

## The Metrical Basis for Children's Subjectless Sentences

LOUANN GERKEN

*State University of New York at Buffalo*

Young English speakers often omit sentential subjects but infrequently omit objects. In this paper I consider five accounts for these omissions that differ in the explanation of why children make omissions (grammar versus production constraints) and what causes the asymmetry in subject and object omissions. Hyams (1986, *Language acquisition and the theory of parameters*, Dordrecht, Reidel; 1987, Paper presented at the Boston University Conference on Language Development, October) proposes that children are born with an innate grammar that causes them to omit pronominal subjects. Valian (1989, *Papers and Reports on Child Language Development*, 28, 156-163) notes that subject deletion is acceptable in casual adult English: Based on these data, children omit subjects when sentence complexity puts too great a burden on the production system. On a pragmatic account (Bates, 1976, *Language and context*. New York: Academic Press; Greenfield & Smith, 1976, *The structure of communication in early language development*. New York: Academic Press), children have limited production abilities and omit the least communicatively informative elements: Because subjects typically contain given information, they are frequently omitted. P. Bloom (1989, *Papers and Reports on Child Language Development*, 28, 57-63) argues that processing considerations cause children to expand sentences rightward, at the expense of leftward elements. Finally, I propose a metrical hypothesis in which children omit weakly stressed syllables, including pronouns and other function morphemes, particularly from iambic (weak-strong) feet. Data from an imitation task strongly support the metrical hypothesis over the others. The results are examined in light of a model of developing speech production. © 1991 Academic Press, Inc.

### INTRODUCTION

A frequent linguistic error committed by young English speakers is their failure to include many of the elements required by an adult grammar (e.g., Brown, 1973). Two general classes of explanations for these omissions have been offered: One assumes that children's utterances reflect their linguistic competence fairly directly and that children omit sentential elements because their immature grammar either does not represent these elements at all or treats them as optional. The alternative to such

competence accounts is the view that children have limits on the complexity of the utterances that they can plan and produce, and therefore they are forced to omit elements that they nevertheless may know are obligatory. One type of omission that has become the focus of debate between supporters of competence-based versus production-based theories is children's sentential subject omissions. Young children learning English often produce declarative sentences like "Bump my train" and "Want look a man." In this paper, I will consider the evidence in favor of competence and production accounts of children's subjectless sentences. I will argue that, although there is a growing body of data indicating that children's sentential subject omissions are correlated with sentential complexity, such findings do little to explain why certain sentential elements tend to be omitted while others are retained. I

This research was begun while the author was a post-doctoral fellow at the CUNY Graduate Center. I thank Tom Bever, Lois Bloom, Paul Bloom, Lissa Newport, and Ginny Valian for their helpful discussions and comments on previous drafts. Reprint requests should be sent to LouAnn Gerken, Department of Psychology, Park Hall, SUNY Buffalo, Buffalo, NY 14260.

will present new data on children's subjectless sentences indicating that these speakers omit weakly stressed syllables from iambic metrical feet. Based on these data, I will propose a production model that is able to predict the pattern of children's subject omissions as well as their omissions of other weakly stressed syllables. Finally, I will examine traditional views of production limitations and discuss how these might be changed to account for the data presented.

A competence account of children's subject omissions that has generated considerable discussion is Hyams' (1986, 1987) *pro-drop* or null subject hypothesis. Hyams' account of children's subjectless sentences is based on a parameter setting model of language acquisition (Chomsky, 1981). Briefly, parameter theory asserts that possible human languages differ from each other on a finite number of dimensions or "parameters," each parameter having a small number of values (often two). On this view, all sentences except imperatives in non-pro-drop languages such as English must contain an overt sentential subject. Conversely, speakers of pro-drop languages, such as Italian or Chinese, can omit pronominal subjects of sentences, provided that the subject can be recovered from pragmatic and/or inflectional information. Because it is not only grammatical, but conventional, for speakers of a pro-drop language to omit pronominal subjects, Chomsky (1981) has proposed that the pro-drop parameter also includes an Avoid Pronoun Principle that forces speakers to omit pronominal subjects wherever possible.

On one parameterized account, the innate default value for the pro-drop parameter is set to allow null subjects (Hyams, 1986). On this view, young English speakers omit pronominal subjects, because these are optional in the initial configuration of their grammar. Later, children who are not learning a pro-drop language discover evidence that their language is in fact non-pro-drop, and they reset their parame-

ter to bar subjectless sentences. What evidence do children use to reset their pro-drop parameter? There is clearly a logical problem with using only the presence of absence of sentential subjects in the adult language. This is because pro-drop is an optional rule, and a child might listen indefinitely to hear an adult sentence without a subject. Furthermore, English imperatives do not have subjects, and therefore might be used by children as evidence that their language does, in fact, allow subjectless sentences.

Hyams avoids these problems by arguing that the evidence children use to reset the pro-drop parameter is the presence of expletive subjects (e.g., "it" in "It is raining"). To support this claim, Hyams notes that languages like Italian, that allow null subjects, do not have expletive subjects; whereas languages like English, that do not allow null subjects, do have expletive subjects. She also notes that children begin correctly using expletive subjects at the same time that they begin consistently producing sentential subjects. Finally, Hyams notes that children begin consistently producing sentential subjects at approximately the same time at which they begin consistently producing verb inflections and modal auxiliaries. Based on this acquisition pattern, Hyams argues that the acquisition of verb agreement and auxiliaries are also linked to the pro-drop parameter. She backs this claim with further cross-linguistic data: Languages in which either all verb forms are inflected or no verb forms are inflected also allow null subjects. Whereas languages like English, in which some (e.g., third person singular) verbs are inflected and others are not, do not allow null subjects.

Several researchers have proposed other competence-based explanations of children's subjectless sentences. I will provide only a brief look at a few examples of these here, because I will argue that all competence-based accounts suffer similar problems when trying to account for the data.

Guilfoyle (1987) hypothesizes that children at the earliest stages of language learning are not able to assign tense. Therefore, they do not produce modals or verb inflections, because these are the carriers of tense information. On this account, children also fail to produce subjects, because the nominative case typically assigned to subjects in adult syntax is assigned by tense. O'Grady (1987) notes that tensed verbs, such as those in 1a and 1b, must have overt subjects in English, while nontensed verbs, such as that in the underlined portion in 1c, cannot have an overt subject. He argues that children have not acquired the distinction between tensed and untensed forms of these sentences. The difference between tensed and untensed forms is represented in the surface structure by auxiliaries and verb inflections, and when children discover the presence of these items, they are also able to determine when subjects are required and when they are barred:

- 1a. Harry left.
- 1b. Harry will leave.
- 1c. Harry tried to leave.

There are at least four problems with Hyams' (1986, 1987) explanation of English-speaking children's subjectless sentences: First, on accounts by Hyams and others (e.g., Guilfoyle, 1987; O'Grady, 1987), children change their immature grammar by noticing new information in the linguistic environment. In Hyams' account, young English speakers reset the pro-drop parameter when they notice the presence of expletive subjects. Why did children fail to notice these elements before? This is not well explained by any of the competence-based accounts of children's subjectless sentences.

The second problem with Hyams' and other competence accounts (e.g., Pierce, 1987) is that they predict that children should avoid producing pronominal subjects and produce predominantly null or lexical subject noun phrases (NPs). This is not supported by the data. Valian (1989, in

press) collected spontaneous speech from 21 American children between the ages of 22 and 32 months. She found that an average of 83% of their sentences had pronominal subjects, and even children with the lowest mean lengths of utterance (MLU: mean = 1.75 morphemes) produced pronominal subjects in 77% of their sentences. This fact flies in the face of the Avoid Pronoun Principle of the pro-drop parameter. Furthermore, children learning Italian, in which the adult grammar *does* allow subjectless sentences, produce pronominal subjects less than half as frequently as English speakers. Valian reports that five Italian children between the ages of 24 and 29 months produced pronominal subjects in only 35% of their sentences. And, while English speakers increase their frequency of overt subjects with transitive verbs as their MLU increases, Italian speakers do not. These differences in subject use between English- and Italian-speaking children suggest that their subject omissions are not based on the same underlying mechanism.

The third problem with the pro-drop hypothesis, as well as several other accounts of children's subjectless sentences (e.g., Guilfoyle, 1987; Pierce, 1987), is that the supporting data comprise elements that children fail to produce: pronominal subjects, expletive subjects, verb inflections, and modals. All of the omitted elements are members of the phonologically defined set of function morphemes (or closed class), that also includes articles and prepositions (Chomsky & Halle, 1969; Selkirk, 1984). The period during which most function morphemes appear in children's speech is relatively short; and although the order of appearance is fairly stable across children, it is by no means fixed (see Brown, 1973). Thus, children's early omission and subsequent production of the set of function morphemes appears to be a developmentally unified phenomenon. Hyams and others have chosen to explain the behavior of a subset of function morphemes without justifying why the remainder are actually dif-

ferent and therefore require a separate account.

The last point against the pro-drop hypothesis, and a problem with all competence-based accounts, is the growing body of evidence indicating that children's speech does not reflect their linguistic knowledge directly: The length of children's spontaneous and imitative utterances is short and varies within only a limited range (Brown, 1973; Brown & Fraser, 1964; Ervin, 1964). This strongly suggests that there is some length limit on children's output. Counter to this claim, Hyams (1987) argues that children occasionally produce longer utterances. However, such utterances are quite rare and may be produced with formulaic segments that constitute a single unit for the child but multiple units for the adult (Peters, 1983). It is also possible that the production limit is statistical, not absolute in nature (e.g., L. Bloom, Lightbown, & Hood, 1975; P. Bloom, 1989; Gerken, 1987a; Suppes, 1970). Another indicator that children's speech does not reflect their linguistic knowledge directly, comes from the numerous studies that have shown children comprehend more than they are able to produce (e.g., Katz, Baker, & MacNamara, 1974; Shipley, Smith, & Gleitman, 1969). Furthermore, children's phonological simplifications (including omission) are linked to the linguistic complexity (and not just the length) of the intended utterance (e.g., L. Bloom, 1970; L. Bloom, Miller & Hood, 1975; P. Bloom, 1989; Brown, 1973; deVilliers & deVilliers, 1978; Gerken, 1987a, 1987b; Gerken, Landau, & Remez, 1990; Streim & Chapman, 1987; Waterson, 1978; but see Kamhi, Catts, & Davis, 1984). At this point, there can be little doubt that children's omission, at least partially, reflect their limited abilities to plan and produce speech.

Several studies have demonstrated that children's subject omissions, in particular, are linked to sentential complexity: L. Bloom (1970; Bloom, Miller, & Hood,

1975) discovered three factors that correlated with children's omissions: syntactic complexity, lexical variation, and discourse variation. She found that children's utterances containing intransitive verbs were more likely to appear with a subject than transitive verbs. Children's affirmatives were more likely to contain subjects than the corresponding syntactic negatives. Children were also more likely to produce subjects for verbs they knew well than for recently learned verbs. And, children were more likely to omit subjects when the utterance was the first in a series of utterances than when it was later in the series. Note that this is exactly the opposite of what should be predicted if subjects are omitted when they can be recovered from context, an important aspect of the pro-drop theory. On this view, children should have introduced the subject or topic in the first utterance in a sequence and omitted it in subsequent utterances. L. Bloom argues that subsequent utterances were longer than the first, because the first utterance provided memory support for the others. More recently, P. Bloom (1989) also found that sentences with longer verb phrases (VPs) tended to be produced without subjects more often than sentences with shorter VPs. And a study of deaf children using "home sign" has also demonstrated that the likelihood of an overt subject decreased as the number of other potential constituents increased (Feldman, Goldin-Meadow, & Gleitman, 1978). Therefore, it appears that there is a complexity limitation in non-spoken languages as well. Such findings cast strong doubt on competence accounts of children's omissions and support production limitation accounts.

However, the fact that a relation exists between children's omissions and the complexity of their intended utterance, does not provide an explanation of why children tend to omit some sentential elements, such as subjects, while retaining others, such as objects, verbs, etc. We must discover the mechanism by which sentential elements

are omitted or changed as a result of sentential complexity. Several mechanisms have been suggested, either for children's function morpheme omissions in general, or for their subject omissions in particular. Valian (1989, in press) has recently proposed an explanation of children's subjectless sentences that takes into account the correlation between sentential complexity and omissions. She notes that it is acceptable for adult speakers to omit subjects in casual conversation. For example, a speaker might say "I saw Mary in the restaurant on Friday. Eats there every day." Valian argues that children who hear such sentences come to the conclusion that it is acceptable to omit subjects, but are not yet aware of the acceptability conditions.

Although Valian's *acceptability* hypothesis might appear to be similar to Hyams' pro-drop account, it avoids some of the pitfalls: First, Valian takes into account the performance data by claiming that children might use their knowledge that subjectless sentences are acceptable, to allow them to reduce sentential complexity. Second, there is no reason, on Valian's account, to assume that children are specifically omitting pronominal subjects, hence the fact that children produce numerous pronominal subjects is not a problem. Finally, unlike parameter setting accounts, Valian argues that children initially hypothesize that subject omission is acceptable based on their analysis of parental speech. Therefore, the fact that English-speaking children omit subjects less frequently than Italian children simply reflects the fact that the parents of these two groups of learners differentially omit subjects. A problem with the acceptability hypothesis is that it does not provide a general explanation for children's omissions. Parents do not typically delete modals, auxiliaries, etc. from their speech, but children do. Therefore, if it can be shown that these omissions are somehow linked to subject omissions, then Valian's hypothesis is substantially weakened.

P. Bloom (1989) discusses an omission

mechanism that is based on the notion that memory and processing constraints make it easier to elaborate a structure rightward than leftward (e.g., Bever, 1970; L. Bloom, 1970; Pinker, 1984). He further argues that there is a trade-off between the phonetic complexity of the subject and the degree to which a sentence can be expanded rightward. In support of this *rightward complexity* hypothesis, P. Bloom found in Brown's (1973) transcripts, that children produced longer VPs in sentences with null subjects than pronominal subjects and longer VPs in sentences with pronominal subjects than lexical (common or proper NP) subjects.<sup>1</sup> A problem with P. Bloom's account is that he presents no theoretical basis on which to argue that pronouns constitute less phonetic material than single syllable lexical subjects. The main segmental difference between subject pronouns and other nouns is that subject pronouns (I, you, he, she, they, we) are all open syllables (not consonant-vowel-consonant), whereas many of the single syllable nouns children know are closed syllables (e.g., Mom, dog, ball). But if closed syllables are "harder" than open syllables, then we might predict that children would omit object pronouns more frequently than subject pronouns, because the former are more likely to be closed (them, him). Although it might be possible to cre-

<sup>1</sup> A related proposal has been made by other researchers (Mazuko, Lust, Wakayama, & Snyder, 1986). They argue that rightward expansion may be preferable on general cognitive grounds, but that the syntactic factor of principle branching direction (PBD) also plays a role. These researchers present data on subject and object omissions from four young Japanese speakers (a language with the opposite PBD to English). Although they claim that their data show fewer subject omissions in Japanese than English, they found subjects in only 53% of the utterances examined. This is, in fact, approximately the same proportion found by Bloom (1989) in the Brown corpus (55%), and it is a noticeably smaller proportion than found by Valian (1989). Because their population was so small and because their results are difficult to interpret in light of their own hypotheses, I will not consider this account of subject omissions any further.

ate a more reasonable theory of a phonological difference between pronouns and lexical nouns, P. Bloom must specify one for his account to be plausible. Another problem with the rightward complexity hypothesis is that it does not account well for children's other omissions, such as articles, prepositions, modals, and auxiliaries. As noted for Valian's acceptability hypothesis, if these omissions are linked to subject omissions, P. Bloom's position is seriously weakened.

Another mechanism that has been offered, in tandem with the production limit hypothesis, to explain why children omit certain sentential elements and not others, is that young children treat some elements as more communicatively important than others (e.g., Bates, 1976; Greenfield & Smith, 1976). Children omit those elements that they deem least important, as pressure on the production system forces them to reduce the complexity of an utterance. On this *pragmatic* view, sentential subjects are omitted more frequently than elements from the VP because the former are more likely to contain given, as opposed to new, information. This position also explains why many members of the set of function morphemes are omitted in favor of the heavier meaning-bearing elements, such as nouns, verbs, and adjectives. Contrary to the pragmatic account, Hyams and Wexler (1989) point out that both subjects and objects can contain given or redundant information. They argue that, if missing subjects or objects represent occasions in which a redundant element has been deleted, then the ratio of redundant subjects to redundant objects should equal the ratio of missing subjects to missing objects. Using the Brown corpus, they created two measures of redundancy: pronouns and lexical NPs that could have been recovered from context. They found that, for both Adam and Eve, the ratio of missing subjects:objects (mean ratio = 4.16) was greater than the ratio of either pronoun subjects:objects (mean ratio = 1.73) or redundant lexical

subjects:objects (mean ratio = 2.30). Therefore, they conclude that subject omissions are not deletions of redundant or given information due to a production constraint.

A problem inherent in all of the explanations for English-speaking children's omissions outlined so far, is that they fail to capture the generality that the elements children omit tend to be weakly stressed (Allen & Hawkins, 1980; Blasdel & Jensen, 1970; Brown, 1973; DuPreez, 1974; Gerken, 1987a, 1987b; Gerken et al., 1990; Gleitman & Wanner, 1982; Pye, 1983). Not only do children tend to omit weakly stressed function morphemes, but they also omit weak syllables for multi-syllabic words (Ingram, 1986; Smith, 1973). Although lack of stress is arguably linked to a lack of communicative importance at the morphological level in English and many other languages (e.g., Zipf, 1949), it is difficult to make such a claim at the syllabic level. Therefore, just as it would be desirable to account for all of children's function morpheme omissions within a single theory, it would be still more desirable to account for their weak syllable omissions in general.

But how can a general tendency to omit weak syllables account for the asymmetry seen in children's subject versus object omissions? Both subject and object pronouns receive weak stress, and only the former are omitted. To account for these asymmetries in weak syllable omissions, I will draw on the fact that children are more likely to omit weak syllables from some positions than from others. In children's productions of two syllable words, they are much more likely to omit a weak syllable from a word-initial position than from a word-final position (Allen & Hawkins, 1980; Echols & Newport, submitted; Ingram, 1986; Smith, 1973). For example, children are more likely to reduce "giRAFFE" to "RAFFE" than they are to reduce "MONkey" to "MON". The difference between these two words is that they represent two different types of metrical

feet. A metrical foot contains one and only one strong syllable plus adjacent weak syllables. There is a bias for speakers to produce binary feet, that is, metrical feet that are two syllables in length (Hayes, 1982; Kelly, 1988). The stress pattern of "giraffe" is an iambic foot (weak-strong), while the pattern of "monkey" is a trochaic foot (strong-weak). Thus it appears that children tend to omit the weak syllables from iambic feet in their productions of two syllable words.

There is evidence that this tendency carries over into children's multiword productions as well. My colleagues and I have found that young two year olds who were asked to imitate four syllable VPs, such as "pushes the dog" were more likely to omit the article than the verb inflection (Gerken, 1987a, 1987b; Gerken et al., 1990). I have hypothesized that children divided the intended utterances into two metrical feet as part of their production planning. Applying rules 2a-c (Gerken, 1990a) to the phrase "pushes the dog" results in one trochaic foot followed by an iambic foot: PUSHes + the DOG ("+" marks divisions between metrical feet). Because the article in this experiment was always the weak syllable in an iambic foot, children omitted it more frequently than the weakly stressed verb inflection. Therefore, it appears that the same phonological processes that children show in their single words also affect their omissions at the sentence level:

- 2a. A metrical foot contains one and only one strong syllable.
- 2b. Create maximally binary left-to-right feet.
- 2c. Metrical structure is independent of syntactic structure.

If we assume, as Hyams has, that children's subjectless sentences reflect pronoun omissions, we can account for young English speakers' tendency to omit sentential subjects and retain objects on the *metrical* hypothesis I have just outlined. Sub-

ject pronouns are sentence-initial and therefore form an iambic foot with a strongly stressed verb (as in 3a). Whereas object pronouns can potentially be the weak syllable of a trochaic foot (as in 3b). The hypothesis that children omit pronominal subjects as weak syllables in iambic feet also predicts that they will omit articles more frequently from iambic feet (as in the object article in 3a and the subject article 3b) than from trochaic feet (as in the object article in 3c):

- 3a. she KISSED + the DOG
- 3b. the DOG + KISSED her
- 3c. PETE + KISSED the + DOG.

Let us now compare the pro-drop, acceptability, rightward complexity, pragmatic, and metrical accounts of children's subjectless sentences. The five hypotheses differ in the generality of their accounts, and in their response to performance data. The main advantage of the pro-drop hypothesis is that it is able to tie together a variety of cross-linguistic and language acquisition facts. It is apparently unable to account for the links that have been found between various aspects of sentence complexity and subject omissions. The acceptability, rightward complexity, pragmatic, and metrical hypothesis are consistent with this performance data, but differ in their scope of explanation. The metrical hypothesis offers a general account of children's word level and sentence level omissions. The pragmatic hypothesis attempts to account for omissions of a range of sentential elements, based on their relative lack of communicative value. Both P. Bloom's rightward complexity and Valian's acceptability hypotheses account only for children's subject omissions and are therefore the least general.

All five hypotheses can account for children's more frequent subject omissions than object omissions. On the pro-drop view, only pronominal subjects are subject to the Avoid Pronoun Principle. On the acceptability view, children note that adult

speakers delete subjects, but not objects. On the rightward complexity view, the subject is leftmost in English sentences and is therefore under the strongest pressure to reduce. On the pragmatic view, subjects are more likely to contain information already given in the conversation. And on the metrical view, pronominal subjects are typically the weak syllables of iambic feet and are therefore more frequently omitted than objects which are not as likely to appear in this metrical position.

Note that both the pro-drop and metrical hypotheses assume that children's subjectless sentences originally had pronominal subjects that were then omitted. In parameter theory, this omission is based on the Avoid Pronoun Principle, whereas on the metrical account, omission is based upon pronouns' lack of stress. Interestingly, the rightward complexity hypothesis makes the opposite prediction: Lexical subjects, because they contain more phonetic material, should be omitted more frequently than pronoun subjects (or at least equally frequently). Neither the acceptability or pragmatic hypotheses clearly predict the frequency of omission of pronoun versus lexical subjects, although both could easily be made to predict more frequent pronoun omissions: When adult speakers delete subjects, it is presumably because the information in the subject has been given elsewhere in the conversation. Because pronouns are typically employed to represent given information, they may be more likely to be omitted. Furthermore, if adults' subject deletion is partially governed by phonological considerations, then it would not be surprising to find that subjects with weakly stressed mono-syllables, such as pronouns, would be more eligible for deletion than other phonological elements (see below). In any case, the relation between pronoun and lexical subject omissions has yet to be demonstrated.

Finally, the acceptability, rightward complexity, pragmatic, and metrical hypotheses can all be made to predict that

children will omit subject articles more frequently than object articles. The acceptability hypothesis could make this prediction based on the fact that adult speakers can omit subject articles in casual speech, just as they can omit subject NPs. For example, the following question and answer seems acceptable: "Is this restaurant any good?" "Man over there seems to think so." The adult acceptability data suggest that speakers can omit sentence-initial weak syllables that can be recovered from the discourse. The rightward complexity hypothesis predicts more subject than object article omissions, because subject articles add sentential complexity on the left. The pragmatic hypothesis predicts more subject article than object article omissions, because any material in subject position is more likely to contain previously given information and is therefore less communicatively important. The metrical hypothesis predicts more subject than object article omissions, because subject articles form an iambic foot with the following noun, while object articles do not necessarily do so (see 3c above). However, the metrical hypothesis further predicts that children will omit object articles in iambic metrical feet more frequently than articles in trochaic feet. None of the other hypotheses make this prediction.

The following experiment was designed to determine if children omit pronoun or lexical subjects more frequently and to determine if children differentially omit articles from iambic versus trochaic feet.

## METHODS

### *Subjects*

Subjects in this experiment were 18 monolingual English-speaking children living either in Manhattan or in Rochester, New York. They ranged in age from 23 to 30 months, with a mean age of 27 months. Each child's MLU was calculated from the spontaneous speech produced during the



experimental session. MLUs ranged from 1.25 to 3.74, with a mean of 2.54.

### Materials

To determine whether children are more likely to omit pronominal subjects than other subject NPs, sentences were created in which subjects were either pronouns ("he" or "she"), proper nouns ("Pete" or "Jane"), or common nouns ("the bear" or "the lamb"). The two types of lexical subjects (proper and common NPs) were used to determine if phonetic complexity (in this case, length in syllables) contributed to omission. Similarly, sentences had either a pronoun ("him" or "her"), proper noun ("Pete" or "Jane"), or common noun ("the bear" or "the lamb") in object position. The combination of three different subject NPs and three different object NPs resulted in nine sentence types in total. A list of sample sentences and their metrical analyses appear in Table 1. If either "he," "Pete," or "the bear" occurred in subject position, then either "her," "Jane," or "the lamb" occurred in object position, and vice versa. Each NP occurred in subject position and object position an equal number of times. Each of the nine subject/object combinations occurred with two different verbs; thus, each child was asked to imitate 18 sentences in total. So that each verb occurred with each of the nine subject/

object combinations, nine lists of sentences were created. Each child received sentences from only a single list. The order of the 18 verbs remained constant across the lists, and a particular subject/object combination appeared once in each half of the list.

### Procedure

Children were visited in their homes by the experimenter. At the beginning of the visit, the experimenter introduced children to two puppets: a bear named "Pete" and a lamb named "Jane." The experimenter and the child played with the puppets for about 10 min before beginning the actual experiment to ensure that the child knew the name and animal type of each puppet. After this period, the experimenter asked the child if (s)he wanted to hear about some things that Pete and Jane could do. Children invariably agreed, and the experimenter read and enacted the first test sentence and asked the child to imitate it. If the child failed to attempt an imitation, the experimenter asked again, up to two more times, before moving on to the next test sentence. Children who did not imitate at least one token of each sentence type were not included in the experiment ( $n = 9$ ).

## RESULTS

Children were generally successful at imitating the target sentences; they refused to respond to only 6%. Utterances that children attempted to imitate were coded as being in one of three categories: recency responses, in which only the last word or phrase was imitated (2%), correct imitations (34%), and incorrect imitations (58%). The last category includes three types of imitation errors: NP omissions, article omissions, and substitutions. Each type is treated as a dependent variable in the analyses below. To determine if children's imitations resembled their spontaneous speech, two analyses were performed. First, a Pearson correlation coefficient was calculated from each child's spontaneous

TABLE 1  
SAMPLE SENTENCES

Sentence	Subject	Object
1. he KISSED her	Pronoun	Pronoun
2. he KISSED + JANE	Pronoun	Proper NP
3. he KISSED + the LAMB	Pronoun	Common NP
4. PETE + KISSED her	Proper NP	Pronoun
5. PETE + KISSED + JANE	Proper NP	Proper NP
6. PETE + KISSED the + LAMB	Proper NP	Common NP
7. the BEAR + KISSED her	Common NP	Pronoun
8. the BEAR + KISSED + JANE	Common NP	Proper NP
9. the BEAR + KISSED the + LAMB	Common NP	Common NP

MLU and the number of syllables omitted in the imitation task. As expected, it indicated that children with higher MLUs were less likely to make omissions in the imitation task than children with lower MLUs ( $r = .55$ ,  $df = 16$ ,  $p < .01$ ). Second, the frequencies of omissions of singular count nouns from various utterance positions were examined to determine if the omission pattern roughly matched that found in imitative speech. These data are reported below.

#### *NP Omissions*

Children omitted the entire NP significantly more frequently from subject position (19%) than from object position (0.3%;  $t_5(17) = 3.74$ ,  $p < .002$ , two-tailed;  $t_1(17) = 9.20$ ,  $p < .00001$ , two-tailed). To determine if the type of sentence to be imitated affected children's subject NP omissions, two 2-way Analyses of Variance (Subject Position  $\times$  Object Position) were performed, one by subjects and one by items. (See Table 2 and Table 4, Actual, for omission rates. The corresponding analysis was not performed on object NP omissions because only one such omission was made.) There was a significant main effect of Subject Position ( $F_5(2,34) = 14.86$ ,  $p < .00001$ ;  $F_1(2,34) = 11.23$ ,  $p < .0002$ ). A Newman-Keuls test among means ( $p < .01$ ) indicated

that subject pronouns (32%) were omitted significantly more frequently than either proper (11%) or common (13%) NP subjects. There was also a significant main effect of Object Position ( $F_5(2,34) = 6.17$ ,  $p < .006$ ;  $F_1(2,34) = 4.82$ ,  $p < .02$ ). A Newman-Keuls test ( $p < .05$ ) indicated that children omitted fewer subjects from sentences with object pronouns (11%) than from sentences with either proper (24%) or common (23%) NP objects. The interaction between Subject Position and Object Position was not significant ( $F_5(4,68) = .96$ , n.s.;  $F_1(4,68) = .69$ , n.s.).

#### *Article Omissions in Imitation*

Examining children's omissions of articles only from common NPs, there were more articles omitted from subject NPs (31%) than from object NPs (18%). This difference was marginal in a by-subjects analysis ( $t_5(17) = 1.87$ ,  $p = .07$ , two-tailed), but significant in a by-items analysis ( $t_1(17) = 2.94$ ,  $p < .01$ , two-tailed). In two sentence types with common noun objects (examples 6 & 9 in Table 1), the article is part of the trochaic foot containing the verb, while the remaining sentence type with a common noun object (example 3) has been analyzed with the article in an iambic foot with the following noun. Planned  $t$  tests revealed that children made more frequent ar-

TABLE 2  
OMISSIONS OF SUBJECT AND OBJECT NPs AND SUBJECT AND OBJECT ARTICLES

Sentence type		Omitted element			
Subject	Object	Subj NP (%)	Subj Art (%)	Obj NP (%)	Obj Art (%)
Pronoun	Pronoun	25	—	0	—
Pronoun	Proper NP	33	—	0	—
Pronoun	Common NP	39	—	0	28
Proper NP	Pronoun	6	—	3	—
Proper NP	Proper NP	14	—	0	—
Proper NP	Common NP	14	—	0	11
Common NP	Pronoun	3	39	0	—
Common NP	Proper NP	25	25	0	—
Common NP	Common NP	11	28	0	14

title omissions in sentences like example 3 than in sentences like examples 6 and 9 ( $t_S(15) = 2.45, p < .05$ , two-tailed;  $t_I(15) = 3.80, p < .002$ , two-tailed). (See Tables 2 and 4.)

#### *Test for Independence of Multiple Omissions*

The analyses of children's object article omissions have been performed on the assumption that children assign metrical structure to the sentence before they utter it and that omission of an item early in the sentence does not change the metrical structure of the remainder of the utterance. This may not, however, be the case. For example, in example 3 in Table 1, omission of the pronoun subject might result in the article becoming part of the trochaic phrase containing the verb. If this reanalysis occurs, children should make fewer object article omissions in sentences in which the subject has been omitted. To test this possibility, children's imitations of sentences like example 3 (pronoun subject—common NP object) were compared to determine if sentences with subject omissions were less likely to have object article omissions. The difference in article omissions for sentences imitated with subjects (28%) versus without (36%) subjects was not significant ( $t(30) = .047, p > .50$ ), nor was the trend in the direction predicted if children metrically re-analyzed the utterance based on previous omissions.

#### *Article Omissions in Spontaneous Speech*

An analysis of children's spontaneous speech was also performed to determine if children omitted articles more frequently from sentence-initial than from sentence-internal positions, as predicted by the metrical hypothesis. Singular count nouns in English must be preceded by an article, and therefore they provide a domain for comparing omissions from different sentential positions. Singular count nouns occurred in

children's spontaneous speech in three contexts: utterances consisting of a single NP, subjects of sentences, and sentence-internally (either as objects or as subjects of questions, e.g., "When the lady comes?"). In the first two contexts, articles, if they were used, would have to appear as the first weak syllable of the utterance. (There were utterances like "No, the blue one" in which some comment or exclamation appeared before the beginning of the main phrase or sentence. But such initial elements are typically followed by a pause or fundamental frequency resetting, and therefore were not included in the metrical structure of the phrase or sentence itself.) It was impossible to divide the sentence-internal article category into those occurring in iambic versus trochaic feet in the child's underlying representation, because it is impossible, in most cases, to guess what this representation was. For example, in the spontaneous question, "Where a lamb?," it is impossible to determine if the child intended "Where a lamb?," "Where's a lamb?," or "Where is a lamb?." In the first two, the article is in a trochaic foot with "where," but in the third, it is in an iambic foot with "lamb." Children failed to produce articles before singular count nouns in 68% of all single NPs, in 31% of all sentence-initial NPs, and in 14% of sentence-internal NPs (see Table 3). Note that the percentages of sentence-initial and sentence-internal article omissions in children's spontaneous speech are nearly identical to the percentages of sub-

TABLE 3  
ARTICLES USED BEFORE SINGULAR COUNT NOUNS  
IN CHILDREN'S SPONTANEOUS SPEECH

NP type	Single phrase utt.	Sentence-initial	Sentence-internal
Articles present	75	20	273
Total contexts	232	29	317
Percent present	32	69	86

TABLE 4  
ACTUAL AND PREDICTED OMISSIONS OF NPs AND ARTICLES

Type of element	Actual	Prediction	
		A	B
Pronoun subject (not included in correlation)	32%	32% (from actual)	32% (from actual)
Proper NP subject	11%	0%	8% (26% of 32%)
Common NP subject	13%	0%	8% (26% of 32%)
Subject article	31%	32%	24% (74% of 32%)
Pronoun object	1%	0%	0%
Proper NP object	0%	0%	0%
Common NP object	0%	0%	0%
Object article (in targets with lexical subjects)	12%	0%	8% (26% of 32%)
Object article (in targets with pronoun subjects)	28%	32%	32%
Correlation w/actual ( $df = 7$ )	1.00	.89	.96

ject article omissions (31%) and object article omissions (18%) from the imitation experiment. A  $t$  test comparing children's article omissions from single NPs and sentence-internal positions was significant ( $t(14) = 4.577, p < .0005$ ). However, due to the low number of sentence-initial singular count nouns, a  $t$ -test comparing sentence-initial and sentence-internal article omissions was not significant ( $t(10) = 0.08$  n.s.). (Only cases in which at least one utterance of each type appeared were included in the analyses.)

#### *Substitutions in Imitation*

An unexpected result was that children sometimes substituted pronouns for proper NP subjects (25%) and common NP subjects (21%). They virtually never did this in object position (3%;  $F_S(1,17) = 12.54, p < .003$ ;  $F_1(1,17) = 10.76, p < .005$ ). They never substituted a common or proper NP for either a subject or object pronoun.

#### DISCUSSION AND CONCLUSION

As shown by previous researchers (Bonde & Korte, 1983; Brown & Fraser, 1964; Fraser, Bellugi, & Brown, 1963;

Leonard, Schwartz, & Folger, 1978; Leonard, Fey, & Newhoff, 1981; Rodd & Braine, 1971; Slobin & Welsh, 1968; Smith, 1973), the imitation task resulted in utterances very similar to those seen in children's spontaneous speech. The significant negative correlation between overall omissions and MLU indicates that children with low MLUs more frequently omitted elements in the imitation task than children with high MLUs. In their imitations, as in their spontaneous speech, children omitted subjects and articles. In their imitations, as in their spontaneous speech, they omitted many more subject NPs than object NPs. And, children's imitative and spontaneous speech demonstrated virtually identical percentages of article omissions from sentence-initial versus sentence-internal positions. Thus, it appears that we are reasonably justified in generalizing the results from this research to children's spontaneous speech.

I will now consider the main findings in light of the five accounts for children's subjectless sentences outlined in the Introduction. Children omitted significantly more subject pronouns than either proper or common NP subjects. This was explicitly predicted by both Hyams' pro-drop hy-

pothesis and the metrical hypothesis, because both assume that children's subject omissions are actually pronoun omissions. The finding could also be accommodated by the acceptability and pragmatic hypotheses, as discussed in the Introduction. However, children's more frequent omission of pronoun subjects than lexical subjects directly contradicts the prediction of P. Bloom's (1989) rightward complexity hypothesis, because pronouns contain less phonetic material than common NPs.

Children omitted more subject articles than object articles. This was predicted by the rightward complexity, pragmatic, and acceptability hypotheses. The metrical hypothesis also made this prediction: Object articles in two of three sentence types (examples 6 & 9 in Table 1) occurred in trochaic feet, while all subject articles occurred in iambic feet. In contrast with the other hypotheses however, the metrical hypothesis predicted that children would omit more object articles from iambic feet (example 3 in Table 1) than from trochaic feet. This prediction was supported by the data, thereby uniquely supporting the metrical hypothesis.<sup>2</sup>

Further indirect support for the psychological reality of metrical feet in children's planning of speech comes from the fact that children omitted subjects less frequently when the object was a pronoun than when it was either a proper or common NP. This might be taken to suggest that sentences with pronoun objects are somehow less linguistically complex than sentences with lexical NP objects. What is the nature of

this complexity difference? It clearly cannot be defined in terms of length in words or syllables, because both pronouns and proper NPs constitute a single syllable and word, while common NPs constitute two syllables and words. P. Bloom's (1989) notion that pronouns are less phonetically complex than lexical NPs might appear to be supported, but his account is only relevant when pronouns and lexical NPs contain the same number of syllables. However, sentences with pronoun objects versus lexical NP objects *do* differ in metrical complexity. Note that, in Table 1, sentences with pronoun objects contain one metrical foot less than their counterparts with lexical NP objects. For example, sentence 1 contains a single foot, whereas sentences 2 and 3 contain two feet. This is because, as a weak syllable, pronoun objects cannot appear in their own foot, but must occur in the foot with the verb. Thus it appears the metrical hypothesis not only provides a mechanism by which some sentential elements are omitted when sentential complexity becomes too great, but it also provides one measure of sentence complexity itself.

To determine, in a more systematic way, how well the metrical hypothesis accounts for the data obtained in the imitation experiment, a Pearson correlation coefficient was calculated between eight actual omission rates and the corresponding rates predicted by the metrical hypothesis. The aspects of the data examined were proper NP subjects, common NP subjects, subject articles, pronoun objects, proper NP objects, common NP objects, object articles in target sentences with lexical subjects (and in trochaic feet), and object articles in target sentences with pronoun subjects (and in iambic feet). The rate of weak syllable omission in iambic feet was taken from the percentage of pronoun subject omission (32%) in the imitation experiment, therefore, pronoun subject omissions were not included in the correlation. The correlation

<sup>2</sup> Broca's aphasics have also been shown to omit more weak syllables from sentence-initial positions than from other positions (Goodglass, Fodor, & Schulhoff, 1967). It would be interesting to reanalyze their sentence-internal omissions in light of the metrical hypothesis to determine if not only sentence-initial functors are omitted more frequently, but also sentence-internal functors in iambic feet.

proved to be highly significant ( $r = .89$ ,  $df = 7$ ,  $p < .01$ ). (See Table 4, Prediction A.)

Why, on the metrical hypothesis, were any lexical NP subjects omitted at all? They are stressed, and therefore should not have been omitted. The answer may be found in the fact that children occasionally substituted pronouns for common and proper NP subjects. Because the same two animals were referred to in each of the 18 target sentences, children may have converted lexical NP subjects into pronouns at the early planning stages of production, based on the discourse rule that given information is typically referred to with a pronoun. Children's avoidance of lexical subjects is consistent with their spontaneous speech (see Table 3). The fact that an average of 23% of lexical subjects in the target sentences appeared as pronouns in children's imitations suggests that some of the omitted lexical subjects may first have been changed to pronouns and then omitted. To test this, a substitution rate of 26% was derived by dividing the number of pronoun substitutions by the number of nonomitted subjects (88%, instead of all subjects) in target sentences with lexical subjects. Thus, I will assume that 26% of all lexical subjects were replaced by pronouns in children's intended utterances. This assumption changes three aspects of the predicted data: First, multiplying the rate of pronoun subject substitution (26%) by the omission rate used in the previous correlation (32%), the predicted values for proper NP and common NP subject omissions are adjusted. Second, if children represented 26% of lexical subjects as pronouns in their intended utterances, then only 74% ( $100\% - 26\%$ ) of target sentences with common NP subjects were actually represented with articles in the intended utterance. Therefore, the predicted values for subject article omissions have also been adjusted. Finally, if 26% of lexical subjects were represented as pronouns in children's underlying representation, then the object articles in 26% of target sentences with lexical subjects were in

iambic feet and therefore subject to omission. Hence, the figure for object article omissions in target sentences with lexical subjects has been adjusted. The new predicted data appears in Table 4, Prediction B. Based on these adjusted predictions, a second Pearson correlation was calculated on the same eight actual and predicted omission rates mentioned above. Again, the percentage of pronoun subject omissions was not included in the correlation. The correlation was slightly higher than before ( $r = .96$ ,  $df = 7$ ,  $p < .01$ ). More importantly, the assumptions regarding pronoun substitution allow us to explain the nonzero omission rates for lexical subjects and object articles in target sentences with lexical subjects.

In summary, the metrical hypothesis better accounts for young English speakers' subjectless sentences than any of the other hypotheses considered here. Assuming that all subject omissions were pronoun omissions, about 92% (96% squared) of the variance in the mean proportions of eight types of omissions in the imitation experiment can be explained by this account. Furthermore, because the metrical hypothesis is also consistent with children's omissions of weak syllables from multisyllabic words, it is by far the most general account considered here.

I do not, however, wish to claim that the totality of children's omissions will be explicable within a metrical framework. Before accepting metrical processes as the sole explanation for children's omissions, we must first consider the possibility that the imitation task itself amplified metrical effects. Perhaps spontaneous speech that is produced in the context of connected discourse would demonstrate some combination of pragmatic and metrical factors.<sup>3</sup> As discussed earlier, there appears to be substantial overlap in these factors in deter-

<sup>3</sup> I thank an anonymous reviewer for pointing out this possibility.

mining acceptable deletions in adult speech (see Valian, 1989, in press). Thus, adult speakers can apparently delete those sentence-initial weak syllables that are recoverable from the conversational context. Further research needs to be done to determine the degree of similarity between adult and child omissions at both the word and sentence levels. In addition, weak stress by itself, without regard to metrical context, may also be linked to children's omission of syllabic function morphemes and weakly stressed syllables in multisyllabic words (e.g., Blasdell & Jensen, 1970; Brown, 1973; DuPreez, 1974; Gerken, 1987a, 1987b; Gerken et al., 1990; Gleitman & Wanner, 1982; Pye, 1983). Clearly the developmental relation between weak stress alone and weak stress as a metrical relation is one that needs exploring. Furthermore, children's omissions of non-syllabic morphemes are probably not linked to supra-segmental, but rather to segmental principles. For example, children who omit the third person singular verb inflection "-s" may do so because they cannot yet produce consonant clusters (Stemberger, personal communication).<sup>4</sup> In any case, the type of linguistic explanation required for children's omissions of syntactically specified elements is not necessarily syntactic, but rather may be linked to processes that occur at the word level as well.

In the remaining pages, I would like to consider potential mechanisms by which children omit pronoun subjects and articles. One possibility is that these listeners have difficulty perceiving weakly stressed syllables (e.g., Gleitman & Wanner, 1982), especially those in utterance initial positions (Echols & Newport, submitted). This

explanation fails to explain children's behavior in previous research (Gerken 1987a, 1987b; Gerken et al., 1990), and it is inadequate for the imitation data reported here. In particular, it cannot account for the fact that children omitted object articles in iambic feet more frequently than object articles in trochaic feet. Both are sentence-internal weak syllables, and therefore should both be omitted or preserved equally frequently on perceptual grounds. In fact, sentence length in syllables is actually longer for sentences with common NP subjects than for sentences with pronoun subjects. Therefore, on grounds of perceptual or general cognitive limitations, object articles should be omitted more frequently from sentences like example 9 than sentences like example 3 in Table 1. Recall that the actual data show the reverse pattern. Perhaps children fail to perceive weak syllables in iambic feet more frequently than syllables in trochaic feet. This possibility is ruled out by contrasting examples 4a and 4b, below. If children failed to perceive the initial weak syllable of the sentence "He kissed the lamb," then the metrical assignment they should give to the remainder of the sentence is the one illustrated in 4a below. Such a metrical structure would predict that, if a pronoun subject is omitted (due to perceptual failure), the object article should be preserved (because it is in a trochaic foot). Recall, however, that children in the imitation experiment were no less likely to omit object articles when pronoun subjects were omitted than when they were not. Therefore, a perceptually-based explanation of the data is not supported:

- 4a. (he) KISSED the + LAMB  
 4b. he KISSED + the LAMB.

Another possibility is that children's omissions are based on production limitations. Recall that several studies have linked children's subject omissions with sentence complexity (L. Bloom, 1970; P. Bloom, 1989; Feldman et al., 1978). Numerous other factors, such as length in syl-

<sup>4</sup> Neither weak stress nor consonant cluster reduction can explain why certain homomorphs tend to be produced earlier than others (e.g., Brown, 1973; deVilliers & deVilliers, 1978). For example, "-s" as a plural marker tends to appear in children's speech earlier than the same marker used to denote third person singular verbs.

lables (Blasdel & Jensen, 1970), length in metrical feet (the current experiment), and length in morphemes (Gerken, 1987a, 1987b; Gerken et al., 1990) have all been linked to children's omissions in general. These data strongly implicate performance limitations in omissions. What might be the nature of such limitations? One possibility is that children employ complexity-reducing rules or strategies to transform intended utterances into producible forms. Thus, on the pragmatic account of children's omissions, children employ their pragmatic knowledge to eliminate those sentential elements that provide for the listener the least new information (e.g., Bates, 1976; Greenfield & Smith, 1976). Similarly, Valian has proposed that children use the fact that subjectless sentences are acceptable in adult English, to reduce the complexity of their utterances. Another proposal is that children use a system of transformational rules ("reduction transformations," L. Bloom, 1970) to reduce the complexity of their intended utterances. A metrical version of the reduction strategy view is also possible: Children might have an optional rule that allows the omission of the first syllable of iambic feet. Such a rule also appears in some dialects of adult English; for example, "potato" produced as "tata." All of these proposals suffer from the same problem: Children must not only represent rules for producing intended utterances, but also a system of meta-rules or strategies to be invoked when the intended utterance is too complex for the production system. Thus, the system is made ultimately more complex by the addition of complexity reducing meta-rules or strategies. Furthermore, children must have extensive evaluation procedures for determining whether the intended utterance is more than they can say. These procedures must be applied before the utterance is begun; otherwise, children should omit more elements from the ends than the beginnings of utterances (for further discussion of these problems, see Weksel, 1964).

Given these considerations, it might be desirable to explain children's omissions with reference to mechanisms within the production system itself, rather than relying on meta-rules or strategies. Figure 1 illustrates one possible production system approach to the relation between children's omissions and sentential complexity; it is based on models of adult speech production. Here, information from a message level of representation is translated through several intermediate levels (e.g., semantic, syntactic, morphological, phonological) before it is realized as an articulated utterance (e.g., Dell, 1986; Garrett, 1975). At each level of representation in the production system, the child has available both rules for generating a range of structures and templates for the preferred or canonical structure at that level (see Slobin & Bever, 1982). The model I am proposing makes several assumptions: First, the child has available for a given utterance only limited processing resources. Second, using templates requires the deployment of fewer resources than does the use of rules. And third, using resources at earlier stages in the production process (closer to the message) results in fewer resources, and therefore more use of templates, at later stages (closer to articulation).

The metrical hypothesis for children's omissions fits naturally into such a production model (see Levelt, 1989, especially pp. 366-385). The model accounts for children's more frequent omission of weak syllables from iambic feet than from trochaic feet by positing a trochaic template (comprising the Foot Formation and Head Location levels of Fig. 1, see below). One possible reason for the development of such a template is that producing a weak-strong sequence is a more difficult planning or motor exercise than producing a strong-weak sequence. However, there are many languages that demonstrate mainly iambic feet, and if such a pattern is difficult to produce, these languages would be at a serious disadvantage. Alternatively, children might



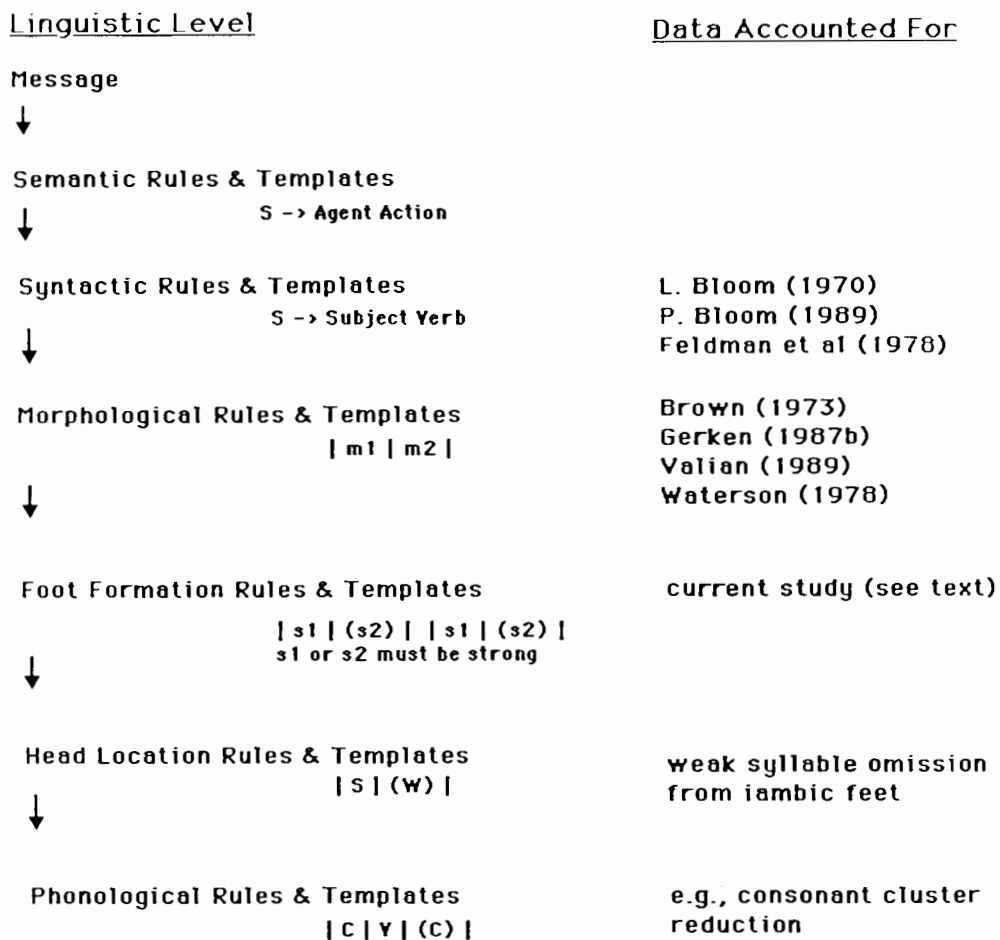


FIG. 1. Template model of speech production (lower case "m" = morpheme, lower case "s" = syllable).

develop a trochaic template based on their observation that trochaic feet are the most common foot-type in English words (e.g., Cutler & Carter, 1988; Hayes, 1982).

The model shown in Fig. 1 can account for a variety of language acquisition data: If the template at the syntactic level is for intransitive declaratives, then children should be more likely to omit weak syllables in iambic feet from syntactic negatives than from sentences that fit the template, as found by L. Bloom (1970; Bloom, Miller, & Hood, 1975). Similarly, children should be more likely to omit weak syllables from iambic feet in transitive declaratives, as found by L. Bloom (1970) and P. Bloom (1989). And if the template at the morphological level is for two or three morphemes, at the age in question (as indicated by MLU), then weak syllables in morphologically longer utterances should be omitted. This may explain Valian's (1989, in press)

finding that English-speaking children's subject use increased with increasing MLU, as well as the more general finding that the use of function morphemes increases with MLU (e.g. Brown, 1973). It is also consistent with findings that weak syllable omissions increase with the number of morphemes as opposed to number of syllables (Gerken, 1987a, 1987b; Gerken et al., 1990).

The model has separate representations for foot formation (the creation of pairs of strong and weak syllables) and head location (locating stress on the left-most syllable of a foot; see Halle & Vernaud, 1987). This accounts for two aspects of the data from the current experiment: First, it accounts for the finding that children omitted fewer weak syllables from iambic feet in target sentences containing fewer feet in total (because the foot formation template includes only two feet). Second, it accounts

for the finding that children omitted object articles from sentences like example 3 in Table 1 regardless of whether or not they had also omitted the subject. If foot formation and head location were combined (i.e., if omissions are based on an avoidance of iambic feet), omitting the subject from sentences like "He kissed the lamb" would have resulted in the metrical analysis shown in 4a above. Based on this analysis, children should not have omitted the object article when they had omitted the subject pronoun. The metrical analysis that results when foot formation occurs independently of head location appears in 4b. Subsequent application of a trochaic template should result in the omission of either the pronoun subject, object article, or both. Thus, the data from the imitation experiment can be explained only on the view that foot formation and head location occur separately.

Children's separate representation of foot formation and head location is consistent with a distinction in the literature on metrical phonology between feet as a timing unit (e.g., Giegerich, 1985) and feet as a representation of the permissible stress patterns of a language (e.g., Selkirk, 1980). Perhaps children's formation of binary feet without regard to "headedness" reflects their use of feet as a timing unit, while the application of a trochaic template reflects their knowledge that feet are left-strong in English (e.g., Hayes, 1982). An interesting question raised by this approach is whether adults also separately represent these two aspects of English meter, or whether they combine them into a single representation (Gerken, 1990b).

Finally, the model also accounts for Waterson's (1978) finding that complexity at the syntactic and morphological levels can result in poorer performance at the phonological level. Waterson found that children's production of single words was often more accurate segmentally than their production of the same words in two-word combinations. On the view I am proposing, this is because word combinations require

more resources at early stages in production than do single words. In the model shown in Fig. 1, children at the ages studied by Waterson might have a template for a single morpheme at the morphological level. Two-word utterances would place a greater demand on resources and increase the likelihood that the child will be forced to use a template at the phonological level. For example, applying a consonant-vowel syllable template might result in initial consonant cluster reduction in two-word utterances, even though the child is able to produce some clusters in single-word utterances.

The advantage of a production model approach is that the effects of complexity on children's omissions and the omissions themselves both arise from the same source: the speech production system. There is no need for a separate set of complexity-reducing rules or strategies, or a complexity evaluation metric, as in previous proposals (e.g., L. Bloom, 1970; Greenfield & Smith, 1976; Valian, 1989, in press). The production model approach also provides a more coherent developmental picture of children's utterances: Omissions and other deviations from adult-like speech decrease in frequency as additional linguistic forms have been sufficiently practiced to become alternate templates (see Bever, 1970, for a similar view of speech perception). Or perhaps, children develop additional resources, or become more efficient at allocating existing resources, resulting in reduced dependence on production templates. In contrast, on the view that children use complexity-reducing rules, children must simply abandon these rules over the course of development. (For further discussion of production models and language acquisition, see Gerken, 1990c, in press.)

Regardless of whether the production model approach is the right one, or whether this particular model holds up under further investigation, it is clear that the metrical account explains English-speaking chil-

dren's omissions in a better and more general way than previous hypotheses. The attraction of the pro-drop hypothesis is that it attempts to provide a general account for a variety of cross-linguistic and developmental facts. It would be unfortunate if gaining generality and explanatory adequacy within a particular language occurs at the expense of the search for linguistic universals. However, this may be the short-term effect of doing careful analyses of language acquisition data. The current research should not be viewed as a negative statement about the quest for universal principles in language acquisition. Rather, it adds to our understanding of the very complex relation between what children say and what they know about language.

## REFERENCES

- ALLEN, G., & HAWKINS, S. (1980). Phonological rhythm: Definition and development. In G. H. Yeni-Komshian, J. F. Kavanagh & G. A. Ferguson (Eds.), *Child phonology. Vol. 1. Production* (pp. 227-256). New York: Academic Press.
- BATES, E. (1976). *Language and context*. New York: Academic Press.
- BEVER, T. G. (1970). The cognitive basis for linguistic structures. In J. R. Hayes (Ed.), *Cognition and the development of language* (pp. 279-362). New York: Wiley.
- BLASDELL, R., & JENSEN, P. (1970). Stress and word position as determinants of imitation in first-language learners. *Journal of Speech and Hearing Research*, 13, 193-202.
- BLOOM, L. (1970). *Language development: Form and function in emerging grammars*. Cambridge, MA: MIT Press.
- BLOOM, L., LIGHTBOWN, P., & HOOD, L. (1975). Structure and variation in child language. *Monographs of the Society for Research in Child Development*, 4, No. 2.
- BLOOM, L., MILLER, P., & HOOD, L. (1975). Variation and reduction as aspects of competence in language development. *Minnesota Symposia on Child Psychology*, vol. 9 (pp. 3-55). Minneapolis: University of Minnesota Press.
- BLOOM, P. (1989). Why do children omit subjects? *Papers and Reports on Child Language Development*, 28, 57-63.
- BONDE, Z. S., & KORTE, S. (1983). Consonant clusters in children's spontaneous and imitative speech. *Phonetica*, 40, 238-246.
- BROWN, R. (1973). *A first language: The early stages*. Cambridge, MA: Harvard University Press.
- BROWN, R., & FRASER, C. (1964). The acquisition of syntax. *Monographs of the Society for Research in Child Development*, 29, 9-34.
- CHOMSKY, N. (1981). *Lectures on government and binding*. Dordrecht: Foris Publications.
- CHOMSKY, N., & HALLE, M. (1968). *The sound pattern of English*. New York: Harper & Row.
- CUTLER, A., & CARTER, D. M. (1987). The predominance of strong initial syllables in the English vocabulary. *Computer Speech and Language*, 2, 133-142.
- DELL, G. S. (1986). A spreading activation model of retrieval in sentence production. *Psychological Review*, 93, 283-321.
- DEVILLIERS, J., & DEVILLIERS, P. (1978). *Language acquisition*. Cambridge, MA: Harvard University Press.
- DU PREEZ, P. (1974). Units of information in the acquisition of language. *Language and Speech*, 17, 369-376.
- ECHOLS, C. H., & NEWPORT, E. L. (submitted). The role of stress and position in determining first words.
- ERVIN, S. (1964). Imitation and structural change in children's language. In E. H. Lenneberg (Ed.), *New directions in the study of language* (pp. 163-189). Cambridge, MA: MIT Press.
- FELDMAN, H., GOLDIN-MEADOW, S., & GLEITMAN, L. (1978). Beyond Herodotus: The creation of language by linguistically deprived deaf children. In A. Lock (Ed.), *Action, symbol, and gesture: The emergence of language* (pp. 351-414). New York: Academic Press.
- FRASER, C., BELLUGI, U., & BROWN, R. (1963). Control of grammar in imitation, comprehension, and production. *Journal of Verbal Learning and Verbal Behavior*, 2, 121-135.
- GARRETT, M. F. (1975). The analysis of sentence production. In G. Bower (Ed.), *Psychology of learning and motivation*, Vol. 9 (pp. 133-177). New York: Academic Press.
- GERKEN, L. A. (1987a). *Function morphemes in young children's speech perception and production*. Unpublished doctoral dissertation, Columbia University.
- GERKEN, L. A. (1987b). Telegraphic speaking does not imply telegraphic listening. *Papers and Reports on Child Language Development*, 26, 48-55.
- GERKEN, L. A. (1990a). A metrical account of subjectless sentences. *North East Linguistics Society*, 20.
- GERKEN, L. A. (1990b). Do adults and children have different feet? *Chicago Linguistics Society*, 26.
- GERKEN, L. A. (1990c). Performance constraints in early child language: The case of subjectless sen-

- tences. *Papers and Reports on Child Language Development*, 29, 54–61.
- GERKEN, L. A. (in press). A slip of the tongue approach to language development. In J. Charles-Luce, P. Luce, & J. R. Sawusch (Eds.), *Spoken language: Perception, production and development*. Norwood, NJ: Ablex.
- GERKEN, L. A., LANDAU, B., & REMEZ, R. E. (1990). Function morphemes in young children's speech perception and production. *Developmental Psychology*, 27, 204–216.
- GIEGERICH, H. J. (1985). *Metrical phonology and metrical structure: German and English*. Cambridge, England: Cambridge University Press.
- GLEITMAN, L., & WANNER, E. (1982). The state of the state of the art. In E. Wanner & L. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 3–48). Cambridge, England: Cambridge University Press.
- GOODGLASS, H., FODOR, I., & SCHULHOFF, C. (1967). Prosodic factors in grammar—evidence from aphasia. *Journal of Speech and Hearing Research*, 10, 5–20.
- GREENFIELD, P., & SMITH, J. (1976). *The structure of communication in early language development*. New York: Academic Press.
- GUILFOYLE, E. (1984). *The acquisition of tense and the emergence of lexical subjects*. Paper presented at the Boston University Conference on Language Development, October.
- HALLE, M., & VERNAUD, J. R. (1987). *An essay on stress*. Cambridge, MA: MIT Press.
- HAYES, B. (1982). Extrametricality and English stress. *Linguistic Inquiry*, 13, 227–276.
- HYAMS, N. (1986). *Language acquisition and the theory of parameters*. Dordrecht: Reidel.
- HYAMS (1987). *The setting of the null subject parameter: A reanalysis*. Paper presented at the Boston University Conference on Language Development, October.
- HYAMS, N., & WEXLER, K. (1989). Pro-drop: Some alternative accounts. Paper presented at the Boston University Conference on Language Development, October.
- INGRAM, D. (1986). Phonological development: production. In P. Fletcher & M. Garman (Eds.), *Language Acquisition*, (2nd ed.) (pp. 223–239). Cambridge, England: Cambridge University Press.
- KAMHI, A., CATTS, H., & DAVIS, M. (1984). Management of sentence production demands. *Journal of Speech and Hearing Research*, 42, 73–80.
- KATZ, B., BAKER, G., & MACNAMARA, J. (1974). What's in a name? On the child's acquisition of proper and common nouns. *Child Development*, 45, 269–73.
- KELLY, M. (1988). Rhythmic alternation and lexical stress differences in English. *Cognition*, 30, 107–137.
- LEONARD, L. B., SCHWARTZ, R. G., FOLGER, M. K., & WILCOX, M. J. (1978). Some aspects of child phonology in imitative and spontaneous speech. *Journal of Child Language*, 5, 403–415.
- LEONARD, L. B., FEY, M., & NEWHOFF, M. (1981). Phonological considerations in children's early imitative and spontaneous speech. *Journal of Psycholinguistic Research*, 10, 123–133.
- LEVELT, W. J. M. (1989). *Speaking*. Cambridge, MA: MIT Press.
- MAKUKO, R., LUST, B., WAKAYAMA, T., & SNYDER, W. (1986). Distinguishing effects of parameters in early syntax acquisition. *Papers and Reports on Child Language Development*, 25, 73–82.
- O'GRADY, W. (1987). *The optional subject stage*. Paper presented at the Boston University Conference on Language Development, October.
- PETERS, A. (1983). *The units of language acquisition*. Cambridge, England: Cambridge University Press.
- PIERCE, A. (1987). *Null subjects in the acquisition of French*. Paper presented at the Boston University Conference on Language Development, October.
- PINKER, S. (1984). *Language learnability and language development*. Cambridge, MA: Harvard University Press.
- PYE, C. (1983). Mayan telegraphese. *Language*, 59, 583–604.
- RODD, L. S., & BRAINE, M. D. S. (1971). Children's imitations of syntactic constructions as a measure of linguistic competence. *Journal of Verbal Learning and Verbal Behavior*, 10, 430–443.
- SELKIRK, E. O. (1980). The role of prosodic categories in English word stress. *Linguistic Inquiry*, 11, 563–605.
- SELKIRK, E. O. (1984). *Phonology and syntax*. Cambridge, MA: MIT Press.
- SHIPLEY, E., SMITH, C., & GLEITMAN, L. (1969). A study in the acquisition of language. *Language*, 45, 322–342.
- SLOBIN, D. I., & BEVER, T. G. (1982). Children use canonical sentence schemas. A crosslinguistic study of word order and inflections. *Cognition*, 12, 229–265.
- SLOBIN, D. I., & WELSH, C. A. (1973). Elicited imitation as a research tool in developmental psycholinguistics. In C. A. Ferguson & D. I. Slobin (Eds.), *Studies in child language development* (pp. 485–497). New York: Holt, Rinehart, & Winston, Inc.
- SMITH, N. V. (1973). *The acquisition of phonology*. Cambridge, England: Cambridge University Press.
- STREIM, N., & CHAPMAN, R. (1987). The effects of discourse support on the organization and production of children's utterances. *Applied Psycholinguistics*, 8, 55–66.

- SUPPES, P. (1970). Probabilistic grammars for natural languages. *Synthese*, 22, 95–116.
- VALIAN, V. V. (1989). Children's production of subjects: Competence, performance, and the null subject parameter. *Papers and Reports on Child Language Development*, 28, 156–163.
- VALIAN, V. (1990). Logical and psychological constraints on the acquisition of syntax. In L. Frazier & J. de Villiers (Eds.), *Language processing and language acquisition* (pp. 119–145). Dordrecht: Kluwer.
- VALIAN, V. (in press). Syntactic subjects in the early speech of American and Italian children. *Cognition*.
- WATERSON, N. (1978). Growth of complexity in phonological development. In N. Waterson & C. Snow (Eds.), *The development of communication* (pp. 415–442). New York: Wiley.
- WEKSEL, W. (1965). Review of Brown and Bellugi's *Acquisition of language*. *Language*, 41, 692–709.
- ZIPF, G. K. (1949). *Human behavior and the principle of least effort*. Cambridge, MA: Addison-Wesley.
- (Received August 20, 1989)  
(Revision received November 29, 1990)