that are clearly not attempts at sentences were not counted as utterances.
7. Non-speech sounds, such as laughing, coughing, or wailing, were not counted as utterances.
8. Rote-learned segments such as portions of songs, nursery rhymes, proverbs, greetings, good-byes, etc., were not included as utterances.

Also important for computing the PLU stage represented by a child transcript is the computation of “words” and “verbs’. The following criteria were used for counting these:

1. Stative/qualitative verbs in Mandarin often correspond to adjectives in English. Such words were counted as verbs (based on Erbaugh, 1992; Tardif, 1993), when in the adult language:
   a. the word can be used in the V-not-V construction, and
   b. the word does not need a copula (or other verb marker) to say that something has the property it denotes.
2. Verb forms such as *shuì-shuì* (sleep-sleep), marked by Tardif with an *rv* (resultative verb), were counted as one word.
3. Verbs that take a goal, such as *guò-lái* (cross-here) were counted as one word.
4. Phonological fragments were treated as non-transcribed utterances, just like “xxx” would be (Vainikka et al., 1999). If the fragment would have counted as an interjection (see previous criteria, #3), it was treated as a particle and included in the word count unless utterance-initial.

5. Repetitions of a single word in an utterance were not counted as separate words if they are:
   a. stutters
   b. incomplete attempts at a single word

   They were counted, however, if they are repeated for emphasis or appear in different phrasal units.
6. Proper names were counted as a single word (despite often consisting of three units).
7. *Méiyǒu* was counted as two words.

APPENDIX 2. Criteria used in coding the *ne* / *le* data

The two native speaker authors developed the following set of criteria for coding the *ne*/*le* data:

1. Sentence-final *le* (S-*le*): Only clear instances of the inchoative *le* were counted. Not all sentence-final *le*'s are counted as S-*le* (since V-*le* can be final with intransitive verbs, e.g., *diào* 'drop', or elliptical expressions, e.g., *xiě le* … 'wrote'). These clear cases are given below.

   a. Where *le* (or *ne*) appears with a stative verb and indicates the inception of a new state (Chan, 1980: 52–3), or the currently relevant state, S-*le* is intended. The example below shows *ne* substituted for an intended S-*le*.

      CH–MO: nà nà: bǐnggān huài ne. wǒ yào chī zhèige.
      That cookie bad le 1sg want eat this:Cl
      'That cookie has gone bad. I want to eat this one.'
      (LXBvis6:29)

   b. When a direct object precedes *le*, it is clearly S-*le*, since perfective V-*le* would precede the object (see 2).

      CH–BM: guān-shàng mén le .
      close-up door le
      '(I have) closed the door.' (YYvis6:37)

c. When *le* appears with the negative particle *bu*, it is S-*le*, since V-*le* cannot appear with *bu*.

CH–MO: zhèi bú yào le.
this neg want le
'(I) don't want this any more.' (LXBvis6:22)

2. Verb-final (perfective) *le*: V-*le* is clearly indicated when it precedes an object. Note that the following utterance was the only instance of correct V-*le* we found, but it also contains a substitution of *ne* for S-*le*.

CH–BM: dào le zàn: [: zhàn] ne:.
arrive le stop le
'(The bus) has arrived at a stop.' (YYvis6:39)

3. Inchoative/Perfective *le*: There are instances of *le* that may be interpreted as either V-*le* or as S-*le* in the child data. These were counted as S-*le* in the analysis.

CH–FA: zhuàng-wán le.
bump-finish le
'(I) finished trashing (the car).' (BBvis5:20)

4. Errors and ambiguous *le* forms (there were very few tokens, and they were excluded from all counts)

a. Errors: Using *mei* and *le* together, ungrammatical in the adult language.

CH–NN: méi huà-wán le .
neg draw-finish le
'I have not have not finished drawing yet.'
(BBvis5:19)

b. Ambiguous cases that could have been either *le* or *ne*, based on the response.

CH–MO: yòu tiào shéngr ne.
again jump rope ne
'It's started to jump rope again now. /
'It's jumping rope again now.'
MO–CH: yòu tiào shéngr le?
again jump rope le
'It has started to jump rope again now?'
(LXBvis1:8)

CH–MO: téng: ne.
hurt ne (crying)
'It's hurting me. / It's started to hurt me now.'
MO–CH: téng: le? Huó gāi!
hurt le Serve (you) right
'It's started to hurt you—Serves you right!'
(LXBvis1:19–20)

5. Progressive *ne*: Only action verbs were counted as exhibiting progressive *ne*. Location verbs with *ne* were not taken to be progressive.

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