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Introduction.

One of the central questions which the study of children's acquisition of language attempts to answer is which aspects of the adult language the child initially regards as crucial in formulating hypotheses about language. For example, Braine (1963) proposed that at the stage during which children speak in two-word utterances, the grammar of the child can best be described in terms of some of the words being "pivot words," and others being "open words." The pivot words comprise a small set of frequently used words which must always occur in the same position (either first or second) in a two-word utterance. The constraint of sentence formation is that no sentence can consist of two pivot words, although two open words or a combination of open and pivot words in either order are possible.

Braine's pivot grammar makes a strong claim about the language acquisition process. According to this theory, lexical class and word order are the criteria which the child makes use of in producing utterances. Other linguistic phenomena, such as grammatical relations, semantic relations and syntactic structure, do not play a role. Not totally satisfied with these claims about the nature of the acquisition process, a number of other linguists have reconsidered the two-word stage. Bloom (1973) makes the claim that pivot grammar misses the point, and that this stage of language development should be described in terms of grammatical relations instead. That is, children's utterances at this stage reflect a knowledge of such notions as "subject," "verb" and "object," and also reflect a knowledge of the order in which these items generally occur in sentences: SVO. What makes this analysis more attractive is that the basic notions, word order and grammatical relations, not only account for the data, but also provide a foundation for further linguistic development. While pivot and open classes of words presumably play no part in adult language, it is entirely possible that grammatical relations do.

Brown (1973) presents still another analysis of this stage. Rather than proposing that grammatical relations are what the child has learned, Brown claims that the child has internalized a set of (cognitively based) semantic relations. Thus utterances are statements about agents, actions, patients, instruments, etc. A possible advantage of this analysis over Bloom's is that the use of semantic relations makes it easier to describe the ambiguity of many of the child's utterances at this time.

Finally, Menyuk (1969) has stated that the two-word stage in child language should be described in terms of rudimentary phrase-structure trees. That is, the aspect of this stage that is central is the child's beginning to learn about syntactic structures.

The above has by no means been intended to evaluate or even summarize the literature on this early stage of language acquisition. Its purpose is solely to point out the following: it is still not clear which linguistic phenomena the child makes use of in his earliest hypotheses. In this paper we will argue that at least some of the errors that children commit in interpreting sentences with relative clauses can only be adequately described as structural generalizations and exclusions, while others involve generalizations based on semantic or grammatical relations. That is, children make use of more than one of the systems discussed above.

There is a significant paradox in the proposals under review. They appear to simplify the child's task in language acquisition when, in fact, they make it more complex. The claim is that a child begins with a simple system; he knows, for instance, just grammatical relations between words.

Then he must learn to map those relationships onto syntactic trees, and to associate the appropriate semantics with the syntactic trees and grammatical relations. Each stage entails a new problem and a much larger set of possible grammars.

Linguistic theory offers the hypothesis that a child has a more complex set of assumptions, but that the acquisition task is therefore easier (see, for example, Chomsky (1965)). Specifically, the assumption is that a single structure is used for several purposes. Both the semantic relations and grammatical relations are mapped onto a syntactic tree, as are phonological matrices. The choice of tree structure, then, eliminates many possibilities, allowing the child to fix several parameters with a single stroke: a decision about tree structure. We shall argue that the latter case is true -- a child makes certain assumptions about tree structure which entail a number of consequences for functional relationships. Specifically, we shall show that children never interpret the boy as the subject of hit in (1),although they sometimes do so in (2).

1) The boy put the dog that hit the sheep in the barn.
2) The boy pushed the dog that hit the sheep.

It will be seen that this fact follows naturally from certain universal constraints on syntactic structure.

In section 1, we will discuss various hypotheses which have been proposed to account for the acquisition of relative clauses, and discuss the predictions which each of them make for the test sentences in our experiment. Theoretical considerations will also be presented. Section 2 describes the experiment and the results, which as we shall see, strongly support the hypothesis that children make structural as well as functional and semantic generalizations. In section 3 we will consider these results in light of other data in the acquisition process, pointing out that similar structural claims have been made to account for diverse aspects of the child's acquisition of language.

1.1. Hypotheses for the Acquisition of Relative Clauses.

In this section we will discuss two hypotheses which are incompatible, and describe an experiment which can choose between them.

1.1.1. The Parallel Function Hypothesis.

Sheldon (1974a) discusses several hypotheses for the acquisition of relative clauses. Having rejected several word order hypotheses, (see, e.g., Slobin (1971)), she proposes the parallel function hypothesis. The claim is that sentences in which the relativized noun phrase has the same function in the main clause and the embedded clause will be easier than sentences in which the relativized noun phrase has a different function in each clause. Consider, for example, the sentences in (3).

3) a. The boy saw the cow that heard the horse. (OS)
   b. The boy saw the cow that the horse heard. (OO)
   c. The boy that heard the horse saw the cow. (SS)
   d. The boy that the horse heard saw the cow. (SO)

The letters following each sentence represent the various roles of the relativized noun phrase. In (3a), the cow is the object of the main clause but the subject of the relative clause. In (3c), the boy is the subject of both clauses, etc.

According to the parallel function hypothesis, SS and OO sentences, such as (3b) and (3c), should be easier than SO and OS sentences, such as (3a) and (3d). Sheldon's data indicate that this is precisely the case. Her subjects were between the ages of three and five years.

Not only do the relative difficulties of these sentence types support the parallel function hypothesis, but the types of errors made also do. Several of the types of errors can be analyzed as parallel function mistakes. For example, if a child interprets an OS sentence as if it were an OO sentence or an SS sentence, then it can be said that the child is using a strategy based on parallel function. A child doing this would interpret (4a) as if it were either (4b) or (4c).

4) a. The cow bit the horse that kicked the sheep. (OS)
   b. The cow bit the horse that the sheep kicked. (OO)
   c. The cow that kicked the sheep bit the horse. (SS)

Thus, both the overall difficulty of the four sentence types and the types of errors made on each lend support to the parallel function hypothesis. Similar evidence in which children interpret SO sentences as SS sentences is also presented by Sheldon, and is considered support for this analysis.

1.1.2. The Structural Misrepresentation Analysis.

The evidence which Sheldon presents for the parallel function hypothesis is indeed very strong. But some of the data are open to other interpretations. Tavakolian (1977) has performed similar experimentation and her data follow from Sheldon's predictions. That is, the SS and OO sentences are easier than the OS and SO sentences, given a toy-moving task for children between the ages of three and five. Tavakolian found that for all four sentence types, however, the most common error was to interpret the sentence as though it were an SS sentence.

Let us consider first, the most pronounced case: OS sentences. It was found that 63% of the responses were SS interpretations. These results are similar to Sheldon's where it was also found that children make this mistake. Sheldon's explanation for the mistake is the extraposition interpretation. The reason children interpret right-embedded relative clauses as modifying the subject of the sentence is that they interpret the relative clause as having been extraposed from its original position as a subject modifier. Note that extraposition from NP is a possible rule for adults:

5) a. The man that Bill saw went away.
   b. The man went away that Bill saw.

The extraposition interpretation, incidentally, is a parallel function error, since both the main clause and the relative clause share the same subject.

Before proceeding further, we must adopt a more precise notation for

describing children's interpretations of these sentences. The notation below is also taken from Sheldon (1974a). We will number the noun phrases in the sentence consecutively, and describe the child's interpretation of the sentence in terms of these numbers.

6) The dog that the horse kicked bit the sheep.
1 2 3

A correct response would indicate that the horse kicks the dog and the dog bites the sheep. We will indicate this by 21,13. The first pair of numbers represents the actor and patient of the first clause, and the second pair represents the actor and patient of the second. Returning to our example of a child misunderstanding OS sentences, we see that this notation would mention that the extraposition interpretation involves a 12, 13 interpretation instead of a 12, 23 interpretation. This can be verified using sentence (7).

7) The dog bit the sheep that kicked the horse.
1 2 3

The extraposition analysis does account for 12, 13 responses for sentences such as (7). It also accounts for similar responses for OO sentences such as (8).

8) The dog bit the sheep that the horse kicked.

But there are several reasons for rejecting this analysis. First, if children interpret OO sentences as extraposed SO sentences, then we would, as Tavakolian points out, expect SO sentences to be relatively easy. Sheldon's data clearly demonstrate that this is not the case. Thus it is difficult to imagine that children are using an extraposition rule to derive OO sentences from SO sentences, since the latter are more difficult than the former. Secondly, Aller (1977) has found that the facts for the acquisition of relative clauses in Arabic are similar. Children interpret OS and OO relatives as modifying the subject of the main clause. But in Arabic there is no rule of extraposition from noun phrase at all. That is, sentences such as (5b) are not grammatical. Thus the extraposition analysis cannot be extended to include similar data in other languages. Finally, another analysis is possible, which not only accounts for the data, but also offers a better explanation. This is the structural misrepresentation hypothesis.

Tavakolian found that at a very early age children are able to correctly interpret conjoined sentences such as (9).

9) The bear kissed the lion and ____ tickled the tiger.

When two clauses are conjoined, if the second conjunct has a missing subject, then it is interpreted as coreferential with the subject of the first conjunct. But note that extending this strategy to relative clauses produces the extraposition interpretation. Any 12, 13 response actually mimics the correct response for conjoined clauses. If we take as given

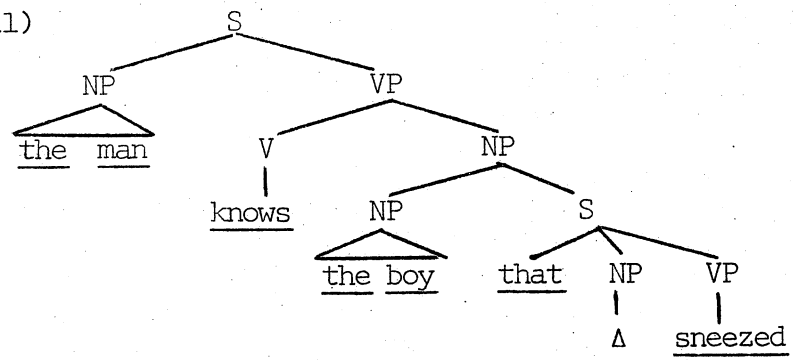
the fact that children at early stages of acquisition do not tolerate deep levels of embedding, then this analysis seems even more plausible.

It is our claim that children simply attach the relative clause to the highest S node on the tree in their 12, 13 interpretations of OS sentences. The mistake is purely a structural misrepresentation of the sentence. For a sentence such as (10), a child who commits this type of error will attach the relative clause to the highest S instead of to the NP which also dominates the boy.

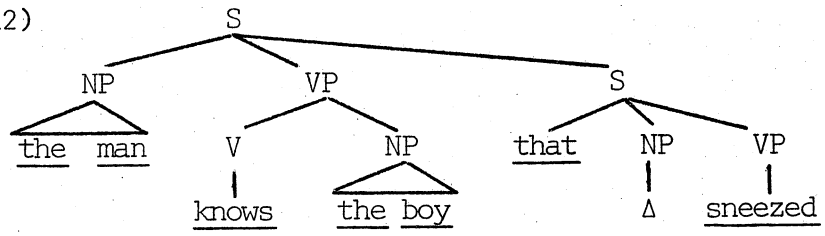
10) The man knows the boy that sneezed.

Whereas adults assign structure (11) to sentence (10), children who give a 12, 13 interpretation to it assign structure (12).[1]

11)



12)



This structural analysis can be justified from both a linguistic and an acquisition viewpoint. We will consider both below.

First, consider the following putative linguistic universal, extracted from Williams (1975).

13) Universal Control Principle: A missing NP cannot be higher on the tree than the NP which is its antecedent.

Returning to (10), if a child mistakenly attaches the relative clause to the highest S node, then he must interpret its antecedent as being the subject of the main clause, since the object of the main clause is lower on the tree than the missing subject.[2] Principle (13) rules out the boy as an antecedent in (12) because it is more deeply embedded than the Δ. Note further that this principle also accounts for why the subject is always the antecedent in sentences with two conjoined clauses such as (9), and sentences with extraposed relative clauses such as (5b). In each of these cases, the missing NP is higher on the tree than the VP of the first clause, but is not higher on the tree than the subject of the first clause. In a

sentence such as (14), the object of the first clause can never be interpreted as the antecedent of the missing subject of the second.

14) John hit Bill and ran away.

In a sense, the structural misrepresentation analysis captures all of the facts that the extraposition analysis captures, but eliminates the problems mentioned earlier. Furthermore, the claim that children make crucial use of Principle (13) follows naturally from the observation that children avoid embedded constructions at an early age. We will look at a number of other cases in which children attach material to the highest S in section 3.

1.2. Structural and Functional Claims.

We can now return to the original question of this paper: what information in a sentence do children consider important in their attempts to assign it an interpretation ? We have thus far considered the parallel function hypothesis, which, combined with the extraposition analysis, accounts for much of the data. In addition, we have proposed the structural misrepresentation hypothesis to account for the same set of facts. These analyses follow from more general hypotheses:

Hypothesis I: Children interpret multiclausal sentences solely on the basis of the syntactic structure they assign.

Hypothesis II: Children interpret multiclausal sentences solely on the basis of functional relations in the sentence, and other general parsing strategies.

Although we have already pointed out arguments from Tavakolian (1977) and elsewhere which cast some doubt on the power of the parallel function hypothesis to account for the full range of data, we have designed an experiment which is intended to separate errors according to whether they are caused by the child's misunderstanding of the syntactic structure, or the grammatical relations within the sentence. The remainder of this section will be devoted to this task.

1.3. A Proposed Study.

The verb put requires both a noun phrase and a prepositional phrase in its subcategorization. Sentences such as (15a) are grammatical, while those like (15b) are not.

15) a. The girl put the book on the shelf.
b.* The girl put the book.

Any speaker of English with native fluency knows this fact. It is, of course, possible to embed a relative clause under the object NP in (15a), yielding (16).

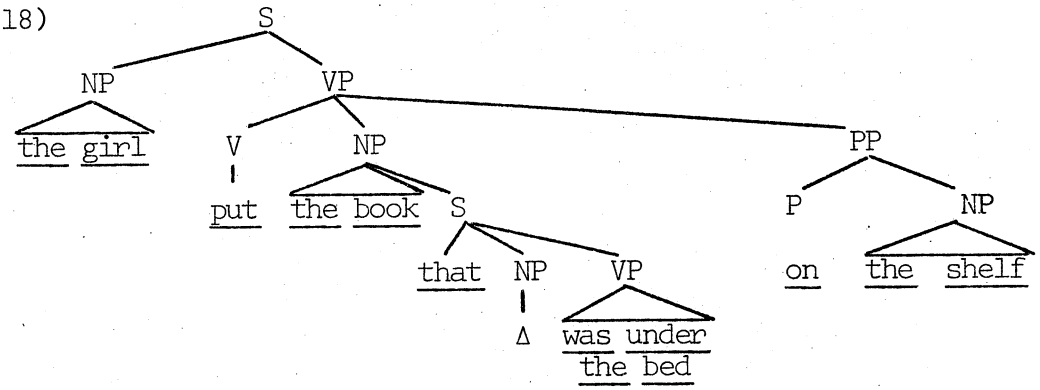
16) The girl put the book that was under the bed on the shelf.

Note that it is impossible to interpret the relative clause as modifying the subject of the sentence. That is, the girl cannot be interpreted as the one that was under the bed. Such a reading is possible, although certainly not preferred, for (17).

17) The girl read the book that ate the sandwich.

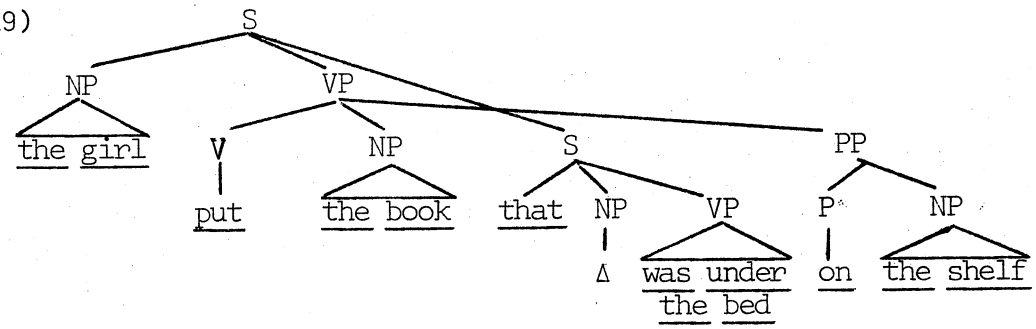
The problem is that the verb phrase of put contains both a noun phrase and a prepositional phrase, as illustrated below.

18)



It was noted above that extraposed relative clauses are attached to the highest S node in the tree. But it is impossible to interpret the relative clause in (16) as being attached to the S node since the verb phrase also contains the PP on the shelf. The only way to attach the relative clause to the S, as can be seen in (19), is to cross lines in the tree.

19)



There is a universal structural constraint, referred to as the "no tangle constraint," which prohibits lines on a tree from crossing.[3] Given this constraint, we can see that there is no longer any way to attach the relative clause to the S node, and the extraposition reading is not possible. Since the no tangle constraint is universal, children should be incapable of constructing trees which violate it.

These sentences bear crucially on the hypotheses stated in the previous section. Hypothesis I, which claims that children make use only of the syntactic structure of the sentence, would predict that children would never interpret sentences with put, such as (16), as having relative clauses which modify the subject of the sentence. If the child has the knowledge that put requires a prepositional phrase in its complement, and

if the 12, 13 reading is caused by attachment of the relative clause to the highest S node, then no tangle constraint considerations rule out the 12, 13 reading for put sentences. Similarly, we would never expect a child to interpret (16) as 12, 31 which also considers the relative clause as modifying the subject of the sentence, but confounds the roles of the NP's within the relative clause.

Hypothesis II, on the other hand, does not predict that it is impossible for children who know the subcategorization for put to interpret the relative clause as modifying the subject. Since the claim of this hypothesis is that only grammatical function and general parsing strategies are used by children, the fact that a 12, 13 interpretation violates various structural constraints is not relevant. That is, if children interpret OS sentences as 12, 13 instead of 12, 23 only because of a strategy which requires them to preserve grammatical function, then whether or not the main verb of the sentence is put should not affect the types of errors children make.[4]

Although Hypothesis II makes predictions independent of the tree structure, we must also consider the possibility that some feature of linguistic theory might permit the notion of parallel function to exist as an aspect of coreference relations. The compatibility of the parallel function hypothesis with linguistic theory hinges on the question of whether there is any kind of rule which allows coreferential relations to overlook the no tangle constraint. In fact, certain rules of anaphora relate pronouns and antecedents, and are not bound by the structural constraint. For instance, we can utter (20), where he refers to John.

20) John put the boy that he liked in the corner.

Even though John and he are not syntactically related on the tree, they can be coreferential. Suppose that the relative pronoun that has the same character as the free pronoun he in the child's grammar. Then it should be possible for the child to make an anaphoric connection between John and that. In the adult grammar, relative pronouns are bound to the sister noun which falls under the same NP. We have developed, in effect, a revision of Hypothesis II (since the predictions remain the same) in terms of anaphora. While the two hypotheses under consideration are still incompatible, it is still possible that both are bound by sets of linguistic constraints.

Thus far we have been considering only errors which involve the child's understanding the relative clause as modifying the wrong noun phrase in the sentence. There are a number of other errors which children make, though. For instance, both Sheldon and Tavakolian found that children interpret SO sentences as though they were SS sentences. Sheldon considers this a parallel function strategy, but we (and Tavakolian) consider it to be a result of structural misrepresentation. But there are errors (which occur very rarely in Tavakolian's data) which could not be easily explained by structural misrepresentation. For example, if a child interprets an OS sentence as if it were an OO sentence (see (4) above), the structural misrepresentation hypothesis would not be able to account for it while the parallel function hypothesis would. No structural principle exists, as far as we can tell, that would ever cause a child to make such a mistake. This does not mean that no non-structural parsing strategy could explain

the phenomena. We have, therefore, prima facie evidence that functional factors play a role.

Consideration of the hypotheses in light of sentences with put is now possible. Children can be presented with four types of sentences: OS and OO sentences where the main verb is put, and OS and OO sentences where the main verb requires an NP, but not a PP. Push is such a verb. Sentence paradigms are given below in (21).

21) a. The boy put the dog that kicked the horse in the barn. (OS)
b. The boy put the dog that the horse kicked in the barn. (OO)
c. The boy pushed the dog that kicked the horse. (OS)
d. The boy pushed the dog that the horse kicked. (OO)

Hypothesis I, the structural hypothesis, predicts that while children who understand that put subcategorizes for a PP may interpret the relative clauses in (c) and (d) as modifying the subject, they will never do so in (a) and (b). Hypothesis II predicts that it should make no difference as to whether the main verb is put or push in the child's interpreting the relative clause as modifying the subject. Furthermore, Hypothesis II predicts that children may interpret (a) as if it were (b) using a parallel function strategy, (b) as if it were (a) using an adjacency strategy (see below), and make the corresponding errors with (c) and (d). If children do this, the structural account would be able to offer no explanation, especially if such errors can be shown to have nothing to do with whether the main verb is put or push.

2. The Experiment.

2.1. Subjects.

The subjects were 30 children attending several schools and day care centers. While it was originally intended to test children between three and five years of age, no one under four completed the questionnaire. The subjects were all between four and six years old.

2.2. Materials.

The subjects were interviewed one at a time and presented with a toy barn whose doors were open, and a number of toy barnyard animals, a boy doll and a girl doll.

2.3. Procedure.

2.3.1. Subcategorization.

Before we could present the child with the test sentences, it was necessary to make sure that she knew that the verb put subcategorizes for both a noun phrase and a prepositional phrase. Each subject was shown the barn, whose doors were open, and the set of animals mentioned above. The animals were all situated in front of the barn, except for one of the turtles, which was placed in the barn by the experimenter. After a number of practice sentences in which the child became accustomed to acting out

sentences with the toys, the following sentence was read:

22) The dog put the turtle in the barn.

If the child had the dog place the turtle which was not already there into the barn, it was considered a correct response. But if the child tried in some way to associate the putting task with the turtle which the experimenter had already placed in the barn, then the response was scored as incorrect. The incorrect response would indicate that the child considers the turtle in the barn to be a constituent, and that he does not know that put requires both an NP and a PP argument.

Two sentences like (22) were presented, the second involving the boy putting the cow in the barn. Only those children who answered both of the subcategorization questions correctly were scored for the remainder of the questionnaire. But since no subject who was able to finish the questionnaire failed to understand the subcategorization of put, this was not an issue.

2.3.2. Test Sentences.

The remainder of the questionnaire consisted of a list of 20 sentences, five of each of the types (21(a)-(d)). Since the task of the put sentences was different from the task of the others (hereafter referred to as push sentences) the two types of sentence were segregated. The sentences were chosen so that the OS and OO sentences formed minimal pairs, such as (23) below, to eliminate lexical bias.

23) a. The girl pushed the cow that bit the horse.
b. The girl pushed the cow that the horse bit.

The child's responses were recorded by the experimenter, using the code which we used to describe the children's responses above (e.g. 12, 13). Any relevant remarks made by the child were also recorded. Two questionnaires were used, which differed only in that the sentences mentioned different animals. The results for the two questionnaires were later combined.

2.4. Results.

2.4.1. Total Number of Errors.

There were 300 responses to put sentences, and 300 to push sentences. Of these, 53 (18%) of the put responses were incorrect, and 64 (21%) of the push sentences were incorrect. That is, there was no significant difference in the relative difficulty of the two sentence types.

Half of the sentences were OS sentences, and the other half were OO sentences. Of the 300 OS responses, there were 59 errors (20%), and there were 57 errors (19%) on the OO sentences. That there were no fewer OO errors than OS errors fails to support the parallel function hypothesis.

2.4.2. Analysis of Errors.

A clearer picture of the results can be drawn by separating the errors

into two classes. The first class of errors we will call structural errors. There were two types of structural errors. The first, which has already been discussed, is a child interpreting the relative clause as modifying the subject, rather than the object. The other type of structural error is a failure to attach the relative clause at all. That is, given a sentence with a relative clause, the child is unable to determine which NP the subordinate clause modifies. Consider, for example, (21a).

21) a. The boy put the dog that kicked the horse in the barn.

A child asking, "Who kicked the horse ?" or being unable to act out the relative clause at all (even though she gets the main clause correct) has committed this second structural error, which we will call failure to attach the relative clause. Table 1 presents a breakdown of structural errors according to whether the sentence was a put sentence or a push sentence. The outstanding result here is the fact that none of the children performed S-attachment with put verbs.

	S-Attachment	Failure to attach
Put	0 (0)	42 (14)
Push	40 (9)	6 (2)

Table 1. Number of each type of structural error according to the syntactic structure of the sentence. Numbers in parentheses indicate the number of children who made each type of error.

The relationship between structural errors and sentence type was found to be highly significant, as was the distribution of children making these errors ($p < .005$ in both cases). Thus, whether or not a child will commit either of these errors depends crucially on whether or not the main verb is put or push.

Table II shows, on the other hand, that whether or not a child makes one of these structural mistakes has nothing to do with whether the sentence is an OS sentence or an OO sentence.

	S-Attachment	Failure to attach
OS	22 (10)	22 (7)
OO	20 (9)	24 (9)

Table II. Number of each type of structural error according to the functional relations of the sentence. Numbers in parentheses indicate the number of children who made each type of error.

Chi-square analysis reveals that the relationship between these errors and functional differences between sentence types is not significant, ($p > .10$ in both cases).

We will discuss the reasons behind a child's inability to attach the relative clauses for put sentences in the next section. What is central now is the fact that whether a child will make one or other of these two errors depends on the presence or absence of the prepositional phrase as part of the verb phrase, and not on the type of relative clause. Since the appearance of the PP alters the structure, but not the functional relationships of the sentence, it seems justified to refer to both of these as structural.

The correlation between structural errors and varying the structure of the sentence combined with the fact that there is no correlation between the structural errors and varying the functional relations in the sentence is strong evidence in favor of Hypothesis I. Certain errors are made only under specific structural conditions, independent of functional variation.

The strength of these results deserves special mention. The no-tangle constraint was obeyed 100% of the time. All of the children to whom put sentences were given either failed to attach the relative clause or attached it to the object. There were, by contrast, 24 instances of non-put sentences with subject interpretations. In other words, subject interpretation occurs exclusively where there is no structural impediment to S-attachment. The results are exceptionless because the no-tangle constraint is different from linguistic rules. The passive, for instance, will generally, but with exceptions, be comprehended by five-year olds (see Austin (1976)). But in the case of the passive we are dealing with a possibility in universal grammar which is optional in particular languages. That is, not all languages have a rule like the English passive transformation. The no-tangle constraint, by contrast, is a fundamental and obligatory feature of grammar construction; it is a

boundary condition on the projection of all syntactic hypotheses. In this light, exceptionless results are to be expected.

The second type of error to be considered is the functional error. A functional error involves misinterpreting the roles of the NP's within the relative clause, regardless of which NP the relative clause is interpreted as modifying. Interpreting an OS sentence as an OO sentence constitutes a functional error. Similarly, interpreting an OO sentence as an OS sentence does also. Note that it is also possible to commit a structural error and a functional error in the same sentence. A child interpreting an OO sentence as 12, 13 (instead of 12, 32) has both misunderstood the relative clause as modifying the subject of the sentence, and has confounded the roles of the two noun phrases within that misinterpretation.

A functional error which consists of misinterpreting an OO sentence (12, 32) as 12, 23 we will call an adjacency error, borrowed from Sheldon (1974b). This sort of misinterpretation involves taking the two NP's which occur before the verb in the relative clause, and considering the first one to be the subject and the second one to be the object. Since this type of error involves word order and grammatical relations, we would expect its occurrence to be independent of the syntactic structure (put or push).

An error which consists of interpreting an OS sentence as 12, 32, we will call a parallel function error. Once again, we would not expect that varying the main verb of the sentence (and adding the prepositional phrase) should have anything to do with whether a child commits parallel function errors. As Table III indicates, this is indeed the case.

	Parallel Function	Adjacency
Put	7 (5)	6 (5)
Push	9 (6)	7 (4)

Table III. Number of each type of functional error according to the syntactic structure of the sentence. Numbers in parentheses indicate the number of children who made each type of error.

Of course, parallel function errors occur only in OS sentences, and adjacency errors occur only in OO sentences.

Although there were not as many functional errors as there were structural, they were very evenly distributed ($p > .10$ for both total

errors and children producing them). Referring to children's interpreting OO sentences 12, 13 as adjacency errors may be somewhat misleading. In a sense, this is also a parallel function mistake since the subjects of both clauses are interpreted as being one. What is at issue here is not which of two overlapping strategies caused children to make this particular response (there were only 13 such responses). Rather, the issue is whether certain errors which cannot be explained in any obvious way by variations in the syntactic structure are in fact independent of structural differences. Clearly they are.

All but three of the errors can be described in terms of the two error types and their subtypes.[5] The total number of errors as related to structural and functional variation is presented below in Table IV. As we would predict, there is no dependence between function (OS vs. OO) and structure (put vs. push) in predicting whether a child will make an error.

	Put	Push
OO	34	31
OS	31	39

Table IV. Total number of errors according to the syntactic structure of the sentence and the functional relations of the sentence.

The distribution of errors described in this section clearly supports a hypothesis which claims that children make use of syntactic structure and non-structural strategies in interpreting multiclausal sentences. Below we will deal with each of these aspects of the child's linguistic ability.

2.5. Discussion.

2.5.1. Children's Use of Syntactic Structure.

It is evident from the above data that children do make use of structural information, although sometimes they use it incorrectly. The structural misrepresentation hypothesis discussed above accounts in a natural way for all of the errors which have been referred to as attachment to the highest S node. These errors occurred exclusively within the group of non-put sentences, as mandated by the no tangle constraint. But the other error which varied statistically with the syntactic struc-

ture, failure to attach the relative clause, has not yet been explained.

The failure to interpret correctly the relative clauses for put sentences can be accounted for by considering children's phrase structure rules. A good deal of evidence, to which we shall return, shows that children go through a stage during which sentential complements can only be attached to the highest S node, and not to the verb phrase node, or any NP's which it dominates. These aspects of the child's phrase structure can be represented as in (24).

24) S → NP VP (S)
VP → V (NP) (PP)

A child with rules such as these will interpret all of the push sentences as modifying the subject, but will be unable to interpret the relative clauses on put sentences at all. This is because the embedded clause cannot be construed as being dominated directly by the S node because of the interference of the prepositional phrase.

There was one child who appeared to have precisely these rules. She interpreted all of the non-put relative clauses as modifying the subject, and showed great confusion in her attempts to interpret the relative clauses on the put sentences. In fact, she was never able to do so.

The remaining errors of this type were committed by 8 other children. One of them asked, "Who bit the horse ?" when trying to understand the relative clause of an OS sentence, such as (21a), and "Who did the horse bite ?" when trying to interpret an OO sentence, such as (21b).

21) a. The boy put the dog that kicked the horse in the barn.
b. The boy put the dog that the horse kicked in the barn.

Another child, who missed two sentences in this way, showed the same confusion. The grammars of these two children might include phrase structure rules such as the following:

25) S → NP VP (S)
VP → V (NP) (PP) (S)

These children have progressed to a stage in which they know that some complement sentences are not dominated by the highest S node, but rather by the VP node. This is the case for sentences like John hopes that Mary will come to the party. Furthermore, it has been shown that children who do attach sentential complements to the VP node interpret their missing subjects (generally) as coreferential with another NP within the VP.

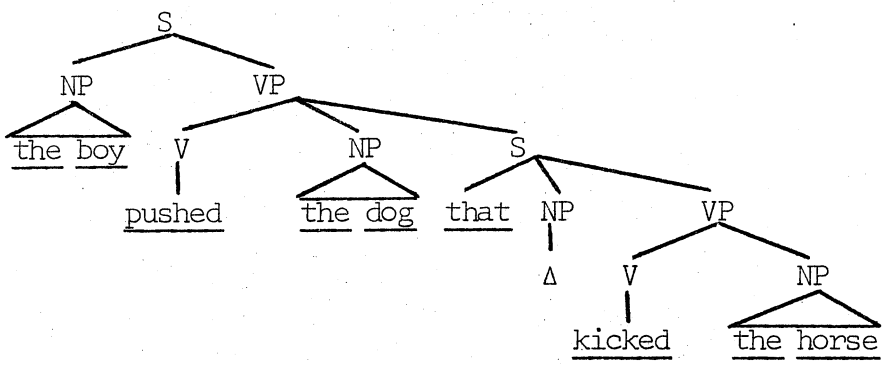
Carol Chomsky (1969) found that children interpret Bill in each of the sentences below as being the subject of go away.

26) a. John promised Bill to go away.
b. John told Bill to go away.

Chomsky attributes this to a strategy which she calls the Minimal Distance Principle (MDP), which is taken from Rosenbaum (1967). The MDP claims that a missing NP is coreferential with the one that is closest to it in the tree. A child with the phrase structure rules in (25) might interpret

(21c) as having the following structure:

27)



By virtue of the MDP, the child will interpret the dog as the antecedent of the missing NP, which is correct. But a child with these rules will not be able to attach relative clauses with put easily, since the rules do not allow sentential complements except at the end of the VP or S. Children with these rules, then, are likely to have trouble attaching relative clauses in put sentences, although they get all of the push sentences correct where the relative clause is at the end of the VP. The only way to assure the proper attachment of relative clauses for all sentences is to generate them as part of the NP which they modify. Children who do this, of course, make no structural errors.

2.5.2. Functional Errors.

Interpreting an OS sentence as an OO sentence is a functional mistake. Once again, let us consider (21c).

21) c. The boy pushed the dog that kicked the horse.
NP V NP V NP

As was noted above, our structural principle offers no explanation for a child making such an error on this type of sentence. Moreover, this type of error is not predicted by general parsing strategies which have been proposed in the literature. For example, Bever (1970) posits a strategy which amounts to grouping NP-V sequences as subject-verb sequences. But this offers no explanation for why a child would interpret the final NP, the horse, as the subject of the embedded clause. The parallel function hypothesis suggests that children preserve the function of the object of the main clause when they try to interpret the relative clause.

Sheldon's parallel function hypothesis makes the claim that children make crucial use of grammatical relations in deciding how to interpret multiclausal sentences. This is not a necessary claim. For example, it could be the case that children use a strategy of parallel semantic relations. Under this analysis, a 12, 32 response for an OS sentence would be the result of the child overgeneralizing the notions of agent and patient instead of subject and object. This is strictly an empirical question, and one which is not answered here. Further research needs to be done to determine the answer to this question. In a larger cognitive or functional theory, the parallel function hypothesis may prove to be the correct means

of accounting for these errors.

The second type of functional error we have been calling adjacency errors. Consider (21d).

21) d. The boy pushed the dog that the horse kicked.

NP V NP NP V

Adjacency errors take the last two NP's and the verb as a subject-verb-object triplet. Thus, the first NP in a clause is the subject of that clause, and the second is the object. The 12, 13 response for (21d) follows the same pattern, with the exception that the child has also attached the relative clause to the highest S node, making the main clause subject as the first NP in the sequence NP NP V.

It is not clear how adjacency errors are to be explained. They entail a shift in function, but they could be the result of a parsing strategy or some other syntactic strategy. In any case, it is not explained by our structural analysis.

3. Conclusion.

In the above pages, we have argued that some errors which children make on sentences with relative clauses are a matter of structural misrepresentations, while others are a matter of misapplying surface structure parsing strategies involving linear order and grammatical function. Thus we reject both of our original hypotheses as not sufficient to explain the full range of data. Having separated these errors, we have been able to conclude that the child works with a number of systems in her attempts to understand these sentences, indicating that each hypothesis is only partly correct. An important question which remains is why a child chooses these particular syntactic structures and strategies. We will attempt briefly to deal with the first part of this question.

The structural misrepresentation hypothesis claims that children mistakenly attach material to the highest S node instead of the appropriate lower node on the tree. There is considerable evidence that this tendency is very general, and reflects children's earliest hypotheses about sentence structure.

Klima and Bellugi (1973) claim that children originally attach the negative particle to the highest S node. Sentences such as (28) are formed by attaching no to the front of the sentence nucleus.

28) No the sun shining. (K&B, p. 341).

Klima and Bellugi use a rule similar to (29) to describe the child's phrase structure at this stage,

29) S → (neg) Nucleus

where the nucleus is the ordinary sentence structure that the child uses.

Similarly, Klima and Bellugi claim that the base rule for questions at an early stage (their stage II) is:

30) S → (Q) Nucleus

This accounts for why questions such as (31) occur.

31) Why not . . . me can't dance ? (K&B, p. 349).

Menyuk (1969) describes questions and negative sentences similarly. It seems reasonable to extrapolate from these data to conclude that when children introduce new material into their phrase structures, they attach it to the highest S.

Roeper and Matthei (1975), in their study of the acquisition of quantifiers, conclude that children go through a stage during which they interpret the scope of the quantifier as being the entire sentence. In (32), for example, children will understand the quantifier as modifying both the circles and black.

32) The circles are all black.

That is, all of the circles are all black. Roeper and Matthei explain this fact by proposing that the highest S dominates the quantifier in deep structure.

Sentences with in order to clauses, it was found by Tavakolian (1977), present no problem for children.

33) Max tripped Bill to run away.

Virtually none of the children in her study interpreted Bill as the one who was going to run away. There is considerable linguistic evidence that in order to clauses are attached to the S node rather than to the VP node. First, if this is the case, then Williams' (1975) Universal Control Principle automatically explains why the object of the main clause is never the antecedent of the missing subject. Secondly, the in order to clause can be preposed to the front of the sentence, without considerable stylistic complication.

34) In order to run away, Max tripped Bill.

This is not possible with complement sentences dominated by the VP:

35) ?? To run away John told Bill.

Thirdly, the fact that children find these sentences so easy (compared to promise sentences such as (25)) can be explained by positing this structure if we assume that children prefer to attach material other than the subject, verb and obligatory verbal complements to the S node.

Finally, Goodluck and Roeper (this volume) found that some children interpret John as the subject of the embedded clause in (36).

36) John saw Bill sitting in a chair.

Although this sentence is ambiguous for adults, the reading in which Bill is the antecedent for the missing subject is preferred. Once again this

fact is explained by the claim that children attach the complement clause to the highest S node. In this case they do so until they learn that perception verbs such as see allow a gerundial clause as part of their complements.

We can see from the above data that the types of structural errors that children make in their interpretation of relative clauses are not specific to this aspect of their grammars. Instead, they follow directly from the much more general notion of children positing syntactic structures at early stages which have relatively little embedding. As their linguistic development progresses, they learn to embed clauses and other material more deeply. This developmental sequence itself may follow from the fact that embedded structures are more difficult to understand than conjoined ones (see, e.g., Chomsky and Miller (1963)). But the point to be made here is that structural, as well as functional strategies and generalizations play a substantial role in the child's acquisition of syntax.

Footnotes.

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1. Throughout the paper we will use the symbol "Δ" to indicate an empty NP node.

2. This principle can be stated more precisely. Helen Goodluck has suggested to us that the controller must c-command the missing noun phrase, where c-command, taken from Rinehart (1976), is defined as follows:

> Node A c-commands node B if neither A nor B dominates the other, and the first branching node which dominates A also dominates B.

Using this notion, our definition of the universal control principle is somewhat different from Williams' in certain details.

3. The no tangle constraint follows automatically from the definition of phrase structure rules, and need not be stated explicitly in the grammar. Since phrase structure trees are constructed from rules of the form A→BC, it is never possible to cross lines. The rules themselves define both precedence and dominance relations.

4. This functional analysis may be stronger than Sheldon's (1974) claims, and is not intended to represent them. It should be considered as a putative theoretical construct, which is being considered for the sake of determining what children take to be significant in making linguistic generalizations.

5. The only other errors were two responses in which the main clause was not interpreted at all (both push sentences), and one response in which both animals were considered to be the object of put, even though the relative clause was interpreted correctly. We consider these random errors.

Actually, several of the younger children who were originally tested were unable to interpret any of the relative clauses for any of the sentences. This indicates an earlier stage in acquisition in which embedded clauses are simply ignored. These children generally lost interest, and did not finish the questionnaire.