# The Microstructure of Morphological Development: Variation Across Children and Across Languages

Ann M. Peters[1], Lise Menn[2]

[1]University of Hawaii
[2]University of Colorado

Institute of Cognitive Science
University of Colorado
Boulder, CO 80309

ICS Technical Report #90-19

## 1.0 INTRODUCTION

**1.1.** In this paper, we examine the detailed structure of the acquisition of some grammatical morphemes in two English corpora, and then begin the task of relating the range of individual variation in the acquisition of morphology within one language to the range of such potential variation across languages, Looking at the microstructure in this way permits us to understand some of the intricacy and variety of the patterns of early morphology, and this information in turn places important constraints on models of the acquisition of morphology. Our interest in the fine structure of acquisition is increased by the amount of attention now being paid to the development of computer models of language acquisition. Regardless of the eventual adequacy of current approaches, we see the value of this work as similar to the value of the grammar-writing approaches of twenty years ago: it forces a great explicitness of both claims and assumptions. And we suggest that data of the type we present here -- especially because of the startling range of individual differences that it reveals -- will provide important and stringent tests of the adequacy of current and future models.

We work from two central assumptions in this enterprise of building theories/models. First, we assume that observed constraints and developmental patterns must result automatically from the way the postulated mechanisms work on the data they encounter (cf. Fodor and Crain 1987, 46, for a similar idea couched in different terms). Second, we assume that the learning mechanisms (though not necessarily the grammars that they produce, as we will show) are essentially the same throughout our speaking lives. This implies that adult grammars must be describable as the end-product of our acquisition mechanism, which in turn allows us to argue that our findings about young children may be relevant to general morphological theory. We consider these implications in our conclusion.

**1.2.** The systematic longitudinal study of the acquisition of English morphology begins with the studies of Adam, Eve, and Sarah by Roger Brown and his original child language research group (e.g. Brown 1973, Cazden 1968).[1] The focus at that time was to determine an order of acquisition for common English inflections and functors, so that the linguistic and cognitive factors determining this order could be inferred. The many successors to Brown's work in English as well as other first and second languages have, to our knowledge, all maintained this focus on the "end state" of acquisition. But Brown devoted some very interesting pages (ca. p.257) to the description of his subjects' extremely unstable use of these functors and inflections before they reached his criterion of acquisition (operationally defined as 90% usage in obligatory contexts, because his subjects did not again drop below this level once they had attained it). He speculated that the variability he found might be due to the children having learned to use a morpheme in some of its contexts of use but not in others. The small sample sizes of his early sessions could certainly have provided, by chance, several instances of one context and none of another context on each occasion, leading to the observed wide fluctuations in percent of occasions when the child supplied the needed morpheme.

After so many years, our work provides a resolution for this speculation: for one of our subjects, Brown's idea is essentially correct, but for the other subject, a different explanation is required. This second explanation of early variability arises out of a careful analysis of the details of the development of schwa-like filler syllables where the adult would have an unstressed functor such as *the* or *is*. This is a transitional phenomenon noted both by Brown (211-212) and by Lois Bloom (e.g. 1970: 75, 82, 105-7, 117); our analysis clarifies the developmental complexity which underlies the variability in some children's use of these fillers and the grammatical morphemes which gradually supersede them.

## 2.0 THE DATA

The pair of case studies that we present here are a very revealing "odd couple", because the two children, both boys learning English, differ so much from one another. Two cases -- even two which contrast sharply -- is a small number to start working from. Our purpose in presenting these cases, however, is not to generalize, for obviously, no general inferences about the acquisition of morphology can be drawn in any case from work limited to children acquiring English. Rather, we wish to use them to **set constraints** on possible generalizations, reasoning that if a case of a certain type exists, then any adequate theory must be able to account for it. And if we have two very different types, an adequate theory must allow for both of them.

We have so few cases to work from because the overwhelming majority of transcriptions for children who are beyond the one-word stage is focused on syntax and provide no phonological information. (We hope the present work will demonstrate that the theoretical payoff for phonetic transcription extends well beyond the study of the acquisition of phonology.) Our first case study is based on a set of longitudinal audiotapes of his son Seth collected by Bob Wilson, working with Peters; the second is based on Menn's diary data from her younger son Daniel. The Wilson-Peters data are transcribed bi-weekly father-son conversations, here described from ages 1;7 to 2;3, with focus on 1;10 to 2;3; the Menn data are daily entries of Daniel's utterances and a few dialogs in phonetic transcription, here analyzed from ages 2;1 to 2;10, with focus on 2;3 to 2;6. While we have worked extensively with these data sets in other publications (e.g. Peters 1987; O'Grady et al. 1989; Wilson & Peters 1988; Menn 1971, 1973), we have never brought them together before.

Before looking at the details from these children, it will be useful to consider just what children need to do in order to acquire the morphological structure of their language. Crucially, they must begin at the beginning, i.e. phonetically. At first they know nothing of language structure -- of words, morphemes, distributions, or alternations -- so they are limited to the kind of information that they can extract from the acoustic signal.[2] And there is more information here than they can pay attention to all at once: pitch contour, loudness (stress), division into syllables, and presence of particular consonants or vowels, not to mention the correlation of particular sound configurations with other real-world events. On the other hand, it is possible to process some of these kinds of information rather independently. Autosegmental phonology has attempted to capture this notion by positing separate "tiers" to represent those dimensions that seem to function independently in particular languages; see, e.g. Goldsmith 1990.

Since children's processing capacities are limited they must somehow choose which aspects of the acoustic signal to focus on. For instance it has been shown that children's early attempts to segment the speech stream into meaningful linguistic units are based on information such as phonetic identity, stress, silence, or syllabicity. As they accumulate more data about the particular language they are learning, however, semantic and distributional information become more usable and children shift over to greater reliance on morphological cues. (See e.g. Mithun 1989, Peters 1985, Pye 1983.) Moreover, data on individual differences shows that not all children initially focus on the same aspects: "formulaic" children (like Seth) pay initial attention to "horizontal" information, such as number of syllables, stress and intonation patterns (with only secondary attention to particular consonants or vowels); "word" children (like Daniel) pay more attention to the "vertical" information contained in single (usually stressed) syllables, focusing on the details of their consonants and vowels (Echols 1990, Klein 1978, Peters 1983). On the other hand, although these early foci are often quite clearly identifiable, they do not prevent children's development in the other dimensions: the formulaic children eventually learn all the segments contained in the longish utterances they like to begin with; the "word" children eventually learn the intonation contours and stress patterns of longer utterances. It seems most accurate to propose that in the early stages children are faced with a selective attention problem which they solve by first focusing on only some aspects of the signal and then shifting to other aspects.

Returning now to morphology, we note that learning about this aspect of linguistic

structure is a second-order process: not only does it involve the discovery of distributional patterns, but the pieces in these patterns usually consist of some of the phonologically and semantically less-salient bits of language. Gaining command of these morphemes, then, involves learning to perceive particles that are barely there in the phonological and semantic senses but which are highly frequent, important syntactically, and participate in the rhythmic structure of the language. It seems reasonable that children will first be aware of grammatical morphemes as relatively faint, fuzzily perceived syllables or sounds of hard-to-determine meaning, which are interspersed among the more clearly perceived content words. As their control of the content words increases, semantic and distributional information will become more available and learners will be able to focus more attention on these aspects of the signal. Individual differences will be evident in that formulaic children will make gestures toward reproducing grammatical morphemes relatively earlier than word children. Thus, as researchers we need to be alerted to the possibility that, at least for some children, grammatical markers may have their origins in formulaic, context-bound phrases which over time become phonetically clearer and for which the structure becomes increasingly general and productive. Studying how these particles develop forces us to deal not only with phonological and morphosyntactic questions, but also with how development in each of these areas influences development in the other, i.e. with the **process** of development.

**2.1 SETH: The Transformation of Filler Syllables**

Seth's route into morphology can best be characterized as "sounds first, functions and meaning later" -- in other words a kind of "phonological bootstrapping" in which development of the ability to reproduce (relatively meaningless) sounds provides needed exposure to the distributional information necessary for sorting out the morphological rules. His progress is both relatively monotonic, without the drastic need for reanalysis that we will see in Daniel, and gradual, in that particular morphemes appear more and more often in the required places, with phonological accuracy slowly converging as well. Before presenting the details we must ask our readers to bear in mind the following two points:

1. Seth is visually impaired, and although his lack of access to visual information does seem to have affected certain aspects of his language acquisition (e.g. Wilson 1985, Wilson & Peters 1989, Peters 1987), as regards the process of acquisition of morphology we do not think that he is substantially different from other "formulaic" children (such as Bloom's Eric (1970) or Peter (1975) or Nelson's (1975) "pronominal" children).

2. Since comprehension/perception data was not specifically collected from Seth, our evidence is most directly about production. Of course, perception is indirectly reflected in production -- children only (re)produce what they notice (perceive). One way to triangulate on the problem of what the child perceives is to reason from the properties of the acoustic signal, but we must remember that this is fundamentally an empirical question. Luckily there are beginning to be some converging kinds of evidence, although we have space only to mention them here. One strand of research has been pursued by Gerken (1989, Gerken et al. 1990), who has found that at a stage when children are not yet producing functors, they may still be aware of their presence. In particular, she finds that when children with low MLUs are asked to imitate sentences, (a) they tend to omit functors which surround **familiar** content words, (b) they are less likely to omit them when the content words are not familiar, but (c) they do reproduce "functoids" that are phonetically similar but not identical to the functors of English. This suggests that, because of their normal lack of phonetic prominence, functors may at first seem to children like weakly specified "frames" for the major content words of sentences they hear -- frames which provide "slots" for the phonologically and semantically more prominent open-class words. A second complementary approach is that of Echols (1990), who has been using the autosegmental and underspecification theories to investigate possible consequences of children paying attention to different aspects of the acoustic signal at different times.

In our analysis we have traced Seth's ability to produce closed class morphemes across the 6-month period when he was between 1;10 and 2;3 (with data points at 2-week intervals).

We have looked at how Seth moves from filler syllables to adultlike grammatical morphemes as measured both by frequency of production where required and by phonological accuracy. It also considers the following influences on Seth's developmental progress, both separately and in interaction: frequency of occurrence, phonological salience, semantic salience, and syntactic complexity. We show that, when looked at as a developmental **process**, the acquisition of English morphology is extremely complex, even for a child whose progress is cumulative and unmarked by false starts.

Seth's attention to speech was "horizontal" in that he seems to have focussed on reproducing phrasal attributes such as intonation pattern and number of syllables. Even at the one-word stage he prefixed many of his words with "filler syllables" consisting of a vowel or nasal, as in (1):[3]

**(1) FILLERS AT SETH'S 1-WORD STAGE (1;7.3)**[4]

| NO PREFIX | VOWEL PREFIX | NASAL PREFIX |
|---|---|---|
| *tape.* | | [əŋə] *tape*? |
| | | [ŋ̍] *do(wn)*? |
| | | [ɚː] *Teddy*? |
| | [ib] *ba(ll).* | [əŋi] *ba(ll).* |
| [məˈɚ]. 'oatmeal' | [ə məˈɚ]? | |
| | [ə] *hot.* | |

During the period when Seth was between 1;7 and 1;9 his prefixes constituted at least 20% and usually over 30% of the "morphs" he produced, soaring to 37% at 1;7.3 (see the last column of Table 1, below). As he moved into productions containing two open class words he used filler syllables not only as prefixes but also in other positions, as in (2):[5]

**(2) FILLERS AT SETH'S 2-WORD STAGE**

**at 1;10.0:**

| | |
|---|---|
| [n] *fwow* [ə] *cup-* 'throw' | [əŋ gE ə] *cup*? 'get' |

**at 1;10.2**

| | |
|---|---|
| [m] *pick* [ə fawis]? 'flowers' | [n] *see* [ə] *bark*? |

**at 1;11.0**

| | |
|---|---|
| [ɚ] *talk*? | [wɚ] *talk*? |
| [m] *brush* [ə] teef? | [ə] *brush* [ə] *teef*? |
| [n tUk ə bæf]? 'take a bath' | [n] *shishi* [ĩ ə] *potty*? |

In order to give a sense of the relative importance of these fillers, as well as to offer a means of comparing Seth's progress with that of other children in the literature, Table 1 presents Seth's mean length of utterance (MLU) starting at 1;7. MLU has been calculated in three different ways: number of open-class words per utterance; number of open- plus identifiable closed-class morphs per utterance; and open- plus closed-class plus fillers. The percentage of each kind of constituent is shown in the last three columns. We see that his open-class MLU jumps from about 1.10 to 1.25 and above at 1;10 and that the percentage of unindentifiable fillers decreases steadily from then on.

**TABLE 1: MLUs FOR SETH**

| age | MLUopen class | MLUopen +closed | MLUall morphs | %open | %closed | %fillers |
|---|---|---|---|---|---|---|
| 1; 7.1 | 1.11 | 1.23 | 1.71 | 65 | 7 | 28 |
| 1; 7.2 | .92 | 1.29 | 1.69 | 54 | 22 | 24 |
| 1; 7.3 | 1.10 | 1.30 | 2.08 | 53 | 9 | 37 |
| 1; 8.0 | 1.13 | 1.38 | 1.97 | 58 | 12 | 30 |
| 1; 8.1 | 1.03 | 1.21 | 1.72 | 60 | 10 | 30 |
| 1; 8.2 | 1.16 | 1.48 | 2.12 | 54 | 15 | 31 |
| 1; 8.3 | 1.02 | 1.21 | 1.72 | 59 | 11 | 30 |
| 1; 9.0 | .98 | 1.28 | 1.64 | 60 | 18 | 22 |
| 1; 9.2 | 1.06 | 1.40 | 1.45 | 74 | 23 | 4 |
| 1;10.0 | 1.26 | 1.64 | 2.04 | 62 | 18 | 20 |
| 1;10.2 | 1.24 | 1.75 | 2.02 | 61 | 25 | 14 |
| 1;11.0 | 1.72 | 2.44 | 2.84 | 60 | 25 | 14 |
| 1;11.2 | 1.33 | 1.86 | 2.09 | 64 | 25 | 11 |
| 2; 0.0 | 1.66 | 2.12 | 2.36 | 70 | 20 | 10 |
| 2; 0.2 | 1.29 | 2.10 | 2.47 | 52 | 33 | 15 |
| 2; 1.0 | 1.44 | 2.46 | 2.85 | 51 | 35 | 14 |
| 2; 1.2 | 1.69 | 2.73 | 3.10 | 54 | 34 | 12 |
| 2; 2.0 | 1.78 | 2.94 | 3.27 | 54 | 36 | 10 |
| 2; 2.3 | 1.79 | 3.53 | 3.81 | 47 | 45 | 7 |
| 2; 3.1 | 1.66 | 3.42 | 3.62 | 46 | 49 | 6 |

**open:** open class lexical items only (no closed class or fillers)
**open + closed:** adds adult closed class (free or bound)
**all morphs:** also includes filler syllables; ages in months.weeks

The phenomenon which interests us is the development of these filler syllables (or "protomorphemes" as Cipriani et al. (1990) call them), which occur where grammatical morphemes are expected in adult speech. Seth's fillers slowly evolve from mere vocalic gestures to better and better approximations of the expected adult targets. We would like to say that they evolve from partial to full morphemes, but existing theoretical frameworks provide no means of dealing with morphemes that are "gradient" in this way. As Bates et al. (1990) ask, "What could it conceivably mean for an organism to possess half a symbol, or three quarters of a rule?" -- and, we would add, a part of a morpheme? We will return to this theme as we go along.[6] In overview, our major findings are three:

1) Distributionally, the production of fillers in each specific position begins fairly abruptly, with each such onset suggesting the point at which Seth achieves a heightened awareness of that particular distributional (syntactic) slot.
2) Phonetically, not all the fillers are vocoids. A closer look reveals distinctive phonological alternation sets for each slot. This suggests that Seth is able to make use of the phonological knowledge he has acquired about what goes where, even though it is only partial and only applied probabilistically.
3) There is a complex interaction between distributional and phonological development, with position in the sentence having an influence. For instance we find different developmental histories for prepositions as opposed to particles, or for subject vs. object pronouns.

Let us now look at the evidence for these claims.

**2.1.1** Seth's productions in different morpheme positions show rather sharp increases, usually after a precursor period in which he fills that slot only occasionally. It is possible that these

surges signal shifts from rote reproduction of sounds to more analytic awareness of slots that need to be filled, even though he may not yet be sure about just which sounds belong there.[7] Table 2 shows counts of how often Seth attempted to fill the positions of a number of adult targets and the jumps in production for almost every one. For instance, we see evidence of awareness of *it* in object position as early as 1;10. The next morpheme to surge into place is the verbal particle *on* at 2;0.2. This is immediately followed by increases in the productions of several more morphemes at 2;1.0, including copular *is*, the prepositions *in* and *on*, and fillers in the subject-of-sentence slot (although *I* and *you* are not yet reliably distinguishable). Awareness of the object pronouns *me* and *you* develops more gradually: there is a surge in the numbers produced at 2;0.2, but these 12 tokens occur in only 6 different sentences, whereas at the next session the 11 tokens occur in 8 different sentences. Finally, *it* in subject position and attempts at prepositions other than *in* and *on* (the column labeled **prep**) do not show jumps until 2;2.3.

**TABLE 2: EMERGENCE OF SOME CLOSED CLASS MORPHEMES**

| age | *it* **obj** | *me/you* **obj** | *I/you* **subj** | *is* **cop** | *it* **subj** | *on* **pt** | *on* **pp** | *in* **pp** | *in* **pt** |
|---|---|---|---|---|---|---|---|---|---|
| 1;10.0 | **42** | 3 | 1 | | | 14 | | | |
| 1;10.2 | 15 | 3 | | | | 1 | | 2 | 2 |
| 1;11.0 | **43** | 4 | 10 | 5 | 3 | 11 | | 2 | |
| 1;11.2 | 15 | 5 | 7 | 13 | 4 | 1 | 1 | 2 | |
| 2; 0.0 | 9 | 6 | 1 | | | 2 | | 5 | 1 |
| 2; 0.2 | 33 | **11** | 14 | 8 | 5 | **23** | 5 | 2 | |
| 2; 1.0 | 29 | **11** | **46** | **25** | 5 | **26** | **10** | **16** | |
| 2; 1.2 | 27 | 10 | 29 | 19 | 7 | 12 | 6 | **12** | |
| 2; 2.0 | 18 | | 15 | 21 | 4 | 8 | 1 | 6 | |
| 2; 2.3 | 32 | 1 | 28 | 22 | **9** | 6 | 3 | 4 | 1 |
| 2; 3.1 | 63 | 1 | 19 | 45 | **16** | 9 | 2 | 8 | |

Numbers are tokens. Schwa-like fillers are on the left, nasal fillers are on the right. *you* does not include *thank you*, only includes *pick ya up* once/tape. **cop** = copula, **pt** = particle, **pp** = preposition.

For almost every one of these targets we note that the initial surge in production is followed by a drop. Assuming that these numbers are not fluctuating randomly -- a possibility that we will address shortly -- one possible reason for these drops is that, after fairly concentrated attention accompanying first real awareness, attention is shifted to other parts of the developing grammar. We would like to adduce this data as support for our proposal that children struggle with the management of their attentional resources when presented with too much information to focus on all at once. On such an account, each child chooses to foreground certain kinds of information and to background other kinds. We are assuming that information that was originally in the background will eventually be raised above threshold with continued exposure. Such an account also offers one source of explanation for the observed variability in the acquisition of grammatical morphemes.

The data in Table 2 also suggests that for Seth these early "morphemes" are quite slot-specific. For instance, *it* in object position precedes *it* in subject position by nearly four months. Moreover, while both the preposition and particle *on* appear at nearly the same time, the particle *in* lags far behind its prepositional counterpart (see below for further discussion). We think it likely that at first these pairs were separate "morphemes". This implies that what for an adult is a single morpheme (such as *it* or *in*), may for a child be a <u>set</u> of not-yet-unified

"morphemes" particular to specific positions in the sentence. This is one aspect of what we mean by "partial acquisition" of a morpheme.

Let us now return to what the numbers in Table 2 can tell us about whether and to what extent Seth has "acquired" any of these target morphemes. Is it possible that his productions are merely fluctuating randomly and that we are not justified in interpreting the surges as evidence of acquisition at all? The dimension of acquisition that these numbers speak to is positionality -- the child's awareness of slots within a sentence, clause, or phrase that need to be filled with something, however fuzzy. We would be more convinced that "acquisition" really accompanied one of these surges if Seth was simultaneously improving along another dimension -- for instance if phonetic accuracy was improving at the same time. Table 3 allows us to compare for several of these morphemes (a) the ages at which surges occur (in cases where two such peaks are found, both ages are given) with (b) ages at which 70% and 80% of Seth's productions were phonetically close to adult target.[8] In order to make the developmental picture clearer, the morphemes have been rearranged by how soon after the initial surge phonetic accuracy is attained.

**TABLE 3: COMPARISON OF AGE OF EMERGENCE OF SOME GRAMMATICAL MORPHEMES WITH AGE OF APPROACHING PHONETIC TARGET**

| AGES | *it* V__# | *me/you* OBJ | *on* PT | *in* PP | *on* PP | *I/you* SUBJ | *it* V__X | *it* SUBJ |
|---|---|---|---|---|---|---|---|---|
| PEAK 1 | 1;10.0 | 1;10.2 | 2;0.2 | 2;1.0 | 2;1.0 | 2; 1.0 | 1;11.0 | 2;3.1 |
| PEAK 2 | 1;11.0 | 2; 0.2 | 2;1.0 | 2;1.2 | | | 2; 1.0 | |
| PHONETIC ACCURACY | | | | | | | | |
| **> 70%** | 1;10.0 | 1;11.0 | 2;0.2 | 2;1.0 | 2;2.3 | 1.11.2 | 2; 3.1 | --- |
| **> 80%** | 2; 1.0 | --- | 2;2.0 | 2;1.0 | 2;2.3 | 2; 3.1 | --- | --- |

For the first few morphemes in this table (utterance-final *it, me/you,* particle *on,* preposition *in*), 70% phonetic accuracy is achieved within one month of the first peak.[9] In other words, convergence between evidence for the two kinds of learning is good. For the other morphemes, none of which is utterance-final, phonetic accuracy is slower to develop. If we consider this phenomenon more closely, we realize that the utterance-internal forms of these morphemes are not pronounced so clearly in the input either. This raises a sticky question about what is the appropriate phonetic yardstick against which to measure Seth's productions: the full citation form or the range of casual forms that appear in a particular position. Since the adult speech in our transcriptions has not been transcribed phonetically, we can not do the required analysis and can only point this out as a further reason why phonetic data is required for studies of the acquisition of morphology. As for our conclusions about evidence for acquisition, while the lack of convergence between the two kinds of data in Table 3 does not increase our confidence in production peaks as indications of acquisition, it does not erode it either. Given the kinds of evidence at our disposal, we suggest two conclusions about point of acquisition. The first is that there is an interaction with position in the sentence, in that the ages of positional awareness and of attaining some level of phonetic accuracy are closer for sentence-final morphemes than for sentence-initial or sentence-internal ones. Our second conclusion is that, lacking comprehension data that would speak to the semantic development of these morphemes, we might feel reasonably confident in asserting acquisition for the sentence-final morphemes, but less so for the others.

**2.1.2** Seth's awareness of the phonological characteristics of each of these particles seems to follow a three-point developmental path from an all-purpose filler to a distinctively characteristic but still fuzzy alternation set to a more adult-like set of allomorphs. One's first impression is that his early multi-"morphemic" productions have been generated by employing a strategy characterizable as "when in doubt use schwa or a syllabic nasal". A closer look at the phonetic details, however, reveals that either his strategy is more subtle or that he actually knows more than this about what goes in each position. When we collect all the fillers that seem to be aiming at a particular adult target and look at the sets of phonetic variants that he produces in each grammatical slot, we find that these sets are in fact quite distinct from each other. The sets of phonetic variants for *in, on, I, you, me, it,* and *is* are as follows:[10]

**(3) SETH'S SETS OF PHONETIC VARIANTS FOR 7 CLOSED-CLASS MORPHEMES**

| | | |
|---|---|---|
| *in*: | ə I In Ĩ əm Un En | } both have nasals |
| *on*: | ə ɔn ən an n ŋ | } but vowels differ |
| *me*: | ə mə mI mi | |
| *I*: | ə a ai au | vowels are low |
| *you*: | ə U o u y yI y yu č̆ə j̆ə | vowels are round or high |
| *it*: | ə I It ət Et lt t CIt* | /t/ is prominent |
| *is*: | ə I dlə sə j̆ ž̆ dz č̆ š̆ s z Is Iš̆ ədz zəz Iz | |

We see here that while [mə/mI/mi] (target *me*) do indeed alternate with schwa, these particular sounds are never used for any other morpheme. Similarly, while [a/au/ai] (target *I*) also alternate with schwa, they too never occur in approximations of any other morpheme. Thus, even though Seth may use schwa as an all-purpose fallback for a number of different morphemes, there is evidence that he already partially distinguishes these targets and that he is sometimes able to make use of this partial knowledge about what sounds belong where.[11]

**2.1.3** If the process of acquisition of these morphemes does indeed involve the simultaneous development of partial knowledge along a number of fronts (distributional, phonetic, syntactic, semantic), including the eventual correlation of all this information, then we need to ask whether there is any evidence of interactions between these kinds of knowledge. For instance, might the specific sets of phonetic variants that Seth produces be influenced by his developing knowledge of the syntactic categories of the open class words they appear with? I.e. does he phonetically distinguish the protomorphemes that he inserts before or after words of different categories? Relevant data is presented in (4).[12]

**(4) PHONOLOGICAL SHAPES OF CLOSED CLASS MORPHEMES BY SLOT**

**a. after verbs**

| | |
|---|---|
| *me*: | mə mI mi |
| *you*: | u y yI yə yu č̆ə j̆ə |
| *it*: | I l dl t ət əč̆ CIt Et lt It |
| indeterminate: | ə E n æ |

**b. before verbs**

| | |
|---|---|
| *I*: | a ai au |
| *you*: | U o u əw y yI yə yu č̆ə |
| *it* | e yI I z Is Et t CIt It |
| COMP*to* | Cə tə tu |
| *want*(AUX) | n ŋ ə̃ õ əŋ on wə wə̃ wə̆ wn wən wan |
| | nə əŋə ə̃nə ə̆ta wənə wanta |
| indeterminate: | ə E n ə̃ |

**c. before nouns**

*the* də dE tə zə Cə lə dl di ðə
*a*/indeterminate: ə̃ u I ɜ̃
*in*: I Ĭ In Un En lIn In
*on*: ɜ̃ lan an ɔn
indeterminate: ə ɜ̃ əm ən

**d. between N and PRED.COMP**

*is* ə I dlə sə j̆ z̆ dz c̆ s̆ s z Is̆ Is ədz zəz Iz

Looking at the post-verbal slot, we see that while [mə/ml/mi] (target *me*) do alternate with schwa in this position, these sounds never appear in any other slot. Similarly, while [a/au/ai] (target *I*) alternate with schwa in the pre-verbal slot, they never occur, for example, before nouns, while the set of approximations for *the* appears only before nouns but not before verbs. This supports the possibility of an interaction between Seth's phonological and distributional knowledge. We also see that the alternation sets for *you* and *it* vary somewhat depending on whether they occur before or after verbs, providing further evidence that at first the pre-verbal and post-verbal forms are separate morphemes for Seth.

Now let us add the dimension of time and consider the developmental trajectories of some of these morphemes. How do they approach their phonetic targets over the 6-months period under study? Table 4 summarizes this information for *I*, *you*, and *me*, showing for each sample how many times Seth tries to produce each form in two slots: preverbal (i.e. in subject position) and postverbal (in object position). It also shows what proportion of his attempts were close to their adult targets.[13]

**TABLE 4: PHONOLOGICAL DEVELOPMENT FOR I/you/me**

| | preverbal | | | | postverbal | | | |
|---|---|---|---|---|---|---|---|---|
| **age** | | *I* | *you* | close (%) | | *me* | *you* | close (%) |
| 1;10.0 | 1 | | | 0/ 1 ( 0) | 2 | - | 7 | 7/ 9 ( 78) |
| 1;10.2 | - | - | - | - | 11 | 2 | 8 | 10/21 ( 48) |
| 1;11.0 | 4 | 1 | 6 | 7/11 (64) | - | 1 | 5 | 6/ 6 (100) |
| 1;11.2 | 2 | - | 5 | 5/ 7 (71) | - | - | - | - |
| 2; 0.0 | 3 | - | - | 0/ 3 ( 0) | - | 3 | 3 | 6/ 6 (100) |
| 2; 0.2 | 9 | 2 | 3 | 5/14 (36) | 3 | 6 | 8 | 14/17 ( 82) |
| 2; 1.0 | 31 | 3 | 12 | 15/46 (33) | 2 | 4 | 5 | 9/11 ( 82) |
| 2; 1.2 | 12 | 8 | 9 | 17/29 (59) | 1 | 4 | 5 | 9/10 ( 90) |
| 2; 2.0 | 12 | - | 3 | 3/15 (20) | - | - | - | - |
| 2; 2.3 | 10 | 8 | 10 | 18/28 (64) | - | - | 4 | 4/ 4 (100) |
| 2; 3.1 | 2 | 7 | 9 | 16/18 (89) | - | - | 1 | 1/ 1 (100) |

In the subject-of-verb slot we see that, after the initial surge in numbers at 2;1.0, most of which were schwas, Seth approximates *I* fairly well. He begins to hit *you* more reliably in the last two samples. As for Seth's pronunciations of *me* and *you* in the object-of-verb slot, *me* was closer to target than *you*, probably reflecting the variability of pronunciation of the latter in the input, where we find, at a minimum: [yu, yə, y, j̆u, j̆ə, cu, c̆ə].

The notion that Seth is sensitive to position in the sentence is supported if we compare how the "same" target morpheme develops in different positions in the sentence. We have just seen the data for *you*. We also find differences for *it* and for prepositions as opposed to particles. Table 5 summarizes the development of *it* in three different positions, both in terms of numbers of occurrences and how accurate these are (percentages are in parentheses).

**TABLE 5: TOKENS (%) OF PRODUCTIONS OF it ON PHONETIC TARGET**

| age | /__V | /V__X | /V__# |
|---|---|---|---|
| 1;10.0 | -/- (---) | 3/ 8 (38%) | 31/35 (89%) |
| 1;10.2 | -/- (---) | 0/ 1 ( 0) | 10/14 (71%) |
| 1;11.0 | 0/3 ( 0) | 0/11 ( 0) | 25/35 (71%) |
| 1;11.2 | 0/4 ( 0) | 1/ 4 (25%) | 6/18 (33%) |
| 2; 0.0 | -/- (---) | 0/ 2 ( 0) | 2/ 7 (29%) |
| 2; 0.2 | 3/5 (60%) | 2/ 7 (29%) | 25/26 (96%) |
| 2; 1.0 | 2/5 (40%) | 1/12 ( 8%) | 14/16 (88%) |
| 2; 1.2 | 3/7 (43%) | 4/10 (40%) | 36/46 (78%) |
| 2; 2.0 | 0/4 ( 0) | 0/ 5 ( 0) | 10/13 (77%) |
| 2; 2.3 | 2/9 (22%) | 4/13 (31%) | 19/20 (95%) |
| 2; 3.1 | 10/16 (62%) | 15/21 (71%) | 42/42 (100%) |

Here we see that, both in terms of sheer numbers and in phonetic accuracy, *it* develops most quickly at the ends of sentences (as in: "Wan' drink it; Didja drop it; Can open it; [ɚwə] go get it."). The slowest development is in subject position (preceding verbs, as in: "It's a tape; There it goes; Where'd it go?"). Here there are no instances until 1;11.0, and *it* remains infrequent until 2;3.1. The development in post-verbal but non-final position (as in: "Turn it on; Put it there; Take it off.") is only a little faster than in subject position and not much more accurate. There are probably two reasons for these different developments. On the one hand, since child-talk tends to be about animate agents acting on inanimate objects, one would expect *I* and *you* to occur more often as subjects, and *it* to occur more often as object of a transitive verb. (We have already seen the complementary picture for *I* and *you* in Table 4.) On the other hand, the end of the sentence is an acoustically salient position, since information about the sounds contained in a sentence-final word is not so apt to be obscured by what comes next. While this developmental picture is not surprising, since it reflects the way people naturally talk, we are not aware that it has ever been noted before in the context of the simultaneous kinds of work children need to do as they sort out how language works.

**2.1.4** As a final integrative example illustrating the ways in which different kinds of development may be intertwined, we will trace Seth's progress with the preposition/particle pairs *in* and *on*. **A priori**, particles and prepositions have different properties that might be expected to affect their ease of acquisition. Tomasello (1987) points out that, syntactically, particles are less complex than prepositions, which require nominal objects; and that semantically, particles are verblike and refer to activities, whereas prepositions are relational and link pairs of nouns. Finally, particles tend to be more phonologically salient than prepositions since they tend to occur sentence finally, and they carry some stress (as opposed to sentence-internal, unstressed prepositions). They can even be used in isolation to request activities (especially *up* and *down*). Thus, whenever in the adult language a preposition has a corresponding verbal particle, these properties suggest the two predictions in (5) about the relative course of acquisition of the two kinds of forms:

(5.1) A child will begin producing **sentence-final particles** ("put your shoes on") before either **sentence-internal particles** ("put on your shoes") or the corresponding **prepositions** ("put the cup on the table").

(5.2) Once a particle has been acquired in the phonologically more salient sentence-final position, it will serve as a bootstrap, alerting the child to the presence of sentence-internal particles and prepositions. Therefore individual members of the class of prepositions will be acquired in roughly the same **order** as their corresponding particles, only later.

How well are these predictions supported? Tomasello (1987) provides confirming evidence: in his daughter's speech particles appeared earlier than prepositions. On the other hand, if we look at Brown's Adam and Eve by taking a sample of three tapes each, in MLU ranges similar to Tomasello's,[14] we find that our predictions do not hold for the development of either *in* or *on*. In fact, as Table 6 shows, Eve almost never uses either form as a particle.

**TABLE 6. THE EMERGENCE OF THE PARTICLES AND PREPOSITIONS in AND on FOR ADAM AND EVE**

| ADAM | | in-PART | | | in-PREP | | | | on-PART | | | on-PREP | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | tape | Ø | *in* | IM | Ø | ə | *in* | IM | Ø | *on* | IM | Ø | ə | *on* | IM |
| 2; 3.4 | (01) | 5 | | | 7 | | 9 | 3 | | 4 | | 16 | | 2 | 1 |
| 2; 8.0 | (11) | 4 | | | 8 | 1 | 22 | 2 | | 17 | | 6 | 1 | 3 | |
| 2;11.11 | (17) | 6 | 3 | | 8 | 1 | 17 | | 1 | 8 | | 1 | | 17 | |

| EVE | | in-PART | | | in-PREP | | | | on-PART | | | on-PREP | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | tape | Ø | *in* | IM | Ø | ə | *in* | IM | Ø | *on* | IM | Ø | ə | *on* | IM |
| 1; 6.2 | (01) | | | | 2 | | | | | | | 13 | 7 | 1 | 1 |
| 1; 8.1 | (05) | | | | 19 | 1 | | 2 | | | | 20 | | 5 | 2 |
| 1;10.3 | (10) | 1 | 1 | | 1 | | 34 | 2 | | 1 | | 3 | | 29 | |

0 = zero form in obligatory context ə = schwa or other filler syllable
IM: produced as an imitation

**What path does Seth follow? Table 7 shows how *in* and *on* developed in his speech between 1;9 and 2;3.**

**TABLE 7. THE EMERGENCE OF THE PARTICLES AND PREPOSITIONS in AND on FOR SETH**

| | in-PART | | | in-PREP | | | | | on-PART | | | | on-PREP | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | Ø | ə | En | In | Ø | ə | n | In | # | Ø | ə | ə̃ | on | Ø | ə | n | on |
| 1;10.0 | | | | | | | | | | | | | | 1 | | 1 | 13 |
| 1;10.2 | | | 2 | | 2 | 1 | 1 | | | | | | | 1 | | 1 | |
| 1;11.0 | | | | | 1 | | 1 | 1 | | | | 6+1* | 4 | | | | |
| 1;11.2 | | | | | 5 | | 2 | | | 1 | | | | | 1 | | |
| 2; 0.0 | | 1 | | | 1 | 1 | 2* | 2* | | | | 2 | | | | | |
| 2; 0.2 | | | | | 1 | 1 | 1 | | | 1 | 4 | 7 | **11** | | | 3 | 2 |
| 2; 1.0 | | | | | 1 | 1 | 1* | **11+3*** | 1 | 1 | | 6 | **20** | 1 | **2** | **5** | **3** |
| 2; 1.2 | | | | | 1 | 3 | | **9** | 2 | | | 3 | 9 | | 2 | 2 | 2 |
| 2; 2.0 | | | | | 2 | 1 | | 5 | | | | | 8 | 1 | 1 | | |
| 2; 2.3 | | | 1 | | | | 2 | 2 | | | | | 6 | | | | 3 |
| 2; 3.1 | | | | | | | | 8 | | | | | 9 | | | | 2 |

0 = zero form in obligatory context ə = schwa other or lone vowel
n = nasal only
# = *in* for *on*, or indistinguishable * in story or song

For him, *on*-PART edges out *in*-PREP at 2;0.2. These two forms are much more robust (both articulatorily and in frequency) than *on*-PREP, which also begins to show up with some reliability at about this time (2;1.0). On the other hand, *in*-PART barely appears at all. Why is this particle so late? Why doesn't the acquisition of *on*-PART (as measured by its early and frequent production) give *on*-PREP more of an advantage? (The prepositions appear in the order *in* first, *on* second.) If we compare these results with our predictions in (5), we obtain the mixed picture shown in Table 8.

**TABLE 8: ACTUAL ACQUISITION ORDERS FOR in AND on**

| | PREDICTED | TOMASELLO | SETH | ADAM | EVE |
|---|---|---|---|---|---|
| **on**-PART | 1 | 1 | 1 | 3 | 3 |
| **in** -PART | 1 | 1 | 4 | 4 | 3 |
| **on**-PREP | 3 | 3 | 2 | 1 | 1 |
| **in** -PREP | 3 | 3 | 2 | 2 | 2 |

Perhaps our predictions have not taken enough factors into account. We have been implicitly assuming that "other things were equal" -- in particular, that the frequencies of these forms in the input are either equal or make no difference to the order of acquisition. Are input frequencies a negligible influence on order of acquisition as proposed by Brown (1973)? Table 9 shows the numbers of occurrences of these four constructions in the adult speech to Seth in the same transcripts.

**TABLE 9: PARTICLES AND PREPOSITIONS IN INPUT TO SETH**

| | **in-PART** | | | | **in-PREP** | | | | **on-PART** | | | | **on-PREP** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | o | st | t | S | o | st | t | S | o | st | t | S | o | st | t |
| 1; 8.2 | 1 | 3 | | | 2 | | | 1 | 10 | 1 | | | 8 | | | |
| 1; 9.0 | | | | | 4 | | | | 2 | | | | 6 | | | |
| 1; 9.2 | | | | | 11 | | | | 13 | | | | 1 | | | |
| 1;10.0 | 1 | | | | 3 | | | | 12 | | | | 11 | | | |
| 1;10.2 | | 1 | | | 7 | | | | 9 | | | | 5 | 2 | | |
| 1;11.0 | 2 | | | | 26 | | 1 | | 17 | | 1 | | 10 | | 2 | |
| 1;11.2 | 1 | | | | 13 | | | | 3 | | | | 6 | | | |
| 2; 0.0 | 1 | | | | 9 | | 7 | | 4 | | | | 2 | | 3 | |
| 2; 0.2 | 1 | | | | 7 | | 1 | | 9 | | | | 7 | | | |
| 2; 1.0 | 1 | | | | 21 | | 5 | | 16 | | | | 13 | | 1 | |
| 2; 1.2* | | | | | 36 | | 1 | 2 | 22 | | | | 22 | | | |
| 2; 2.0 | | | | | 18 | | 1 | | 2 | | | | 15 | | | |
| 2; 2.3 | | | | | 8 | | | 1 | 4 | | | | 4 | | 1 | |
| 2; 3.1 | | | | | 15 | | | 1 | 10 | | | | 7 | | | |

S: to Seth
o: to other persons
st: in story-retelling game
t: to tape recorder
* 1 hour (other transcripts are 1/2 hour)

The rank ordering of these input frequencies looks very much like Seth's acquisition order: a near tie between *in*-PREP and *on*-PART, followed by *on*-PREP, with only a few instances of *in*-PART. Perhaps we have found the reason for Seth's delay in acquiring *in*-PART: what he does not hear often enough he can not learn. But input frequency alone is not sufficient to explain why Seth produces *on*-PART more than *in*-PREP, or why the *on*-PART should appear ahead of its prepositional counterpart.

So far in this analysis, increase in frequency of production in the different distributional slots has been our index of "acquisition". How well does this measure

correspond with Seth's growing phonological knowledge about these two targets? Looking at Table 7 more closely, we can see that his productions of *in*-PREP are quite close to target by 2;1.0, although there is some regression at 2;1.2. At 2;3.1 they are adultlike.[15] He does next best with *on*-PART, for which 70% (16/23) are on target by 2;1.2; from 2;2.0 he is hitting the mark. *on*-PREP takes longer: at 2;1.0 only 27% (3/11) are on target; from 2;2.3 the few tokens are adultlike. Last to develop is *in*-PART, for which there are too few instances to say anything definitive about its phonological development during the period under consideration. (This information is summarized in Table 11.) We suggest that because of differences in acoustic salience of different positions in the sentence, the phonological characteristics of even highly frequent forms are not necessarily acquired quickly.[16]

Before summarizing further, let us first look at the input for Adam and Eve. Table 10 shows that, in contrast with Seth, they use both prepositions much more frequently than their corresponding particles.

**TABLE 10: PARTICLES AND PREPOSITIONS IN INPUT TO ADAM AND EVE**

| **ADAM** | | **in-PART** | **in-PREP** | **on-PART** | **on-PREP** |
|---|---|---|---|---|---|
| age | tape | | | | |
| 2; 3. 4 | (01) | 0 | 18 | 6 | 15 |
| 2; 8. 0 | (11) | 3 | 27 | 5 | 10 |
| 2;11.11 | (17) | 7 | 26 | 7 | 20 |

| **EVE** | | **in-PART** | **in-PREP** | **on-PART** | | **on-PREP** | |
|---|---|---|---|---|---|---|---|
| | | | | *go/cmon* | | | **book** |
| age | tape | | | | | | |
| 1; 6. 2 | (01) | 3 | 27 | 4 | 1 | 31 | |
| 1; 8. 1 | (05) | 3 | 45 | 2 | 4 | 28 | 7 |
| 1;10. 3 | (10) | 1 | 35 | 2 | 1 | 15 | 3 |

**book**: while reading book *go/cmon*: in phrases "go on/come on"

These results help explain the paucity of particles in the productions of these two children. If we now compare, for all three children, orders of acquisition with frequency in the input, as in Table 11, we see that there is quite a good match.

**TABLE 11: INPUT AND ACQUISITON ORDERS FOR in AND on**

| | **SETH** | | | **ADAM** | | **EVE** | |
|---|---|---|---|---|---|---|---|
| | input | produce | phonetic | input | acq.order | input | acq.order |
| **on**-PART | 1 | 1 | 2 | 3 | 3 | 3 | 3 |
| **in** -PART | 4 | 4 | 4 | 4 | 4 | 4 | 3 |
| **on**-PREP | 3 | 2 | 3 | 2 | 1 | 2 | 1 |
| **in** -PREP | 1 | 2 | 1 | 1 | 2 | 1 | 2 |

We conclude that explanations of the order of acquisition of grammatical morphemes such as these will have to take into account the simultaneous interaction of various kinds of salience (acoustic, functional, semantic, input frequency). On the basis of these findings we can now revise our predictions in (5) as follows:

(6.1) A child will first produce forms that are both more salient and highly frequent in the input (Seth's particle *on*), followed by those that are highly frequent in the input but low in salience (all three children's prepositions *in* and *on*). Those that are very low in frequency will appear last (Seth's particle *in*, Adam and Eve's particles).

(6.2) To the extent that a morpheme has positional variants which differ in salience (either phonologically or due to higher input frequency), the more salient form may serve as a bootstrap, alerting the child to the presence of the other variants.

Seth's case, then, illustrates how the acquisition of morphology can begin through a kind of "phonological bootstrapping". We saw how such an approach may be necessitated by a child's difficulties in managing attentional resources when faced with too much information to process all at once. The strategy is one of "divide and conquer", starting with the most accessible information first, which for Seth is "horizontal" acoustic characteristics of the speech stream. As learning proceeds, his ability to cope with this information expands, allowing him to shift to less immediately accessible kinds of information (syntax, semantics). This picture of the simultaneous development of partial knowledge along a number of fronts, also provides a preliminary answer to the question: What does "partial acquisition of a morpheme" mean?

## 2.2 DANIEL: A Dead End and a Fresh Start

Menn's son Daniel also had what might be considered an initially phonological approach to what is in fact a morphological phenomenon, but his story is different from Seth's at every turn, and this is not just due to the fact that our focus here is on bound grammatical morphemes rather than free functors, as will become evident. In Daniel's case, his attempt at "phonological bootstrapping" was a failure; he made a "hypothesis" about word-final sibilants which had to be scrapped entirely before he could acquire English. Furthermore, he apparently engaged in incorrect rule-making several times.

Diary materials for Daniel are available from the onset of speech at 1:4 to age 2:10. He was a fairly late talker, the younger of two brothers, and his parents were both graduate students during the period of study. Diary entries were written down on the spot in phonetic transcription, and were annotated for meaning and context; entries were made almost daily. The phenomena under investigation occurred during the months from age 2:0 (MLU/words still 1.0) to age 2:10 (most sentences 4 to 5 words long). At 2:0, Daniel's lexicon contained about 250 words, and about 10 two-word utterances had been recorded.

By 2:1;7, Daniel was using a phonologically conditioned rule that added [s ~ z] -- hereafter symbolized as Z -- to the end of non-reduplicated two-syllable words which ended in /ɪ/, or had medial coronals and ended in /i/, and variably to other two-syllable words and to monosyllables of the shape /XVɪ/, where V was [-low]. The Z appeared on these words whether or not they were plural, possessive, or in the context to take a following contracted auxiliary or copula. This highly idiosyncratic rule, which we call the "*-ɪs* rule", seemed to derive partly from the frequent appearance in the input language of a number of words of rather similar shape whose Z-marked forms were very frequent, especially the plurals *berries* and *pears,* and the possessives *Peter's* and *Barbara's.* Examples are:

2:0;24 [bɛiz] 'berry, berries' (Blueberries were in season)

2:0;24 [bʌɪs] 'butter'

2:0;26 [ɔɛɪs] 'water'

2:1;3 [döis] 'dirty'

These were followed by an avalanche of similar forms; e.g.,

2:1;8 [dæis] 'Daddy, Daddy's'

This rule was highly productive and applied immediately to new words that are in the core of its domain (two-syllable, with medial coronal, ending in /ɪ/ or /i/), and more slowly to many bisyllables on its periphery. At its high point, just before it started to break down at 2:3;0, about 45 words with the extraneous [s] or [z] were attested, and seven more words were newly attested in the three weeks after the start of the breakdown. (For a more detailed account of this rule, see Menn & Matthei 1990.)

The absence of a morphological marker for the possessive and the plural was a linguistic matter, not a cognitive one, since Daniel had cognitive control of both notions (as one would expect in a normal two-year-old!) and had attempted to express them verbally, as follows:

2:0;23 [urs] 'yours' (to designate objects belonging to himself)
2:1;1 *Mommy, mommy* (excited, with gestures, indicating LM and a 'mommy' doll in a family set)
2:1;20 [bi, bi] (excited, with gestures, indicating two frisbees)

At this stage, Daniel demonstrably still failed to comprehend the plural morpheme: at 2:2;19, adult requests for *car* or *cars* got apparently random response. Imitation and production data give further evidence for absence of control of genuine plural:

2:2;19 [kar], [karz] (both used interchangeably to refer to one or many cars.)
2:2;21 [par ak] 'pair of socks' (imitation)

Similar data are available to show limited or no control of the possessive. There were six uses of names of owners with reference to objects possessed. (Only names which did not fall into the domain of the *-rs* rule can be considered, of course.) Two of these uses plus an imitation were correct:

2:0;22 [ɛiks] 'Erik's'
2:1;23 [tiz] 'Steve's/Stevie's' (contrasting with [ti], subject or vocative)
2:2;15 [baps kar] 'Grandpop's car' (imitation)

But then the apparent possessive marker disappears:

2:2;18 [bap] 'Grandpop's'
2:2;22 [bab kar] 'Bob's car'
2:2;27 [ɔrts ti] 'shorts [belonging to] Stevie'

We then see a dramatic fresh start on the plural and possessive morphemes at two years and three months: the onset of contrastive use of both the plural and the possessive morpheme was essentially simultaneous with the beginning of the breakdown of the phonological rule. Inaugurating this fresh start, four core-domain words (*Danny, Benny, pony, Granny*) showed imitations and self-corrections without the Z on 2:3;0. The next day, *Daddy,* a very common word in the core of the rule domain, began to be produced spontaneously without the extraneous Z; and a day later, a new word in the domain, *dinner,* was attested as [gɪr], without the Z ever appearing on it.

However, the *-rs* rule crumbled slowly; as mentioned, a handful of new attests cropped up during the next three weeks (until 2:3;22). It was still found at 2:4;0 on seven established words (*butter, gerbil, heavy, pillow, cereal, pacifier, water*) -- and the last three of these, which were very frequent items, still had the Z at 2:5;0.

Morphological plural marking began to show contrastive use on a few words, beginning with *car,* from 2:3;3 to 2:3;15, and it was generally used appropriately after that time. (Data for the affixes are taken from words not subject to the *-rs* rule.) The onset appeared to be fairly general, given the limitations of sampling density:

2:3;3 correct use for both sg. and pl. of 'car'
2:3;5 correct pl. of *book*; 2:3;8, correct sg. of *book*

2:3;12 correct sg. of *truck*; 2:3;16, correct pl. of *truck*

However, the expected plural was absent from *done hand* (i.e. 'done cutting nails') at 2:3;15.

After this point, the plural appeared wherever it was needed for a month and a half; then, surprisingly, some errors started to show up around 2:5. At 2:5 we also see overgeneralization, and therefore can demonstrate its productivity in 2:5-2:6:

2:5;25 [ɹz, ɹzəz] 'scissors'
2:5;29 *b(l)ue (s)ocks*

By contrast:

2:5;29 *both blue car*
2:6;0 *black* (one black block)
2:6;0 *two blacks* (looking for second black block)
2:6;0 *lots sticks out*

However, starting at about 2;5, Daniel omitted some needed plurals: *sleeve down, two prune, two ball*; note also *both blue car,* above. Some weeks later, from 2:6;15 to 2:7;0, he had become quite systematic about these omissions: he was omitting the plurals after numerals and some quantifiers (also one adjective) in non-imitated utterances. The pattern appeared to be a clean rule for about a week starting 2:6;18 -- but the omissions were always correctable in imitation, and the last item for 2:6;23 (*two eyes*) shows the correct rule being re-internalized. Overgeneralizations (*mans*) continued during this period; see Table 12.

**TABLE 12: DISTRIBUTION OF PLURALS**

| | **post-modifier** | **unmodified** (except 'both') |
|---|---|---|
| 2:6;17 | | Cars in kitchen, mommy? |
| 2:6;18 | two, two, two<br>(L: Two what, Danny?)<br>[ʊn:o]<br>(L. Two windows.)<br>[ʊn:oz] | |
| 2:6;18 | two window | [wivi] hold hands |
| 2:6;18 | more truck | |
| 2:6;21 | two car, red car (There were two cars, both red.) | |
| 2:6;21 | | (l)adies no beard ('Ladies don't have ...') |
| 2:6;23 | four mats (imitation) | both mans |
| 2:6;23 | two (wr)ench<br>(L: Two wrenches.)<br>two (wr)enches | buttons<br>[uz] hands, not (f)ork (Formula: how to eat bread.) |
| 2:6;23 | | tea [gægz] (bags) |
| 2:6;23 | two (f)oot<br>(L: Two feet.)<br>two (f)eet<br>Two (f)eet too? (of another toy)<br>two eyes (Note that this dialog did not model the regular allomorph!) | |
| 2:8;25 | | Bought pears? |
| 2:8;26 | two pin | |
| 2:8;26 | two [paps] (tops) | |
| 2:8;27 | | Do (l)adders (for) me. |

Here is an example of rule invention again, without an obvious prototype in the adult language. The only English morphosyntactic phenomenon that seems even distantly relatable is the rule forbidding plural marking on pre-nominal modifiers: Daniel by this point knew phrases like *toy box* and *prune box* (* *toys box,* **prunes box*). Perhaps he had extracted from these phrases a general pattern of suppressing plural markers in multi-word NP's, but had yet to learn to restrict it to the modifying elements.

The possessive was acquired simultaneously with the plural, but it showed a fairly slow and demonstrably lexical start. Evidence of the onset of contrast on one word occurs at the about same time as the first contrastively used plurals:

2:3;1 [ɲaiks] 'Mike's' (contrast with 2:3;5 *up Mike*)

The possessive on *Mike* was maintained without error until at least 2:6 -- there were nine attested uses of *Mike's* during these three months, contrasting with seven attestations of *Mike* in vocative and other non-Z uses.

However, we also have evidence that onset of the possessive was lexical (word-by-word) and gradual, for the marker was definitely absent from the possessive *Mommy* on 2:3;5, and was still unreliable on 2:3;16.

2:3;5 [mʌmi hæs] 'Mommy's house'

2:3;5 [mʌmi hæsɛz] 'Mommy's houses'

2:3;5 [mʌmi] (referring to LM's cup of tea; corrected after imitation)

2:3;12 [mʌmi] *toast*

2:3;12 [mʌmiz] *toy*

2:3;16 [mʌmi æpw] 'Mommy's apple'

2:3;16 [mʌmiz æpw] 'Mommy's apple'

Other names took even longer to acquire the possessive marker; for example, on 2:3;14 we have [ɲaiks] *car*; but on the same day note this dialog, with failure to pick up the Z even on imitation:

2:3;14 D. [gin] *car* (of a toy car).
L. *Green car?*
D. *No,* [gin].
L. *Oh, Jean's car.*
D. [gin] car (nods yes)

But by 2:6, the possessive had been completely mastered. We find both attributive and predicative examples:

2:6;1 [næniz pær] 'Danny's pacifier'
2:6;1 *Cake* -- [ginz] 'Jean's'

The only other richly attested name, [tiz] 'Stev(i)e', appears to have some complication, perhaps due to the variability of its form and the presence of the fricative /v/. It seemed to show a reliable final Z in all possessive uses beginning on the same day as *Mike* (2:3;1). But the Z also sporadically showed up on vocatives and before verbs, starting on 2:3;12. No other name outside the *-rs* rule showed a Z where it didn't belong.

The possessive, like the plural, underwent an unexpected reanalysis between 2:6;19 and 2:7;12. The data show that it took on the attibutive/predicative distribution of the pronominal possessives like *my/mine,* which (except for the invariant *his*) involve a Z in the other persons and numbers: *your/yours, her/hers* etc. This pronominal distribution he had acquired only a short time before, since as late as 2:5;18 we find *mine box*; see Table 13.

**TABLE 13: DISTRIBUTION OF POSSESSIVE FORMS**

| | Attributive | Predicative |
|---|---|---|
| 2:6;1 | [næniz pær] 'Danny's pacifier' (full correct use, before new rule) | Cake -- [ginz] 'Jean's' |
| 2:6;17 | | [wiviz?] 'Is that Stevie's?' |
| 2:6;17 | | Not Mike's? |
| 2:6;18 | | [wiviz] 'Stevie's?' |
| 2:6;19 | Daddy pen | Daddy's? |
| 2:6;19 | | Mine? |
| 2:6;19 | Mommy pen? | |
| 2:6;20 | Mike hammer? | |
| 2:6;20 | | That Mommy's and Mike's. |
| 2:6;21 | | Just Daddy's. |
| 2:6;23 | Daddy car. | |
| 2:6;23 | Mommy car. | |
| 2:6;23 | Mommy [ger] 'chair' | |
| 2:6;23 | [wivi ger] 'Stevie's chair' | |
| 2:6;23 | my [ger] | |
| 2:6;26 | (Th)is my c(r)acker. | |
| 2:6;28 | My cake! | |
| 2:7;0 | (W)ipe my nose. | |
| 2:7;0 | (W)ipe (y)our nose? | (F)inish (y)ours? |

This possessive alternation rule started to break down about three weeks after it first appeared:

2:7;12 [bivz] 'Steve's' *pen* ; *Mommy's pen*

However, it persisted variably for several months, much longer than the incorrect plural rule did. Possibly it had more reinforcement from the pattern of the possessive pronouns in the target grammar.

Turning now to the verbal Z morphemes, we find that the third singular marker was, as expected, attested later than the plural and the possessive. Some evidence of contrastive use on regular verbs is found during the time in which the plural and the possessive underwent their reanalyses:

2:6;17 *Danny comes out*
2:6;17 *goes*
2:6;22 *stands*
2:6;23 *Goes on can!* (of a lid)
2:6;24 *Stand here?*

However, it took a while to become productive, and the irregular third singular marker took even longer. Evidence for both these facts is supplied by the following dialog:

2:7;9 D. *Daddy have* [gʊk] (book).
L. *The daddy has a book.*
D. *Daddy have* [gʊk].
L. *The daddy has a book.*
D. *Daddy* [hævz gʊk].

And by an example of the next day:

2:7;10 *Daddy have a* [gækin] 'napkin'.

Attestation of the third singular Z is not frequent enough to show whether it also underwent any interesting reanalyses or failures to generalize before it was fully acquired.

The present copula/auxiliary *is* had an entirely different history, as might be expected, given its complex morphosyntactic and phonological status. (There are no instances of auxiliary *has* during the period of the diary.) From 2:3;12 to 2:4;15, as the plural and possessive were becoming established, there were also about 18 collocations with various personal names (e.g. *Mike's gone*) in which the copula or auxiliary should have been used, and 50% of these had the sibilant after the name. On 2:3;25, several names are used in copula environment, with mixed results: *Mommy's going,* but *Jean working, Jean home, Mike going*; on 2:3;30, [tiz] *going.* In the following 20 days, the 50% use was maintained with only one name; it was used in 3 out of 6 instances with *Stev(i)e* (with a variety of following predicates) and also found on both of two predications (2:4;28, [tiz] *need wash,* and 2:5;2, [tiz] *sit here?*) that do not take the copula in adult English. After that, this apparent attempt at the copula disappeared entirely, and was not restored (except in formulaic and emphatic utterances) through the end of data collection at 2;10.

After considering Daniel's false start, it begins to seem remarkable that young children acquire the commonest allomorphs of the plural relatively early in English. (It is fourth in "mean order of acquisition" of Brown's 14 morphemes.) The Z, which the child must at least partially decode in order to master the plural, is in fact the reflex of seven different morphemes involving several morphological, syntactic, and phonological rules (formation of most plurals, all possessives, and possessive plurals of nouns; 3rd singular present indicative of almost all verbs in affirmative statements; contraction of 3rd singular copula *is,* auxiliary *is,* and auxiliary *has*). The acquisition of English morphology, which is usually viewed as trivial compared with the acquisition of morphology in more highly inflected languages, thus includes the presumably bewildering job of sorting out five or six homonymous noun suffixes and a verb suffix. The fact that English-speaking children do not in general begin to acquire affixes until after they have reached the two-word stage may have a great deal to do with this particular massive homonymity. (Mervis & Johnson 1987 provide a counterexample to this generalization.) We will return to this topic in the next section.

## 3.0 CROSSLINGUISTIC CONSIDERATIONS

Up to this point we have been focusing on the microstructure of how two English-learning children went about constructing their knowledge of the morphology of that language. We have seen evidence that learners begin the process of acquiring this aspect of language by using some sort of phonologically based strategy. Seth's approach was approximation with filler syllables, while Daniel's was to infer a phonological rule for the {Z}-morphemes. It seems that the acoustic characteristics of English functors afford more than one phonological way into the system. Viewed crosslinguistically, however, English is not a prototypical language within which to study the acquisition of morphology since relatively little of the structural load of the language resides here. But it is also valuable to study English for two reasons: first, because the morphological system is so limited that there is less development to follow; second, because (as we have seen with Daniel) we are forced to confront the problem of homonymy among functors, which also occurs in more morphologically complex languages. We will now consider the insights gained from our two cases in a wider, crosslinguistic perspective, focusing on the ways in which different languages may afford different kinds of entry paths into morphological structure.

Thanks to the efforts of Dan Slobin and his colleagues, considerable research has now been done on the acquisition of morphosyntax in a number of languages (Slobin 1986, forthcoming). While the data is suggestive, as we will see below, no microstructural analyses of morphological development in any of these languages have yet been carried out. Our own results, however, coupled with the hints we have gleaned from studies of acquisition of other languages, have led us to begin to characterize the ways in which specific properties of particular languages might be expected to influence the acquisition process. This list of properties and their predicted influences naturally leads to new research questions for the field of language acquisition. Both the properties and the research questions will be presented in section 3.2. First, however, we would like to review our earlier description (in 2.0) of the task facing beginning language learners, but this time from a crosslinguistic perspective.

**3.1** No matter which language they are learning, children in the early stages of language acquisition do not know which part of the acoustic signal to attend to because they do not know how semantic and structural information are distributed.[17] Furthermore, in all languages, not just in English, certain kinds of linguistic information are harder to perceive than others. In particular, open-class items (members of major lexical categories) and closed-class items (grammatical morphemes) tend to differ in salience along a number of dimensions.[18] Open-class items are usually more prominent both acoustically (having more syllables, bearing stress) and semantically (more easily interpretable). Closed-class items, on the other hand, are important structurally, distributionally predictable, relatively frequent, and play a role in the rhythmic pattern of the language, even though they may not be acoustically salient in themselves.

Languages differ, however, in how easily segmentable their morphemes are. For instance, word boundaries are particularly easy to find in isolating languages, such as Mandarin, which have little or no affixal morphology, or in languages within which word-stress always falls in the same position, such as Hungarian (initial), Polish (penultimate) or French (final). In agglutinating languages, such as Turkish or K'iche' Maya, on the other hand, once children have found the word boundaries, they are still faced with the task of identifying which sub-parts carry open-class information and which carry structural information. And because of characteristics such as syllabicity of morphemes and/or boundary-obscuring morphophonemic processes, languages also differ on how easy this task is to accomplish, with Turkish being remarkably easy (Aksu-Koç & Slobin 1986) and K'iche' (Pye 1983, forthcoming) much more difficult.

For the naive learner the acoustic signal provides the most immediately accessible information about possible lexical units and their boundaries. For instance, certain portions of the speech stream are acoustically more salient than others, and these highlighted chunks are likely candidates for early segmentation and reproduction. Evidence from children's early

productions in different languages suggests that salient portions of the speech stream include stressed syllables, final syllables, stressed initial syllables, and syllables with full (as opposed to reduced) vowels (see Peters 1985 for fuller discussion).

The acoustic signal also offers natural segmentation points that influence the child's search for the locations of the boundaries between lexical units. Of course, how useful such purely acoustic clues are to the learner depends on the particular language. Probably the most important natural boundary is the syllable boundary. In Mandarin or Turkish, where morpheme and syllable boundaries tend to coincide, children rarely make segmentation errors; in K'iche' Maya, where they do not, production of syllables containing parts of two morphemes is unavoidable (Pye 1983, forthcoming).

A second potential guide to boundaries is the natural metrical footing of the language. Growing awareness of such patterning leads to attempts to segment the speech stream on the basis of prosodic patterns (stress or rhythm or pitch contour, depending on the language). For languages in which stress is always located in a fixed position with respect to word boundaries, such a strategy is very successful. For English, however, which only has a strong tendency toward a trochaic (strong-weak) patterning (Cutler & Carter 1987) it may lead to segmentation errors as children learn that a stressed syllable is likely to be the beginning of a new word (Gerken 1990) and neglect initial unstressed syllables.[19]

These acoustic cues may interact, either reinforcing or working against each other as indicators of important units to segment, or of important units to pay attention to. For instance although French has the helpful property of regular word-final stress, children nevertheless have a hard time finding the boundaries of words that begin with vowels because a resyllabification process which operates across these boundaries obscures them. For instance, Grégoire describes a 2-year-old's series of attempts to say *arbre* 'tree', each time including a different elided consonant: *le beau z-abe, le beau t-abre, un petit n-arpe, au l'arpe* (1971, 94). Guillaume also notes examples of what looks like reduplication of morphemes in French:

> "A ... curious effect of the awareness of the necessary existence of the morpheme is that the child, in many utterances where its existence is not obvious, because it has been absorbed into a neighboring word of which it is a part, reduplicates it in some way. One child of three says: *Tu la l'otes. Ne la l'ote pas.* (= you take-it it off. Don't take-it it off; *la* is redundant beside *l'* in *l'ote[s].* Another child says: *Moi la l'ai vue* ( = me, [I] saw-it it; *la* is redundant), *Il la l'ouvre* (= he opens-it it). (1973, 242)

It is possible that these are the result of segmentation errors where the cliticized pronouns are perceived as belonging to verb-stems which actually begin with vowels.

These considerations therefore lead us to expect that the different sets of useful phonological clues afforded by each language will foster profiles of morphological acquisition that differ systematically from language to language. We have already seen that the use of filler syllables is a natural (but not necessary) strategy in learning a stress-timed language such as English. While fillers have also been observed in learners of other languages such as Italian (Cipriani et al. 1990) or Turkish (Aksu-Koç & Slobin 1985, 847), children are not tempted to use them in the acquisition of every language -- learners of K'iche' Maya do not seem to produce them at all (Clifton Pye, personal communication).

Evidence of other early phonological strategies can be gleaned from the literature. For instance, descriptions of the acquisition of Mohawk (Mithun 1989) and K'iche' (Pye 1983, forthcoming) reveal the use of a syllable-based strategy. In both these languages, children are confronted with long, morphologically complex verb structures in which morpheme and syllable boundaries often do not coincide, and in which there is a considerable amount of

fusional morphophonology. And in both of these languages children's early attempts at these verbs tend to consist of the stressed syllable (and perhaps the following syllable), whether or not it contains any of the verb root. (This is as if English-learning children began by producing *coming* as *ming*.)

(6) **Mohawk** (from Mithun 1989, 291)[20]

| | | | |
|---|---|---|---|
| **Child's try:** | *ti* | *ki:(r)* | *io:* |
| **Adult form:** | *satita* | *shneki:ra* | *sewahio:wane'* |
| **Morphs:** | s-at-ITA | s-HNEK-IHRA | s-w-AHI-owan-' |
| **Syllables:** | sa+TI+ta | shne+KI:+ra | se+wa+HIO:+wa+ne' |
| **Gloss:** | get in! | drink! | apple |

**K'iche' Maya** (from Pye 1983, 587-588; personal communication)

| | | | | | |
|---|---|---|---|---|---|
| **Child's try:** | *loh* | *lik* | *ma* | *k'am* | *taj* |
| **Adult form:** | *kawiloh* | *kawarik* | *ma* | *kink'am* | *taj* |
| **Morphs:** | k-aw-IL-oh | k-WAR-ik | ma | k-in-K'AM | ta-j |
| **Syllables:** | ka+wi+LOH | ka+wa+RIK | ma | kin+k'am | TAJ |
| **Gloss:** | I like it | he is sleeping | I won't take it | | |

As the children gain in productive control, they continue for a while on a phonologically governed path, adding a syllable at a time until they reach the end of the word, regardless of how many morphemes are involved in each syllable. Especially in K'iche', since many affixes are of the form VC, adding a syllable tends to entail adding halves of two different morphemes.

(7) **Mohawk** (from Mithun 1989, 292)

| | | | |
|---|---|---|---|
| **Child's try:** | *ta:ti* | *waest* | *io:wana* |
| **Adult form:** | *sata:ti* | *wakeras* | *sewahio:wane'* |
| **Morphs:** | s-atati | w-akr-as | s-w-ahi-owan-' |
| **Syllables:** | sa+TA:+ti | WA+ke+ras | se+wa+HIO:+wa+ne' |
| **Gloss:** | get in! | it stinks | apple |

**K'iche' Maya** (from Pye, personal communication)

| | | | |
|---|---|---|---|
| **Child's try:** | *nuk'amoh* | *ink'am* | *e, ch'ich'* |
| **Adult form:** | *kinuk'amoh* | *kink'am* | *e, ch'ich'* |
| **Morphs:** | k-in-u-K'AM-oh | k-in-K'AM | le, ch'ich' |
| **Syllables:** | ki+nuk+'a+MOH | kin+K'AM | le, ch'ich' |
| **Gloss:** | he will take me | I'll take that, truck. | |

Once they can produce everything from the stressed syllable to the end of the word, the children begin adding material in the other direction (moving from the stressed syllable toward the beginning of the word). Thus Pye reports that "[K'iche'] children added new syllables to the front of those they were already producing, in effect working from the back of the verb to the front" (1983, 589). And Mithun describes one of the children she studied as follows: "His speech still showed some phonological limitation on the length of new words... [A]cquisition seemed to move from right to left: syllables were omitted from the beginnings of words rather than the ends... Although his limitation on new word length was phonologically based [he] clearly showed the productive use of morphology" (296). She concludes that: "Overall, although this fourth child still retained a phonological limitation on the length of new words, he had begun to develop sets of morphological distinctions no longer according to their positions within the word, but rather according to their utility and semantic transparency" (303). These observations suggest that the learner is shifting from a phonologically based strategy to a more morphologically based one.

The syllable-based strategy used by learners of Mohawk and K'iche' is, then, another kind of phonological bootstrapping into morphology -- one that is at least partially determined by the way in which phonology and morphology are interrelated in the particular language being learned. These characteristics do not uniquely determine the strategies that children must use, however, as attested by the existence of individual differences among learners of a single language. Since each of the many kinds of information present in the acoustic signal is a possible candidate for attention, it seems that it is possible for a child to deal with this processing limitation by somehow choosing which aspects of the signal to focus on first. Such "choices" lead in turn to the observed individual differences (such as those between formulaic and word-oriented children) in the acquisition profiles of particular languages.

3.2 From the point of view of acquirability, what are the important ways in which the morphological systems of languages differ? Our position is that crucial attributes involve the interplay between phonology, semantics, and position in word and sentence. We now propose five kinds of attributes that are likely to be important in the acquisition of the morphological systems of different languages.[21]

**A. The degree to which a language has distinct "slots" for particular morphemes.** What is important here is the linearity as opposed to superposability of pieces of linguistic information. For the learner, distinct slots for different kinds of information offer the advantage that each kind of linguistic information has its own characteristic position. This makes it easier to segment morphemes from each other, to map forms onto meanings, and to learn to assemble new productions. For instance, polysynthetic languages such as Mohawk or Eskimo have clear slots, as do agglutinating languages such as the Bantu languages with their agreement prefixes, Turkish, or Japanese.[22] Isolating languages such as Mandarin, or even English, also rank well on "slottedness". It is the inflectional languages, such as Russian or Greek, where several different kinds of information are inextricably combined in a single morpheme, that can be expected to cause problems for the learner.

**B. The consistency within a particular language of the placement of specific kinds of information.** For instance, the Scandinavian languages do not have a single position in which to mark the definiteness or indefiniteness of noun phrases: the indefinite marker is preposed while the definite marker is postposed (e.g. Danish *en dag* 'a day', *dag-en* 'the day') (Haugen 1987). In contrast, although German is not such a clear example of a "slot language" as those in 1), it does have clear and consistent functor slots in some of its phrases: articles in noun phrases, and prepositions in prepositional phrases.

**C. The distinctness/blurriness of morpheme boundaries.** Languages also differ in the extent to which morpho-lexical boundaries are blurred by morphophonemic processes such as deletion or assimilation, which affect the ease of recognizing occurrences of the "same" morpheme. Languages like Mandarin and Turkish have very little in the way of boundary-obscuring morphophonology; Hungarian and Finnish have considerably more. And the French processes of deletion, elision and resyllabification cause segmentation problems such as those cited above.

**D. The size and syllabicity of grammatical morphemes: the bigger the easier.** Across languages these range from subsyllabic (a lone vowel or one or two consonants, as in Mohawk, or in some allomorphs of the English {Z}- and past-tense morphemes), to syllabic (English prepositions or *-ing*; Bantu prefixes), to multisyllabic (some Finnish case endings). A perceptually difficult situation occurs when morphemes straddle syllable boundaries, as in K'iche'. In Semitic languages, where root morphemes can be interdigitated with grammatical morphemes, syllabicity provides no help at all in finding morpheme boundaries; children are forced to start with whole words, from which they extract the inflectional patterns after they have learned enough words (Berman 1985).

**E. Other attributes that may help to distinguish open class from closed class items.** For instance, in English the set of phonemes that appear in functors is somewhat distinctive: schwa, /w/, and /s,z/ are common, while initial /ð/ appears only in closed-class morphemes.

What predictions do these attributes suggest about characteristics of morphemes which children might first approximate with filler syllables? We expect that, (a) to the extent that a particular morpheme is both highly frequent and has a highly predictable position (slot), this salience will render its presence relatively easy to detect; (b) if, in addition, it consists of a single full syllable, its phonetic details are hard to perceive because it never occurs with full stress[23], and its semantics/function are relatively opaque, then it will be a good candidate for the filler syllable strategy. This is because the learner is likely to notice the presence of something even if she can't tell what it means, and may choose to replace it with a filler syllable.

Part (a) of our prediction is similar to the following Operating Principle (OP) for language acquisition proposed by Slobin:

> OP:UNINTERPRETED FORMS. If a speech element is frequent, perceptually salient, but has no obvious semantic or pragmatic function, use it in its salient form and position until you discover its function; otherwise do not use it. (1985b, 1202)

Part (b) highlights the importance of the syllable as a natural unit of perception and production.

Let us look at some examples gleaned from studies of the acquisition of languages in which grammatical morphemes share these characteristics, and where we find that filler syllables do occur in just the kinds of places that we expect.

**Bantu languages:** studies of the acquisition of SiSwati (Kunene 1979) and SeSotho (Connolly 1984; Demuth 1988, forthcoming) report that agreement prefixes on both nouns and verbs first tend to be approximated by what Connolly calls "shadow" prefixes (1984, 79). These morphemes are syllabic, unstressed, and occur word-initially. Examples from SeSotho are presented in (8).

(8) **SiSwati** (from Connolly 1984)[24]

| | | | |
|---|---|---|---|
| **Child (2;0):** | **a**-*sale* | *a-hae* | 'her earrings' |
| **Adult form:** | *ma-sale* | *a-hae* | |
| **Morphs:** | 6-earrings | 6POSS-her/his | |

(from Demuth forthcoming)

| | | | |
|---|---|---|---|
| **Child (2;2):** | *kolo* | **ya**-*ne* | 'that school' |
| **Adult form:** | *se-kolo* | *sa-ne* | |
| **Morphs:** | 7-school | 7-DEM | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Child (2;2):** | *le-bese* | *ke* | **eo** | **e** | *papa* | 'there's the milk |
| **Adult form:** | *le-bese* | *ke* | *leo* | *le* | *papa* | and the porridge' |
| **Morphs:** | 5-milk | COP | 5DEM | CONJ | 9porridge | |

**Turkish:** Aksu-Koç and Slobin report that, at the earlier stages of development (under about 2;6), children may fill out the prosodic contours of complex verb forms by including "extra, meaningless syllables between the stem and the final person-number affixes". Their interpretation is that "the child attempts to retain some of the rhythmic picture of complex verbs, incomprehendingly inserting morphemes that sound like passive and causative particles" and revealing "a semantically unmotivated analysis of words into combinable syllables" (1985, 847-8).

**English:** free (as opposed to bound) grammatical morphemes such as determiners, subject or object pronouns, and auxiliaries are syllabic, are typically unstressed, and have their own structural slots (positions within NPs (articles), VPs (auxiliaries, modals, semi-modals; object pronouns), PPs (object pronouns) and S (subject pronouns). Examples of Seth's production of fillers in some of these slots are in (9).

(9) **English:** Seth at 2;1.0

**a. proto-subject pronoun**

ə bez In ə bEd. ə pUt tə fawr In ə ves.

*I/you bounce in a/the bed* *I/you put the flower in a/the vase.*

**b. proto-subject pronoun + semi-modal**

ən tEl sowi. ə ŋ kal græ ndæ diy?

*I-want-to tell story.* *let's/wanna call Grandaddy?*

**c. indirect object pronoun**

gIv u ə mEs--?

*give you (some) medicine?*

**d. proto-determiner**

ə bez In ə bEd. gIv u ə mEs--?

*I/you bounce in a/the bed* *give you (some) medicine?*

ə pUt tə fawr In ə ves.

*I/you put the flower in a/the vase.*

The children studied by Bloom also produced constructions similar to these. Some examples from each of the three children in Bloom 1970 are presentedin (10)-(12). Bloom comments about Eric's productions: "this utterance type appeared to represent his linearly extending a monomorphemic element - perhaps in an effort superficially to duplicate syntactic speech - without either grammatical or semantic motivation" (107).

(10) **English:** Eric at 1;8.2 (from Bloom 1970, 108-109)

**a. proto-subject pronoun** (Eric actor: possible source = *I*)

ə *sit* ə *play it*

ə *find it* ə *put* ə *baby*

ə *help you* də *see the [ma]chine*

**b. proto-subject pronoun** (other actor)

ə *home* ə *broke*

**c. proto-determiner**

ə *toy* ə *baby*

*down* ə *cookie* *here comes* ə *'chine*

*here's* ə ə*'chine*

(11) **English:** Gia at 1;8.2 (from Bloom 1970, 101):

**a. proto-subject pronoun**

ə *peekaboo* ə *push* ə *carriage*

**b. proto-determiner**

ə *record* ə *Mommy*

ə *Gia Mommy* ə *push* ə *carriage*

**c. other**

ə *more in* ə *more upidown*

*bank* ə *broke* *hand* ə *wipe*

(12) **English:** Kathryn at 1;9.0 (from Bloom 1970, 75):

**proto-subject pronoun**

ə *try* ə *see ball*

**Italian**: Cipriani et al. have found that children learning Italian may produce filler syllables to approximate the copula and articles, as shown in (13).

(13) **Italian** (from Cipriani et al. 1990):[25]

| | |
|---|---|
| *e bimbo* | '[e] child' |
| *a palla* | '[a] ball' |
| *en pappa* | '[en] mush' |
| *ɔ mio* | '[ɔ] mine' |
| | '[e] cow eats' |
| | 'want [e] mush' |

**Norwegian**: Simonsen (1990) has also found instances of filler syllables in her data on the acquisition of this language.

(14) **Norwegian:** Nora 2;3

**a. subject pronoun**

| | |
|---|---|
| ɛ ˈse: pɔ ˈdi: | æ ˈvi:s ta j |
| *du se på de* | *jeg vise deg* |
| you look at them | I show you |

**b. auxiliary/copula**

| | |
|---|---|
| ɛ ˈden a ˈɯne | ˈtæ:ɾ ɛ ˈle:sa malt |
| *og den er under* | *der har Lisa malt* |
| and that-one is beneath | there has Lisa painted |

| | |
|---|---|
| ɛ ˈdæn æ ˈliɾe ˈdæ: | |
| *og den skal/kan ligge der* | |
| and that-one shall/can lie there | |

**c. preposition**

| | |
|---|---|
| icɛ ˈdɛn ɔ ˈfale ɛ ˈsejɛn | |
| *ikke den skal/kan falle nedi seng-en* | |
| not that-one shall/can fall in/into bed-the | |

Since filler syllables are not reported to occur in every language, we may ask whether grammatical morphemes in these languages have specific properties that would lead us to expect children **not** to employ them. Their syllabic status seems to be a crucial attribute in this respect. As we have already seen for K'iche', when morphemes straddle syllable boundaries, children tend to produce that **part** of a morpheme (whether it be a consonant or vowel) that **fills out a syllable** that they are currently attempting to produce, because it is salient or stressed. Pye reports that at an early stage "the children always observed the syllable divisions in their words, not the morpheme boundaries" (1983, 588). The importance of syllabicity is reinforced when we note that, even in languages where children do use fillers, not all morphemes are first approximated by them. For example, in English the most frequent allomorphs of past tense and plural are not full syllables, but there are no reports yet of filler syllables standing in for these morphemes.

Much work remains to be done in this crosslinguistic arena, including: looking for evidence of phonological bootstrapping into morphology in different languages; characterizing these strategies; and making and testing predictions about how phonological characteristics of languages affect the acquisition of the morphological structure of the language. In order to carry out such studies it is also going to be crucial to have the right kind of data. The importance of phonetic information in the analyses presented here highlights the relevance of phonetic transcription in the study of the acquistion of morphology. Moreover, in order to understand the **process** of morphological development it will be necessary to have data that is temporally fine-grained enough. At present, however, not enough microstructural studies of the process of acquisition have been done that we can specify the optimal degree of resolution (spacing of language samples) for carrying out such analyses.

## 4. Drawing Implications for Morphological Theory

### 4.1. Logical requirements for a valid argument from developmental morphology to adult morphology.

What sort of implications might these acquisition patterns have for morphological theory? Do they resemble any phenomena of the adult language? If so, is this resemblance only superficial, or does it result from a genuine underlying identity? Finally, supposing that the answer to these questions is "yes", are the related adult phenomena important ones, or only marginal?

We can dispose of the last question first, on philosophical grounds alone: a theory that accounts in a satisfactory way for both central and marginal phenomena is to be preferred over one that handles central phenomena only. Therefore, if we can show that the kinds of partial knowledge displayed by Seth and Daniel are also to be found in adult language, it follows that morphological theories which are held to be adequate in dealing with central phenomena should now be tested against acquisition data.

Actually, of course, as we stated in the introduction, we hold a much stronger position: since adult morphological knowledge is the endstate of children's (and adolescents') morphological development, we claim that the best morphological theory is one that can account for this development at all its points, treating the individual adult's knowledge as asymptotically approaching some near-steady state. In saying this, we show ourselves to be aligned with such linguists as Mohanan 1990 (see also Chomsky 1988), who consider that the object of study is the individual's knowledge of language rather than an abstracted *langue*.

How do we model the maturation of a grammar? The desired end-state must (in almost all cases) produce output that conforms with the grammar of the ambient language. It must also enable appropriate parsing of input. (It may, however, produce idiosyncratic analyses and syntheses for forms that "nobody ever says" or for other forms where there are no detectable adverse consequences (cf. Mohanan).

It is generally believed that adult grammar changes at a glacial pace, if at all; however, assuming that this is true, a model of acquisition does not need to represent it explicitly. Any theory that describes learning and has some internal stability is going to predict that eventually almost everything that is "out there" in the language will be acquired, and there will be essentially no further reason to change. Therefore, our stated assumption that the acquisition mechanism remains the same over the life-span does not amount to much of a constraint on theorizing in itself, but it does mean that phenomena that we see in children's morphology are expected to have parallels in adult morphology; if they don't, we have to find a well-motivated explanation of their disappearance.

### 4.2. Looking for adult parallels to the morphological phenomena shown by Seth and Daniel.

Now let's return for a moment to our hedge in sec. 4.1: we said that "almost everything" in the morphology of the language will be acquired. Psycholinguistic studies of adult word knowledge, and common experience as well -- not to mention the brute fact of language change -- show that, around their core of solidly acquired morphology, adults have a penumbra or margin of shakier and/or less accurate information. For example, outside the productive morphological patterns of English, adults seem to show only partial knowlege of the morphological patterns latent in the distributional facts of the language. This was the principal thrust of the experimental work on the "psychological reality of phonological rules" that began around 1970 (Moskowitz 1973, Steinberg & Krohn 1975, Wilbur & Menn 1975, Jaeger 1980, 1984, Myerson 1975; for a review of some aspects of this work, see Kiparsky & Menn 1977). The rules questioned were of course the more abstract English morphophonemic rules of Chomsky & Halle 1968 (the vowel shift rule and Romance stratum velar softening were the most popular targets of study); nowadays they have been restored, by lexical

phonology and other current theories, to a morphological component of the grammar (Kaisse & Shaw 1985).

For children at the beginning of language, everything is in the margin, and there is no core (in our sense of a solidly mastered, richly connected body of data and analyses). Acquisition is a matter of patterns becoming confirmed and consolidated into the core, but there is always a margin of *langue* which has not been really internalized by the individual. If this view is accurate, it gives us an important hint as to where we might best look for analogs to the stranger properties of our subjects' systems: they may be in the margins of adult knowledge, rather than in the core.

Recall that the data we have identified as fitting poorly with most adult theories of morphology are evidence for two kinds of continuum phenomena: for continuity between derivational and inflectional categories (or at least between lexically-determined and productive), and for continuity in the identifiability of a sequence of segments as being a morpheme. We also saw one phenomenon which is easily described within standard theories but which does not seem to be an everyday event: Daniel's construal of a morphological rule as a phonological one. We have little direct evidence of adults who have reconstrued the adult morphology in the way that Daniel did, or of adults whose knowledge of the shape of a morpheme is as fuzzy as Seth's appears to have been. But that may well be for lack of looking, since most adult studies in morphology (with the notable exception of Gleitman & Gleitman 1970 on compound nouns) deal with the *langue* of the idealized speaker-hearer rather than the parole of the individual.[26] For example, only experimental probes will be able to show a possible slow assignment of meaning to the *-cept* of *reception, perception, deception, conception,* with perhaps more hestitant extension to *interception* or *inception.* However, once again, our quasi-morphemic spelling system does sometimes allow us a hint about a writer's tacit morphemic analysis. The now-common misspelling of *supersede* as 'supercede' (is the latter form starting to look correct to you?) indeed suggests that the semantics of the *-cede/-ceed* group is available to English speakers -- and of course, the meaning of *supersede* fits in with them very well.

Continuing with a diachronic perspective, we find indirect evidence that imperfect and possibly fuzzy states of knowledge may also characterize adults, at least during periods of language change. For example, Hoenigswald's (1960) survey of categories of morphological change includes cases where morphs representing two previously contrastive morphemes have come into complementary distribution, and so become mere allomorphs of a single morpheme. He gives as an example (pp. 36-37) the case syncretism that occurred when the Indo-European dative in */-ay/ and locative in */-i/ fell together as conditioned allomorphs of the dative in Greek (/-ai/ appearing in Greek with one class of noun stems, and /i/ with another). Daniel's re-analysis of previously contrastive zero (base form) and Z morphemes (possessive or plural) into zero (base form), contrasting with complementary zero and Z allomorphs (possessive or plural), is not a syncretism, because of the persisting zero-marked base form. But it is still a case of complementary distribution, and hence of allomorphy, that have arisen from input language data which display no such pattern.

This is not to be taken as a suggestion that young children's reinterpretations are the direct basis for diachronic changes in grammar; what we are inclined to agree with is the theory that reinterpretations which arise in and/or persist into adolescence without "correction" are the basis for diachronic change (and that these are especially to be looked for in language-contact situations). How such reinterpretations arise remains unclear; but this part of the Daniel story, as well as Bowerman's well-known series of papers on her children's late analysis and over-generalization of the English causative (e.g. Bowerman 1982), tell us that novel pattern extraction may occur in children at some time after they have used enough examples of an adult rule to satisfy ordinary distributional criteria for mastery of the adult pattern.[27]

Can we find diachronic cases of interpretation of morphological rules as phonological ones, as in Daniel's *-rs* rule? Joseph & Janda 1988 discuss two putative phonologization examples of "demorphologization" and find them unconvincing, but seem willing to allow for the possibility of such a change. A possible case is the following. Standard French has a morphological rule inserting /t/ before 3rd person pronouns in inverted questions, e.g. *a-t-elle* 'has-/t/-she?' (This morphological *t*-insertion rule itself, of course, comes from a reanalysis of an earlier phonologically conditioned *t*-deletion rule.) There is now a non-standard French generalization of this rule along phonological lines, or so we have heard. Relevant references would be appreciated!]

Analogs of the other aspects of morphological development treated in this paper probably can be identified within adult phonology. If Seth's vacillation among schwa and fuller forms in output is due to competition among alternative underlying forms, his behavior is like adults with a choice of /i/ or /ɛ/ for the initial vowel of *economics*. It could also be due the operation of a Labovian variable rule, with inadequate knowledge of the conditions attached to the variables.

If, on the other hand, his vacillation is due to uncertainty about what the underlying target form actually is, then we will not be able to find an adult analog unless adults permit such uncertainly to persist in their lexicons. The potential for this state to exist is clear, however: consider the speakers of American English who write *of* for *have* in conditional sentences, using *I should/could/would of* for standard *I should/could/would have,* presumably as a result of insufficient exposure to the unreduced /hæv/ form in these collocations. (If you do not have personal acquaintance with this grammatical phenomenon, you are not currently giving essay assignments to average American undergraduates.) Either before deciding to identify the /v/ of the reduced form with *of,* or in the process of learning that it is in fact to be identified with /hæv/, the speaker may be in an uncertain state, and a speaker at the literacy level of some of our undergraduate students may conceivably remain uncertain indefinitely. Whether this in fact happens seems to be a matter for future research.

Of direct concern for some versions of morphological theory is the transitional status that Daniel's possessive morpheme must have had as he discovered that it was generalizable across names (and eventually, we must suppose, across nouns). This suffix underwent a transition from being lexically determined to being productive/inflectional. Does this event have a parallel somewhere in the core or the margin of adult morphology, or do we have to find a way to keep such transitional states out of the adult system? This depends on the morphological theory to which one subscribes. Anderson 1988 makes a clear division between derivational and inflectional morphology, but he does so in such a way that the lexical determination of most derivational morphemes is incidental rather than essential. For Anderson, the early lexical status of Daniel's possessive would have nothing to do with its membership in the derivational or inflectional category. Other approaches take lexical limitation as one of the defining characteristics of the derivational morpheme; for these, Daniel's lexical stage and evolution of the possessive seem to pose a problem as long as an exhaustive division into inflectional and derivational categories is maintained. Something would have to be done to make sure that the adult system could no longer tolerate such anomalies. But one approach to morphology predicts, and therefore welcomes, developmental stories like Daniel's: that is Bybee's (e.g. 1988), which arranges inflectional and derivational morphology on a productivity continuum. In her model (p. 125),

> "morphological rules and lexical considerations are not separate from one another. Rather, morphological and morphophonemic rules are patterns that emerge from the intrinsic organization of the lexicon. Patterns that range over large numbers of lexical items are highly reinforced or strengthened and apply more readily to new items, while patterns that are found in a smaller number of items are correspondingly weaker and less apt to be productive. Thus the difference between

major productive rules, minor rules, and suppletion is just a matter of degree, not a matter of qualititative difference."

We regard our data as support for Bybee's theory. The insistence that a morphological theory must handle diachrony smoothly suggests the same conclusion: the generalization of endings originally appropriate to one declensional or conjugational class, as has happened in various branches of Indo-European, is easier to follow in a continuum theory. So are the transformations of the French adjective ending *-able* and the noun ending *-age* into productive English "native-stratum" morphemes as more and more French loanwords containing these endings entered the English lexicon. (We admit that a continuum theory is not necessary, however; after rejecting a *langue*-based linguistics, one can always describe a continuous shift in the behavior of a group from Analysis 1 to Analysis 2 as the result of more and more individuals choosing Analysis 2. See Joseph & Janda 1988, Stein 1988 for further discussion of continuity in diachrony.)

Let us turn to the last matter of morphological theory to which we we would like to apply our approach. A basic and standing issue is the question of what "counts" as a morpheme, and the expectation of most theorists (except those who follow Bybee and Bolinger) is that there should be a single well-defined answer to this question. The straw-person extremes may perhaps be characterized as follows: the extreme hyper-semantic position would hold that any opposition that even hints at semantic-formal systematicity (*we*: *us*: *our*:: *they*: *them*: *their*) requires that the non-basic members of the series must be considered as multi-morphemic (here, for example, *us* = *we* + accusative, and *our* = *we* + possessive), regardless of whether any phonetic substance for some of the morphemes can be isolated.

The extreme hyper-concrete position, on the other hand, counts as morphemes only segmentable, recurrent "pieces" of words, and would regard *geese* as a monomorphemic lexical entry used as a suppletive replacement for the plural of *goose*. Real people seem to take up positions between these straw extremes; see, for example, Matthews 1974 and most of the papers in Hammond & Noonan 1988. (However, in order to be maximally conservative in attributing morphological knowledge to their subjects, Roger Brown and his group actually took the extreme concrete position in deciding how many morphemes to credit to a child's utterances for doing mean-length-of-utterance computations [Brown 1973:54]).

The problem of the status of Seth's filler syllable similarly suggests to us that only a continuum theory will work, this time a continuum theory of the morpheme rather than a continuum theory of morpheme types. Bybee's theory has a continuum here also (see e.g. Bybee 1988:128-9), but to our knowledge the most exhaustive and challenging review of the English data is still Bolinger 1960, mentioned above. There is a twist here, however; Bolinger focused on the problem posed by recurrent elements (e.g. the *sn-* 'nose' words, the *gl-* 'sight/light' words); here semantics and form tempt us to a segmentation which would leave us with embarrassing leftover unassignable phoneme strings. But the initial situation with Seth (and the other filler-syllable children mentioned in sec. 3.1) resembles the problems of meaningless morphemes which serve to connect well-behaved pieces, e.g. the linking vowels of Greek and Latin.

The intermediate situation of phonetic variability linked with emerging semantic distinction does not seem quite like anything that is normally recognized as a problem of general morphological theory. However, instead of thinking of reasons why the mature system might not have such phenomena, we might well undertake a search for them and see what's out there. Consider our freshman who is still writing *would of, should of, could of* for *would have, should have, could have,* and who then starts to get your blue-pencil feedback on his/her essays. If the result of this feedback is an "Aha!", followed by uniform correct performance, thenthe learning has been across-the-board, like Daniel's first morphological analysis of the plural. But if the homework shows only a slow and

variable replacement of *of* by *have,* then the transition resembles Seth's gradual learning of filler syllables.

### 4.3 Conclusion.

What we saw in the course of Daniel's acquisition of the possessive morpheme is a progression which begins with recognition of a semantic opposition (e.g. nominative/ possessive). Next we found one lexical item which signaled that opposition by production of the phonetic substance (*Mike/Mike's*); then we found general, rule-governed production of it on all names. Going beyond the data, we know that, for the plural, Daniel will have to pull back from full generality to match the distribution of irregular allomorphs. When he eventually runs into a morpheme which is minimally productive, like the English *-ity* nominalization, we assume that there is a similar progression which stops before full productivity is reached (cf. Meyerson 1975).

The course of Seth's acquisition of the functors discussed in sec. 2.1, above, is quite different; he began with recognition of their phonological substance and their distribution, and then worked out their semantics.

Instead of saying that there is a point at which either of these children "acquires" a given morpheme, we would rather say that they become more and more aware of and able to control the various factors that govern its use. Trying to count their morphemes (except for specific limited purposes, such as Brown's) is not only a nightmare, it is theoretically indefensible. Acquisition theory must develop a way to acknowledge this; quoting Bates again, as she complained at an oral presentation of this paper,[28] we simply "have no way to represent 35% of a morpheme!"

We are hampered by our notation, and keep treating acquisition of a morpheme as an all-or-none matter -- not only in our scoring procedures for everyday language development, where it can sometimes be defended as a necessary approximation, but also in our theories, where it cannot. The need to deal with continuity is, of course, a major reason why Bybee, as well as Bates and other psycholinguists (Bates, Thal, & Marchman 1990) and cognitive linguists (Lakoff 1987, Langacker 1990) have been turning to connectionist modeling as an inspiration for theory building, even though the obstacles to plausible computer modeling of the acquisition of morphology and phonology remain formidable (Menn 1990). In connectionist models, it is continuity which is the norm, and it appears that Seth's patterns would be expected; the greater problems are posed by Daniel's sharp hypothesis formation. In order to do justice to learning, the correct model will have to be able to handle both continuous and discontinous learning patterns, both "bottom-up" and "top-down" phenomena.

If we now carry this conclusion back to general morphological theory (which, except for Bybee's approach, also lacks any mechanism for contemplating, let alone representing partial morphemes), we can say the following: many controversies over how to define the morpheme are mistaken in assuming that the right answer will always allow us to end up being able to count the number of morphemes in a word. Why should it? Rather, the best theory of the morpheme will be the one that gives the most insight into the ways in which a given word is complex and the ways in which it is simple.

## NOTES

* Draft: Comments solicited. We plan to submit a revised version for journal publication by late 1991, so comments received by September 1, 1991 would be most helpful. Because of our travel plans, please send comments to Ann Peters, Department of Linguistics, 1890 East-West Road, Honolulu, HI 96822, up to June 1, 1991, and after that to Lise Menn, Department of Linguistics, University of Colorado, Boulder, CO 80309-0295. We would like to thank the following people for their helpful comments as we have been developing these ideas over the past several years: Robert Bley-Vroman, Lyle Bourne, Bill Bright, Katherine Demuth, Patricia Donegan, Charles Ferguson, Zygmunt Frajzynger, Ed Matthei, Mike Mozer, Cliff Pye, Ken Rehg, Herb Roitblat, Ronnie Silber, Dan Slobin, Paul Smolensky, and other members of the audiences to whom we have presented versions of this work as it progressed.

1. The earlier studies by Berko (e.g.1958) were cross-sectional.

2. We realize that this view is somewhat simplistic: Hirsh-Pasek et al. (1987) have shown that 7- to 10-month-old children do seem to be able to perceive clause boundaries. There is no evidence, however, that these children are able to segment the speech stream into words or morphemes for quite some time, and it is this level of segmentation that we wish to deal with here.

3. Bloom found similar "constructions" at the early stages for all three of her subjects Eric, Katherine and Gia (1970, 105).

4. Seth's ages are given as years;months.weeks. Intonation: . = falling; ? = rising; - = level

5. Again, such internal fillers are found in Bloom's 1970 data for Eric II (107) and III (117), for Gia II (101) and Kathryn II (35).

6. If it is true that fillers do evolve phonetically toward identifiable adult targets, then it is crucial for researchers to have access to at least broad phonetic information about how they are pronounced -- information which is too often lacking in transcriptions of children who are past the one-word stage.

7. This interpretation is congruent with the findings of Plunkett (1990) who has been looking for articulatory evidence that would suggest when formulaic children are shifting from completely unanalyzed formulas to partially analyzed formualas.

8. This same phonetic information is presented in fuller form in Tables 3, 4 and 6 below.

9. Although phonetic accuracy for *me/you* is above 70% at 1;11.2, it falls off again until 2;3.1.

10. C = consonant geminated from end of preceding word, e.g. [opənnIt] 'open it', [kwozzIt] 'close it', [pollIt] 'pull it'.

11. Menn's student Bettina Perregaard has just found a similar alternation between, /It/, / /, and zero for *it* in object position while listening to tapes of "Patricia" and mother from the Berko Gleason corpus. Not only does this lend credence to our findings for Seth, it also underscores our point about the inherent inadequacy of orthographic transcriptions for understanding transitional phenomena in morphological development. The Berko Gleason corpus has been available for some time on the ChiLDES database, but the orthographic transcripts lead researchers to believe that *it* has been acquired, whereas Perregaard, with good phonetic training, was able to pick up something much more subtle by going back to the original tape recording.

12. In the east Texas dialect of American English spoken by Seth's father, the initial fricative of the article *the* is often assimilated to the final consonant of the preceding word. E.g., *in the* > [Innə]; *at the* > [ætːtə]. As a general notational device, we use C to represent this assimilated consonant: *the* -> [Cə].

13. As a first approximation, in the subject slot the unglossable schwas have been evenly distributed between *I* and *you*. Postverbal *you* does not include *thank you*.

14. Estimates of their MLUs were made from Brown 1973, Figure 2, p.57. For Eve they are: 1.5, 2.0, 2.8; for Adam they are: 2.0, 2.5, 2.5.

15. Since the tapes have not been transcribed phonetically after 2;2.3, we can not tell how accurate he is after this age.

16. Ken Rehg has also suggested to us that, for either the particle pairs or the preposition pairs, the lower vowel of *on* may make it more acoustically salient than *in*.

17. Even though children do seem to be sensitive to clause and phrase boundaries as early as 9 months (Hirsh-Pasek et al. 1987), they still do not know how semantic and functional information are distributed within these multi-morphemic constituents.

18. We are aware that "open class" and "closed class" refer to somewhat fuzzy categories. For the sake of simplicity we use these terms to refer to their prototypical members, e.g. concrete nouns vs. adpositions or pronominal clitics. Our generalizations will of course have to be modified for less prototypical elements such as directional adverbs or verbal particles.

19. English-speaking adults rely on this statistically likely pattern as well. Cutler (1990) has shown that adults make speech perception errors involving resegmentation of words with initial unstressed syllables: they tend to move the word boundary to just before the stressed syllable.

20. Verb roots and stressed syllables are capitalized.

21. We make no claim that this list is exhaustive, and we solicit suggestions for additions.

22. This is why "item and arrangement" descriptions work well for these languages.

23. In stress-timed languages, at any rate. The more even weighting of syllables in syllable- or mora-timed languages would be expected to enhance the perceptibility of unstressed syllables.

24. Numbers refer to agreement classes.

25. Although the Italian was not given for the last two of these examples, we include them because they show the production of filler syllables with more than a single word.

26. See Derwing & Nearey 1986 for comment.

27. In the Daniel case, his earlier and apparently adult-like pattern of use actually violates his later invented possessive and plural patterns. This seems puzzling, but we see no reason to regard this as different from the more familiar cases of (over)generalization based on a correctly apprehended adult pattern like the regular past tense.

28. Budapest meeting of the International Association for the Study of Child Language, July 1990.

## REFERENCES

AKSU-KOÇ, AYHAN A., & DAN I. SLOBIN. 1985. The acquisition of Turkish. In Slobin 1985a:839-78.

ANDERSON, STEPHEN R. 1988. Inflection. In Hammond & Noonan (eds.), pp. 23-43.

BATES, ELIZABETH; DONNA THAL; & VIRGINIA MARCHMAN. 1990. Symbols and syntax: A Darwinian approach to language development. To appear in *The biological foundations of language development,* ed. by N. Krasnegor et al. Oxford: University Press.

BERMAN, RUTH A. 1985. The acquisition of Hebrew. In Slobin 1985a:255-371.

BLOOM, LOIS. 1970. *Language development: Form and function in emerging grammars.* Cambridge, MA: MIT Press.

----; PATSY LIGHTBOWN; & LOIS HOOD. 1975. *Structure and variation in child language.* (Monographs of the Society for Research in Child Development, no. 160, vol. 40, no. 2.) Chicago.

BOLINGER, DWIGHT. 1950. Rime, assonance, and morpheme analysis. *Word* 6.117-36.

BOWERMAN, MELISSA. 1978. Systematizing semantic knowledge: changes over time in the child's organization of meaning. *Child Development* 49.977-987.

-----. 1982. Reorganizational processes in lexical and semantic development. In *Language acquisition: The state of the art,* ed. by Eric Wanner & Lila Gleitman, pp. 319-46. Cambridge: University Press.

BROWN, ROGER. 1973. *A first language: The early stages.* Cambridge, MA: Harvard University Press.

BYBEE, JOAN. 1988. Morphology as lexical organization. In Hammond & Noonan (eds.), pp. 119-41.

CAZDEN, COURTNEY B. 1968. The acquisition of noun and verb inflections. *Child Development* 39.433-48.

CHOMSKY, NOAM. 1988. *Language and problems of knowledge: The Managua Lectures.* Cambridge, MA: MIT Press.

-----, & MORRIS HALLE. 1968. *The sound pattern of English.* New York: Harper & Row.

CIPRIANI, PAOLA; ANNA MARIA CHILOSI; PIERO BOTTARI; & PAOLA POLI. 1990. Some data on transitional phenomena in the acquisition of Italian. Paper presented at the 5th International Congress for the Study of Child Language, Budapest.

CONNOLLY, MICHAEL JOHN. 1984. *Basotho children's acquisition of noun morphology.* Doctoral dissertation, University of Essex.

CUTLER, ANNE. 1990. Exploiting prosodic probabilities in speech segmentation. In *Computational and psychological approaches to language processes,* ed. by G. Altmann, 000-00. Cambridge, MA: MIT Press.

CUTLER, ANNE, & D. M. CARTER. 1987. The predominance of strong initial syllables in the English vocabulary. *Computer Speech and Language* 2.133-42.

DEMUTH, KATHERINE. 1988. Noun classes and agreement in Sesotho acquisition. In *Agreement in natural languages,* ed. by M. Barlow and Charles A. Ferguson, 305-21. Stanford: CSLI.

----. MS. The acquisition of SeSotho. To appear in Slobin, vol. 4.

DERWING, BRUCE L., & TERRENCE M. NEAREY. 1986. Experimental phonology at the University of Alberta. In *Experimental phonology,* ed. by John Ohala & Jeri J. Jaeger, 187-210. Orlando, FL: Academic Press.

ECHOLS, CATHERINE H. 1990. A perceptually-based model of children's earliest productions. Paper presented at the Society for Research in Child Development, Kansas City, MO.

FERGUSON, CHARLES A.; LISE MENN; & CAROL STOEL-GAMMON. To appear (eds.) *Phonological development: Models, research, implications.* Parkton, MD: York Press.

GERKEN, LOU ANN. 1987. Telegraphic speaking does not imply telegraphic listening. *Papers and Reports in Child Language Development* (Stanford University) 26.48-55.

----. 1990. Do adults and children have different feet? Paper presented at the Chicago Linguistic Society.

----; BARBARA LANDAU; & ROBERT REMEZ. 1989. Function morphemes in young children's speech perception and production. *Developmental Psychology,* to appear.

GLEITMAN, LILA R., & HENRY GLEITMAN. 1970. *Phrase and paraphrase: Some innovative uses of language.* New York: Norton.

GOLDSMITH, JOHN A. 1990. *Autosegmental and metrical phonology.* Oxford: Blackwell.

GRÉGOIRE, ANTOINE. 1937. *L'apprentissage du langage.* Paris: Droz. Excerpt translated in *Child Language: A book of readings,* ed. by A. Bar-Adon & W. F. Leopold, 91-95. Englewood Cliffs, NJ: Prentice-Hall.

GUILLAUME, PAUL. 1927. Le développement des éléments formels dans le langage de l'enfant. *Journal de Psychologie* 24.203-29. Translated as: The development of formal elements in the child's speech. In *Studies of child language development,* ed. by Charles A. Ferguson & Dan I. Slobin, 240-51. New York: Holt, Rinehart & Winston.

HALE, KENNETH L. 1973. Deep-surface canonical disparities in relation to analysis and change: An Australian example. In *Current trends in linguistics,* ed. by Thomas A. Sebeok, vol. 11: *Diachronic, areal, and typological linguistics,* pp. 401-58. The Hague: Mouton.

HAMMOND, MICHAEL, & MICHAEL NOONAN. 1988 (eds.) *Theoretical morphology: Approaches in modern linguistics.* San Diego: Academic Press.

HAUGEN, EINAR. 1987. Danish, Norwegian and Swedish. *The world's major languages,* ed. by Bernard Comrie, 157-79. New York: Oxford University Press.

HIRSH-PASEK, K.; D. G. KEMLER-NELSON; P. W. JUSCZYK; K. W. CASSIDY; B. DRUSS; & L. KENNEDY. 1987. Clauses are perceptual units for young infants. *Cognition* 26.269-86.

HOENIGSWALD, HENRY M. 1960. *Language change and linguistic reconstruction.* Chicago: University of Chicago Press.

JAEGER, JERI J. 1980. *Categorization in phonology: An experimental approach.* Berkeley: University of California dissertation.

----. 1984. Assessing the phonological status of the vowel shift rule. *Journal of Psycholinguistic Research* 13.13-36.

JOSEPH, BRIAN D., & RICHARD D. JANDA. 1988. The how and why of diachronic morphologization and demorphologization. In Hammond & Noonan (eds.), pp. 193-210.

KAISSE, ELLEN, & PATRICIA A. SHAW. 1985. On the theory of lexical phonology. *Phonology Yearbook* 2.1-30.

KLEIN, HARRIET. 1978. *The relationship between perceptual strategies and production strategies in learning the phonology of early lexical items.* Bloomington: Indiana University Linguistics Club.

KIPARSKY, PAUL, & LISE MENN. 1977. On the acquisition of phonology. In *Language learning and thought,* ed. by John Macnamara, 47-78. New York: Academic Press.

KUNENE, EUPHRASIA. 1979. The acquisition of SiSwati as a first language. Los Angeles: Dissertation, University of California.

LAKOFF, GEORGE. 1987. Lecture given at University of Colorado, Boulder.

LANGACKER, RONALD. 1990. The rule conspiracy: A cognitive grammar perspective. *Center for Research in Language Newsletter* (University of California, San Diego) 4:3.4-15.

MATTHEWS, PETER H. 1974. *Morphology: An introduction to the theory of word-structure.* Cambridge: University Press.
MENN, LISE. 1971. Phonotactic rules in beginning speech. Lingua 26.225-51.
----. 1973. On the origin and growth of phonological and syntactic rules. Chicago Linguistics Society 9.378-385.
-----. 1990. Building our own models: Developmental phonology comes of age. To appear in Ferguson et al. (eds.)
----, & EDWARD MATTHEI. 1990. The two-lexicon account of child phonology: Looking back, looking ahead. To appear in Ferguson et al. (eds.)
MERVIS, CAROLYN A., & KATHY E. JOHNSON. 1987. Acquisition of the plural morpheme: A case study. Paper presented at the Boston University Conference on Language Development, October.
MITHUN, MARIANNE. 1989. The acquisition of polysynthesis. *Journal of Child Language* 16.285-312.
MOHANAN, K. P. 1990. Emergence of complexity in phonological development. To appear in Ferguson et al. (eds.)
MOSKOWITZ, ARLENE I. 1973. On the status of vowel shift in English. In *Cognitive development and the development of language,* ed. by Timothy E. Moore, 223-60. New York: Academic Press.
MYERSON, ROSEMARY. 1975. *A developmental study of children's knowledge of complex derived words of English.* Doctoral dissertation, Harvard Graduate School of Education.
NELSON, KATHERINE. 1975. The nominal shift in semantic-syntactic development. *Cognitive Psychology* 7.461-79.
O'GRADY, WILLIAM; ANN M. PETERS; & DEBORAH MASTERSON. 1989. The transition from optional to required subjects. *Journal of Child Language* 16.513-29.

PETERS, ANN M. 1981. Language typology and the segmentation problem in early child language acquisition. *Berkeley Linguistics Society* 7.236-48.
----. 1983. *The units of language acquisition.* Cambridge: University Press.
----. 1985. Language segmentation: Operating principles for the analysis and perception of language. In Slobin 1985a:1029-67.
----. 1987. The role of imitation in the developing syntax of a blind child. *Text* 7.289-311.
PLUNKETT, KIM. 1990. Identifying formulaic expressions in early language acquisition. *Center for Research in Language Newsletter* (University of California, San Diego) 4.0.00-00.
PYE, CLIFTON. 1983. Mayan telegraphese: Intonational determinants of inflectional development in Quiché Mayan. *Language* 59.583-604.
----. MS. The acquisition of K'iche' Maya. To appear in Slobin, vol. 3.
SLOBIN, DAN ISAAC. 1985a (ed.) *The crosslinguistic study of language acquisition,* vols. 1-2. Hillsdale, NJ: Erlbaum.
----. 1985b. Crosslinguistic evidence for the language-making capacity. In Slobin 1985a:1157-249.
----. To appear (ed.) *The crosslinguistic study of language acquisition,* vols. 3-4. Hillsdale, NJ: Erlbaum.
STEIN, DEITER. 1988. On the mechanisms of morphological change. In Hammond & Noonan (eds.), pp. 235-49.
STEINBERG, DANNY, & R. K. KROHN. 1975. The psychological validity of Chomsky & Halle's Vowel Shift Rule. In *The transformational paradigm and modern linguistic theory,* ed. by E. F. K. Koerner, 233-59. Amsterdam: Benjamins.
TOIVAINEN, JORMA. 1990. *Acquisition of Finnish as a first language.* (Publications of the Department of Finnish and General Linguistics, 35.) Turku: University of Turku.

TOMASELLO, MICHAEL. 1987. Learning to use prepositions: A case study. *Journal of Child Language* 14.79-98.

WILBUR, RONNIE, & LISE MENN. 1975. Psychological reality, linguistic theory, and the internal structure of the lexicon. *San Jose State Occasional Papers in Linguistics* 1975:212-21.

WILSON, BOB, & ANN M. PETERS. 1988. What are you cookin' on a hot? A three-year old blind child's 'violation' of universal constraints on constituent movement. *Language* 64.249-73.