THE INTERRELATIONSHIP OF CERTAIN FACTORS AFFECTING SENTENCE COMPREHENSION IN CHILDREN

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INTRODUCTION

In this paper, I look at the development in young children of how the meaning is derived from sentences when certain types of cues are present. The general mental development of children has long been an area of considerable interest. Language development is one of the major focuses of this interest, as it is felt that an assessment of competency can be an indicator of the stage of development a child is at. There are obviously stages where the child does not have adult competence, and the task of discovering, describing and defining these stages is most difficult indeed.

Bever 1970 hypothesizes that a child first has basic linguistic capacities, such as realizing that words can refer to objects and actions; then develops some 'perceptual strategies for mapping external sequences onto internal ones'; then later develops adult linguistic intuitions about grammaticality. In this original presentation the perceptual strategies between two and four years of age included semantic constraints determining functional (grammatical) relations (Strategy C), and any NV(N) sequence, without semantic constraints, being viewed as Actor-Action-Object (Strategy D). Bever also concluded syntactic factors can be 'bypassed' by semantic constraints. That is, in the sentence 'Donald Duck is picked up by the chair', to quote Bever 'the most likely semantic organization can guide the interpretation independent of the perceptual processing of syntactic structure'; this interpretation would then be that Donald Duck picks up the chair. Bever has raised here the question of how two factors that can affect comprehension interact in a child's processing of language.

An obviously important factor in language comprehension is syntax. Regarding the 'syntactic knowledge' of children, C. Chomsky 1969 claims that not all syntactic rules are acquired even by age nine. Limber 1973 disagrees strongly with Chomsky's claim, saying generalizations made at two and three years of age 'snag' when they hit exceptions, and that the child must learn to give up certain effective structural generalizations when confronted by specific lexical items that do not follow the generalization (e.g. 'promise' sentences and the Minimum Distance Principle).

In addition to semantic constraints, pragmatic constraints can interact with syntax. In an earlier paper (Jackson 1977) I showed that for adults the determination of which noun is the 'controller' for Equi-NP Deletion can be manipulated by pragmatic factors even though the structure remains constant. Regarding children and pragmatic considerations, Bever 1970, Strohner and Nelson 1974, and Herriot 1969 all demonstrated that young children comprehend probable passives

better than strictly reversible ones. Herriot felt that the emphasis that had previously been placed on the use of semantic rules in regards to comprehension may have been exaggerated. He concluded that pragmatic expectations are a significant variable and that cues to comprehension may be 'probabilistic and based on experience rather than axiomatic and intrasentential'. Gowie 1976, and Forthcoming reports that 'sentences contrary to expectation elicited more misinterpretations than did harmonious and neutral sentences' when the syntactic structure used was still being learned. The structure was that usually referred to as the Minimum Distance Principle, where the general rule is that a deleted complement subject is seen to be co-referential to the NP which is the least distant. In sentences like 'Bill asked Tom to go home', Tom is perceived as the subject of the verb (to go) in the embedded complement. The children tested, who were kindergarten, first, and second graders, were first surveyed to determine which of the two NP's in a reversible sentence they 'expected' would do the action. Harmonious sentences reflected the preferences of the greatest number of children, contrary ones the preferences of the fewest, and neutral ones had equally mixed expectations of who the actor was. Gowie concluded that 'children's role expectations are as real to them as are logical constraints to adults'. The nature of some of the expectations indicate that it is not only role expectations that are important, but other types may have effect also. Even in what would seem to be a very neutral sentence like 'Sue tells Nancy to push the swing', children had expectations related to the names, such as, Sue 'sounds older' or that it 'sounds like the mother'.

Another factor in comprehension that has been considered is context. Foss, Bever and Silver 1968 tested the effect of context (pictures) on reaction time to a verification task using ambiguous and non-ambiguous sentences. They found reaction times the same for ambiguous and non-ambiguous sentences if the meaning was the 'expected' one (the expected one was selected most on a pre-test), but longer for ambiguous sentences if it was not the expected meaning. Passives and context were examined by Bem 1970, Turner and Rommetveit 1968, Olson and Filby 1972, and Olson and Nickerson 1977, mostly using pictures. The first three demonstrated that whether context directed attention to subject or object affected use and comprehension of the passive. Olson and Filby claim that ease of processing actives and passives can be a function of prior coding of a perceptual event (viewing pictures). Some other effects of context have been postulated: Dooling 1972 claims it speeds up comprehension, Foss 1970 hypothesizes that in processing ambiguity, context may 'throw a switch' directing which direction accessing of memory takes place. Foss and Jenkins 1973 formulate a 'canonical order' hypothesis for ambiguous meanings, for use when context is neutral, where the canonical meaning is the most frequent, the second is the next most frequent, etc. But in the real world, a neutral context is rare. As Garcia 1976 so succintly puts it, 'unless two interpretations are so equiprobable that both are perceivable', a sentence will not be perceived as ambiguous. Context often keys a certain meaning and it is probably due to this that we do not even notice the ambiguity in most cases. Olson 1970 agrees with this, claiming that ambiguity

'has to have a non-specifying context'.

The question of how 'processing' takes place has also received considerable attention. Bever, Garret and Hurtig 1973 put forth a model for adults where underlying structures for each clause are mapped out (to determine underlying relations) and then the clause is recoded in a more abstract form so that Short Term Memory space is immediately available for further processing. Olson and Nickerson 1977 add to this model by claiming that young children (around five) make this abstract proposition differently from adults, and that they do not recode it in the same form. They draw this conclusion from data that indicate that children, tested with a verification task, have grammatical competence with passives but do not see the implicational relations of propositions, that is, the fact that the active form of a passive basically means the same thing, and vice versa. Kimball 1973 proposes an adult model similar to Bever, Garret and Hurtig's, but which is more explicit and includes the claim that once a clause has been closed, that is, a final organization of the semantic relationships has been arrived at, the recoded abstract form goes to a 'Processing Unit' so that short term memory is cleared. There, 'pointers' (some kind of tags) keep straight the relations. Watt 1970 goes further and claims that the longer one goes without being able to assign a structure (or 'close' in Kimball's terms), the more it will tax the 'working' memory.

What must be considered in more detail is how the 'underlying relations' are determined by children. Factors such as those already mentioned provide input to this process. Prior studies have investigated the effect of individual factors in the comprehension process of children. What is not clear is how these factors interact, especially for children. If several factors are involved, will one prevail in determining the meaning? If so, which one? Will one systematically be 'stronger' than another? In other words, is there a hierarchy among these factors, and does this hierarchy change with age? It is the purpose of this study to address this question. The specific hypothesis examined is that a hierarchy of strength among factors exists which allows us to predict what the perceived meaning will be.

DESIGN

The Sentences. In order to test this hypothesis, sets of sentences were formulated in which one factor was opposed to another. The sentences were such that the child's choice of actor indicated which strategy had cued this choice. This was observed by having the children act out the sentences with toys and familiar characters. An example is: 'The horse rides Mickey Mouse'. If the child had the horse ride Mickey Mouse, syntax had prevailed; if Mickey Mouse was made to ride the horse, probableness had cued the meaning.

The Factors. Not only are there numerous factors that can affect comprehension, it is also difficult to delineate them. It is a question of interpretation whether they are separate entities or whether some are subcategories of a more general class. For example,

semantics, probaleness, expectations, pragmatics and context have all been mentioned already. 'Semantics' can include semantic relations (actor, patient, instrument, etc.) as well as constraints of a lexical nature (e.g. 'The sugar is happy'). But these constraints depend on knowledge of the world, and thus might also be considered pragmatic factors as well. Although there is this shared feature, we can differentiate the two. Pragmatic constraints include knowing what the real world situation is. Pragmatic factors are ones that are not specified in the linguistic content, but still play a role in determining meaning or acceptability. R. Lakoff 1973 discusses various aspects of these constraints and as an example gives the sentence 'Please shut the window'. If the speaker is subservient to the addressee, it has a meaning more like 'I'm asking you to do this as a favor to me, since I can't constrain you to do it'. If he is superior, it is more like 'I'm asking you to do this, but I really have the power to force you, I'm just acting like a nice guy'. Pragmatic factors constrain the meaning. Lakoff also gives a good example of the difference between a semantic and a pragmatic constraint. In English, the question form is polite. In the sentence 'You can take your methodology and shove it', the communicative content is undeniably impolite. If we make it a question, 'Can you take your methodology and shove it?', we know, pragmatically, that this content in this form is wrong, because we have matched a polite form with an impolite meaning.

It is not clear to me whether context is a separate entity or a type of pragmatic factor. Above, pragmatic factors were said to be 'not specified in the linguistic content'. Yet one type of context can be contained in the linguistic content. For example, in the sarcastic statement 'You really showed 'em, didn't you!', extraction of the intended meaning is dependent on 'linguistic context'. But there are 'non-linguistic contexts' as well, which can be established by any number of means, for example by a picture, or by viewing a certain situation (e.g. while traveling in a car, seeing the traffic light go to yellow provides the non-linguistic context for the question, 'Shall I go for it?'). These latter fit the description above for pragmatic constraints, 'knowing what the real world situation is'. Intuitively I feel that there is a difference but I cannot seem to characterize it.

Further, it seems that we cannot clearly differentiate 'expectations', 'probableness' and 'semantics'. Expectations are based on what is perceived as being most probable, and so can be thought of in terms of probableness. As for probableness and semantics, I originally intended to distinguish between these two, the former defined as the distinction between probable and improbable events, the latter possible and impossible events. However, it is not possible in this design to oppose these in the same sentence, because something semantically deviant cannot be opposed by something probable since it cannot be deviant and probable at the same time. That is, in a sentence 'X verb Y' where X is the probable actor, to set up an opposition that would have semantic anomaly cue Y as actor, X would have to be semantically anomalous as actor, but at the same time be the probable actor, which is not possible. It appears the distinction between them is only one

of degree, and that they are basically the same phenomenon, based on our perception of and our beliefs about the world.

The factors whose relative 'strength' was examined in this study were limited to context, probableness and syntax. In terms of strategies, these factors can be regarded as a contextual strategy, a 'probable event' strategy, as posited by Strohner and Nelson 1974, and a syntactic strategy. For the purposes of this study, they are defined as follows:

Syntax refers to the surface structure of the sentence. This includes cues of the passive, but as noted earlier, an NVN sequence will be perceived as Actor-Action-Object at certain stages of development. Rather than attempt to control this, it was simply included in the definition of syntax, as only simple active sentences were used in the sets of sentences designed to test for a hierarchy of the factors. A separate group of passive sentences was used to compare the NVN strategy and this one aspect of syntax, the passive construction. The purpose of this separate group was to replicate prior studies, since some of the results have been inconsistent (c.f. Bever 1970, Maratsos 1974, DeVilliers and DeVilliers 1973).

Context refers to information that is available which is related in some manner to what is being said. The context was established by a combination of linguistic and non-linguistic material, in the form of hand-drawn pictures depicting an action with the experimenter verbalizing this action. This verbalization was necessary because it was not obvious at first glance exactly what was happening in some of the pictures, but once verbalized this became quite clear. As an example, a picture of a monkey jumping over a man was shown, then described. This established a context, that the monkey jumps, for the following, related sentence.

Probableness refers to one's perception that something is more likely to 'be' or 'take place' than something else. Difficulties exist in controlling this variable which must be recognized. For any given sentence the choice of which of two possibilities was more probable was made by me, not the children (e.g. I assume that it is more probable that 'to shoot a squirt gun' means shoot with it, as opposed to shoot at it). Also, it was in this area of probableness that the most attention had to be paid to selection of materials. Great care was taken to minimize the effect of any attributes of the toys and characters used. Attributes such as size, ferocity of an animal, personality of a character, known habitual activities, etc., can establish expectations about which one will do a certain type of activity. Despite the attention paid to this area, it is not certain that these kind of effects did not occur.

Another attempt to control a specific variable required that a special set of sentences be devised. Since each factor is opposed to each of the other two within a set of sentences, one set deals with probableness versus context. An attempt to factor out syntax

from this set was made by using ambiguous sentences in the form 'X is ready to ...', where X can either do the action or be the object of it. Example: 'X is ready to follow'; X can then either follow or be followed. Thus, the same structure, with certain verbs, can have two meanings, one of which will usually be more probable than the other. Unfortunately, syntax still plays a role, especially in young children, through the NVN strategy. One is accustomed to the first noun most often being the actor. It is not possible, in English, to avoid the influence of syntax. Because of this, two sets of sentences contrasting probableness and context were formulated. In one set, the NVN effect reinforces probableness, and in the other, it reinforces context. Examples are: 'Bert is ready to ride'; here NVN indicates that Bert will do the riding, as does probableness. A context countering this is established with a picture of a dog riding on Bert's shoulder. In 'The horse is ready to ride', probableness indicates someone will ride the horse, but a context, which is reinforced by NVN, can be established in which the horse does the riding. Thus, the purpose of these two sets was to provide a means of checking the effect of syntax.

METHOD

Subjects. The experimental sample consisted of eighty children, ranging in age from 3.0 to 5.0. The sample was divided into four groups of sixteen children each: 3.0 - 3.6, mean age 3.28; 3.7 - 4.0, mean age 3.89; 4.1 - 4.6, mean age 4.31; 4.7 - 5.0, mean age 4.95; and a control group of sixteen children, four from each of the above age groups. Each group had eight males and eight females. The subjects were from a middle class suburb of San Diego. They were all monolingual, native speakers of English. The majority were attending pre-school[2]; the rest spent the day at a professional babysitter's.

Materials. Sets of sentences were formulated in which two factors were opposed. The sets were thus: Syntax versus Probableness, Syntax versus Context, Probableness versus Context, and one set where the NVN strategy was opposed to the Passive construction. Probableness versus Context required two sets, as explained earlier. The sentences were:

Syntax versus Probableness

(1) The bench hits the hammer.
(2) The chair sits on Snoopy.
(3) The horse rides Mickey Mouse.

Syntax versus Context

(4) Snoopy jumps over the monkey.
CONTEXT PICTURE: Monkey jumping over man.
(5) Big Bird kicks Mickey Mouse.
CONTEXT PICTURE: Mickey Mouse kicking tin can.
(6) The monkey hits Ernie.
CONTEXT PICTURE: Ernie hitting Big Bird.

Probableness versus Context (reinforced by Syntax)

(7) The horse is ready to ride.
CONTEXT PICTURE: Horse riding on Ernie's shoulders.
(8) The stroller is ready to push.
CONTEXT PICTURE: Stroller pushing truck.

(9) The ball is ready to kick.
CONTEXT PICTURE: Ball striking telephone.

Probableness (reinforced by Syntax) versus Context

(10) Bert is ready to ride.
CONTEXT PICTURE: Dog riding on Bert's left shoulder.
(11) The squirt gun is ready to shoot.
CONTEXT PICTURE: Boy shooting a space gun at squirt gun.
(12) The man is ready to bite.
CONTEXT PICTURE: Dog biting man's ankle.

NVN versus Passive

(13) The bear is pushed by the horse.
(14) The fire engine is followed by the truck.
(15) Bert is spanked by Mickey Mouse.

The pictures were hand drawn, and the characters or toys depicted were the actual ones used. The toys were typical store-bought items. Any toy depicted in a context picture but not mentioned in the sentence itself was also on hand. This was to allow the possible reaction of acting out the picture rather than the sentence.

Procedure. The children were tested at their pre-school or at their babysitter's home. Their parents were not present. Each child had a 'play' session with the experimenter[3]. Other children were kept at a slight distance so they could not hear or see the materials in advance but could observe that there was indeed a game to play. When starting at a new location, a child identified by the teachers to be outgoing and cooperative would be tested first. This helped induce cooperation, as other children would invariably want to play a game that one of their companions had been allowed to play.

All the toys were laid out in a small area, and the pictures were kept turned away until the appropriate time. Before starting, names were established for the toys. Most were very familiar but a few were given special attention each time. If the child gave his/her own name for something, this was used. Bert and Ernie were occasionally confused and for this reason were never used together in a sentence. It was initially established that the 'game' was to make the toys do whatever was said to the child. A sentence like 'Bert sits in the chair' would be given and the child prompted to seat Bert in the chair. The children caught on after two or three sentences. At this point the test sentences were begun. The order of presentation of the sentences was: 15, 9, 7, 4, 13, 8, 1, 6, 11, 5, 10, 14, 2, 12, 3. Context pictures were shown before the appropriate sentence was given. The experimenter then described the action, and asked the child 'What's happening?', eliciting a verbalization of the action. In this manner, it was established that a certain toy did a certain action. The sessions lasted from fifteen to twenty minutes each, depending usually on shyness or how much the child was distracted by a desire to play with a particular toy or toys he/she was drawn to.

Four children from each of the four age groups were not shown the pictures at all. These sixteen constituted the Control group. This group was used to establish what the choice of actor would typically be

without the pictures, i.e. a baseline to compare the others to.

RESULTS

The responses obtained are tabulated below in Table 1.

TABLE 1: Numerical Results for All Sentences[4]
'C' denotes Control Group

Set 1: Syntax versus Probableness

	Age Group	Syntax	Prob	Refuse
1	I	2	17	1
	II	6	14	
	III	9	11	
	IV	15	5	
3	I	9	11	
	II	7	13	
	III	14	6	
	IV	14	6	

	Age Group	Syntax	Prob	Refuse
2	I	13	7	
	II	12	7	1
	III	16	4	
	IV	19	1	

Set 2: Syntax versus Context

	Age Group	Syntax-C		Context-C	Refuse
4	I	14	4	2	
	II	14	4		2
	III	16	4		
	IV	16	4		
5	I	16	4		
	II	15	4	1	
	III	16	4		
	IV	15	4	1	
6	I	11	4	5	
	II	13	4	1	2
	III	16	4		
	IV	15	4	1	

Set 3: Context (reinforced by Syntax) versus Probableness

	Age Group	Context-C	Prob-C		Ego-centric-C	Refuse-C	Other
7	I	2	14	2		2	
	II	7	9	3		1	
	III	10	5	4	1	1	
	IV	14	2	4			
8	I	12	4	3		1	
	II	11	4	4			1
	III	15		4		1	
	IV	14	1	4			1

	Age Group	Context-C		Prob-C		Ego-centric-C	Refuse-C	Other
9	I	4		12	4			
	II	6	1	9	3			1
	III	9		7	4			
	IV	12	1	4	3			

Set 4: Probableness (reinforced by Syntax) versus Context

	Age Group	Prob-C		Context-C		Refuse-C
10	I	11	4	5		
	II	10	4	5		1
	III	11	4	5		
	IV	13	4	3		
11	I	9	4	7		
	II	12	4	4		
	III	11	4	5		
	IV	9	4	7		
12	I	7	4	8		1
	II	6	3	10	1	
	III	9	4	9		1
	IV	9	4	7		

Set 5: Syntax versus NVN Strategy

	Age Group	Syntax	NVN	Refuse	Verb Not Understood	Egocentric
13	I	8	11	1		
	II	13	7			
	III	10	10			
	IV	17	3			
14	I	2	10	1	7	
	II	4	11	1	4	
	III	5	11	1	3	
	IV	4	12		4	
15	I	11	5			4
	II	13	4	1		2
	III	14	6			
	IV	14	6			

DISCUSSION

The analysis of the data was carried out set by set, comparing numbers of responses to see if any factor is systematically stronger. A standard method of analyzing such data has been to examine the total number of responses from a set of sentences. Figure 1 shows the relationship of the number of responses, by age group, that fall in the categories of syntax and probableness in the first set of sentences[5]. In Figure 1 a trend can be seen where syntax becomes a stronger factor, in relation to probableness, as age increases.

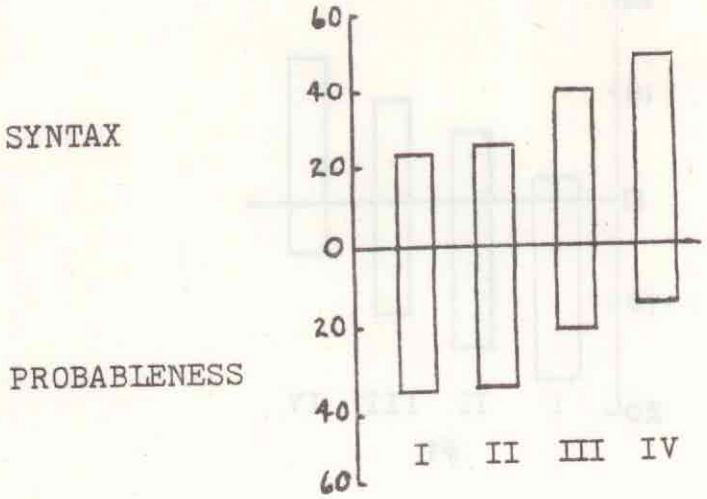

FIGURE 1: Graph of Total Responses in the Categories Syntax and Probableness for Sentences 1, 2, and 3.

This finding is consistent with previous studies (c.f. Bever 1970, DeVilliers and DeVilliers 1973, Strohner and Nelson 1974, Chapman and Miller 1975, Chapman and Kohn 1977). The phenomenon of word order defining relationships is not a universal of language; it is language specific and so must be deduced by the child. For speakers of English, the use of syntax in comprehension becomes more dominant as age increases, until it is by far the most important and hence the strongest factor.

The summing of responses to these three sentences, as done in Figure 1, shows a smooth looking trend. But, if the individual sentences are analyzed in a similar manner, as in Figure 2 (see next page), an interesting fact becomes apparent. Each individual sentence has a different degree of probableness. Combining the responses masks this variation. More general remarks about the processing involved will be made later.

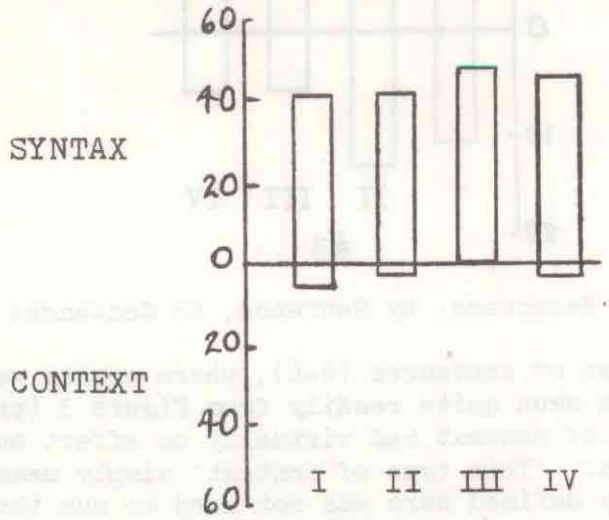

FIGURE 3: Graph of Total Responses in the Categories Syntax and Context for Sentences 4, 5 and 6.

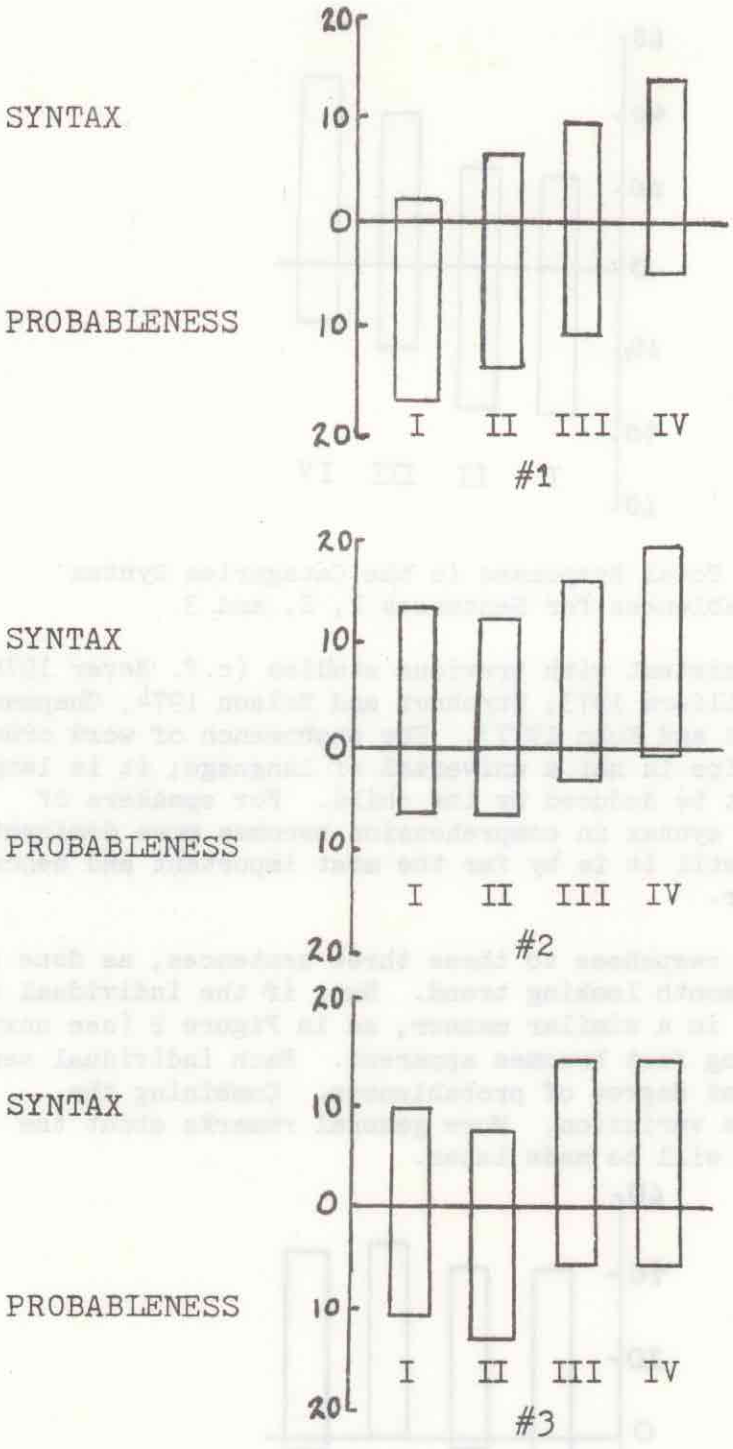

FIGURE 2: Graphs of Responses, by Sentence, to Sentences 1, 2 and 3.

In the second set of sentences (4-6), where syntax was opposed to context, it can be seen quite readily from Figure 3 (preceding page) that this type of context had virtually no effect on simple declarative sentences. 'This type of context' simply means that context as operationally defined here was not used to cue the meaning. That is, the contexts established that the characters who were direct objects in the test sentences were actors of certain actions, but did

not depict the actual actions of the test sentences, and this information had no effect on the perceived meaning of the test sentences in this set.

The total results from the two sets where probableness was opposed to context (7-12) are shown in Figure 4.

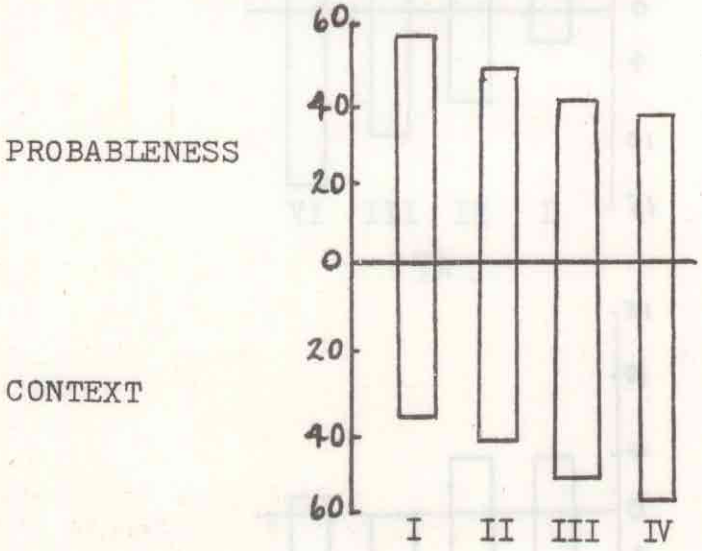

FIGURE 4: Graph of Total Responses in the Categories Probableness and Context for Sentences 7 through 12.

One might be tempted to conclude that there is a mild increase in the effect of context as age increases. This would be erroneous. Again, the individual sentences must be examined, as well as the effect of the NVN Strategy, which was controlled for between the two sets. Figure 5 (see next page) shows sentences 7, 8 and 9. Sentences 7 and 9 have similar graphs while 8 differs. In 8, the context picture had a very strong effect. Looking at sentences 7 and 9, there appears to be a trend from probableness being predominant in the younger children, to context becoming the stronger of the two. But is this indeed the case? Probably not. In this set NVN reinforces context. The trend seen is the same as in Figure 2, where syntax becomes stronger. Examination of sentences 10, 11, and 12 in Figure 6 provides evidence that it is in fact the effect of the NVN Strategy (i.e. syntax) that produces this trend. In this set, NVN reinforces probableness, vice context, and the same pattern does not occur. There is no shift as before. In the younger ages probableness is most likely predominant as before but in the older ones syntax becomes a stronger factor and maintains the predominance of the probableness choice in 10 and 11. The reason the pattern in 12 is different warrants further scrutiny. There are at least two possible explanations for this difference. The first is that, as in sentence 8, the context picture has a stronger effect, somehow due to the nature of what is depicted. The second is that in establishing the 'man' as the probable actor in this sentence ('the man is ready to bite'), I was myself influenced by the NVN Strategy and was in error. Considering the presence of a toy dog as a possible choice of actor,

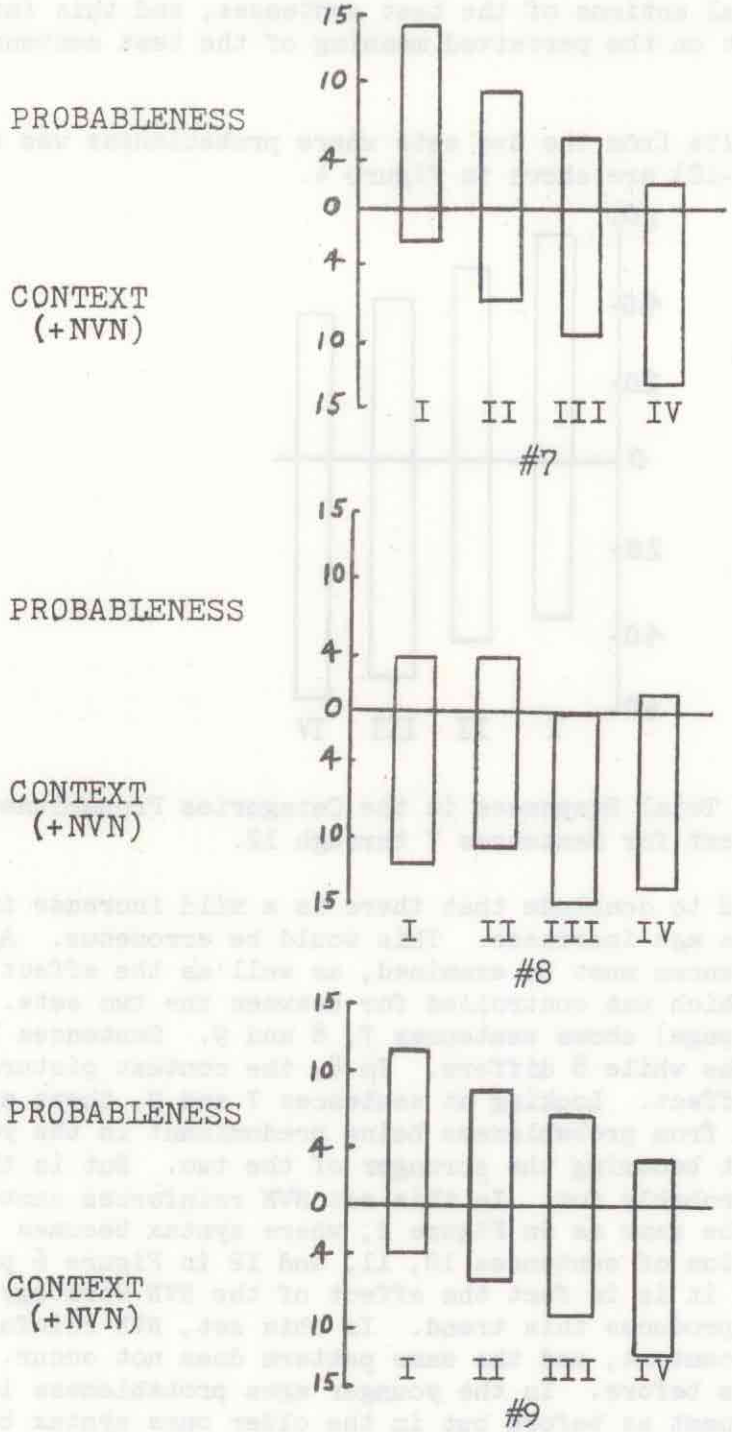

FIGURE 5: Graphs of Responses, by Sentence, to Sentences 7, 8 and 9.

it may be that this choice should be considered the more probable. In this case there results an interesting opposition of probableness and context combined (giving 'dog' as choice of actor) versus syntax (giving 'man' as actor). Thus the combination of two factors tends to offset syntax more than just one factor can. If this second possibility is indeed the correct analysis of what is happening

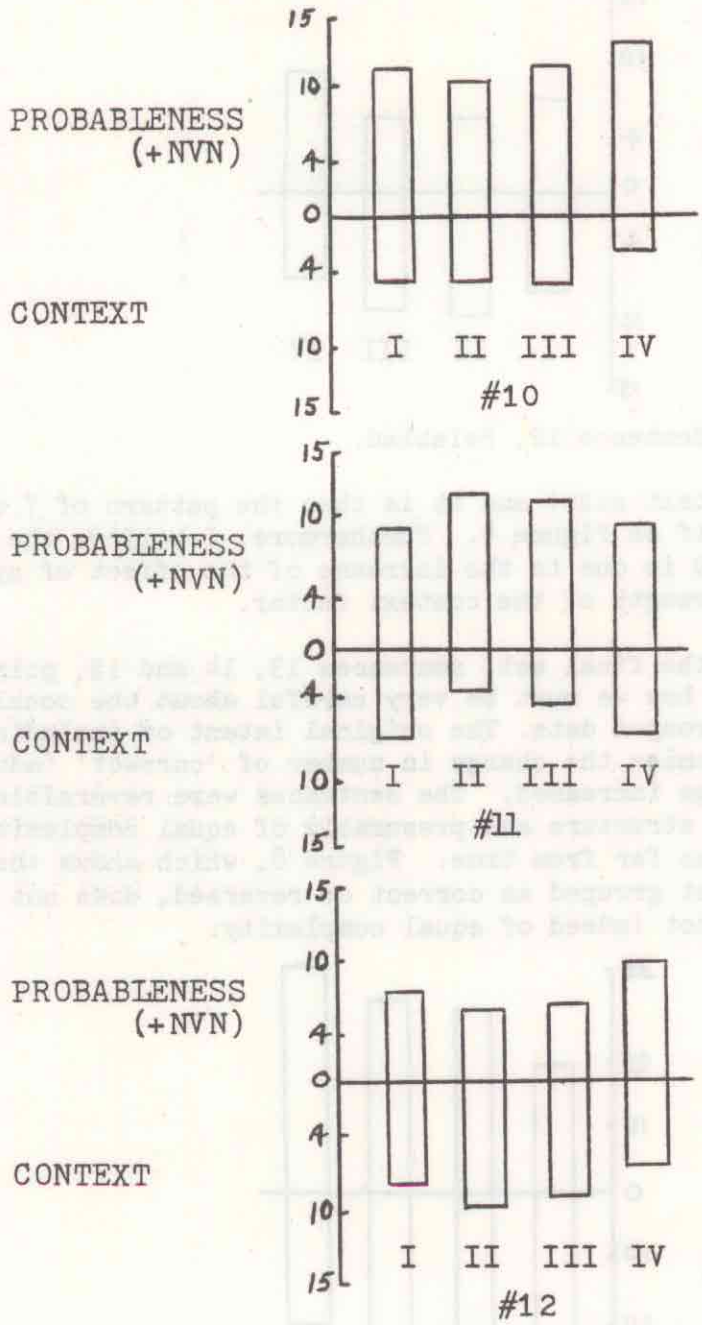

FIGURE 6: Graphs of Responses, by Sentence, to Sentences 10, 11, and 12.

then the graphic representation of sentence 12 should read as in Figure 7 (see next page).

Returning to Figure 4, it is now obvious why a conclusion of an increasing effect of context as age increases would be wrong. Sentences 8, 10, 11 and 12 do not indicate this. In fact, it appears that the pattern of 10 and 11 (more responses on the probableness side) somewhat offsets the pattern of 8 and 12 (more

FIGURE 7: Graph of Sentence 12, Relabled.

responses on the context side) and it is then the pattern of 7 and 9 that imprints itself on Figure 4. Furthermore, I believe the trend seen in 7 and 9 is due to the increase of the effect of syntax, not an increasing strength of the context factor.

The results of the final set, sentences 13, 14 and 15, point out even more strikingly how we must be very careful about the conclusions we draw from grouped data. The original intent of including this set was simply to examine the change in number of 'correct' (adult like) responses as age increased. The sentences were reversible passives of the same structure and presumably of equal complexity. Surprisingly, this was far from true. Figure 8, which shows the responses for this set grouped as correct or reversed, does not reveal that they were not indeed of equal complexity.

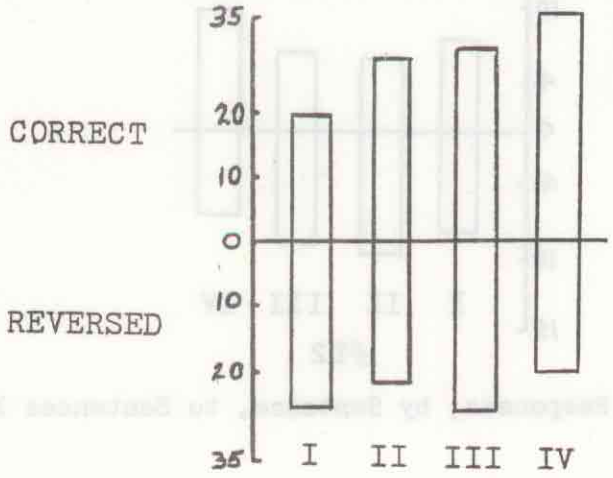

FIGURE 8: Graph of Total Responses as Correct or Reversed for Sentences 13, 14 and 15.

Figure 8 does show a moderate increase in correct responses from Group I to Group IV, but much less than would have been expected. Again it is necessary to examine the individual sentences. Figure 9 shows these results, and reveals a most unexpected pattern.

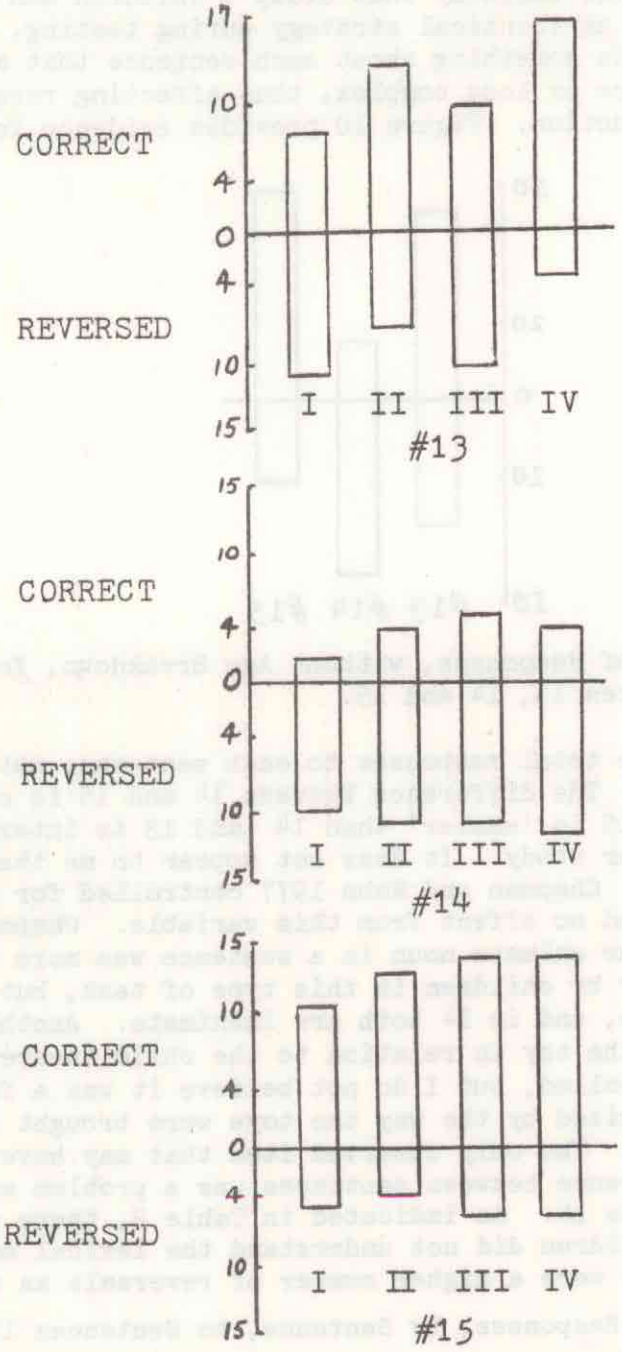

FIGURE 9: Graphs of Responses, by Sentence, to Sentences 13, 14, and 15.

The responses to 13 are mixed, favoring correct ones. 14 has more reversals in all age groups while 15 has more correct in all age groups. Superficially the sentences were the same. But obviously there is a great difference in each one. What this difference is is not clear. There are several possibilities, or even combinations of these possibilities. The order of their appearance in the experiment was 15-13-14. 15 was in fact the first sentence (of all fifteen) presented. 13 was midway, and 14 was at the end. It is possible a strategy developed during the testing, but not likely. Strategies tend to change with increase in age; they do not remain constant.

It is therefore quite unlikely that Group I children adn Group IV children developed an identical strategy during testing. It is more likely that there is something about each sentence that makes it psychologically more or less complex, thus affecting recognition of its passive construction. Figure 10 provides evidence for this assertion.

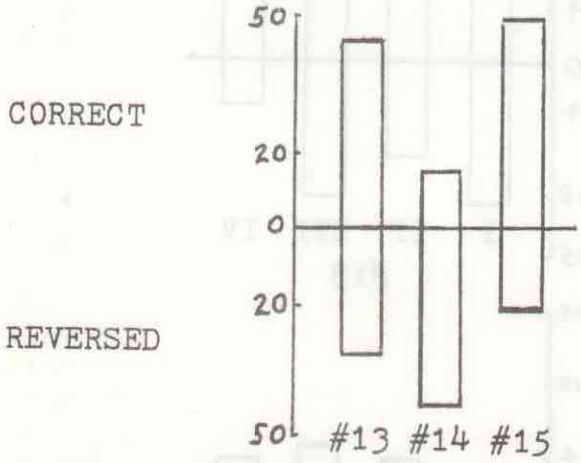

FIGURE 10: Graph of Responses, without Age Breakdown, for Sentences 13, 14 and 15.

Figure 10 shows the total responses to each sentence, not broken down by age group. The difference between 14 and 15 is considerable. The answer to why 15 is 'easier' than 14 (and 13 is intermediate) will require further study. It does not appear to me that it is related to the toys. Chapman and Kohn 1977 controlled for size of toys in a study and found no effect from this variable. Chapman and Miller 1975 showed that the animate noun in a sentence was more often selected as the actor by children in this type of task, but in 13 and 15 both are animate, and in 14 both are inanimate. Another possibility, position of the toy in relation to the child (nearer the right hand) was not controlled, but I do not believe it was a factor. This was probably randomized by the way the toys were brought forward haphazardly each time. The only observed item that may have played a part in this difference between sentences was a problem with the verb 'follow' in sentence 14. As indicated in Table 2, there were many instances where children did not understand the lexical meaning of the verb, and there were a higher number of reversals as well.

TABLE 2: Types of Responses, by Sentence, to Sentences 13, 14 and 15.

	C	R	REF	EGO	NC
#13	47	32	1	0	0
#14	15	44	3	0	18
#15	52	21	1	6	0

C = Correct, R = Reversed, REF = Refused, EGO = Egocentric
NC = Did not comprehend verb

To assert that there is something more 'difficult' about the verb 'follow' in this sentence would be speculative, based only on this data, but it is a possibility that merits further study.

Thus far the various results for the passives have been grouped together. A question that arises at this point is, how did each child react to the different passive sentences? That is, did individual children tend to have either all passives correct or all reversed? Actually, from Figure 10 it is already apparent that this is not the case, or the sentences would have equal numbers of correct and reversed responses. I was struck from the beginning by the number of children that had a pattern of Correct-Correct-Reversed (on the score sheets, where the order was 15-13-14). This led me to compile Table 3.

TABLE 3: Number of Children per Age Group in Different Patterns of Response to Sentences 13, 14 and 15.

#15	C	R	C	C	R	R	R	C	R	C	R	E	E	E	C	R	R	-
#13	C	R	C	R	C	R	C	C	R	R	C	C	R	C	C	R	-	R
#14	C	R	R	R	C	C	R	N	N	N	N	N	R	C	-	-	R	R
I	1	1	3	3					2	3	1	1	2	1	1		1	
II	3	2	3	3	1		1	2		1		1	1		1			1
III	2	2	5	4	1	2		2		1						1		
IV	3		5	3	1		4	3			1							
	9	5	16	13	3	2	5	7	2	5	2	2	3	1	2	1	1	1

C = Correct, R = Reversed, - = Refused, E = Egocentric, N = Did not comprehend verb

Possible response patterns are given for the order 15-13-14 (the order in which the items were presented). There are eighteen different patterns. The most striking thing is the low frequency of both all correct (9) and all reversed (5), while there are sixteen subjects who had the first two (15-13) correct and the third (14) reversed, and seven more who had the first two correct while the third was not understood. The only pattern that did not occur was Correct-Reversed-Correct. Also, egocentric responses only occur in sentence 15, the first sentence presented during the testing. DeVilliers and DeVilliers 1973 obtained many responses of this type from young children in their study and hypothesized that the children were not using word order yet. The DeVilliers did not conduct pre-training. Chapman and Kohn 1977, on the other hand, did conduct some pre-training and did not obtain similar results. They conclude the child had learned to make 'one object act on another, rather than acting on either himself'. As no pre-training was conducted in this experiment, this notion was learned as it progressed, and thus there were no more egocentric responses by the time sentence 13 was reached, halfway through the sentences.

Implications of the Results. Close scrutiny of the data in the previous section showed that the degree of probableness, context, etc. varies significantly with each sentence. It further revealed that each child perceives each sentence idiosyncratically. Sentence 3 is a good example of this (see Figure 2). In all four age groups, some children extract the meaning from the word order, the others from their expectations of probableness. Given an individual child, one cannot predict which of these 'strategies' will prevail. What is taking place in this situation is probably something like what Bever 1970 describes: 'If one hears a series of words with only one reasonable semantic connection, then we suspend further perceptual analysis of the speech signal and assume it follows the usual semantic constraints'. This is a good starting point on which to build a theoretical model, but there is obviously much more that must be considered. Bransford, Barclay and Franks 1972 point out that, first, the meaning is not in the sentence but in the people who hear it; and second, a sentence is not just a perceptual object but a source of information, derived by the listener, that is assimilated to existing cognitive knowledge. Bransford and Johnson 1972 claim that an activated semantic context is essential to the comprehension of linguistic input. This is to say that we all interpret input in relation to what we know of the existing world, and in relation to how we think it fits into current happenings (the context), and that we always have some sort of 'context' we are fitting the input into. This view implies a strong criticism of using isolated sentences, with no contextual framework, as the basis for any kind of study. In the design of this experiment, no context for the sentences was provided, in a large sense. That is, the sentences were isolated events, rather than part of some large scenario. It is my opinion that this accounts for some of the mixed results, i.e. the idiosyncratic nature of the responses, because the child must provide his/her own 'activated semantic context', and what this is varies individually. An example of this can be seen in the experiment, where some children were affected by the task. In response to sentence 9 ('the ball is ready to kick'), three children from the control group had Bert or Ernie kick the ball, instead of kicking it themselves as the others in the control group had (these were still tabulated as child acting on ball rather than ball acting on something). Bert kicking the ball is a different meaning than the child kicking it, and this meaning was derived within the context that the task was to have toys do the action. Numerous non-controls used the telephone, which appeared in a passive role in the context picture, to strike the ball. The conclusion here is that knowing the task can be a context, but that this potential factor only comes into play in some of the children. The question is, what other contexts may arise that we are not aware of? Others undoubtedly do. A chance mistake during the testing gives further indications of this. One subject was inadvertently retested by the second experimenter; the first time the subject saw the context pictures, the second time, about a week later, he did not (control situation). The second time it was quite obvious from his response to sentence 11 that he had seen the context picture previously and was still influenced by it[6]. One wonders if something a child had been doing recently prior to the experiment provided a 'context' for any of the sentences.

We must, then, include in any model of sentence processing, anything which aids the comprehension process. All of the factors discussed to this point must be incorporated. Yet, a model for adults must differ from that of one for young children, since they often interpret sentences differently. Figures 11 and 12 present two possible models for speakers of English, the first for adults, the second for children, that attempt to illustrate where the difference in processing may lie. They are not intended to be comprehensive models, as no attempt has been made to deal with the interaction of phonology, lexicon accessing and other such items.

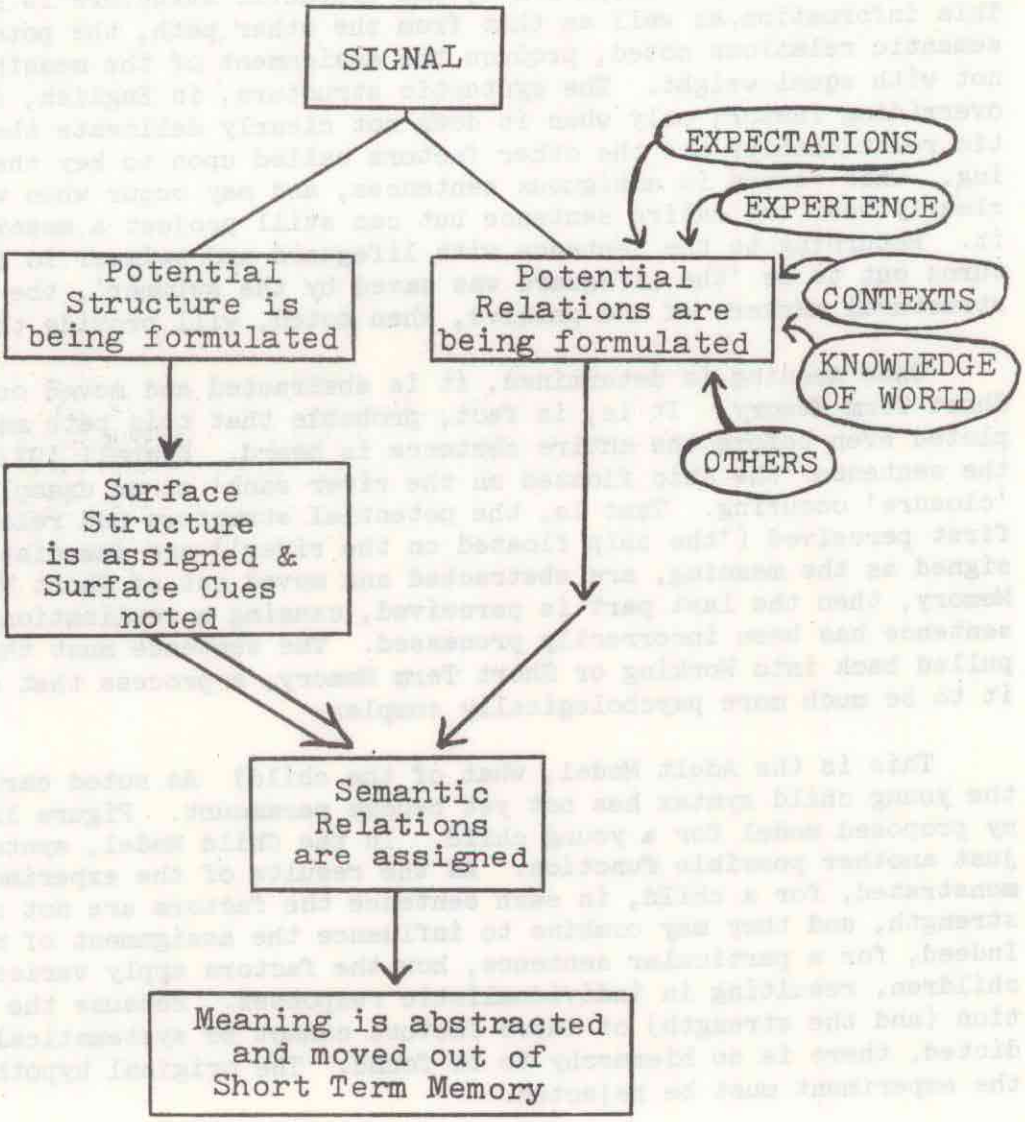

FIGURE 11: A Proposed Limited Model of Adult Sentence Processing

In the adult version the signal or input is received and the processing path bifurcates. There is a simultaneous processing of potential surface structures and of potential semantic relations (this notion of simultaneous processing is from Bever 1970). These phases are ongoing as the input is coming in. That is, upon hearing the string 'the ship floated on the river...', potential relations are

noted. But if the sentence at this point is not complete, and in fact is 'the ship floated on the river sank', further processing is required. As indicated in Figure 11, many factors enter into the formulation of potential semantic relations, and are the types of factors that have been discussed throughout this study. As an example of this formulation process, upon hearing a sentence that included 'lifeguard...swimmer', the potential relationship, based on experience, would be that the lifeguard acts on the swimmer.

Next, word order and grammatical markers are recognized, the surface cues to relationships noted, and syntactic structure is assigned. This information, as well as that from the other path, the potential semantic relations noted, produce the assignment of the meaning, but not with equal weight. The syntactic structure, in English, is the overriding factor; only when it does not clearly delineate the semantic relationships are the other factors called upon to key the meaning. This occurs in ambiguous sentences, and may occur when we do not clearly hear the entire sentence but can still project a meaning onto it. Returning to the sentence with lifeguard and swimmer in it, if it turns out to be 'the lifeguard was saved by the swimmer', the surface structural markers of the passive, when noted, will provide the meaning.

Once meaning is determined, it is abstracted and moved out of Short Term Memory. It is, in fact, probable that this path may be completed even before the entire sentence is heard. Kimball 1973 gives the sentence 'the ship floated on the river sank' as an example of 'closure' occuring. That is, the potential structure and relationships first perceived ('the ship floated on the river') are immediately assigned as the meaning, are abstracted and moved out of Short Term Memory, then the last part is perceived, causing a realization that the sentence has been incorrectly processed. The sentence must then be pulled back into Working or Short Term Memory, a process that causes it to be much more psychologically complex.

This is the Adult Model, what of the child? As noted earlier, in the young child syntax has not yet become paramount. Figure 12 shows my proposed model for a young child. In the Child Model, syntax is just another possible function. As the results of the experiment demonstrated, for a child, in each sentence the factors are not equal in strength, and they may combine to influence the assignment of meaning. Indeed, for a particular sentence, how the factors apply varies across children, resulting in individualistic responses. Because the application (and the strength) of these factors cannot be systematically predicted, there is no hierarchy to be found. The original hypothesis of the experiment must be rejected.

In the Child Model, any of the factors may turn out to be paramount. It was clear in sentences 1, 2 and 3 that probableness was often responsible for determining the meaning, especially in Group I. If one of the factors immediately provides a reasonable meaning (i.e. it prevails in strength), consideration of the others is not necessary. This is not to say syntax is never considered. It is still a factor, and as sentences 4, 5 and 6 indicated, strong in simple declaratives; during the testing, many times the children would start reaching, while

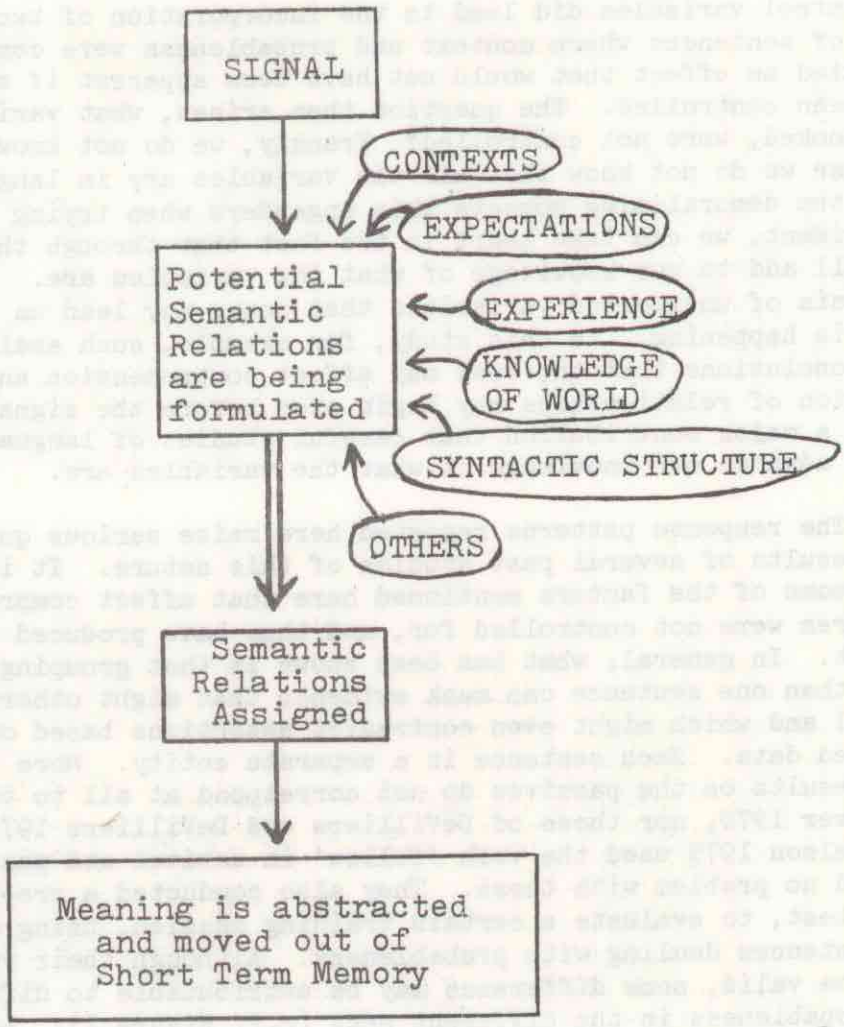

FIGURE 12: A Proposed Limited Model of Child Sentence Processing

the sentence was being spoken, for the toy that did the action in the context picture, then switch to the actual actor toy as the sentence was processed. The context of the task (knowing some toy was to be selected) and an expectation established by the picture were already acting on the potential relations being formulated, but the cue from the syntax of the sentence was heeded. This, in fact, points out the over-simplified nature of the models as presented, since they show a simple sequence. Formulations of potential relations may begin before the utterance even occurs. The children in the example above were using context and other information given to begin this processing before the signal was received. An adult often does the same; everyone has experienced 'knowing' exactly what someone is about to say. To account for this a much more complex model must be devised. Those presented here are intended merely to illustrate where some differences in adult and child sentence processing lie.

CONCLUSIONS

Controlling the variables in an experiment dealing with language is problematic at best. In the design of this experiment, the attempt

to control variables did lead to the incorporation of two separate sets of sentences where context and probableness were compared. This revealed an effect that would not have been apparent if syntax had not been controlled. The question then arises, what variables were overlooked, were not controlled? Frankly, we do not know, precisely because we do not know what all the variables are in language. Despite the demoralizing moments this engenders when trying to design an experiment, we can take heart in the fact that through these attempts we will add to our knowledge of what the variables are. That is, analysis of unexpected variations that occur may lead us to discover what is happening. In this study, for example, such analysis lead to the conclusions that the task may affect comprehension and that formulation of relationships may begin even before the signal is received. Thus, a major contribution that careful studies of language can make is to advance our knowledge of what the variables are.

The response patterns reported here raise serious questions about the results of several past studies of this nature. It is very possible that some of the factors mentioned here that affect comprehension in children were not controlled for, and thus have produced a confounding effect. In general, what has been shown is that grouping responses to more than one sentence can mask evidence that might otherwise be meaningful and which might even contradict assertions based on only the grouped data. Each sentence is a separate entity. More specifically, the results on the passives do not correspond at all to those obtained by Bever 1970, nor those of DeVilliers and DeVilliers 1973. Strohner and Nelson 1975 used the verb 'follow' in actives and passives and mentioned no problem with these. They also conducted a pre-test and a post-test, to evaluate a certain training session, using different sets of sentences dealing with probableness. Although their results may well be valid, some difference may be attributable to different degrees of probableness in the different sets (c.f. Figure 2). Bever mixed actives and passives in evaluating the effect of probableness. He also used three reversible passives, as I have, to study the effect of NVN, but unfortunately does not give the actual sentences used, nor a breakdown of the results, just totals. It seems likely that a difference in sentences used accounts for the very different results obtained in these studies. The idea that simply grouping sentences by putative 'types' is problematic has implications for many past studies. It is a variable that future studies will need to control.

I have claimed here that adult speakers of English have developed simultaneous and separate syntactic processing and that this is a language specific trait. Unfortunately, I believe further studies to check this and test for alternatives will have to wait until a detailed model of sentence processing and parsing is developed. Though I am not sure how seriously this claim should be taken, I have made it because I believe some guess is better than none, and in hopes that it may provide a starting point for further research.

NOTES

[1]This paper is a version of my MA Thesis, completed at San Diego State University, under the supervision of Charlotte Webb, Jeff Kaplan

and Tom Cox. I am deeply indebted to them, as well as Susan Fischer and Jeff Elman for the tremendous amount of help and guidance received.

[2]One of the four pre-schools was a Montessori school.

[3]There was one other experimenter, an undergraduate participating in the project as a Special Study.

[4]The refusals were spread out among the children, that is, there was never more than one per child. It simply occured occasionally that a child would not do a sentence. If every time this happened I had eliminated this child from the study, I would have possibly biased the results and would probably never have finished.

In sentence 7, the response labeled 'Egocentric' indicates the subject made the horse run around. In sentence 15, it indicates the subject spanked one of the dolls.

In sentence 14, for a response to have been scored 'Verb Not Understood', some indication that this was indeed the case had to have been noted, e.g. moving the two vehicles side by side, or as one child forthrightly and succinctly stated, 'I don't know what it means'. A simple refusal to do anything was scored a refusal.

[5]Where bar graphs are used, throughout the study, responses such as refusals are simply left out. These can be found in Table 1.

[6]This response prompted a check of the results and the re-duplication was verified. Records were kept and checked such that it is certain that this did not re-occur.

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