- [-ø & umlaut]
  fall 266/334
  hold 0/5
  come 109/174
- [-ø & Rime → u]
  blow 5/15, *grow* 4/12, *know* 17/23, *throw* 11/34, *draw* 2/12, *fly* 8/15
- [-*d* & Vowel Shortening]
  say 522/525

4

Grammar Competition in Children's Syntax

> Phylogenesis is the mechanical cause of ontogenesis. The connection between them is not of an external or superficial, but of a profound, intrinsic, and causal nature.
>
> Ernst Hackel, *Ontogeny and Phylogeny* (Gould 1977: 78)

Hackel's proposition that 'ontogeny recapitulates phylogeny', which has been drifting in and out of fashion in biology, may well be vindicated in the ontogeny of human language, with a twist. If language is delimited in the finite space of Universal Grammar, its ontogeny might well recapitulate its scope and variations as the child gradually settles on one out of the many possibilities. This is exactly what the variational model leads one to expect, and the present chapter documents evidence to this end.

The variational model also serves another important purpose. If we survey the field of language acquisition, we cannot fail to notice an unfortunate gap between learnability studies and developmental studies. As far as we know, there is presently no formal model that directly explains developmental findings, nor any rigorous proposal of how the child attains and traverses 'stages' described in developmental literature. The variational model intends to fill this gap.

The variational model makes two general predictions about child language development:

(58) a. Other things being equal, the rate of development is determined by the penalty probabilities of competing grammars; cf. (25).
b. As the target grammar gradually rises to dominance, the child entertains coexisting grammars, which ought to be reflected in the non-uniformity and inconsistency in its language.

What follows is a preliminary investigation of (58) through several case studies in children's syntactic development.[1] These cases are selected for two reasons. First, they are based on a large body of carefully documented quantitative data.[2] Second, they are major problems in acquisition that have received a good deal of attention. Nevertheless, we will show that some interesting and important patterns in the data have never been noticed; in addition, an explanation of them may not be possible unless a variational approach is assumed.

This chapter is organized as follows. Section 4.1 presents crosslinguistic longitudinal evidence in support of prediction (58a), drawing evidence from child French, English, and Dutch. The statistics established there will be used in section 4.2 in a quantitative interpretation of the Argument from the Poverty of Stimulus presented in response to recent challenges by Sampson (1989) and Pullum (1996). Section 4.3 gives a systematic account of null subjects in child English, in comparison with child Chinese and Italian. Based on the children's null subject *Wh* questions and null object sentences, we show that English children have simultaneous access both to an obligatory subject grammar (the target) and to an optional subject grammar, supporting prediction (58b). The case studies will be concluded with a 'working manual' for acquisition studies in the variational framework.

4.1 Learning three parameters

Recall that from (25), we know that the penalty probability of the competitor grammar (or parameter value) determines the rate of language (or parameter) learning. Following the discussion of parameter learning in section 2.4, we estimate the frequency of signatures that unambiguously express the target value of each of three parameters under study. We will test the variational model

[1] Section 4.2 represents joint work with Julie Anne Legate; for a different and fuller treatment, see Legate & Yang (in press).

[2] Hence a large debt is due to the researchers who collected the data used here.

by examining the acquisition of three parameters: that of finite verb raising in French (Pierce 1989), acquired early, that of obligatory subject use in English (Valian 1991, Wang et al. 1992), acquired relatively late, and that of V2 in Dutch (Haegeman 1995), also acquired late.

Before moving on, we would like to clarify our claim here that some parameters are acquired later than others. As reviewed in section 2.1, the dominant view, shared by researchers from a wide spectrum of theoretical inclinations, is that parameters are set correctly from early on: for the subject parameter, see e.g. Bloom (1990, 1993), Valian (1991), Hyams (1996), Wexler (1998), and for the V2 parameter, see e.g. Boser (1992) and Poeppel & Wexler (1993). While we believe that the setting of the verb-raising parameter, and indeed of many parameters, is genuinely early, the claim that the subject and the V2 parameters are also set early is unconvincing. As we shall see shortly, for some parameters, assertions of early setting either fail to explain important developmental patterns or amount to dismissing up to half of the quantitative data.

4.1.1 *Verb raising and subject drop: the baselines*

Consider first the verb to Tense raising parameter, for which the [+] value is expressed by signature of the type V_{FIN} Neg/Adv. A grammar with the [−] value for this parameter is incompatible with such sentences; when probabilistically selected by the learner, the grammar will be punished as a result. Based on the CHILDES corpus, we estimate that such sentences constitute 7% of all French sentences heard by children. Since verb raising in French is an early acquisition, by 1;8 (Pierce 1989; for similar findings in other verb-raising languages, see Wexler 1994), this suggests that 7% of unambiguous signatures—an entirely *post hoc* figure—is a lower bound that suffices for an early acquisition: any aspect of grammar with at least 7% of signatures should also be acquired very early.

We then have a direct explanation of the well-known observation

that word order errors are 'triflingly few' (Brown 1973: 156) in children acquiring fixed word order languages. For example, English children rarely produce word orders other than SV/VO, nor do they fail to front *Wh* words in questions (Stromswold 1990). Observe that virtually all English sentences display rigid word order, e.g. verb almost always (immediately) precedes object. Also, *Wh* words are almost always fronted in questions, which, in our estimation, constitute roughly one third of all sentences English children hear. These patterns give a very high (far greater than 7%) rate of unambiguous signatures, which suffices to drive out other word orders very early on.

From (58a) it also follows that if signatures are rare in the input, the development of a grammar (or a parameter) will be relatively late. Consider then the acquisition of subject use in English. Following Hyams (1986), Jaeggli & Safir (1989), and many others, the use of pure expletive (*there*) subjects (59) correlates with the obligatoriness of subject use in a language:

(59) a. There is a man in the room.
b. Are there toys on the floor?

Optional subject languages do not have to fill the subject position, and therefore do not need placeholder items such as *there*.[3] We estimate that expletive sentences constitute 1.2% of all adult sentences to children, based on the CHILDES database. Subject use is acquired relatively late—at 3;0 (Valian 1991), judged by comparability with adult usage frequency[4]—we may conclude

[3] This does not mean that we are committed to a particular parameter, [± pro-drop] or [± Null Subject], which is in any case too crude to capture the distributional differences between two representative classes of optional subject grammars, the Italian type and the Chinese type. We only make the assumption that languages make a small number of choices with respect to the use of subject. We are, however, committed to what seems to be a correct generalization that the use of expletive subjects and the obligatoriness of subject are correlated—hence, something in UG must be responsible for this.

[4] As remarked earlier, Valian nevertheless claims that the subject parameter is set correctly, and attributes the missing subjects to performance limitations; we will return to this in section 4.3.2.

that 1.2% of unambiguous evidence ought to result in a late acquisition. Similar to the case of French verb raising, we will use 1.2% as a baseline for *late* acquisition: if a parameter is expressed by 1.2% of the input, then its target value should be set relatively late; more specifically, as late as the consistent use of subjects in child English.

4.1.2 *V1 in V2 learners*

Consider then the acquisition of the V2 parameter in Dutch. As noted in (26), there appears to be no direct signature for the V2 parameter: the four competitor grammars together provide a complete covering of the V2 expressions. However, three competitors, namely, the English, Irish, and Hixkaryana type grammars, while compatible with SVO, XVSO, and OVS patterns respectively, nevertheless have very high penalty probabilities: 35.3%, 66%, and 98.7%, according to our corpus analysis. As a result, these grammars are eliminated quite early on; see Fig. 2.1.

A Hebrew grammar, or a similar Semitic grammar such as Arabic, fares considerably better in the competition. By the virtue of allowing SVO and XVSO alternations (Fassi-Fehri 1993, Shlonsky 1997), it is compatible with an overwhelming majority of V2 patterns (98.7% in all). However, it is not compatible with OVS sentences, which therefore are in effect unambiguous signatures for the target V2 parameter after the other three competitors have been eliminated very rapidly. The rarity of OVS sentences (1.3%) implies that the V2 grammar is a relatively late acquisition, with a Hebrew-type non-V2 grammar in coexistence with the target V2 grammar for an extended period of time.

A Hebrew type grammar, then, allows verb-initial (V1) sentences, which are ungrammatical for the target V2 grammar, but will nevertheless constitute a significant portion of Dutch child language, if the variational model is correct. This prediction is confirmed based on the statistics from a Dutch child, Hein

(Haegeman 1995), one of the largest longitudinal studies in the acquisition of V2 languages.[5] The data concern the position of the finite verb in matrix sentences, and are reported in Haegeman's tables 5 and 6, which we combine in Table 4.1.

Based on these, we can compute the ratio of V1 sentences over all sentences. The number of V1 sentences is the number of postverbal subject sentences minus those with overt material left of V; that is, column 3 minus column 2 in Table 4.1. The number of all sentences is the sum of column 2 and column 3 in Table 4.1. The results are shown in Table 4.2.

Some of the V1 patterns are given below (from Haegeman 1995: n. 21):

(60) a. Week ik neit.
know I not
b. Zie ik nog niet.
see I yet not
c. Schijnt de zon.
shines the sun
d. Kan ik niet lopen.
can I not run

Now we have to be sure the V1 patterns in (60) are 'real', i.e. are indeed due to the presence of a competing Semitic-type grammar. First, it must be stressed that all the sentences contain overt subjects, hence ruling out the possibility that the superficial V1 patterns are due to subject drop, which Germanic children are known to use. Another compounding factor is the precise location of the (finite) verb. According to Shlonsky (1997), finite verbs in Hebrew move to a position above Tense, presumably an Agreement node. Thus, if the V1 patterns are genuinely Hebrew-like, the finite verb must reside in a position higher than Tense. The presence of an overt subject again confirms this. Stromswold & Zimmerman's (1999) large quantitative study shows, contrary to the earlier claims of Deprez & Pierce (1993), that the subject is consistently placed above Negation,

[5] I should point out that Haegeman's paper does not directly deal with the V2 phenomenon, but with the nature of Optional Infinitives instead; it happens to contain a large body of quantitative data needed by our study.

TABLE 4.1. Subjects and non-subject topics in Hein's finite clause

Age	Preverbal subject	Postverbal subject	Overt material left of V
2;4	76	94	22
2;5	44	88	22
2;6	239	172	25
2;7	85	116	23
2;8	149	143	49
2;9	126	143	55
2;10	146	175	82
2;11	124	135	99
3;0	126	120	64
3;1	108	160	59

TABLE 4.2. Hein's longitudinal V1 patterns

Age	V1 sentences	All sentences	% of V1 sentences
2;4	72	170	43
2;5	66	132	50
2;6	147	411	36
2;7	93	201	46
2;8	94	292	32
2;9	98	269	36
2;10	93	321	28
2;11	36	159	14
3;0	56	246	22
3;1	101	268	37

presumably in the [Spec, T] position. Hence, the verbs in (60) are higher than Tense, consistent with the Hebrew-type grammar.

From Table 4.2, we see that before 2;6 the child used V1 patterns in close to 50% of all sentences; see Wijnen (1999) for similar findings. It thus disconfirms the claim that the V2 parameter is set correctly very early (Poeppel & Wexler 1993, Wexler 1998). With half of the data showing V1 patterns, to say that children have learned V2, or have adult-like grammatical competence, is no different from saying that children use V2 randomly.[6]

[6] One may object that the V1 patterns are due to the process of topic drop, and thus maintain the early setting of the V2 parameter. But this only begs the question: how do Dutch children figure out that topic drop is not used in their language? And there would still be half of the data to explain away.

Before we move on, consider the influential paper by Poeppel & Wexler (1993) in which the claim of early V2 setting is made. They found that in child German, while nonfinite verbs overwhelmingly appear in the final (and not second) position, finite verbs overwhelmingly appear in the second (and not final) position. But this does not warrant their conclusion that the V2 parameter has been set. A finite verb in the second position does not mean it has moved to the 'V2' position, particularly if the preverbal position is filled with a subject, as some of the examples taken from Poeppel & Wexler (1993: 3–4) illustrate below:

(61) a. Ich hab ein dossen Ball.
I have a big ball
b. Ich mach das nich.
I do that not

If this were true, then an English utterance like *Russell loves Mummy* would be classified as a V2 sentence. Poeppel & Wexler's data do show, however, that finite verbs raise to a higher position and nonfinite verbs stay in the base position, thus replicating Pierce's (1989) French findings in child German.

As shown in Table 4.2, Hein's use of V1 sentences dropped to about 14–20% at 3;0.[7] This can be interpreted as the target V2 grammar gradually wiping out the Hebrew-type grammar. Furthermore, because the frequency (1.3%) of Dutch OVS sentences is comparable to the frequency (1.2%) of English expletive sentences, we predict, on the basis of (25) (see Chapter 2), that the V2 parameter should be successfully acquired at roughly the same time that English children have adult-level subject use—3;0. If we use Brown's criterion that 90% correct usage signals successful acquisition, we may conclude that the Dutch child studied by Haegeman has mastered V2 at 3;0, or has come very close. There is also evidence from the acquisition of German, a similar language, that children reach adult-level V2 use by 3;0–3;3

[7] We suspect the unexpectedly higher rate of V1 at 3;1 to be a sampling effect: while all stages were recorded over 5–10 sessions, the recording at 3;1 took place in only one session.

(Clahsen 1986). Under the present model, it is no coincidence that the timing of the acquisition of English subject use and that of Dutch/German V2 are comparable.

4.2 Quantifying the stimulus poverty argument

Based on the acquisition model and the findings in section 4.1, we can give a quantitative evaluation of the Argument from the Poverty of Stimulus (APS).

Recall from section 1.1 that at the heart of APS lies the question: why do human children unequivocally settle on the correct (structure-dependent) rules for question formation, while the input evidence does not rule out the incorrect, structure-independent, inductive generalization?

(62) a. Front the first auxiliary verb in the sentence.
b Front the auxiliary verb that is most closely follows a noun.
c. Front the last auxiliary verb in the sentence.
d. Front the auxiliary verb whose position in the sentence is a prime number.
e. . . .

for which the relevant evidence is in many ways ambiguous:

(63) a. Is Alex *e* singing a song?
b. Has Robin *e* finished reading?

Recently, the argument for innate knowledge based on structure dependency has been challenged by Sampson (1989), Pullum (1996), and Cowie (1998), among others. They claim that the learner is actually exposed to the relevant evidence to rule out the incorrect, structure-independent hypotheses. Here we will focus on Pullum's objections and show that they are not valid.

First, Pullum (implicitly) assumes that there is only *one* alternative hypothesis to be ruled out, namely, that of (62a), the inversion of the first auxiliary in the sentence. This assumption is incorrect: the learner in fact has to rule out *all*, in principle infinitely many, hypotheses compatible with (63); cf. Freidin (1989). But for the sake of argument, suppose it were the case that the

learner had only a binary choice to make, while keeping in mind that if the learner did not have prior knowledge of structure dependency, the effort it takes to rule out all possible hypotheses can only be harder than that to rule out just (62a).

Second, Pullum notes, correctly, that auxiliary inversion in *yes/no* questions is not the only type of sentences that rules out (62):

(64) Is_1 [the boy who is]$_{NP}t_1$ in the corner smiling?

Wh questions with an inverted auxiliary over a complex NP are also informative:

(65) How could$_1$ [anyone that was awake]$_{NP}t_1$ not hear that?

Pullum proceeds to count the frequency of sentences such as (64) and (65), using a *Wall Street Journal* corpus. He discovered that in the first 500 sentences he examined, 5, or 1%, are of these two types. Some examples are given below:

(66) a. How fundamental are the changes these events portend?
b. Is what I'm doing in the shareholders' best interest?
c. Is a young professional who lives in a bachelor condo as much a part of the middle class as a family in the suburbs?
d. Why did 'The Cosby Show's' Lisa Bonet, who has a very strong screen presence, think that participating in a graphic sex scene would enhance her career as a legitimate actress?

Pullum then concludes that the APS is flawed, since the learner does have access to a non-trivial amount of disambiguating evidence.

This argument commits a logical error: a mere demonstration that critical evidence exists does not mean that such evidence is *sufficient*. Knowledge despite insufficiency—rather than absence—of relevant learning experience is the foundation of the APS.

It then forces us to the problem of how to quantify 'sufficiency' of critical evidence that serves to disambiguate alternative hypotheses. Surely one would like to say, for example, '287 sentences will set this parameter correctly', but our understanding

of language acquisition at this point is far too primitive to make statements with that level of accuracy.

But there is another, equally suggestive, way of evaluating Pullum's claim: we situate the case of structure dependency in a *comparative* setting of language acquisition. That is, we need an independent yardstick to quantitatively relate the amount of relevant linguistic experience to the outcome of language acquisition—the variational model offers just that.

First and foremost, we must take an independent case in acquisition, for which we have good knowledge of children's developmental time course, and for which we can also obtain a corpus frequency of the relevant evidence. The null subject phenomenon is a perfect example.

As reviewed earlier, English children's subject use reaches adult level at around 3;0 (Valian 1991). This is comparable to the age of the children whose knowledge of structure dependence was tested by Crain & Nakayama (1987): the youngest group was at 3;2. In both cases, the learners make a binary choice: Valian's children have to determine whether the language uses overt subjects, and Crain & Nakayama's children would, if Pullum were correct, have to rule out the possibility that language is structure-dependent but not linear. Under the present model—in fact, under any quantitative model of language acquisition—comparability in the completion of two acquisitions must entail comparability in the frequency of their respective evidence.[8] If English subject use is gradually learned on the basis of *there* expletive sentences, which represent roughly 1.2% of all sentences, then one would expect sentences like (64) and (65), which supposedly establish structure dependence, also to be close to 1.2% in the input data.

Which takes us to a second problem in Pullum's argument: we must start with *realistic* corpora of children's linguistic input. The *Wall Street Journal* hardly fits the bill, a point that Pullum himself

[8] One may reject models that do *not* predict such frequency–development correlations, on the ground that the comparable time courses of subject acquisition and V2 acquisition (section 4.1.2) would be an accident.

acknowledges. Realistic counts can be obtained from CHILDES. For example, based on fifty-six files in the Nina corpus, we found:

(67) 46,499 sentences, of which 20,651 are questions, of which
  a. None were *yes/no* questions of the type in (64).
  b. Fourteen were *Wh* questions of the type in (65), exhaustively listed below:
    i. Where's the little red duck that Nonna sent you? (NINA02.CHA)
    ii. Where are the kitty cats that Frank sent you? (NINA03.CHA)
    iii. What is the animal that says cockadoodledoo? (NINA04.CHA)
    iv. Where's the little blue crib that was in the house before? (NINA05.CHA)
    v. Where's the other dolly that was in here? (NINA05.CHA)
    vi. What's this one up here that's jumping? (NINA05.CHA)
    vii. Where's the other doll that goes in there? (NINA05.CHA)
    viii. What's the name of the man you were yesterday with? (NINA10.CHA)
    ix. What color was the other little kitty cat that came to visit? (NINA28.CHA)
    x. Where's the big card that Nonna brought you? (NINA38.CHA)
    xi. And what was the little girl that came who also had whiskers? (NINA41.CHA)
    xii. Where's the card that Maggie gave you for Halloween? (NINA41.CHA)
    xiii. Nina # where are the pants that daddy sent you? (NINA43.CHA)
    xiv. Where are the toys that Mrs Wood told you you could bring home? (NINA46.CHA)

This puts the frequency of relevant evidence at approximately 0.03%:[9] that is forty times lower than 1.2%, the amount of

[9] Following Sampson (1989), Pullum argues that sentences like (i) also disambiguate the correct rule from the first auxiliary hypothesis:

(i) If you don't need this, can I have it?

If the underlying representation of (i) is [*If you don't need this, I can have it*], the first auxiliary rule would front either *don't* or *can*, producing erroneous output. However, this line of reasoning would not work if children know where sentence boundaries are, i.e. that the punctuation between two clauses signals a fresh start. There is, however, evidence that children do recognize sentence boundaries, for which perhaps even low-level acoustic cues suffice (Fisher & Tokura 1996). In any case, we only found 10 such sentences in the Nina corpus, 4 of which contain the special symbol #, which encodes a significant pause separating two clauses. Even including these examples would still give a frequency far lower than 1.2%.

evidence needed to settle on one of two binary choices by around the third birthday.

Just to confirm that the Nina statistics are no accident, we considered another corpus, that of Adam. In an earlier paper, Legate (1999) finds the following:

(68) In a total of 20,372 sentences, 8,889 were questions, of which
  a. None were *yes/no* questions of the type in (64).
  b. Four were *Wh* questions of the type in (65):[10]
    i. Where's the part that goes in between? (ADAM43.CH)
    ii. What is the music it's playing? (ADAM37.CHA)
    iii. What's that you're drawing? (ADAM47.CHA)
    iv. What was that game you were playing that I heard downstairs? (ADAM52.CHA)

which gives a frequency of 0.01%.

Furthermore, crucial evidence at a frequency around 0.01% may not be frequent enough to be distinguishable from noise. Interestingly, the canonical type of critical evidence, [aux [NP aux]], appeared not even once in all 66,971 adult sentences. Hence the original APS not only stands unchallenged, but is in fact strengthened: the knowledge of structure dependence in syntax, as far as we can test quantitatively and comparatively, is available to children in the absence of experience.[11] And the conclusion

[10] Of these, it is not even clear whether the equative sentences (68b-iii) and (68b-iv) necessarily count as evidence against the first auxiliary hypothesis. The child might analyze them with the *wh* word in the subject position and the complex NP in the object position (although this is arguably not the analysis ascribed to these questions in adult grammar). The Nina sentences in (67b-iii), (67b-vi), and (67b-viii) are of this type as well. There is an additional *wh* question containing a complex NP in the Adam files, however the context reveals that it is unambiguously an echo question with the *wh* word in subject position: Adam: *Dat's de funniest bird I ever saw*. Mother: *What is the funniest bird you ever saw?*

[11] In any case, the claim that children entertain the first auxiliary hypothesis for question formation is false. There is, of course, no way to prove that no possible

then is Chomsky's (1975: 33): 'the child's mind . . . contains the instruction: Construct a structure-dependent rule, ignoring all structure-independent rules. The principle of structure-dependence is not learned, but forms part of the conditions for language learning.'

4.3 The nature of null subjects in children

We now turn to a detailed analysis of null subjects (NS) in English children in comparison to Chinese and Italian children. We begin with a typology of subject use across languages, which serves to establish the nature of the candidate grammars that compete during acquisition.

To recover the referential content of a null subject, optional subject grammars employ one of two (almost inevitable) strategies (Huang 1984). In one group that includes languages like Italian and Spanish, a null subject is identified via unambiguous agreement (number, person, gender) morphology on the verb. It seems that unambiguous morphological agreement is only a necessary condition for the Italian type pro-drop. That is, there is no reason that unambiguous agreement would *force* a language to be pro-drop. There are Scandinavian languages such as Icelandic with full agreement paradigms but no (systematic) pro-drop. That is,

(69) a. Pro-drop ⇒ unambiguous agreement.
b. Unambiguous agreement does not imply pro-drop.

In the group of languages that includes Chinese, a null subject is identified via linking to a discourse topic, which serves as its antecedent. Because of the differences in the identification mechanism, Chinese and Italian show different distributions of null arguments.

structure-independent hypothesis is *ever* entertained; no such proof can exist, given the normal ethics of human subject experimentation. However, whatever alternative hypothesis one conjures up, one had better crank out some frequency counts not far from 1.2% for relatively late 'learnings'.

First, Italian does not allow arbitrary null objects (NO) (Rizzi 1986). In contrast, Chinese does freely allow NO (Huang 1984), which, like null subjects, can be recovered by linking the empty pronominal to a discourse topic:

(70) TOPIC$_1$ [Zhangsan kanjian-le e_1]. (e_1 = him)
TOPIC$_1$ [Zhangsan saw-ASP him$_1$].
'Zhangsan saw him.'

However, Chinese NS is more restrictive than Italian. When a topic phrase (Top) is fronted, subject drop in Chinese is grammatical only if Top is not a possible antecedent for the null subject, for otherwise the linking to discourse topic is disrupted. More specifically, Chinese NS is possible (71a) when Top is an adjunct, which can never be the antecedent of a dropped subject, and not possible (71b) when Top is an argument (object).

(71) a. Zai gongyuan-li$_2$, [e_1 t_2 da-le ren]. (e_1 = John)
In park-LOC, [e_1 t_2 beat-ASP people].
'It is in the park [but not at school] that John beat people up.'
b. *Sue$_2$, [e_1 xihuan t_2]. (e_1 = John)
Sue$_2$, [e_1 likes t_2].
'It is Sue [but not Mary] that John likes.'

Italian identifies null subjects through agreement morphology, and does not have the restrictions on subject drop seen above in Chinese. Subjects can be dropped freely in nominal and non-nominal *Wh* questions,[12] as shown below:

(72) a. Chi$_2$ e_1 ha baciato t_2?
Who$_2$ has(3SGM) kissed t_2?
'Who has he kissed?'
b. Chi$_3$ e_1 credi che e_2 ami t_3?
Who$_3$ e_1 think(2SG) that e_2 loves(3SGF) t_3?
'Who do you think she loves?'

[12] Following Chomsky (1977) and many others, we adopt the generalization that topicalization and *Wh* movement are essentially the same process (movement to [Spec,CP]), for they share many syntactic and semantic properties. Since Chinese cannot front *Wh* phrases (in questions or any other constructions), only topicalization data can be given in (71).

c. Dove$_2$ hai e_1 visto Maria t_2?
Where$_2$ have(2SG) e_1 seen Maria t_2?
'Where have you seen Maria?'

The differences between Chinese, English, Italian subject use are summarized below:

(73) a. The Chinese type: object drop, no subject drop with argument topicalization.
b. The English: no object drop, obligatory subject, use of expletive *there*.
c. The Italian: no object drop, unrestricted subject drop, rich Agreement morphology.

We shall see how such differences play out their roles in child language acquisition, disambiguating these grammars from one another. In addition, we shall see how these differences are repeated in (English) children's acquisition of subject use. We will again stress that the learner does not actively search for the patterns in (72) to identify their target grammar, as in a cue-based learning model. Rather, the grammars are probabilistically selected to analyze incoming sentences, and they will face different outcomes in different linguistic environments. For example, both English and Italian grammars will be punished in a Chinese environment when a null object sentence is encountered. Only the target grammar wins out in the end.

4.3.1 *The early acquisition of Chinese and Italian subject drop*

Here we study the acquisition of subject use in Chinese and Italian children; we turn to English children in section 4.3.2. Throughout our discussion, when we refer to a particular language, we mean the property of subject use in that *type* of I-language grammar. So, when we say a 'Chinese grammar', we mean that the type of grammar that employs discourse-based argument drop.

Consider first how a Chinese child rules out English and Italian grammars. Here, null object sentences like (70) are unambiguous

evidence for a Chinese-like grammar. A study by Wang et al. (1992) shows that Chinese adults use a fair amount of object drop sentences in speech to children (11.6%, computed from their appendix B) as well as among themselves (18%, computed from their appendix D). In section 4.1 we empirically established that 7% of unambiguous evidence suffices for very early acquisition, as in the mastery of finite verb raising by French children (Pierce 1989). We thus predict that from very early on, Chinese children have eliminated English and Italian grammars, and converged on the remaining grammar, the target.

This prediction seems correct. Wang et al. (1992: appendix C) find that the youngest group of Chinese children (2-year-olds) drop subjects 55.728% and objects 20.192%. The figures for subject drop is slightly higher than for adults, for whom the ratios are 45.852% and 18.000% (appendix D). This is probably due to the fact that the statistics from Wang et al. are based on elicitation, which clearly introduces more contextual situations for subject drop. Our own study of production data yields the figure of 49%.[13]

Additional evidence for early mastery by Chinese-speaking children of the target form of subject drop comes from an elicitation experiment carried out by Wang et al. in the same study (1992: 240–2). They tried to get Chinese children to use expletives, the equivalent of the weather *it* in English, as in (74):[14]

(74) a. [e] Xiàyǔ-le
(It) rain-ASP.
'[It] is raining.'
b. [e] Kànshàngqù [e] yào xiàyǔ-le.
[It] seems (it) going to rain-ASP.
'[It] seems that (it) is going to rain.'

In general, Chinese children in all age groups leave the subject position null.

[13] We used a random sample of 100 sentences each from 3 children: All are from the Beijing corpus in CHILDES. All sentences contained a verb or a predicate, and thus an opportunity for subject drop.

[14] Chinese adults may use 'Tiān' (sky) in place of *it* in English, but this is purely stylistic.

Let us now turn to Italian children. Recall that Chinese does not allow subject drop when an argument assumes the topic position (71b), and Italian does (with a fronted argument *Wh* phrase). This means that every subjectless question with an argument (object) *Wh* question punishes a Chinese grammar, and of course an English grammar as well.

It is known that approximately 70% of adult utterances have dropped subjects (Bates 1976, cited in Caselli et al. 1995). We also know that *Wh* questions are one of the most frequent constructions children are exposed to. We estimate that about 10% of all sentences are object questions involving empty subjects: again, the lower bound of 7% then warrants an early acquisition. This prediction is confirmed by Valian's findings (1991): at both of the developmental stages investigated (1;6–1;10 and 2;0–2;5), Italian children drop subjects in about 70% of sentences, roughly the same as the figures in adult speech reported in the references cited above.

4.3.2 *English children speak Chinese*

Finally, we consider how English children come to learn that their language uses an obligatory subject grammar, ruling out the Chinese and Italian grammars that are also made available by UG.

We first claim that the Italian grammar can very rapidly be eliminated by English children on the basis of their knowledge of agreement morphology. In Chapter 3 we reviewed the very strong evidence that young children's agreement morphology is near-perfect. Phillips (1995: 327), reviewing a number of crosslinguistic studies, observes that 'in languages with overt agreement morphology, children almost always use the agreement morphemes appropriate to the argument being agreed with'. Again, Guasti (1992) found that three young Italian children used agreement morphology correctly in more than 95% of all contexts; see e.g. Clahsen & Penke (1992) for similar findings in German, Torrens (1995) for Catalan, Levy & Vainikka (1999) for Hebrew.

Children's near-perfect knowledge of agreement morphology plays an important role in grammar competition. It rules out the Italian grammar that is almost extensionally a superset of English—minus the presence of *there*-type expletives. Hence, one must understand the variational model and the evaluation of grammar–sentence compatibility in the sense of strong generative capacity (cf. section 2.2.2). We remarked earlier in (69) that unambiguous agreement is a necessary condition for pro-drop. Thus, if a language does not have unambiguous agreement, then it cannot be pro-drop. Specifically, if an Italian grammar is chosen to analyze English input, the lack of unambiguous agreement in English causes the Italian grammar to fail and be punished as a result.[15]

The Chinese grammar is more difficult to rule out. Chinese employs discourse linking as the mechanism for null subject identification; morphology provides no useful information. The only evidence against the Chinese grammar is expletive *there* sentences, which constitute only 1.2% of all input sentences. Hence, with respect to subject use, we predict that English children ought to use an English grammar in coexistence with a Chinese grammar for an extended period of time.

The claim of grammar coexistence attributes English child NS to the presence of the Chinese grammar, which is probabilistically accessed. This directly explains the fact that 2-year-old English children use a non-trivial amount of NS, but at a lower rate (30%) than Chinese children of the same age group (46.5%) (Wang et al.

[15] The acquisition of a language—Icelandic, say—with unambiguous agreement but not pro-drop raises some interesting questions. Note that an Italian-type grammar selected by an Icelandic learner will not be contradicted by agreement reasons. A possible reason for rejecting the pro-drop grammar may be some version of the Avoid Pronoun Principle (Chomsky 1981). It is well known that in pro-drop languages such as Italian and Spanish, the use of overt pronouns is unnatural for normal discourse, and is reserved only for focus, contrast, stress, etc. If so, then the presence of overt pronoun, despite (redundant) unambiguous agreement, may count against the pro-drop grammar—which, if true, again suggests that grammar-input analysis is not simply string compatibility, but turns on UG principles.

I would like to thank Norbert Hornstein for bringing this problem to my attention.

1992). We also predict that child English ought to contain a certain amount of null objects (NO), grammatically acceptable in Chinese. Such an account of NO does not appeal to performance factors (e.g. Bloom 1990, Valian 1991) that are usually hard to quantify. Furthermore, the presence of the Chinese grammar entails that the distributional patterns of English child NS ought to show characteristics of a Chinese grammar. To demonstrate this, we look at two quantitative predictions that are borne out below.

First, recall that in a Chinese-type grammar, NS is only possible in adjunct topicalizations (71a), but not in argument topicalizations (71b). Since we attribute English child NS to a Chinese grammar, we expect that NS will be possible in adjunct questions but not possible in argument (object) questions.[16] This prediction is strongly confirmed. During the NS stage of Adam (CHILDES: files 1–20), we found an almost categorical asymmetry of NS in adjunct and argument questions:

(75) a. 95% (114/120) of *Wh* questions with NS are adjunct (*how, where*) questions.
b. 97.2% (209/215) of object questions (*who, what*) contain subjects.

The second prediction concerns the relative frequencies of NS and NO. Since both NS and NO are attributed to the Chinese grammar, we predict that the relative ratio of NS/OS will hold fairly constant across English and Chinese children in a same age group. This prediction is made as follows. Suppose that for Chinese children, NS ratio is s and NO ratio is o, and that for English children, NS ratio is s' and NO ratio is o'. Suppose further that, during the NS stage, English children access the Chinese grammar with the probability p, which leads to the NS and OS patterns in production.[17] Recall that Chinese children learn their grammar very early,

[16] The fronting of the *Wh* word in question formation, of course, is an early acquisition, as noted in section 3.1. Again, the parameter for *Wh* fronting and the subject parameter are set independently.

[17] Note that p is a variable that diminishes over time when the Chinese grammar is on its way out.

showing adult-like performance; they hence use the Chinese grammar 100% of the time. Now if we scale up p to 100%, that is, English children were to use the Chinese grammar *monolingually*, we expect their NS and OS ratios to be identical to those for Chinese children.[18] That is, $s' = sp$ and $o' = op$, which implies $s'/o' = s/o$.

The confirmation for this prediction is shown in Fig. 4.1, based on the statistics reported in Wang et al. (1992).[19] It plots the slopes of NO/NS for both Chinese and American children, which are virtually indistinguishable: the raw statistics are 20.192/55.728 = 36.2% and 8.308/25.885=32.1%, respectively.

Finally, we may add that the expletive subject elicitation study of Wang et al. (1992: 242) did succeed on American children, who alternately use null subjects (76) (as well as overt ones (77):

(76) a. It is raining. (SR: 2;8)
b. It's rain. Rain. They can't come out. (DS: 2;10)

(77) a. No snow. (SR: 2;8)
b. Snow. Raining. (DS: 2;10)

This again demonstrates the coexistence of both types of grammars.

The quantitative predictions reported here, including the categorical asymmetry in argument and adjunct questions and the relative ratio of NS/NO, is expected under the variational model of grammar competition. The model explicitly appeals to the syntactic properties of competing UG grammars given by theories of adult linguistic competence. Again, they cannot be made under performance-based theories that assume English children have an adult-like obligatory subject grammar and that null

[18] Assuming, without evidence to the contrary, that English and Chinese children are equally likely to encounter discourse situations in which NS and OS would be employed. Hence it is important to use statistics from a single study: the experimental design and counting procedure would be consistent for both American and Chinese children.

[19] We have used the statistics for American children between 2;0 and 3;0, when they are in the subject stage.

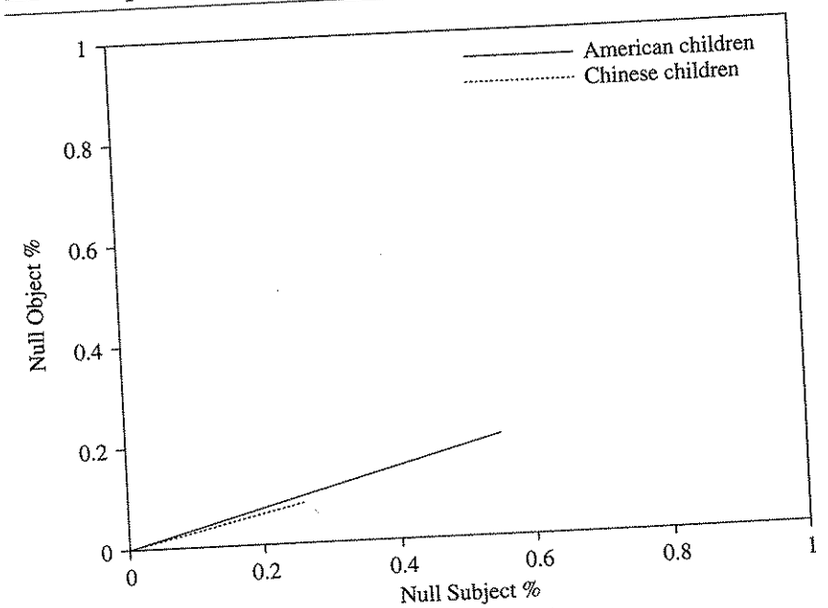

FIGURE 4.1. Chinese and English child NO/NS ratios

subjects result from performance factors that perturb the use of their grammar.[20] In addition, performance-based theories seem to be self-contradictory. If performance limitations are the cause of English child NS, why do not the same limitations affect Italian and Chinese children, resulting in NS (and NO) ratios higher than Italian and Chinese adults? In fact, it seems that Italian and Chinese children have adult-level subject usages from early on, as reviewed in section 4.3.1.

The recent optional infinitive (OI) based approach to null subject (e.g. Rizzi 1994, Sano & Hyams 1994, Hyams 1996, Wexler 1998), which holds that null subjects are licensed by non-finite root verbs, also says nothing about the quantitative findings reported. Furthermore, if the OI approach to NS were correct, it would predict that the OI stage and the NS stage should end at

[20] There is by now a large body of literature against the performance-based approach to NS; see e.g. Hyams & Wexler (1993), Roeper & Rohrbacher (1994), Bromberg & Wexler (1995), Waller (1997) and the present study.

roughly the same time. There is, however, prima facie evidence to the contrary.[21] For example, the OI stage for a Dutch child Hein (Haegeman 1995: table 4) essentially ended at 3;0 and 3;1, when his OI usage dropped to 4% and 6%. However, at 3;0 and 3;1 there were still 30% and 31% of NS sentences.

4.4 Summary

We summarize the key features and results of the variational model as applied to syntactic acquisition:

(78) a. Language acquisition can be modeled as a selectionist process in which variant grammars compete to match linguistic evidence.
b. Under the condition of explanatory continuity, the irregularity in child language and the gradualness of language development can be attributed to a probabilistic combination of multiple grammars, rather than to imperfect exercise of a single grammar.
c. Formal sufficiency and development compatibility can be simultaneously met in the variational model, for which the course of acquisition is determined by the relative compatibilities of the grammars with input data; such compatibilities, expressed in penalty probabilities, are quantifiable and empirically testable.

The variational theory offers a new interpretation of child language. The first step is the observation of non-uniformity in children's language: the deviation from the adult grammar they are acquiring. Second, we try to identify the grammars, which are not what the learner is exposed to but nevertheless are options allowed by UG (and possibly realized in the world of existing languages), and which, *collectively* with the target grammar, give a complete coverage of children's language. Third, we associate each of the competing grammars with its corresponding disconfirming evidence in the linguistic environment, i.e. input patterns that they are incompatible with. It is clear that both steps two and three are guided by linguistic theories and typology. Finally, we

[21] See Phillips (1995) for additional discussion that the correlation between OI and NS is weak.

may use naturalistic adult-to-child linguistic databases to access the penalty probabilities of the competing grammars. Quantitative predictions are then possible. The idiosyncratic properties of coexisting competing grammars will be repeated in children's language, as demonstrated in this chapter: Dutch children use Hebrew grammar, English children use Chinese grammar, etc. In future work, this procedure will be systematically applied to a wider range of topics in children's syntax.

5

The Dynamics of Language Change

> An observed linguistic change can have only one source—a change in the grammar that underlies the observed utterances.
>
> Noam Chomsky and Morris Halle, *The Sound Patterns of English* (1968), p. 249

Language is not a random object, but is governed by UG principles and constraints that are ultimately grounded in human biology.[1] If our (linguistic) ancestors had brains like ours, then UG, as we understand it through our languages, would have governed their languages as well. And if UG defines the intrinsic space of language variations—past, present, and future—then the historical process of language change cannot step out of these boundaries. Thus, UG must be placed at a central position in the explanation of language change.

Equally important to the study of language change is language acquisition, long recognized by linguists as the medium through which language change is transmitted over time (e.g. Paul 1890, Halle 1962, Chomsky & Halle 1968, Andersen 1973, Lightfoot 1979). Ultimately, language changes because learners acquire grammars that are different from that of their parents. In addition, as children become parents, their linguistic expressions constitute the acquisition evidence for the next generation. Following Battye & Roberts (1995) and others, this iterative

[1] I owe a special debt to Ian Roberts, Tony Kroch, and Ann Taylor for their scholarship on the history of French and English. The statistics used in this chapter, indispensable for the sort of modeling reported here, are taken from their works.