

### 3 THE SEGMENTATION OF EXTRACTED UNITS

According to the present view, after a number of units have been extracted and memorized, knowledge about them can be put to use in acquiring further knowledge about the language. In this chapter I will first consider what strategies might be used to refine and extend linguistic knowledge in two ways: the segmentation of extracted units into smaller units, and the perception of the structural patterns implied by these segmentations. I will then return briefly to the question of developmental variability and its possible causes .

#### 3.1. Segmentation Of Units Into Smaller Ones

In order to be able to progress beyond the mere recognition and production of single extracted units, the child needs to make a basic assumption, namely, that any such unit is potentially complex: that it may in turn be composed of smaller units that can be segmented out and stored independently. Once such an assumption has been made (or once that fact about language has been realized), the following general strategy can be applied:

**SEGMENT. Attempt to segment units into smaller ones and store these also as units.**

It must be noted here that the discovery of certain kinds of morphological and syntactic patterns can be expected to follow hard on the heels of such segmentation; in fact, these two processes are inextricable. For ease of exposition, however, I will here consider them separately, deferring a discussion of pattern perception until 3.2.

It should also be noted that a unit, once segmented into smaller units, may not be forgotten but may remain available as a single unit for production purposes and for possible reanalysis in those cases where it is discovered that the first segmentation is erroneous. Some evidence for this sort of lexical redundancy will be examined in the next chapter.

##### 3.1.1. Segmentation: internal cues

In order to segment a unit into smaller ones the child needs some heuristics for finding points at which to make cuts. Certain kinds of phonological salience can be expected to play a role here, highlighting either likely cut points (SG:RHYTHM and SG:INTONATION) or likely chunks to cut off (SG:END, SG:BEGIN, SG:STRESS, SG: REPETITION):

**SG:END. Segment off the last syllable of a unit from the rest.\***

**SG:BEGIN. Segment off the first syllable of a unit from the rest.\***

**SG:STRESS. Segment off a stressed syllable from the rest.**

**SG:RHYTHM. Segment units at rhythmically salient places.\***

**SG:INTONATION. Segment units at intonationally salient places.\***

**SG:REPETITION. Segment off sub-units that are repeated (in segmentals or meter or melody) within the same unit.<sup>1</sup>**

The syllables at the ends (SG:END) and beginnings (SG:BEGIN) of utterances have particular phonological salience, since they are adjacent to silence (EX:SILENCE). The ability to remember such syllables may be enhanced by the tendency for items at the end and beginning of a series (especially at the end) to be remembered better than items located in the middle (see Kintsch 1977 for a review of research on serial recall by adults, and Hagen & Stanovich 1977 for work with children).

In his study of the acquisition of Quiche Mayan, Pye (1980, 1981) makes a good case for the perceptual salience of word-final syllables, especially when they are stressed (SG:END and SG:STRESS). Note, however, that a strategy of paying attention to unit-final syllables (SG:END) would find less support in a language with word-initial stress. Such a

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<sup>1</sup> All of the heuristics flagged with an asterisk are adaptations of Operating Principles for the acquisition of syntax originally proposed by Slobin (1973, 1981). Many of the other heuristics presented in this chapter owe much to discussions with Slobin and his students in a seminar held at the University of California at Berkeley during the winter quarter, 1981.

situation would produce a conflict between two saliency factors: stress and recency. In such a case it would seem that the regularity of patterning of word-initial stress would override - at least once such regularity was perceived - that is, SG:STRESS and SG:BEGIN together would carry more weight than SG:END by itself.

Weir observed that her son Anthony oversegmented the two words *whistle* and *measure*: "The child owned a whistle and apparently did not like to use the same phonetic sequence for noun and verb, and the action of whistling he termed [wɪs]. The same apocopation was performed on measure where the verb became [mɛΩ]" (1962, 74). In both these cases Anthony seems to have segmented off the stressed syllables (which also happen to be the first syllables of their respective adult words (SG:STRESS and SG:BEGIN)). Whether he was also invoking a noun:verb analogy such as helper:help = measure:mezɪh is hard to say. The possibilities for such analogies will be discussed later.

SG:RHYTHM and SG:INTONATION have been included by analogy with the corresponding extraction heuristics. I do not have evidence for the operation of either one without the support of other segmentation heuristics, and yet it seems reasonable that rhythm and intonation should play a part in determining segmentation points. It is most likely that their effect is a reinforcing one; see the discussion of convergence in 3.1.3.

SG:REPETITION is based on the fact that repetition of elements can increase their salience enough to overcome natural loss of accessibility owing to memory overload. Languages where SG:REPETITION would prove useful are those in which gender or number agreement is marked with phonologically repetitive morphemes. Thus, in Hebrew, plurality is marked on both noun and modifying adjective by suffixation of *-im* (masc.) or *-ot* (fem.), for example:

ha-yelad- <i>im</i>	ha-gdol- <i>im</i>	me-dabr- <i>im</i>	The big boys speak'.	
the boy m.pl.	the big m.pl.	speak m.pl.		[Berman 1981b, 26]

Here the rhyming recurrence of *-im* may help the child to segment it.

In Bantu languages gender-class agreement is marked on both noun and modifying adjective (as well as on the verb if the noun in question is the subject of the verb) by prefixation of phonologically repetitive classifier particles. Two examples from Xhosa illustrate the alliterative quality of such repeated morphemes (cl = classifier):

<i>b-</i> onke	<i>a-ba-</i> ntu	<i>ba-</i> funa	u- xolo	'All people want peace'.	
cl. all	cl. man	cl. want	cl. peace		
<i>s-</i> onke	<i>i-si-</i> zwe	<i>si-</i> funa	u- xolo	'The whole nation wants peace'.	
cl. all	cl. nation	cl. want	cl. peace		[Jordan 1966, 24]

### 3.1.2. Segmentation: comparative method

Another kind of phonological salience results from phonological similarity between two or more known units. This suggests a comparative heuristic, here stated in two parts, the second being a generalization of the first:

**SG:MATCH1.** If the beginning or final portion of a unit is phonologically similar to another unit, the remainder of the larger unit is a candidate for storage as a unit.

**SG:MATCH2.** More generally, if two units share any phonologically similar portion, the shared portion can be segmented out and stored as a unit, and so can the residues.

SG:MATCH1 is a relatively simply heuristic that segments an utterance into exactly two pieces, one of which is "known" and one of which may not be known. As children's linguistic knowledge and processing capacity grow they will be able to handle segmentations into more than two units. This generalization is expressed in SG:MATCH2 and will be considered in more detail later. For now I will confine the discussion to two-unit segmentations.

When making phonological comparisons such as those described in the MATCH heuristics, the child may draw the material to be compared from two sources: previously extracted and memorized speech (units in long-term memory) or more recently heard speech (units in short-term memory). Any combination of sources is presumed to be

possible: Either the shorter unit or the longer unit in the match may be drawn from either long-term or short-term memory. If both units have just been heard in the input speech (e.g., the child's mother says, "See the tree? The tree"), segmentation may take place right away ("on line," to use a computer metaphor). If the longer unit has been memorized, either hearing one of its sub-units or somehow recalling it may trigger segmentation.

Evidence of such "off-line" processing might be gathered under circumstances in which children are obliging enough to play with their language aloud, as in the pre-sleep monologues studied by Weir. Since Anthony Weir was 2;4 to 2;6 at the time of this study, he was largely beyond the early segmentation phase of language acquisition, although the following sequences are suggestive:

that's the right way  
right way [1962, 164]

now the blanket's allgone  
the blanket's allgone  
yellow blanket's allgone [207]

I will call this segmentation process "fission," after Bateson: "When internal differentiation is made within a praxon [i.e., a unit that has already been acquired and used as a whole], as in the case of a child, competence is also being changed, by praxonic Fission" (1975, 62).

The effects of applying a heuristic such as SG:MATCH1 are most easily seen when children go too far and oversegment adult words. For instance, the word *behave* seems prone to such overanalysis by children learning English. Assuming that admonitions such as "I want you to be good" and "I want you to behave" are frequently heard, such a segmentation principle could be the basis of productions such as Rachel Scollon's "I'm going to be very very /heyv/," or Norman Gibson's "Daddy, Laura's not being /heyv/."<sup>2</sup>

The existence of sub-units that can occur in different orders can also lead to matching and segmentation. Thus the realization that both "put your shoes on" and "put on your shoes" can occur would prevent both *shoes on* and *put on* from being fossilized as units.

Older children have also been observed to use a strategy of segmenting an unfamiliar long unit on the basis of a partial match with a familiar word. Thus, at age 4;0, when Kelly Horgan's mother "explained that Bonnie and Kathy lived in the same dormitory . . . Kelly asked: 'Is the mitory for Bonnie's door or Kathy's door?'" (Horgan 1980, 16).

Wong Fillmore (1976, 1979) shows that for her second-language learners English phrases that had been memorized and used as wholes were more easily segmented than constructions heard for the first time. Having the phrases constantly available in memory and knowing at least their holistic meanings meant that the formulas the children learned and used constituted the linguistic material on which a large part of the analytical activities involved in language learning could be carried out. . . Once in the learner's speech repertory, they became familiar, and therefore could be compared with other utterances in the repertory as well as with those produced by other speakers . . . They provided the data on which the children were to perform their analytical activities in figuring out the structure of the language. [1979, 212]

Thus the formulas that these children found useful right from the beginning and that they originally assimilated whole so as to have something to say in a socially demanding play situation were also used by them as the basis for much of their linguistic analysis.

Roger Brown has described from a subjective point of view an experience with fission that he had when learning Japanese by the Berlitz method:

Hearing again and again the question *Kore wa nan desu ka?* (What is this?) but never seeing it printed I conceived of *korewa* as a single word; it is spoken without pause. Some lessons later I learned that *wa* is a particle, an unchanging uninflected form, that marks the noun it follows as the topic of the sentence. Interestingly enough I did not, at once, reanalyze my word *korewa* and such others as *sorewa* and *arewa* into noun and particle forms. I did not do that until I started to hear such object forms as *kore o* and *sore o* and *are o* in which *o* marks the direct object. Then the truth dawned on me, and the words almost

<sup>2</sup> I have collected anecdotes on overanalysis of this particular word by four different children. The information has come from Robert Gibson, Michael Peters, Steven Schoen, and Ron Scollon .

audibly cracked into *kore*, *sore*, and *are*, three demonstratives which took *wa* in the nominative form and *o* in the objective. [1973, 5]

This observation provides support for the claim that speech that is originally learned in "long units" does not just fade away, but may provide material for eventual analysis, with the resulting pieces themselves becoming part of the growing language system.

The idea that memorized chunks can provide the raw material for much of a language learner's linguistic analysis has so far been explicitly proposed and explored by only a very few people. Wong Fillmore (1976, 1979), of course, is one of these. Another is Clark (1974, 1977), who considers the effects of her own two children's strategy of incorporating large chunks of preceding adult utterances into their own utterances, for example:

(4) Mother: We're all very mucky.

Child: I all very mucky too.

(5) Mother: Do you want to get off? (He was riding on a roundabout.)

Child: No, I want to get on. (Meaning, apparently, that he wanted to stay on.)

[1974, 3, spacing mine]

In her 1977 paper she calls this strategy of copying a part of an adult utterance Extraction (342) and suggests that, armed with evidence that children do indeed do this, we reconsider

Brown's (1968) examples of children's questions that he considers could not originate as imitations: *What he wants?*, *Why you can't open it?*, *What his name is?* Although these questions do not reflect the word order of well-formed adult questions, they do reflect the word order of well-formed adult dependent questions, i.e. *Ask him what he wants. He'll tell you what his name is.* Such dependent questions are very likely to be noticed by children, since they are common as answers to the child's own questions, e.g. Child: *Where teddy?* Mother: *I don't know where teddy is.* When is a child more likely to be attentive to what his mother has to say than when he has just asked her a question? The above response to *Where teddy?* could be interpreted by the child as an expansion which corrects the incomplete form of his own question. [1977,343]

Later in the same paper she proposes that "imitation has a . . . positive role to play in the acquisition of syntax, by making adult forms available to the child, thus helping him to notice these forms more readily when adults use them, and enabling him to assimilate their function gradually through use" (351).

Bolinger, too, suggests that "learning goes on constantly - but especially with young children - in segments of collocation size as much as it does in segments of word size, and that much if not most of our later manipulative grasp of words is by way of analysis of collocations" (1976, 8). Elsewhere he observes that

words as we understand them are not the only elements that have a more or less fixed correlation with meaning. They are not even necessarily the first units that a child learns to imbue with this association. In the beginning stages a child apprehends holistically: the situation is not broken down, and neither is the verbal expression that accompanies it. That is why the first learning is holophrastic: each word is an utterance, each utterance is an undivided word, as far as the child is concerned. It is only later that words are differentiated out of larger wholes. [1975, 100]<sup>3</sup>

More recently, Snow has begun to look at the phenomenon of imitation more carefully. She points out that two specific kinds of imitation, both of which have generally been ignored for methodological reasons, may be particularly important windows on language development - namely, expanded and deferred imitations. Expanded imitations are defined as "including at least one stressed content word from the adult utterance and at least one word or morpheme not in the modelled utterance" (1981a, 207), for example,

Mother: What did we crash into last night, Nathaniel?

Nathaniel: Crash into living room.

[207]

Deferred imitations are those in which the copied, extracted, or imitated chunk does not get produced by the child right away, but only sometime later. Both Snow (1981a, 1981b)

<sup>3</sup> Note that Bolinger uses the term "holophrastic" in the less common perceptual sense of a single unit in the child's linguistic system made up of one or more morphemes of the adult language, rather than in the more common productive sense of a single word that is used as if it meant a whole sentence.

and Moerk and Moerk (1979) are able to show how such deferred or delayed imitations are used by their two subjects in developmentally progressive ways. Snow concludes that the judicious use of expanded and deferred imitations on the part of a language learner might constitute a very effective strategy for performing communicatively far above his linguistic level, and might at the same time provide the learner with linguistic material which is susceptible to segmentation and further analysis. [1981a, 211

### 3.1.3. Segmentation: evaluation

Not all applications of these segmentation heuristics just given will yield useful sub-units. In fact, most will not. Thus some heuristics are needed for evaluating possible segmentations, confirming some of them and being neutral about or disconfirming others. The three evaluation heuristics proposed here are based on three types of perceptual salience with respect to potential results of segmentation: convergence of several segmentation heuristics, frequency of resulting sub-units, and transparency of meaning: **EVAL:CONVERGE.** If several segmentation heuristics result in the same cut or subunit, the result is a better one than if only one segmentation heuristic could have achieved it.

**EVAL:FREQUENCY.** If a particular sub-unit resulting from a segmentation occurs frequently, especially over a short span of time, it is better than one that occurs less frequently .

**EVAL:MEANING.** If a clear meaning can be associated with a particular sub-unit resulting from a segmentation, then the cut is better than one that does not result in a unit with a clear meaning.

As with the extraction process, saliency factors can mutually reinforce each other, since if more than one is relevant their combination will increase the salience of a particular sub-unit. On the other hand, they may also work at cross-purposes scattering different kinds of segmentation cues across an utterance. These different kinds of interaction possibilities are reflected in EVAL:CONVERGE .

Pye (1980, 1981) has shown for children learning Quiché Mayan that stress is a particularly important perceptual determinant of which (phonological) parts of morphologically complex words are acquired first. Moreover, SG:STRESS works particularly well in languages where stress is fixed with respect to word boundaries: In such languages children rarely make segmentation errors that cross word boundaries. Evidence for this conclusion comes from studies of the acquisition of languages such as Hungarian (MacWhinney 1974), which has word-initial stress, as well as Quiché, which has word-final stress and in which SG:STRESS can converge with SG:BEGIN or SG:END, respectively (EVAL:CONVERGE). (See Peters 1981 for further discussion.)

The application of EVAL:FREQUENCY may cause the persistence of many of the missegmentations that language learners make. An example of such a missegmentation in English is the overanalysis of *behave* through the false segmentation of *be*. Similar missegmentation errors, this time involving the more familiar forms of the definite article, occur in French acquisition; for example, *l'avion* may be perceived as *la vion*, *l'électricité* as *les lectricités*.<sup>4</sup>

As the child's linguistic system develops, awareness of her or his own speech may become an increasing source of saliency for (re)analysis and segmentation. As will be discussed in more detail shortly, segmentation results not only in subunits to be stored in the lexicon, but also in patterns for the formation of novel utterances, some of which may prove more acceptable than others. This suggests another evaluation heuristic:<sup>5</sup>

**EVAL:PRODUCE.** If a novel utterance based on a presumed segmentation is not acceptable (not understood, not heeded, or somehow sounds funny), then such negative feedback casts suspicion on the segmentation.

<sup>4</sup> Eve Clark, personal communication.

<sup>5</sup> See also MacWhinney (1978) for discussion of a production-perception feedback cycle.

It must be borne in mind, however, that although language learners must monitor their own speech and become aware of discrepancies between what they produce and what they hear, not all such discrepancies are equally accessible at a given stage of language development. This claim is attested by the oft-repeated anecdotes of children whose language is impervious to repeated corrections by adult caretakers (e.g., Braine 1971, 160-1). I would like to suggest that the monitoring and awareness of discrepancy that does take place occurs at those points in the system that are currently being most clearly focused on, since this is where the most active development is taking place. Any discrepancies that occur in the fuzzy background of detail not yet focused on will be ignored.

A segmentation that is rejected by these evaluation heuristics may simply be quietly forgotten (i.e., the sub-units may fade from storage), or it may be actively repaired.

**SG:REANALYZE. When a segmentation fares poorly with respect to these evaluation heuristics, reanalyze the original unit.**

The following sequence, reported to me by Steven Schoen, is a good example of SG:REANALYZE in action:

Christine is a 4-year-old girl; Steven is an adult male. They are riding in the back seat of a car. Christine is acting rowdy. Steven tells Christine she "must behave" if she wants Steven to read her a book. He is, however, paying more attention to a cassette tape that is playing music than he is to Christine. A couple of minutes later:

C: Steven I am /heyv/.

S: What? You hate? What do you hate?

C: /heyv/. I am /heyv/.

S: You hate? You hate me? The music? What?

C: No, I am /heyv/. /heyv/.

S: I don't know what you are talking about.

Silence. A bit later:

C: I /heyv/.

S: You hate me?

C: (shakes her head no)

S: Who do you hate?

Silence. A bit later:

C: I am behaving.

In this example, Steven's repeated lack of understanding twice forced Christine to try and reanalyze the word *behave*. It was only when she reached the correct (adult) analysis that Steven became aware of the nature of her difficulty.

A somewhat more complex example of reanalysis comes from Iwamura's study of the speech of two 3-year-old girls, Suzy and Nani, who were recorded daily (five days a week) as they talked to each other in the back seat of a car on their way to or from nursery school. In order better to communicate with each other the girls often struggled valiantly with constructing a particular sentence, and in the process they sometimes produced evidence about analysis in progress. A particularly intriguing example involves what Iwamura calls the "unpacking" of the catenative *wanna*. In this instance Suzy (3;8) had suggested that Nani (3;5) pretend that Nani's shawl was a poncho, but Nani did not want to do this:

7. S: Just *pretend* to have a poncho.

8. N: No, I wan' to. No I don' wanna. I wanna be it, a, shawl.

9. S: Sha'

10. N: I wan' it to be a *shawl*. I wa { n'

11. S: { Sha', sha'

12. N: (shouts) No, I say it *myself*. (giggles) [1980, 85]

The reanalysis that allowed Nani to break *wanna* into *want to so* that **she could** insert *it* (line 10) can be seen more clearly if we look at the way Iwamura has diagrammed utterances 8-10

8.	N	No	I		wan to		
8'		No	I don		wanna		
8''			I		wanna be it,		a shawl.
9.	S						sha'
10.	N		I		<u>wan it to be</u>		a shawl. [86]

As Iwamura points out, *wanna* is hard to analyze, not only because it tends to occur as a unit in American English, but also because it can be analyzed in two ways:

In the case of *wanna*, Nani had probably used it for a long time in sentences such as "I wanna cookie." and "I wanna come too." She would have had to learn the difference between *wanna* meaning "want a" and *wanna* meaning "want to" before she could approach the construction of *want* + NP + VP. [87]

Though it is a good bet that attention to catenatives such as *wanna*, *gonna*, *oughta*, and *hafta* will provide valuable insights into the fission process, Iwamura points out that evidence for this kind of analysis will have to be collected in conversational contexts. This is not only so that the successive breakdown stages can be observed, but also because such analysis tended to occur

at times when the children were under communicative stress. In such situations they felt an urgent need to express certain ideas. This need forced them to strain their linguistic resources to their current limits . . .

The development of new analyses may occur at such moments of great communicative need. This is likely to be indicated by the breaking down of previously unanalyzed speech formulas. [1979, 10-11]

See 4.3 for further discussion of communication pressure.

### 3.2. Extraction Of Morphosyntactic Frames

As I have already suggested, the process of segmenting units yields not only the sub-units but also information about the underlying structural pattern of the original unit. We are now ready to consider how children may extract and make use of such structural patterns.<sup>6</sup> At the very early stages of acquisition of syntax that I discuss in this book, I do not believe that it is possible to distinguish between surface and deep linguistic structure with respect to children's internal representations of the simple morphosyntactic frames<sup>7</sup> they are working with. Whether children go on to develop such a distinction, and if so how this might happen, is a question I am not prepared to address. Therefore my presentation here will be very much at the surface level.

Structural information does not become available to the learner immediately upon segmentation of a long unit into two shorter units through the application of SG:MATCH; at first the learner will know no more than that she or he is dealing with the juxtaposition of two units. If, however, the child is able to collect a number of segmented sequences, all of which begin (or end) with the same unit (e.g., *all clean*, *all done*, *all dry*, *all gone*, *all through*, *all wet*), she or he will be in a position to make an abstraction from unit + unit to unit + list (i.e., *all + clean*, *done*, *gone*, *through*, *wet*). As long as the list is a closed class of specific items where each combination has been learned individually, the pattern is not yet "productive," but is what Braine calls a "positional associative pattern" (1976, 9). (The example just given is from his data, p. 7.) The next move involves perhaps the most crucial

<sup>6</sup> As we know, children do succeed in acquiring the syntax of adult language, by whatever means. In fact, they may be more successful at extracting patterned regularities from input language than are adult language learners (Newport 1981). We can speculate that although the apes that have been taught sign language may be able to extract units from the sign language they see, and although they might even be able to segment longer units into sub-units, it is precisely in the task of extracting the underlying structural patterns of these longer units that they may fail. As we shall see, there is evidence that such pattern extraction is at least one route to the acquisition of syntax for children. It would be of interest to look at the data on apes' acquisition of sign language within this framework to see how far they seem to be able to get, thus pinpointing their limitations more precisely.

<sup>7</sup> My term "morphosyntactic frame" is approximately equivalent to Braine's (1976) term "positional formula" and Wong Fillmore's (1976) term "sentence frame." Braine and Wong Fillmore, however, are focusing on the productive aspect of early constructions, whereas I am focusing on the perception of constructional patterns, in particular, on awareness of constraints on the order of constituents (syntax), on the separation of content items from grammatical functors (morphology), and on the specification of possible slot fillers.

abstraction in the early acquisition of syntax, the generalization from unit + (closed) list to unit plus (open) class. This move entails the recognition that there is some general feature that characterizes all the members of the list and that any other unit that shares this characterization can also be combined with this particular (constant) unit. Once this abstraction has been accomplished, the child has what Braine calls a "positional productive pattern" (1976, 8) and what Wong Fillmore calls a "frame" with an "analyzed slot" (1976, chap. 6). Although I will generally stick with Wong Fillmore's terminology, I may sometimes refer to such a pattern as being of the "constant + variable" type.

### 3.2.1. Frames

The move from unit + unit through unit + list to frame + slot is summarized in the following pair of heuristics:

**FRAME.** If two (or more) units, after segmentation by any of the SG: heuristics, appear to share a common sub-unit, A, followed or preceded by alternative sub-units, B or C, and so on, take note of this fact, namely, that there is a pattern in which A can be followed (or preceded) by either B or C, and so on.

**SLOT.** When you have a list of items, such as B, C, and so on, that can co-occur with a given unit, A, notice properties common to the members of the list and assume that other items that have those properties can also occur in that slot.

If the child assumes that such frames, which have been generalized from repeated instances of particular constructions, will continue to recur, the child can use this knowledge as a segmentation aid:

**FR:SEGMENT.** Use known frames as templates in attempting to segment new utterances.

Although frames are different from lexical units in that they contain a variable part, they are a possible way to generalize units. That is, they could be viewed as a more general kind of unit, namely, one that has a variable part. Pursuing this line of inference could lead the child (or us) to a lexically based (theory of) syntax in which syntactic information is naturally stored in the lexicon. In any case, the main point here is that these frames, wherever they are stored, embody rudimentary syntactic information and represent a possible start in the learning of syntax.

Supporting data for this claim come from Braine's monograph (1976), in which he examines the data on the first word combinations of twelve children, looking for the kinds of early patterns they use. If, within a given child's corpus, there is a set of utterances involving combinations with a particular (constant) word (e.g., *more*), this is a "pattern." If there are statistically significantly more utterances with the constant term in one position than in the other, then the pattern qualifies as a "positional pattern" (11-12), for example, *more car, more cereal, more cookie, more fish, more hot, more juice, outside more* (7). (Required ratios for the .05 significance level include 6:0, 8:1, 9:2.) If all the combinations within a corpus could have been taken directly from adult utterances, the pattern is termed "positional associative" (9), for example, *more cereal, more fish, more juice*. If, however, there is evidence of novel combinations on the child's part, the pattern is considered to be "productive," for example, *more car* 'drive around some more', *more hot* 'another hot thing' (8).

Braine finds evidence in all twelve corpora for positional productive patterns. These patterns are, moreover, quite restricted semantically in that they are "formulae of limited scope for realizing specific kinds of meanings" (4). On the basis of semantic content he identifies a number of basic types of common early patterns, some of which are of the constant + variable type (the others will be dealt with in 3.2.3.), for example, *see + X, hot + X, two + X, more + X, allgone + X, there + X, want + X* (56-7). Although Braine's focus is on the limited semantic scope of these patterns, his data can be interpreted in terms of the limitations on combinatorial possibilities as well; that is, children learn a number of highly

restricted two-part frames without perceiving for some time that they can be generalized into a smaller number of more general frames. Thus *big + X*, *little + X*, *hurt + X*, *old + X* would exist at first as independent frames rather than as a more general frame PROPERTY + X (33-5).

We will consider these more general frames presently; let us first examine some examples of two-part frames with one constant and one variable part. The oversegmentation of *behave* may in fact be based on the perception of a frame-and-slot type pattern since children are frequently exhorted to "Be good," "Be nice," or "Be quiet," as well as to "Behave." This could lead to the analysis Be X, where X = (good, nice, quiet, /heyv/).

As discussed in 2.2.2, for some children the input speech may include many expressions that introduce various kinds of labels. From such expressions these children may discover useful formulaic frames such as *that's a X*, *what's this X*, *see the X*, which can be used as segmentation aids. In fact, such a strategy may work so well that adult observers never notice it. But it could also lead to undersegmentations, as in the following examples:

1. Clark (1977, 350; Adam nearly 2;4):  
 Mother: What's the cat's name?  
 Adam: Cat name.  
 Mother: What's that a picture of?  
 Adam: Picture of.
2. Peters (tape of Minh at 1;9):  
 Mother: What is this whole thing?  
 Minh: Whole thing.  
 Mother: Huh?  
 Minh: Whole thing.

In these examples Adam and Minh seem to have been segmenting on the basis of frames such as *what's the X*, *what's that a X*, and *what's this X*. Or perhaps they had discovered only a single poorly perceived frame such as *what's th-- X*.

A similar strategy can be used in Hebrew, where labels are introduced by the morpheme *ze*, as in *ze kelev* 'This/ it's a dog'. Ruth Berman has described for me a three-year-old Israeli child who talked about an animal called a *bra* for which no one could determine the referent. Finally they realized that she was referring to a zebra: *zebra* had been heard as *ze bra* 'It (is a) bra'.

Thomas (1980) describes the speech of fathers to their 2-year-old sons as they were videotaped in a laboratory playroom. She finds that much of this speech can be described in terms of routines that have predictable associations between syntactic forms and pragmatic functions; in fact, she calls them "SYN-PRAG" routines. These include not only noun and attribute introducers such as *that's(-a) X*, but also such verb introducers as

<i>whyncha</i>	+ verb	(why don't you X)
<i>let's</i>	+ verb	
<i>wammeda</i>	+ verb	(want me to X)
<i>can you</i>	+ verb	
<i>ya hafta</i>	+ verb	

Perception of such frames could help these boys to segment labels for actions (i.e., verbs).

In her study of Spanish-speaking children learning English, Wong Fillmore discusses what she calls "sentence producing tactics." She notes that these sometimes involve "paradigmatic substitution" in "formulaic sentence frames" where substitution slots have been discovered but the syntax of the whole construction has not yet been completely analyzed (1976, 305).

Consider, for example, I wanna X, where X is a NP, which functioned as a formulaic sentence frame for some of the children. The use of the categorial symbol NP indicates that in this particular formula, the structure has been analyzed to the extent that the user realizes that a variety of noun phrases can be substituted in the formulaic frame, such as "I wanna *the little ones toys*," "I wanna *red color*," and "I wanna *you toy*." The NP's themselves may or may not be analyzed further - that is, some may be analyzed into component parts . . . or they may be partially or wholly unanalyzed formulas themselves. [306]

At least three of the children whom Wong Fillmore studied were observed to go through a stage where they were producing utterances consisting of either one or two units, and many of these two-unit utterances were based on formulaic frames. Thus Juan during Time II<sup>8</sup> produced formulaic sentences built on *I wanna be* + noun phrase, for example, "I wanna be the doctor," "I wanna be the cowboy" (321). Similarly, Jesus during Time I produced formulaic sentences built on *lookit, looky*, or *hey look* + NP or adverb, for example, "lookit, like that," "looky, chicken" (344). And Alej during Time I produced three types of formulaic constructions: unit + vocative, for example, "'scuse me, Kevin," "Teacher, wha' happen?"; formulaic sentences built on *looky* or *lookit + X see*, for example, "Looky telephone see," "Looky see"; formulaic sentences formed from NP + *es brokie*, for example, "Mi pencil es brokie" (374).

### 3.2.2. Frames: evaluation

As we have seen, even in this limited two-part form, frames can be useful in the segmentation process itself, in that, once a frame is established ("taken note of" in the terminology of FRAME), the occurrence in speech of the constant part of the frame can be a strong indication that an unfamiliar neighboring unit (preceding or following, as the case may be) is extractable, and thus that the whole construction is segmentable. This leads to a new evaluation heuristic based on the recognition of frames:

**EVAL:FRAME. If a segmentation yields the form of a known frame, the segmentation (and its sub-units) is probably a good one.**

Just as with units, meaning may accrue to certain frames. There may be a convergence at work here in evaluating frames: If a frame can be clearly tied to some meaning, it is a better frame than one that cannot.

A frame may occur so frequently with unfamiliar slot fillers that children may come to expect a large class of units to occur in that frame. This could lead to a production strategy in which children produce not only utterances they have previously heard and extracted, but novel utterances based on such a frame, filling the slot with an item that they may never have heard in this slot but that shares some similarity with items they have heard there. This strategy can produce feedback for confirming or disconfirming the segmentation of the frames themselves, in a manner analogous to EVAL:PRODUCE.

**FR:EVAL.PRODUCE. Use the feedback from novel utterances based on a presumed frame to evaluate the frame.**

When these evaluation heuristics converge with those suggested earlier, both the frame and the sub-units will be reinforced. Thus the overanalysis of *behave* may be reinforced by frequency as well as by the good fit to a familiar pattern - until attempts to make novel constructions with one of the sub-units result in negative feedback and force reanalysis.

Wong Fillmore's subject Nora was a child who was particularly willing to produce utterances using new frames she had discovered, discarding those that did not seem to work well and keeping those that did. For instance, she made use of the similarities and differences of two formulas that she had learned (*I wanna play wi' dese*, and *I don' wanna do dese*) to discover two frames. In Wong Fillmore's words:

No doubt the similarity of these expressions allowed her to discover that the constituents following *wanna* were interchangeable, and that she could say *I don' wanna play wi' dese* and *I wanna do dese*. As soon as she realized that these phrases were interchangeable, she was on her way to discovering that similar phrases could be inserted. At that point, these formulas became formulaic frames with analyzed slots: *I wanna X [where] X = VP* and *I don' wanna X [where] X = VP*. [1979, 212-13]

In terms of the heuristics presented here, we could say that Nora first used SG:MATCH to match up and segment the *wanna* in the two phrases that she had already extracted:

I-wanna play-wi'-dese  
I-don'-wanna do-dese

<sup>8</sup> Time I refers to the first quarter of the school year during which Wong Fillmore conducted the study; Time II is the second quarter.

Application of FRAME would then result in the two formulaic frames described by Wong Fillmore. Positive feedback from the production of the new constructions suggested by these frames would be evaluated by FR:EVAL.PRODUCE, and would result in confirmation of the segmentations, the resulting frames, and the sub-units.

But this is not the end of the story, since Nora went on to apply her heuristics to her new (sub-) unit *play wi' dese*, with further analysis resulting: When she realized that *dese* could be segmented from *play wi'* and replaced by any NP she had a new formulaic frame *play wi' X*, where X = NP. This formulaic frame could now be used wherever a verb phrase was called for, including, for example, *Le's X*, where X = VP ("Le's play wi' dese"). The breakdown process can be schematized as follows:

<u>Utterance</u>	<u>Analysis</u>
Iwannaplaywi 'dese.	(unit)
Iwanna playwi'dese.	Iwanna + VP
playwi' dese	playwi' + NP

Wong Fillmore concludes:

Thus, the analytical process carried out on formulas yielded formulaic frames with abstract slots representing constituent types which could substitute in them, and it also freed constituent parts of the formula to function in other constructions either as formulaic units or as wholly analyzed items. Finally, when all of the constituents of the formula have become freed from the original construction, what the learner has left is an abstract structure consisting of a pattern or rules by which he can construct like utterances. [1979, 213]

### 3.2.3. Frames: generalization

So far we have considered only how children might deal with simple two-part frames. It is possible to generalize such frames in several directions. I have already mentioned that children may generalize by inserting into the slot units they have never actually heard in that position. Moreover, the shape of the frame itself may become more complex. I will for convenience describe this development with the simplified statement:

#### **FR:GENERALIZE. Look for more general frames.**

This heuristic produces several types of increasingly general results: discontinuous frames with one slot, discontinuous frames with multiple slots, and frames so general they can no longer be termed "frames."

**Discontinuous frames with one slot.** Let us first look at some evidence that children are indeed able to handle discontinuous frames. Then we will consider the question of discontinuity more generally.

Sinikka Hayasaka observed that her son Satoshi, while at the stage where he was constructing utterances no longer than two words (1;8), learned the sentence *What a nice bicycle you have* from some Sony Talking Cards he had.<sup>9</sup> Soon after he learned this sentence he produced "What a nice elbow you have" and then "What a nice daddy you have." Assuming that Satoshi already knew the words *bicycle* and *daddy* (*elbow* appeared for the first time in this construction), we can say that after extracting *What a nice bicycle you have* he used the word *bicycle* and SG:MATCH2 to segment this phrase as follows:

what-a-nice bicycle you-have  
bicycle

By then applying FRAME he would have discovered the pattern

what-a-nice X you-have

which he then tried out (applying FR:PRODUCE), replacing X with other units he knew (*Daddy, elbow*) and evaluating the response (EVAL:PRODUCE). There is not enough evidence to determine just how general a pattern Satoshi was able to induce, although his mother

<sup>9</sup> Personal communication. These cards are designed for teaching English to Japanese speakers: A sentence is recorded on a magnetic tape strip along the card, and when the card is inserted in a special playback machine the recording is heard. Satoshi was able to operate the machine himself and loved to play with the cards.

noted that he used only concrete nouns in the phrase. He does, however, seem to have found a formulaic frame with an analyzed slot, much as Wong Fillmore's subjects did.

Slobin (1973, 1981) and MacWhinney (1978) have repeatedly suggested that discontinuity is difficult for a child to deal with. Their evidence comes from certain discontinuous structures (e.g., French negative *ne . . . pas*; Arabic negative *ma . . . sh*; English progressive *be . . . -ing*; Russian and Hungarian case marking involving both prepositions and case suffixes), which children seem to deal with by first producing only the second of the two elements in question. Saliency factors surely play some role in the particular cases cited. Thus French *ne* is phonologically almost nonexistent. Is the same true for Arabic *ma*? The English *-ing* suffix is certainly the most constant aspect of the progressive, since the form of the verb *be* not only is variable (*is, am, are*) but can be phonologically much reduced ('s, 'm, 're). As for the case-marking constructions (e.g., Russian locative), it may be that the prepositions are more variable than the case inflections (i.e., that several different prepositions take the same inflection). If this is true then the more constant (or frequent) inflections would be more salient. Of course, the greater salience of word ends may have an effect here, too. In other words, the cited examples do not provide a real test of the effects of discontinuity, since the two pieces are not equally salient.

All of these cases, moreover, involve discontinuous *morphemes*, where the two pieces are at once semantically and functionally related. These relationships do not necessarily hold for discontinuous *frames*. Thus, although at the morphological level there may be justification for Slobin's "Avoid interruption . . . of linguistic units" (1973, 199) or MacWhinney's "The child avoids acquisition of discontinuous morphemes" (1978, 11), discontinuous frames do not need to be avoided altogether. Evidence from the success of pattern practice and substitution drills shows that adult language learners can handle discontinuous frames quite easily. And the example just cited of Satoshi Hayasaka shows that children can handle such frames, too.

On the other hand, Slobin's and MacWhinney's claims do reflect two common-sense processing constraints suggested by Slobin (1981); since it is hard to process too many elements at once one should do two things: attempt to keep the total number of elements in any structure to a minimum, and try not to be processing more than one element at a time (i.e., one should at first proceed as if structures are not embedded). But if the situation seems to require it, discontinuity is acceptable (within one's processing capabilities).

**Discontinuous frames with multiple slots.** Although I have no example of such frames from first-language acquisition, the following, from Wong Fillmore, is a good example from children's second-language acquisition and shows what we might expect to find in the former type of data. After around five months of exposure to English, 7-year-old Jesus had the following sentence frame:

*is + Verb + it + Noun phrase*

which led to such productions as

Is putting it dese.

Is making it the car.

Is got it dese one.

Is got it un truck. [1976, 350]

**A constant part of a frame becomes a variable.** Finally, the frame may itself "dissolve," the constant parts (or some of the constant parts) becoming variable slots. Ultimately the entire frame becomes a pattern of slots fillable by specific classes of items.

Evidence for this step can be found in Braine (1976) and Ewing (1981). In 3.2.1 we saw that some of the basic types of common early patterns that Braine identifies are of the constant + variable type. The others are of the variable + variable type (X + Y) and express such basic semantic notions as possession 'X has a Y', class membership 'X is a Y', actor + action 'X Ys', and location 'X is in, on, or has moved to Y' (Braine 1976, 56-7). Working within Braine's concept of limited-scope patterns, Ewing asks how children might extend their productive capabilities. He proposes that in order to do so they would have to "integrate these patterns to create . . . more inclusive patterns" (2), and he suggests that there are two main kinds of pattern integration, "horizontal" and "vertical." We will discuss horizontal integration later in this section, under "Generalization of slots." Vertical integration involves



We have seen such generalizations in a number of the examples already cited in this chapter, for example, Satoshi's generalization of the *bicycle* slot to include *Daddy* and *elbow*; Jesus's action (*putting, making, got*) and object (*dese, the car, dese one, un truck*) slots; and Nora's more complex analysis and refinement.

A second approach to the generalization of slots involves the realization that slot fillers may themselves be frames. If it is true that frames are a possible generalization of units (as proposed in 3.2), it would follow that if units can occur in frames, frames must be able to do so too.<sup>10</sup> This type of generalization corresponds to Ewing's second kind of pattern integration, which he terms "horizontal" (1981, 3), for example,

big/little + X		
see + X	>	see + big/little + X
I + want		
want + X	>	I + want + X

Horizontal integration also involves the important move from two- to three-word utterances, and Ewing's data again support such a process.

### 3.3. Further Examples

Let us now look at several more complex examples, each of which illustrates the application of several of the heuristics that we have been considering. The first two examples illustrate children's temporary misanalyses of bits of the language they are trying to learn - misanalyses that are eventually corrected. The subsequent examples are from older children and adults, and they illustrate how the use of certain heuristics can lead to misperceptions or misanalyses, some of which may persist for a long time.

1. The following data from Minh are rather intriguing because they seem to reveal a case of misanalysis that was temporarily reinforced by another (phonologically similar) word that happened to come along at just the crucial time. Briefly, the sequence (as I reconstruct it from my tapes and field notes<sup>11</sup>) was as follows: At 1;9 Minh was given a book containing a picture of a cow in a mid-leap over a crescent moon. This picture was accompanied by the phrase "The cow jumping over the moon." This seems to have fascinated him, and he evidently segmented off the first (stressed) and last syllables of this phrase, which he produced himself as "cow moon." This phrase was then extended to "cow moon daddy," which he was heard to repeat "at least fifty times" at a party one evening - whenever he saw either the moon or his daddy. At this point any reference to a cow already seems to have gotten lost. The next development seems to have been that by 1;11 *cow*, which had the form <ka><sup>12</sup>, was interpreted as an existential demonstrative introducer for labels: He seems to have constructed a frame <ka> + X, where X was some kind of label. Thus my data include "ka moon," "ka baby," and "ka dirty." For the next month or so <ka> showed up sporadically in my tapes, especially when Minh was reading books and pointing out things, for example [ka lu] 'ka (ba)lloon', [ka mu] 'ka moon', [ka pipi] 'ka/gotta(?) peepee'. It was not, however, the only form used to introduce labels, since I also find <ba> (e.g., [ba bɛrz] 'the bears', [ba sak] 'the sock') and <dl(z)> (e.g., [dlrai] 'this write', [dlz xrak] 'this clock'). At 1;11.18 the use of <ka> increased slightly, at least on my tapes; it was now used to point out things he saw while watching television .

<sup>10</sup> I am indebted to Robert Hsu for this observation.

<sup>11</sup> Field notes, vol. 2, p. 69. Since I was out of town between 1;9 and 1;11 I am relying on what was told me by Minh's mother and Ron Scollon about developments while I was away.

<sup>12</sup> Since Minh's pronunciation often varied rather widely I have adopted the convention of using angle brackets in such cases to indicate a reconstructed underlying target form (an abstracted impressionistic average). In this case, <ka> varied phonetically from [ka] and [kə] (most of the time) to [kail and [kil a few times.

A week later (1;11.25) a new, and evidently temporarily confusing, element entered the picture in the form of his brother's new Kikaida doll.<sup>13</sup> In the tape I made on that day Minh said <kadaw> more than twenty times in referring to Kikaida doll. Although he made a few tries at a fuller pronunciation, for example, [kadhaida:], [haikədaw], he seems to have settled on <kadaw> as the best working version of *Kikaida* for the moment. Moreover, since he also heard the word *doll* in other combinations, he must have segmented (kadaw) into *ka doll* on the basis of his extracted and productive frame. Later on in the same tape, when he was watching "Sesame Street" with his brother, Minh used <ka> at least seventeen times in the old existential/demonstrative way as he commented about things he was seeing on the screen, for example, "ka lion," "ka four," "ka nine," "ka foot," "ka fall-down." Since I recorded the peak usage of the existential <ka> on the same day that Kikaida entered the picture, it seems as if the one temporarily reinforced the other. By the time of the next tape, two weeks later (2;0.9), the usage of <ka> seems to have been restricted to reference to Kikaida, and this development was confirmed by his mother at 2;1.13.

This history of the evolution of <ka> is a good illustration of the complexity of the task of linguistic analysis that the child faces, as well as of the difficulty the linguist has in drawing inferences about what is going on. A good guess about the sequence of strategies applied by Minh is the following:

1. He uses SG:BEGIN, SG:STRESS, and SG:END to segment *cow* and *moon* from the beginning and end of "The cow jumping over the moon."
2. He produces them together and fuses them into a single phrase with the underlying pattern *ka + moon*.
3. He uses FRAME to generalize this pattern to a frame with a slot *ka + X*, where X is some kind of label.
4. He uses SG:MATCHI and FR:SEGMENT to segment the new unit *Kikaida* into *ka + doll*, on the basis of this pattern and another known unit, *doll*.
5. He discovers through feedback and further analysis (EVAL:PRODUCE, SG:REANALYZE) that *ka* is not used in an existential/demonstrative way by adults. This leads to loss of *ka* except in referring to Kikaida. The existential/ demonstrative function is taken over by <dlsɪz> and <dlsə>.

2. Another insight into the segmentation process is drawn from data on 3- to 6-year-olds that were collected in Pasadena, California (Peters & Zaidel 1980). The subjects were thirty nursery school children, five boys and five girls from each of three classes (Group IV: range 5;1-6;3, mean 5;8; Group III: range 4;3-5;1, mean 4;10; and Group II: range 3;3-4;5, mean 3;10, Group I having been found incapable of performing the tasks in question). The tasks the children were asked to perform included a picture-naming one ("Can you show me X?") and a homonym-recognition one (presentation of four pictures together with the instruction "Can you show me two pictures that [have names that] sound the same but mean different kinds of things?")

One item in particular shows an interesting progression from an all but unknown vocabulary item in Group II, through a unitary item in Group III, to a segmented phrase in Group IV. This was the word *bow* as in *bow and arrow*. On the naming task ("Can you show me bow?"), only four of the ten children in Group II, when presented with four pictures including one of a bow and arrow but none with a ribbon-type bow, were able to point to the right picture (see Table 1). Of these four, two spontaneously made remarks as they pointed: "That's a bow an' arrow for the Indians," "Bow a' arrow." In Group III all of the children could point to the correct picture (although one needed a second try), and half of them made spontaneous remarks about "bow and arrow," including the phonological misanalyses "bow and narrow" and "bow nan arrow" ("bone an' arrow"?). In Group IV all but one did the naming task correctly, and only one asked "Bow an' arrow'?"

<sup>13</sup> Kikaida is a Japanese superhero, the subject of a television series that was then the rage among children in Hawaii, who eagerly acquired all the toys that were being produced to take advantage of this enthusiasm.

Table 1. *Children's naming and homonym responses to bow (and arrow)*

Group	Naming		Homonyms 1		Homonyms 2	
	No.corr.	Spont. phrase	No.corr.	Spont. phrase	No.corr.	Confusion w. <i>bone</i>
II	4	2	3	1	1	2
III	9 > 10	5	4 > 6	3	1 > 6	4
IV	9	1	6 > 8	2	5 > 8	0

Note: > = after self-correction

The homonym-recognition task was given twice: The first time the set of pictures was *bow* (ribbon), *bow* (and arrow), *gun*, *hoe* [rhyme]; the second time the pictures were *bow* (ribbon), *bow* (and arrow), *know*, *bone* [assonance]. The target pictures differed from the first set to the second. On the first presentation the homonyms were found by three children in Group II, six in Group III (of whom two made at least one wrong choice to begin with but clearly knew why the correct pair was right when they found it), and eight in Group IV (of whom, again, two self-corrected). Again several spontaneously said the phrase "bow an' arrow" while doing the task (see Table 1).

The second presentation of the homonym task was the more interesting for us in that it contained (by design) an assonance, *bone*, that (unintentionally) was phonologically contained in the phrase *bow and arrow*. And this phrase seems to have been the way the vocabulary item *bow* was first acquired by most of these children. The results on this presentation were slightly poorer than on the previous one (see Table 1): one correct in Group II, six in Group III (of which five made initial wrong choices), and eight in Group IV (of which three were initially wrong). When we look at the distribution of mistakes involving *bone* we find two in Group II (and in neither case is it clear that the phrase *bow and arrow* played any part) and none in Group IV. In Group III, however, four of the children picked *bone* as one of their choices, and two of them very clearly were confused by the phrase "bowan'arrow." For example, A.J., girl 5;1:

<u>Points to</u>	<u>Says</u>	<u>Investigator says</u>
<i>knot, ribbon bow</i>	String and string.	That's the same kind of string. They should have different meanings.
<i>bow and arrow</i>	Bow an arrow.	And?
<i>bone</i>	Bone. Nope. Bow an' arrows. Bow an arrows an' bone. Bone. Bone an' bone.	Bow and bone?  They're not the same, are they?

Another example is E.N., girl 4;3. She couldn't find the pair when asked to "find two that sound the same but mean different kinds of things," so the investigator (by design) pointed to the bow and arrow and asked if she could find "another picture that sounds like this."

<u>Points to</u>	<u>Says</u>	<u>Investigator says</u>
	Bone an' narrow? I don' know where the other one.	
<i>ribbon bow</i>	Bone an' arrow	
<i>bone</i>	Bone an' arrow'?	
	Ah where dat other bone an' arrow'?	Well, maybe not the whole thing.
	Bone. Bone an' arrow.	

In summary, then, these data seem to illustrate the following developmental sequence with respect to the word *bow*: The youngest children (Group II) tended not to know the word at all; when it was first learned (Group III) it tended to be learned as part of the unitary phrase *bow and arrow*, which may have been tied to a particular context ("for the Indians"). The Group IV children, however, had already correctly segmented *bow and arrow* into its adult constituents. The fact that five of the children in Group III who had difficulty with the homonym task in the presence of the distracter *bone* were eventually able to find

the right pair seems to indicate that for these children the segmentation process may already have begun but had not yet been completed. That is, the data they had gathered so far on this phonological sequence were not yet sufficient to allow them to reject *bone* immediately as a possible candidate for a constituent. Once the learner feels confident in making such rejections categorical and immediate, segmentation can be said to be complete.

3. Let us now turn to evidence for the use of segmentation heuristics by older language processors. In order to make sense of the streams of speech they hear, even adults must apply strategies such as those we have been discussing. Adults differ from children, however, in that their use of these strategies has become very automatic, and their knowledge of the potential words and structures they will hear is very extensive. Nonetheless, they may occasionally make wrong guesses about segmentation points or sub-units. If such guesses are too much at odds with the expected context of a message, an attempt at repair will be made. The following discussion is based on data from two of the few studies that have been made of such misperceptions (Browman 1978; Garnes & Bond 1980).

Browman (1978) deals with a corpus of 222 misperceptions that were heard to occur in casual speech. The errors were collected by linguists in Los Angeles, California, and Columbus, Ohio, who actually observed their occurrence. A careful look at Browman's data suggests that perceptual analysis of chunks of fluent speech follows a specific set of steps (in English, at least). Attention is first paid to those syllables with primary stresses (SG:STRESS). Since these are the most salient syllables, containing longer, fuller vowels, aspirated stops, and so on, they are more accurately perceived phonetically. Next an attempt is made to find a sequence of plausible lexical items<sup>14</sup> that fit with the stress pattern and the segmental sequences of the matched (stressed) syllables (SG:MATCH). The next step is to try to interpret the unstressed syllables in such a way that the syntactic expectations for the phrase are met without violating the rhythmic stress pattern of the input (FR:SEGMENT). It appears that in these unstressed syllables phonemes may be added, dropped, or altered as necessary to accomplish this syntactic-semantic fit. Also, contrary to Browman's claims about the phonetic saliency of word boundaries (97), these seem to get shifted quite often (e.g., in about one-third of the examples in Browman's corpus).

Garnes and Bond consider a corpus of approximately 900 errors collected in circumstances similar to Browman's. On the basis of their data they propose four basic (ordered) strategies for speech perception (1980, 237-8; I have embedded, in square brackets, the corresponding heuristics developed in this chapter):

1. "Pay attention to stress and intonation patterns" (237) [SG:INTONATION, SG:RHYTHM, SG:STRESS] and segment the utterance into "phrases that can at least roughly be identified on the basis of stress and intonation" (238) [EX:SUPRASEG, EX:RHYTHM].
2. "Pay attention to stressed vowels" (237) [SG:STRESS].
3. "Find a word" (238); that is, scan for possible lexical items [SG:MATCH].
4. "Find a phrase," which must "be given some semantic analysis, 'edited' for appropriate morphological markers, and probably ultimately unified into a semantic representation of the utterance" (238) [FR:SEGMENT, EVAL:FRAME].

If the listener cannot come up with an analysis that makes syntactic-semantic sense, the misperception will have to be signaled and the original utterance clarified. It is interesting to note, however, that in those errors that have been reported, syntactic integrity seems to take precedence over semantic plausibility. That is, when it is possible to make an analysis at all, the resulting phrase fits the preceding sentence syntactically, even though it may not fit semantically.<sup>15</sup>

Let us look at a specific example, one in which I was heard to say "in closeted time" when I had actually said "a clause at a time." The entire sentence was "Pawley thinks that

<sup>14</sup> By 'plausible' I mean that somehow they also fit in semantically with the listener's expectations.

<sup>15</sup> A. W. F. Huggins has pointed out to me, however, that this seeming bias may be due to the greater communicative need for reporting misperceptions that are semantic misfits than for reporting those that are syntactic misfits but make semantic sense.

people construct sentences *a clause at a time*." My hearer evidently had no trouble identifying the stressed syllables [klaz] and [taim], although his semantic interpretation of the former was at variance with my intention. Next he had to account for three unstressed syllables, which he accomplished by adding two phonemes, altering an unstressed vowel, and deleting two word boundaries, to come up with an adverbial phrase that did not make sense - hence his request for repair:

a clause at a time:     [\ kl á z \ t \ t à i m]  
 in closet-ed time:     [I n kl á z \ t \ d t à i m]

Thus the kinds of extraction and segmentation heuristics that are crucial to children learning a new language system are useful, in a less major way, to adults in their processing of heard speech.

### 3.4. Factors Affecting The Course Of Segmentation

So far we have been focusing on children's heuristics for segmenting extracted units. Just as with the extraction process, however, the course of segmentation will depend not only on children's own processing activities but also on the kinds of data they have to work with and on the amount and type of cooperation they get from their caretakers. Therefore we also need to look at possible external and interactive influences on segmentation, considering in turn properties of input speech that may facilitate segmentation, the importance for segmentation of certain kinds of variation in the input, the possible contribution of interactive routines, and individual differences among children.

#### 3.4.1. Input speech

In 2.2.2 we looked at ways in which input speech might affect the extraction process. Now let us consider what sorts of characteristics of the speech addressed to children may help or hinder children in applying particular segmentation strategies and in discovering adult sub-units and structural patterns in the speech they hear. For instance, bearing in mind heuristics such as SG:STRESS, SG:INTONATION, and SG:RHYTHM, we can ask whether caretakers add stresses to important words, use exaggerated and characteristic intonation or rhythmic contours with certain words or phrases, or prolong certain words or syllables. Any such modifications could serve to make it easier for the child to apply one or more segmentation heuristics. What is the evidence?

Garnica looked at prosodic and paralinguistic aspects of input, comparing the speech of middle-class English-speaking mothers to 2-year-olds, 5-year-olds, and adults. Some of the differences she found include more rising sentence-final pitch contours when addressing 2-year-olds (even on imperatives, which normally have falling final contours); whispered *parts* of sentences in speech to 2-year-olds but not to older listeners; and addition of primary stresses resulting in more than one per sentence when addressing 2-year-olds (1977, 81). As Garnica points out, these modifications probably have general social and communicative effects in that they function to get the child's attention and to focus on the communicatively important aspects of adult utterances. But she also notes that they can serve to help the child perform linguistic analysis on the input. Thus she hypothesizes that the distinctive rising pitch terminals may help the child to locate sentence boundaries, since "the high pitch would tend to accentuate the termination of the sentence by the speaker" (84). Similarly, the addition of duration and stress to crucial content words would serve to "indicate to the child the 'key' words in the sentence" (84), not only enhancing communication but also serving to indicate which sub-units should be extracted first. moreover, the addition of extra primary stresses "may serve to divide up a sentence perceptually into smaller units. The adult thereby segments the sentence into pieces he/she thinks are of adequate size for the child to process easily . . . By this division, the adult may be providing the child with important information about constituent structure" (85). From Garnica's study, then, it is clear that at least in some cultures prosodic modifications of the input speech do occur along just those lines that would provide support for certain of the prosodically oriented heuristics.

#### 3.4.2. Variation in the input

The most central of the proposed segmentation heuristics, however, is phonological matching (actually presented already as the two related heuristics SG:MATCH1 and SG:MATCH2, but collectively referred to as SG:MATCH). Let us see what sort of support for such a strategy may be present in input speech. If we look first at studies of middle-class English-speaking mothers, we find that one characteristic of their speech to their young children is repetition with variation. This can take a number of forms: A sentence will be offered and then a crucial sub-unit will be extracted and repeated (reduction); a word or phrase will be offered and then included in a larger sentence (expansion); two sentences containing a particular word or phrase in different frames will be offered (variation); two sentences built on a single frame with different items in the slot will be offered (substitution). Here are some examples, taken from a tape made when Minh was 1;2, of consecutive sets of utterances by his mother (the alignments are intended to highlight the repetitive sequences that the child may find useful for SG:MATCH):<sup>16</sup>

- |                         |  |  |                       |
|-------------------------|--|--|-----------------------|
| A.                      | You go <u>show</u> mommy.                    |  | stress on <i>show</i> |
|                         | Show mommy.                                  |  | reduction             |
|                         | Show mommy whatcha talking about.            |  | expansion/variation   |
| B.                      | Birdie birdie.                               |  | repetition            |
|                         | Where's birdie?                              |  | expansion             |
|                         | Birdie's we::t.                              |  | expansion/lengthening |
|                         | Birdie's all <u>wet</u> 'cause it's raining. |  | stress on <i>wet</i>  |
| C.                      | Chopstick.                                   |  | theme 1               |
|                         | That's chopstick.                            |  | expansion             |
|                         | An' you pick up <u>food</u> with that.       |  | theme 2               |
|                         | Can you say again chopstick?                 |  | expansion of 1        |
|                         | Chopstick.                                   |  | repetition/reduction  |
|                         | Chopstick, to pick up <u>food</u> .          |  | reduction/variation   |
|                         |  |  | stress on <i>food</i> |
| <i>(18 turns later)</i> |  |  |                       |
|                         | Pick up food.                                |  | reduction             |
|                         | Ooh you pick up food like <u>that</u> .      |  | expansion             |
| D.                      | I don't see birdie.                          |  |                       |
|                         | Do you see birdie?                           |  | variation             |
|                         | Do you see any doggie too?                   |  | substitution          |

The point here is that such repetitions, expansions, variations, and substitutions in caretaker utterances provide ideal material upon which to apply SG:MATCH and FRAME.

Of course, not all of the speech addressed even to middle-class English-learning children is so ideally suited as this is to the application of segmentation heuristics. And when the input is less than ideal, the child not only will have to work harder to effect plausible segmentations, but may make mistakes in some instances. Evidence for this is found in children's difficulties in dealing with certain chunks of language that are usually encountered as invariant and unsegmented units. Such chunks include (lines of) nursery rhymes, songs, prayers, proverbs, and stereotyped favorite expressions, all of which tend to get presented as nonnegotiable wholes, in the sense that reductions, expansions, and other variations are not considered appropriate or necessary. With this type of input children will have to do the best they can, looking for stresses, lexical items they can identify, morphosyntactic frames they already know, and so on. It is easy for the researcher to collect anecdotes about the "cute" misanalyses that result when children try to make sense of such stereotyped language; newspapers and popular magazines regularly contain articles about them. Here are some examples I have collected myself, mostly from friends:<sup>17</sup>

<i>Original</i>	<i>Misanalysis</i>
open sesame	open says me

<sup>16</sup> Similar sequences have been observed by Snow (1977).

<sup>17</sup> Thanks for some of these examples are due to Elizabeth Barber, John Bisazza, Charles Fillmore, Elizabeth Kimmell, Dennis May, Ted Peters, and Virginia Wayland.

guinea pig	beginning pig
shoo fly	shoe fly
Don Quixote	donkey goat
where the grapes of wrath are stored	where the grapes are wrapped and stored
lead us not into temptation	lead us not into Penn Station
the dawn's early light	the donzerly light
life is but a dream	life is butter and cream
it costs an arm and a leg	it costs a nominal egg
to all intents and purposes	to all intensive purposes
<i>qu'est-ce qui se passe?</i>	<i>qu'est-ce qui space</i>

The same sorts of matching and segmentation strategies seem to have been applied in these instances as in the misperceptions discussed by Browman and by Garnes and Bond, but the lack of variation in these particular frozen phrases, along with their general nonnegotiability, meant that these misanalyses were not subject to correction for a long time, if ever. It is interesting to note that these analyses involve not only lexical matching but the application of grammatical knowledge as well. Thus, in the case of "the donzerly light," the linguist who told me of this (whose name I have forgotten) said that he had no idea what "donzer" meant, but that it had seemed to fit into some sort of adverbial (-ly) frame. In a similar vein, when I was a child my grandmother used the expression *scripture measure* whenever anyone overfilled a cup or glass (from *my cup runneth over*). For a long time the best I could do with this was *script your measure* - possibly based on a frame commonly heard by children: Imperative *your X*.<sup>18</sup>

In any case, it is precisely this frozen, formulaic type of language that is least segmentable. This is the epitome of the linguistic "dead end" for the learner, from which it is nearly impossible to extract either lexical or syntactic information. But as we shall see presently, although such language can also be characterized as "routine" in that it is fixed, it does not constitute *all* of input speech that can be so characterized. And *some* "routine" input *can* be extremely helpful for segmentation.

Before we explore "routines" in more depth I first want to consider briefly input speech in one other culture. As we saw in the last chapter, in Trackton, speech to children is not modified along the lines presented at the beginning of this section. That is, it lacks the reductions, expansions, substitutions, and variations intended to enhance the children's comprehension. And yet it is intriguing to discover that, as the Trackton children's linguistic skills develop, children are heard, not only imitating phrases, but also playing with them, manipulating the parts in various ways. Heath calls this stage "repetition with variation" (1983, chap. 3). It seems quite significant that in this community, as in Samoa, such repetition and paraphrase, although not directed to children, are common among adults. In the black community of Trackton it is a valued aspect of a verbal style that is heard in storytelling and prayers (chap. 7); thus repetition with variation may be a strategy that is somehow easily available to children in this community. Heath's description of a language-acquisition process such as the one in Trackton, where children start with long chunks that they then learn to vary on their own, without specially tailored input language from their caretakers but with repetition with variation being modeled in the community, seems particularly important for a theory of segmentation (and language acquisition in general). This is because now we have documentation that children do not need to have language predigested, nor do they have to start at the level of single words in order to acquire language satisfactorily; that is, segmentation heuristics are applicable to a wide range of input. We need to do more studies of input in different cultures with an eye to ways in which it may support or interfere with segmentation processes.

### 3.4.3. The place of routines in segmentation

In studies of both first- and second-language acquisition the term "routine" has been used in a number of diverse ways. One way, as we have just seen, refers to frozen, nonnegotiable phrases (which we will refer to here as "formulas") from which it is generally

<sup>18</sup> Stephen Boggs suggested this frame to me.

difficult to extract either lexical or grammatical information. This is the sense of the term as it is used by Krashen and Scarcella, who refer specifically to memorized phrases such as *How are you?* and *Where is your hotel?* (1978, 283), and by Gleason and Weintraub, who are interested in politeness routines like *thank you* (1978) or in even more situationally specific "routines" such as *trick or treat* (1976).

Other researchers, however, have used the term "routine" in quite a different way, namely, to refer to caretaker-child *interactions* that are predictable in form, both with respect to the content of the individual "lines" (in a dialogue) or 'moves" (in a more general interaction) and with respect to their sequencing. Two such routines that have been carefully followed over a period of time for one mother child pair are the peekaboo game (Ratner & Bruner 1978, for the child Richard between 0;6 and 1;10) and picture-book reading (Ninio & Bruner 1978, for Richard between 0;8 and 1;6). The fixed form of these routines seems to give the child, at quite an early stage, a clear set of expectations upon which to base his participation in the interaction.

But what is of concern to us here is not so much the fixed aspects of the routines as the types of developmental modifications they can undergo. Thus at first - until her child has learned the basic sequence of lines or moves - the mother typically plays both parts, answering or acting for her child, but including him in the action as much as possible. Ratner and Bruner (1978) term this kind of parental support "scaffolding." Thus, in the peekaboo game, the mother at first is the agent who initiates all the moves, hiding either her own face or her son's, removing the mask, and saying "Hello!" on reappearance. Later, when Richard has learned to anticipate the sequence of moves, although she still initiates the game, he joins in more and more on the later moves, helping in the unmasking and beginning to vocalize along with her "Hello!" (398). And in the book-reading game the mother at first says all the lines, schematized as

1. Look !
2. What's that?
3. It's an X.
4. Yes (an X). [Ninio & Bruner 1978, 6]

As Richard comes to know the sequence she begins to pause after her question in line 2 in order to allow him to participate by trying to produce the requested label. One effect, then, of such interactive routines is to give the child a predictable way of participating in an interaction. Another effect, at least in the book-reading game (and in its more general form, the labeling game), is to give the child a means of acquiring new labels, both when they are offered by the mother and later when the child learns to ask for them (i.e., to take over lines 1 and 2).

Although the two studies just described have been of interactive routines in which the basic "script" consists of three or four lines or moves, even shorter routines in which each participant has only one line (or move) can develop to support specific communicative needs. Thus, in studying a tape of Minh and his mother made when Minh was 1;2, I found a number of two-line sets that could be classed as routines on the grounds that they occurred more than once, that their form was relatively fixed, and that each such set had an identifiable communicative function. One such routine was used by Minh to get a response from his mother:

Minh: Mommy!  
 Mother: What? / Huh? / Yes?

Another was used to call attention to a particular object:

Minh: Ooh! (breathy voice)  
 Mother: What? (or some other response directed toward the object Minh focused on)

Still a third routine was used to signal that something had dropped:

Minh: Oh-oh!  
 Mother: What did you do? / Pick 'em up.

It is significant that even at so young an age as 14 months, when his nonroutine language was neither particularly well developed nor very intelligible, Minh was able to use these little routines quite effectively as communication supports. The fact that he had learned these routines from others, much in the manner described by Bruner and his associates, is also evident on this tape, since his mother also initiates both the *Ooh* and *Oh-oh* routines,

whereas Minh's older brother clearly uses (and thus models) the *Mommy* routine several times. Thus the communicative support that Minh is able to draw on here is tied to the fact that his interactants know the routines too, and can use the predictable formats to figure out Minh's communicative intent when he invokes a given routine. Looking for such routines, then, may offer us an important insight into how children get hold of communicatively useful chunks of language so as to be able to participate in rudimentary conversations very early, much as Wong Fillmore's second-language learners did.

But this is not all there is to be said about such interactive routines. Although they may be fixed at first, both in the sequence of communicative moves and in the content of each line, there is evidence that they may go on to develop in interesting ways. As we have just seen, one of the first developments concerns which participant makes each move in the still-fixed sequence. Thus at first the mother makes all the moves, but indicates to her child which moves might be construed to be his. As he comes to know the sequence so that he can anticipate certain key moves, she encourages him to participate leaving pauses for him to make a try, taking his turn if he does not, reinforcing him if he does. As he comes to participate more reliably she acts as a "communication ratchet" (Bruner 1978, 254) by insisting on his participation where she knows he can do it, while supporting and encouraging participation in more marginal situations.

As with the formulaic chunks of language discussed earlier, if variation is present we would expect segmentation to occur, but if the situation does not allow for variation we would expect stagnation. Ratner and Bruner (1978) observed that the peekaboo game went through a developmental sequence until Richard could play both parts, but then died out as he lost interest. The bookreading situation, however, allows for more variation. Once a child has learned to produce labels in the proper slot (line 3), and then to request labels her- or himself (by playing the other part, using lines 1 and 2), new kinds of moves can be added, for example, requesting the noise a pictured animal is alleged to make, labeling parts of pictures, relating pictures to personal experiences, and so on. Thus a more open-ended routine potentially provides support for several kinds of linguistic and communicative development. How much of this potentiality will actually be taken advantage of may depend on cultural factors: Heath (1983, chap. 7) describes how in a community that she calls Roadville even book reading reaches a dead end quite early.

Snow (1981b) describes the book-reading routine at a later stage, as it had developed between herself and her son Nathaniel by the time he was 21/2 years old. Her data are taken from eight tapes in which they were looking at the same book from one session to the next. She shows how, within the by then well-known format of the routine, N is able to make progressive use of information he receives from his mother. Thus at one session a new topic (and label) may be jointly introduced (these examples are taken from Snow's Table 7):

N: Who's that?

M: X.

N: X.

M: X, right.

At a subsequent session N may reintroduce the topic, using the recently acquired label, which his mother confirms before she offers more information about this topic:

N: Who's that X.

M: X, right. What's X doing?

N: X doing?

M: X is Y-ing.

N: X Y-ing.

The expression and development of topic X may get carried yet a step further in a still later session, with N again introducing the topic at the level of his expanded ability:

N: X Y-ing.

M: That's right.

N: X have?

M: X has a Z.

N: a Z.

M: Right, a Z.

Again we see that interactive routines that allow for variation and expansion are neither linguistic nor communicative dead ends. but rather offer an important kind of support for growth in which the learner may even have some control over how fast new information is offered.

As we can see, in order for researchers to pursue the implications of these observations it is necessary both to broaden and to restrict the notion of "routine." We must broaden it in the sense that the criterion for recognition can no longer be that its form is absolutely fixed, for it is precisely its possibilities for variation that engender linguistic development. Thus the "sameness" can only be relative - within a fixed general framework that is allowed (expected) to develop over time. The general communicative function of a particular routine, however, might be expected to remain more constant. Another important point is that these routines must be studied over time so as to reveal how changes in their format contribute to the child's developing linguistic and communicative systems.

On the other hand, our ideas of routines must be more focused in that we must expect to discover routines that serve specific functions, and we must expect that routines which serve different functions will contribute in different ways to the child's linguistic knowledge. We have seen how the book reading routine contributes to the segmentation and learning of various kinds of labels. Several recent studies have looked at ways in which parental requests for narratives of personal experience (e.g., "Tell Daddy what we did today") can provide support for learning not only culturally accepted norms for structuring stories (appropriate sequencing of appropriate topics) but also correct linguistic forms for doing so (Eisenberg 1981; Sachs 1977b; Stoel-Gammon & Cabral 1977; see also discussion in Cazden 1979). In a similar vein, Johnson (1980) shows how children can acquire such specific linguistic material as question words by starting with "set phrases tied to very specific interaction routines" (1), which the children only slowly segment into appropriate constituents. We need to follow up on these pioneering studies by selecting specific linguistic structures and possible associated communicative functions, and then looking for routines that might serve to support the acquisition of these structures and functions. These routines must then be recorded and described, with attention paid not only to changes in the type of support available but also to the strategies children use to discover the linguistic information available to them in these routines.

#### **3.4.4. Individual differences**

In 2.2.4 I discussed individual differences among children with respect to the extraction process. A few more remarks are in order as I conclude this look at segmentation and perception of structural patterns, if only to raise questions for further research.

If a child makes heavy productive use of frames of the constant + variable type, the aggregate of her or his productions will have what has been termed the "pivot look."<sup>19</sup> It has recently been noted by several researchers that this pivot look may be more characteristic of some children than others (Bloom, Lightbown, & Hood 1975; Horgan 1980; Nelson 1981). In fact Horgan (1980, 7-8) and Nelson (1981, 173) suggest that Expressive/Noun-leaver children may tend to rely on patterns of the constant + variable type, whereas Referential/Noun-lover children may be more likely to produce variable + variable constructions.

The sequencing of analysis and production may be crucial in the creation of a pivot look. Accordingly, if a child is productively cautious and does a great deal of analysis before saying much, the child's sentence frames may quickly become of the variable + variable (nonpivot) type. However, a child who is eager to talk may not wait upon her or his

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<sup>19</sup> The term "pivot" refers to Braine's (1963) suggestion that children's two-word combinations could be described in terms of two classes of words: "pivots," which constitute a closed class of words that occur with high frequency in fixed positions (corresponding to the "constant" terms in our frames), and an "X" (or "open") class of words that can combine with the pivots or with each other (the "variable" terms). Although "pivot grammars" as such have been abandoned as a useful description of the two-word stage, the "pivot look" is still recognized as a real phenomenon that has to be dealt with in some other way (Brown 1973). Moreover, Braine's work on "limited scope formulae," already discussed in 3.2, can be seen as a revision and extension of his ideas on pivot grammars.

analysis but rely heavily on "formulas"(useful extracted units) and "pivot constructions" (constant + variable frames). Like Wong Fillmore's Nora (1976), such a child may produce freely, relying on feedback to guide evaluation of her or his productions.

More work is needed to sort out these differences among children in segmentation and pattern perception strategies. For instance, how much of these differences might be due to innate preferences for processing language in certain ways (e.g., "pattern extractors" vs. "builder uppers"), as opposed to differences in the uses to which language is to be put, input variables, and/or cultural factors?