UNIVERSAL GRAMMAR AND SYNTACTIC DEVELOPMENT IN CHILDREN: TOWARD A THEORY OF SYNTACTIC DEVELOPMENT

by

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SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE
DEGREE OF

DOCTOR OF PHILOSOPHY

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 1981

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May 27, 1981

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Submitted to the Department of Linguistics and Philosophy
on May 27, 1981 in partial fulfillment of the requirements for
the Degree of Doctor of Philosophy in Linguistics

ABSTRACT

Linguistic theory, if conceived as providing a framework for grammars that are mental representations of linguistic competence, should constitute an important part of a theory of language development, i.e., a theory of how children acquire language. Despite this obvious point and the recent proliferation of developmental psycholinguistic literature, there exists a gap between studies of linguistic theory and of language development in children. This dissertation is one attempt to fill this gap between the two fields.

The aim of this dissertation is to test experimentally whether some alleged linguistic universals in recent theories of generative grammar play a role in language development in children. We have taken up the Subjacency Condition and Binding Theory, both discussed in recent literature in generative grammar. Our experiments point to the conclusion that as soon as the child masters a structure that is relevant to the application of a linguistic universal, he honors that universal with respect to that structure. This not only gives empirical support to the existence of the universal in question, but also provides insight into the nature of human language development. Particularly, it supports the claim that the universals we tested are part of the innate schematism that allows language acquisition.

Thesis Supervisor: Dr. Noam Chomsky
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In Memory of

My Grandmother

Matsu

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Acknowledgements

My scholastic as well as personal indebtedness to my committee members is enormous. Noam Chomsky, whose insight into the nature of the human mind made possible the kind of research represented in this dissertation, has given me suggestions and criticisms on earlier drafts that truly helped me clarify the issues involved. Ken Hale has provided me with extremely useful suggestions about the choice of materials used in the experiments as well as the interpretation of the obtained data. I hope, by the way, that some day the mystery of his everlasting language acquisition device will be revealed. The conversations I have had with Dan Osherson on an almost daily basis have really been indispensable for this study. What I learned from him ranges from psychology to BASIC to loose-ball foul. Tom Roeper's interest in connecting linguistic theory and language development has also been indispensable for this study. Without a series of studies on language development by him and his students at the University of Massachusetts, this study might not have been possible. Susan Carey taught me how to conduct experiments -- not only about the experimental design but also more practical matters about experiments. I regret that she was on leave during my dissertation year.

Everyone realizes the importance of one's initial training on the remainder of his academic career. I was very fortunate in having had excellent teachers such as Akira Ota, Masaru Kajita, Toshio Nakao, and Masatomo Ukaji at the Tokyo University of Education.

It is a pleasure to acknowledge my indebtedness to: the following researchers in the same field for comments and encouragement - Carol Chomsky, Ed Matthei, Larry Solan, Marianne Phinney, Alec Marantz, and Helen Goodluck; my assistants for conducting experiments - Linda Sibley, Debbie Pekala, Doremy Tong, Amy Honda and Anne Doerner; the department

heads, past and present, for creating an exciting atmosphere that I will certainly miss - Morris Halle and Jay Keyser; the Center for Cognitive Science for their efforts in encouraging research such as this, particularly to Ed Walker; Wako University for having permitted me to do the research in the U.S., particularly to Shozo Tokunaga and Yukio Rizawa; my teachers, friends and others for helping me in various ways - Peter and Kerry Ingold, Carol and Martin Malkin, Ken Safir, Nick Ostler, David Pesetsky, Hagit Borer, Tim Stowell, Mamoru Saito, Ann Farmer, Ray LoRee, Keiji Konomi, Jim Huang, Celia Jakubowicz, Jim and Florence Harris, Paul Kiparsky, Joan Bresnan, Haj Ross, Wayne O'Neil, Art Palakas, Bob May, Jane Lyman, Merrill Garrett, Kenzo Ito, and many others.

The moral as well as academic support I received from Susumu Kuno has been invaluable. I am also thankful to Noriko Terazu for her friendship. The last minute editorial help from Shuji Chiba has greatly improved the readability of this dissertation, for which I am grateful.

I'd like to thank the various day-care centers and schools (Laboure Center, South Boston Salvation Army, Wee Folds, Wee Care, Dandelion, Fun-for-All, Oakland Park, Golden Dome, Cambridge Montessori, Bridge, and West Tisbury) for allowing me to conduct the study, including the pilot experiment, with their children. I thank all the children who participated in this project for their cooperation.

My graduate study in the United States was made possible by the fellowship provided by the Japan Society for the Promotion of Science. The research reported here was in part supported by a dissertation grant from the National Science Foundation under grant No. BNS-7923098 to the author, and also by a grant from NSF under grant No. BNS-8014326 to Thomas Roeper and Edwin Williams. I am also grateful to the Josephine

de Karman Fellowship Committee for their financial support.

Many thanks to my parents and sister - Toru, Sonoko and Kazuko for their constant understanding and encouragement.

This dissertation is dedicated to my grandmother, Matsu, whose affection enormously helped instill confidence in myself.

Last but not least, I express my love to Sanae - my wife, typist, and above all best friend. For the efforts she paid to make our life in Cambridge fruitful, Sanae should certainly be given her own credits.

PART I

Chapter 1 Introduction

Linguistic theory, if conceived as providing a framework for grammars that are mental representations of linguistic competence, should constitute an important part of a theory of language development; a theory of how children acquire language. Despite this obvious point and the recent proliferation of developmental psycholinguistic literature, there exists a gap between studies of linguistic theory and of language development in children. However, a growing, although still small, number of interesting attempts to bridge this gap have emerged, mainly under the influence of recent advances in generative grammar. This dissertation is one such attempt.

The aim of this dissertation may be in a sense more ambitious than those of most other studies in this area: to test experimentally whether (some of) the alleged linguistic universals in recent theories of generative grammar (e.g., Chomsky 1981) play a role in language development in children. As a result, our experiments point to the conclusion that as soon as a child masters a structure that is relevant to the application of a linguistic universal, he honors that universal with respect to this structure.[1] As will be discussed later, this not only gives empirical support to the existence of the universal in question, but also provides much insight into the nature of language development.

We now describe the organization of the dissertation. Chapter 2 is intended to clarify the issues concerning a theory of language development, and to put into proper perspective the experimental studies to be described in Part II.

Part II is a detailed report of a series of experiments designed to

test when and how the Subjacency Condition and Binding Theory--both alleged to be part of the biological linguistic endowment--come into play in language development in children. Chapter 3, the first of Part II, makes general remarks about these experiments. Chapters 4 and 5 take up experiments concerning the Subjacency Condition and Binding Theory, respectively. Each of these chapters begins with a section that describes the nature of the condition to be tested in the chapter. Each chapter contains a section (4.2 and 5.3) in which the major experiment is reported. Other related experiments are collectively reported in the section that follows (4.3 and 5.4). An Appendix is added to Chapter 4 which surveys recent studies on the development of complex structures. Another Appendix to this chapter contains an interim report of a related experiment in progress. Chapter 5 contains a section (5.2) where we discuss developmental studies concerning Binding Theory. Some previous studies related to the topic of Chapter 5 are discussed in 5.2.

Chapter 6 is an attempt to link the findings of our experiments with the issues discussed in Chapter 2. It discusses the implications of our experimental findings to a theory of language development.

An Appendix in the end of the dissertation provides the experimental data in raw form. Hopefully, this will be helpful for other researchers who attempt to analyze the present data in their own light.

Note to Chapter 1

[1]For the sake of readability, he, his, and him will be used generically to refer to people of both sexes.

Chapter 2 Aspects of a Theory of Language Development

Language development is uniquely a human achievement. Therefore, exploration into the nature of language development is an exploration into the nature of the human mind. Modern rationalist theory of language development has its foundation on this very fact, and has generated much excitement and led to tremendous progress in the field.

This dissertation aims to contribute to the construction of a theory of language development within this general framework. The major part of this study is experimental, and will be reported in detail in the subsequent chapters. The aim of this chapter is to clarify some of the issues that are crucial for the construction of a theory of language development, and set a general framework for our experiments. This is particularly important because of the curious present situation of the field of developmental psycholinguistics, i.e., explicit effort has not been made for the construction of such a theory. We start from some obvious observations.

2.1 Basic Framework

Consider some of the features of language development in children. The following are of particular importance for us:

(A) A human child succeeds in acquiring his mother tongue in almost all cases.

(B) The acquired knowledge about one's language, which we call "the grammar (of his language)," involves a complex system that in principle cannot be learned by such processes as analogy or association on induction.

(C) The acquisition of language is accomplished in a relatively short span of time as compared with the complexity of the outcome as mentioned in (B).

(D) The data the child receives are fragmentary and are also the products of interaction of grammar and other subsystems of mind, and therefore only indirectly reflect properties of the grammar he is acquiring.[1]

(E) The acquired grammar is essentially uniform among the speakers of the same linguistic community despite the fact that the linguistic experiences in childhood differ from speaker to speaker.

A theory of language development would be inadequate to the extent to which it fails to explain any of these features of language development. Rationalist theory of language development attempts to explain these features with the following assumption:

(*) A human child is genetically equipped with the Language

> Acquisition Device (LAD) that contains rich information as to the nature of natural language, and the LAD guides the child in reaching the correct adult grammar of his language when appropriate data are given.

According to (*), every child is equipped with the LAD by hypothesis, and hence (A). Although the system the child acquires is complex, the system is learnable as long as it is derivable from the properties of the LAD and the data. Hence, (B) and (C). The data only plays the role of setting the conditions under which language development proceeds and not of shaping the course of language development. Furthermore, the child knows which data are relevant when he hears them thanks to the LAD. Hence (D). The outline of the grammar which the child acquires is already set in the LAD, and as we just mentioned the experience only plays a limited role. Hence (E).

Properties of the LAD define the initial state of mind with respect to language. The actual language development will proceed through successive states until the steady state is reached, from which no significant change should take place. The grammar of a particular language is a representation of the steady state of a speaker of that language. Correspondingly, a theory of language development must give answers to the following, among others:

(a) What are the properties of the initial state of language development, i.e., LAD?

(b) What are the properties of the steady state of language development, i.e., the adult grammar?

(c) What is the nature of the process of language development?

(i) What is the input to the child?

(ii) What are the determinants of the course of language development?

(iii) What are the nature of the transition from one state to the other in the course of language development?

To approach the problems of language development, generative grammar has adopted the following research strategy. First, there are attempts to write (generative) grammars of particular languages. This should be understood as an attempt to answer (b). Another kind of attempt has been made, i.e., an attempt to establish Universal Grammar (UG) based on the observations of the particular grammars. UG is an attempt to represent the essential features of natural language, i.e., the properties that define natural language in a meaningful way. The modifier <u>essential</u> is crucial in the preceding sentence, because some of the properties that are common to languages might be merely the results of historical accidents. See Chomsky and Halle (1968:4) for an example.

To further approach to the problem of language development, generative grammar sets up the following hypothesis:

(**) Properties of UG correspond to properties of the LAD.

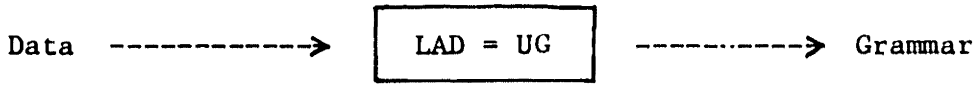
If (**) is true, then exploration of the properties of UG is equivalent to the search for the answer to (a) above.

In order for (**) to be correct, the following must be true:

(***) Variation in properties of intervening states between the initial and steady states and variation in order and arrangement of data have at most a negligible effect on the steady state.

See Chomsky (1975: 119-22).

Assuming this to be correct, generative grammar sets up the model of language acquisition that can schematically be represented as follows:



This model is commonly called the "instantaneous model" of language acquisition. As has been emphasized by Chomsky, particularly in Chomsky (1975, 1980d), the assumption of the instantaneous model that language acquisition is achieved in an instant is obviously false. Setting up this false assumption must be understood as a case of idealization, which is in general needed in any rigorous scientific inquiry. Of course, whether or not this is a correct idealization is an empirical question. If it turns out that (***) is false, then the instantaneous model must be modified accordingly. For more discussion, see Roeper and Otsu (forthcoming).

2.2 Aspects of a theory of language development

This study is intended to constitute part of an initial attempt to construct a theory of language development. In this section, we will consider what must be involved in the construction of such a theory. As a point of departure, let us consider the following remarks by Chomsky (1965:30-31):

> Let us consider with somewhat greater care just what is involved in the construction of an "acquisition model" for language. A child who is capable of language learning must have
>
> (12) (i) a technique for representing input signals
> (ii) a way of representing structural information about these signals
> (iii) some initial delimitation of a class of possible hypotheses about language structure
> (iv) a method for determining what each such hypothesis implies with respect to each sentence
> (v) a method for selecting one of the (presumably, infinitely many) hypotheses that are allowed by (iii) and are compatible with the given primary linguistic data
>
> Correspondingly, a theory of linguistic structure that aims for explanatory adequacy must contain
>
> (13) (i) a universal phonetic theory that defines the notion "possible sentence"
> (ii) a definition of "structural description"
> (iii) a definition of "generative grammar"
> (iv) a method for determining the structural description of a sentence, given a grammar
> (v) a way of evaluating alternative proposed grammars

As we have seen, this "acquisition model" is a highly idealized theory, and embodies much abstraction. It assumes the homogeneity of the outcome, i.e., grammar, among the members of the same speech community. The assumption is false, because there are actually dialectal, or even idiolectal, differences among the speakers of the same language. To the extend that these actual dialectal differences are essential for the grammatical description, this assumption must be altered. However, this assumption has never been challenged in a serious way. The "acquisition

model" also assumes the instantaneity of language acquisition, and thus it is called an "instantaneous model" of language acquisition. We have pointed out that this assumption is also false, and that to the extent that the actual developmental sequence is essential for linguistic theory, it must be altered. Furthermore, the "acquisition model" assumes the autonomy of linguistic competence. In actual performance, competence interacts with other components of mind, e.g., information processing mechanisms. The model in question abstracts away from these interacting factors, and singles out linguistic competence as an autonomous component. Note also that the model assumes that knowledge of within-sentence phenomena (called "sentence-grammar")constitutes an autonomous component, distinct from knowledge of discourse.

It should be also pointed out that the autonomy of the language faculty is consistent with the modularity theory of mind. According to the modularity theory, the human mind consists of distinct subsystems (modules) each of which has rich internal structure. In Chomsky (1980d), it is claimed that language faculty constitutes one such module. Here again, this is not a logical necessity, and could well be proved wrong with empirical evidence.

Osherson and Wasow (1976) discuss this issue under the rubric of task-specificity. They characterize the problem as follows: "In what ways do adequate theories for the several human faculties resemble each other, and in what ways do they diverge?" (p.204) They further argue that the task-specificity problem should be considered at (at least) three different levels: physiological, psychological, and linguistic. Chomsky's thesis of the modularity of mind is to be understood as claiming the task-specificity of linguistic faculty at all these levels.[2]

Let us go back to the original question with which we started this seciton, i.e., what must be involved in the construction of a theory of language acquisition? The theory we are constructing will assume, with Chomsky's "acquisition model," the homogeneity of a speech community, and the autonomy of language faculty (as distinct from langauage processing faculty on the one hand, and from discourse faculty on the other). Thus our theory is of an abstract nature. (Any scientific theory could only be abstract for that matter.) It is of course an empirical question whether this particular idealization is legitimate or not. However, our theory is less abstract than Chomsky's on one dimension. Namely, we are not assuming the instantaneous model of language acquisition. Therefore, the major questions we would be asking will be among others as follows:

[For (i) through (v), see above]

(vi) What are (i) through (v) in each state in development?

(vii) What triggers transition from one state to the next?

(viii) What are the principles that govern transition from one state to the next?

(ix) What constitutes input signals to the child at each state in language development?

Unfortunately, there have been only a small number of studies that aim at the construction of such a theory. As Wexler and Culicover (1980:12) correctly put it: "On the whole ... the field [of developmental psycholinguistics ---YO] ignores what we take to be the central problem in the theory of language acquisition, namely, the construction of a system that will learn natural language." A few such attempts will include: Kelly (1967), Erreich et al. (1980), and Wexler and Culicover (1980).

See also Chomsky (1975: 120-22) for important discussion concerning (ix) above.

The experiments which follow in this dissertation aim at providing a partial answer to (vi) above; they aim to examine whether the properties that belong to (iii) function when it is logically possible in the course of development to use them, by taking the Subjacency Condition and Binding Theory as examples.

2.3 Connecting Developmental Data with Linguistic Theory: An Example

There are several logically possible ways to connect language developmental data with linguistic theory. See Roeper and Otsu (forthcoming) for a relevant discussion. However, such an attempt would often fail if the advocate does not clarify the accompanying assumptions about language development; in other words, he must have a (partial) theory of language development. In what follows, we will take up Maratsos (1978), and critically analyze his arguments.[3]

Maratsos' paper as a whole is intended to show that the new "surfacier" linguistic descriptions such as Bresnan (1978) more appropriately represent the essence of the linguistic system captured both by the child and the adult than the more traditional descriptions in the framework of the theory of transformational grammar. More specifically, Maratsos attempts to present "empirical evidence from the study of language acquisition which strongly suggests that children do not postulate" (p.249) the type of deep structures postulated ordinarily by more traditional theories of transformational grammar for passives, subjectless infinitival complements, and so on. His claim is based on the following three points. First, for "a number of forms"[4] (p.262) "the most adequate description of what children initially acquire consists of close-to-surface representations" (p.245). Second, "it complicates the theoretical description of the acquisition of these constructions to assume that the child quickly thereafter (or even eventually) formulates the kind of uniform grammatical representation of underlying relations suggested by classical transformational theories" (p.245), while, if we adopt the surfacier grammatical model, development can be characterized as more "gradual" (p.258). Third, analysis of possible grammatical errors which

fail to occur gives empirical support for the second point, i.e., non-occurrence of reformulation of grammatical representation.

As mentioned above, Maratsos takes up two competing descriptions about each of the four English constructions, i.e., prenominal adjectives, possessives, subjectless complements, and passives. Among these, however, virtually no linguists today would seriously consider deriving prenominal adjectives and possessives from underlying relative clauses, such as deriving a red house from underlying a house which is red, and Bill's house from underlying house which Bill has. Furthermore, as for passives, Weinberg (1981) argues that the acquisition data are at least neutral between the surfacier account that Maratsos defends and the more traditional account of passives. Therefore, in what follows, we will take up his arguments about subjectless complements.

Let us first discuss Maratsos' conception of the relationship between the linguistic competence of adult speakers and linguistic performance, and the former and language development. He does not explicitly state his conception of the relation between adults' competence and performance, but the following statement clearly indicates that he is assuming a rather "direct" relationship between them. He refers to experimental evidence that shows that "adults find short passives no more difficult to process than corresponding long passives" and "the addition of prenominal adjectives resulted in no additional difficulty in sentence comprehension." Then he says:

> Thus in these cases evidence from adult language use fails to provide support for uniform grammatical representation of underlying relations. (p.262)

Then what kind of "direct" relationship is Maratsos assuming?

Maratsos has not made the relevant assumptions explicit, but in order for his argument to hold he needs to assume at least: (i) that there is a one-to-one correspondence between grammatical operations (transformations, in particular in Martsos' case) and psychological operations involved in comprehension, (ii) the process is strictly serial (i.e., not parallel), and (iii) other components of mind will not interact with the "comprehension component" to which the psychological operations mentioned above belong in such a way that the interaction makes the complexity of the psychological operations (as measured by the number of operations involved, for example) is obscured in the real comprehension process. The important point here is that Maratsos' conclusion cited above holds only when one assumes such a "direct" relation between competence and performance, and such a position is far from being established, although it is surely one of the logical possibilities.

There are at least two---there are obviously more---logically possible positions as to the relation between (representation of) linguistic competence of adult speakers and developmental sequence of language in children. First, it is logically possible to assume the following. Suppose two constructions A and B share an essentially identical deep structure. The surface difference between these two is due to the application (in the case of A) and non-application (in the case of B) of optional transformation(s) and the two derivations are identical up to that point. Then, in development B should always be acquired earlier than A. This position assumes that language development is a cumulative and gradual process.

Let us take an example. The difference between long and short passives in English, such as (2.1a) and (2.1b), respectively, is one such

example.

(2.1) a. the dog was kicked by Mary

b. the dog was kicked

If we assume that the deep structures of (2.1a) and (2.1b) look roughly like the following:[5]

(2.2) a. Mary kicked the dog

b. someone kicked the dog

and that passive transformation applies to both (2.2a) and (2.2b), thus yielding the following:

(2.3) a. the dog was kicked by Mary (=2.1a)

b. the dog was kicked by someone

and that agent deletion transformation which deletes the agentive phrase by someone applies to (2.3b) and generates the (2.4)

(2.4) the dog was kicked (=2.1b)

then the position under discussion would predict that long passives should always be acquired earlier than the corresponding short passives. To my knowledge, this position is most clearly stated by Brown and Hanlon (1970) and Brown (1973) as "cumulative grammatical complexity."

> In general, a relation of cumulative complexity exists in the following circumstances: x and y is more complex than either x or y alone....[The law of cumulative complexity] predicts that any child able to construct x+y will also be able to construct either x or y alone. (Brown 1973:186)
>
> When the derivation of a sentence "Y" follows all the rules applied in the derivation of a sentence "X" plus at least one rule not applied in X, then Y has greater cumulative

> derivational complexity than X (X<Y). (Brown and Hanlon 1970:13)
>
> Since a grammar formalizes adult knowledge it is reasonable to hypothesize that the child's knowledge of the structure of his language grows from derivationally less complex grammar to derivationally more complex grammar. The hypothesis is reasonable but not necessarily true. (Brown and Hanlon 1970: 14)

On the other hand, it is also logically possible to assume that language development is not necessarily a cumulative process and that it could happen that the child assigns structures to sentences that are different from the structures that the adult grammar would assign to these sentences. Let us take an example. Assume that (2.5a) and (2.5b) have deep structures (2.6a) and (2.6b), respectively.

(2.5) a. I want Mary to go

b. I wanna go

(2.6) a. I want [Mary to go]

b. I want [ï to go]

The derivation of (2.5a) is straightforward, while the derivation of (2.5b) involves a rule which deletes the subject of an infinitival complement which is coreferential with the subject of the matrix clause, plus a rule of contraction (want to --→ wanna). The first position we have discussed above predicts that (2.5a) should be acquired earlier than (2.5b), because the former involves less rules for its generation. A proponent of the second position would say that it is not necessarily the case, and that the child first acquires the form wanna as a single lexical item which should be followed by a bare infinitive. Thus at this stage the generation of (2.5b) does not involve the postulation of (2.6b) as its deep structure. Thus even if (2.5b) is acquired earlier than

(2.5a), it is not a mystery at all. See Klima and Bellugi-Klima (1969) for a similar view about the early acquisition of don't and can't.

Several variations of these two positions have been proposed, and Maratsos in his paper argues that the second position is untenable because there are no observations of errors which should occur if it is true. Thus, the examination of his "error analysis" becomes crucial, and that is our next subject.

Maratsos repeatedly emphasizes the "usefulness of studying possible grammatical errors that fail to occur" as "clues to the child's analysis of language" (p.249). His model of language development crucially depends on his claim that there are those types of errors which should occur in the course of development if the second position we saw above is correct but which actually do not occur.

He refers to oft-quoted examples of morphological development in the English-speaking child. At an earlier stage, the child learns irregular (i.e., lexically marked) forms like went and came and only these. Then he learns the regular (i.e., lexically unmarked) pattern of morphological change like baked and wanted. At this stage, the child overgeneralizes this regular pattern and produces forms like goed and comed in spite of his earlier forms like went and came. This type of error, which we call "overgeneralization," is more common than this single example illustrates. Thus, even the child who can correctly produce forms like went and came in addition to baked and wanted is still susceptible to errors like bring-brang-brung, which is clearly based on a subregularity among the marked cases, e.g., sing-sang-sung and swim-swam-swum.

A somewhat different example is found in C. Chomsky (1969). Her well-known example is the child's misinterpretation of sentences like John

promised Bill to leave. For a predominantly large class of verbs in English that take infinitival complement, the subject of an infinitival complement with no surface subject, roughly, the noun phrase (NP) which immediately precedes the complement (e.g., Bill is the subject of to leave in John wanted Bill to leave.), but there is a small class of verbs which violates that principle. Promise is one such example. Thus, the subject of to leave in John promised Bill to leave is John rather than Bill which immediately precedes to leave. The child tends to overgeneralize the above-mentioned general principle and gives the interpretation in which the subject of to leave is Bill in John promised Bill to leave.

Maratsos says:

> [Subjectless complements] constitutes an exception to the general pattern that subjects may appear freely in complements except in those cases in which the specified subject would be identical with a certain NP in the matrix clause; hence as children acquire complements with specified subjects, overgeneralization might be expected to lead to error such as *I want I to go (or I want me to go). (p.260)

However, this argument is not clear. Maratsos seems to be assuming that presence of the subject of infinitives is unmarked while its absence is marked. This does not follow even if we assume the Equi-NP deletion analysis. In fact, in the framework of Chomsky (1981), presence of the subject under the E(xceptional) C(ase) M(arking) is highly marked. Furthermore, the erroneous form that Maratsos cites, i.e., *I want I to go (or I want me to go), is blocked in any way by Binding Theory that will be discussed in Chapter 5.

Maratsos might defend his claim by saying that the production of a form such as I want me to go is predicted for another reason if we adopt the deletion analysis. Namely, he would say that such an error is

predicted if we assume as follows:

> If a construction is produced by means of discrete operations, one of the operations might sometimes slip, producing a revealingly incorrect utterance. (p.259)

For example, an oft-quoted error like where we should put that by the child who can correctly produce questions like should we go home can be explained in the following way. In order to generate where should we put that, two transformations, wh-fronting and subject-auxiliary inversion, among other things, are necessary. If we assume that there are discrete processing operations corresponding to these two transformations, then the above-mentioned error can be accounted for as the child's failure to combine these two operations while he can use either of them independently. However, it is far from being an established fact that there is a processing operation corresponding to each of the grammatical transformations, and furthermore the assumption we cited above is still quite doubtful (even putting aside the fact that the statement contains such an unspecified term as sometimes). In fact, as Maratsos himself mentions, there is no empirical evidence that the child makes such errors as he ising go or he being go, dropping the "affix-hopping operation".

A very interesting observation has been made in Iwamura (1980:85ff.). The following is a dialogue between Suzy (3 years and 8 months old) and Nani (3 years and 5 months old).

1. S[uzy]: My poncho's bigger now.
2. N[ani]: My pon', my. My sh', my shaw', my shawl is bigger now.
3. S: My, my poncho's bigger now. Your poncho is bigger now. Just like mine.
4. N: (upset) No, this is not a poncho.
5. S: Mines { is / Just pretend to have a poncho.

6. N: This is not a poncho. This is a shawl.
7. S: Just pretend to have a poncho.
8. N: No, I wan'to. No I don' wanna. I wanna be it, a, shawl.
9. S: Sha'
10. N: I wan' it to be a shawl. I wa { n'
11. S: { Sha', sha'
12. N: (shouts) No, I say it myself. (giggles)

[{ X / Y indicates that X and Y were uttered simultaneously.--YO]

Iwamura comments on this in the following way:

> Utterances 8, 9, and 10 can be diagrammed this way:
>
> | | | | | | |
> |---|---|---|---|---|---|
> | 8 | N: | No I | wan to | | |
> | 8' | N: | No I don | wanna | | |
> | 8'' | N: | I | wanna be it, | a shawl | |
> | 9 | S: | | | sha' | |
> | 10 | N: | I | wan it to be | a shawl | |
>
> In Utterance 8, Nani was upset and spoke quickly. She has trouble forming the sentence that she wanted and paused after 'it' and 'a', finally finishing the sentence with the word 'shawl'. Suzy was ready to help her remember the word she wanted, but that only made Nani more angry. By comparing 8 and 10, the target Nani finally achieved, it is clear that one aspect of the target sentence that Nani found difficult was the problem of dividing 'wanna' into its components 'wan' and 'to' and inserting 'it' between them. (Iwamura 1980:86; emphasis mine)

We agree with Iwamura, and take the above piece of dialogue as showing that the child first considers wanna as a single lexical item.

An analogous example is given in Fischer (1976). She says:

> Children have very many unanalyzed forms early on which they must later reanalyze and 'unpack.' Very early, without any evidence that they have dative movement, children produce forms such as gimme, and one often hears children saying gimme it in, as it were, one breath. (Fischer 1976:93)

These observations show that there are forms that are treated as a single lexical item and later reanalyzed as adult form, and that wanna is one of them.

One apparent problem of considering wanna to be treated as a single lexical item by young children is the following. If that is true, it should be assigned the syntactic category auxiliary on the basis of its distribution and semantic properties. If this is the case, there should be questions observed in which wanna and its subject are inverted, e.g., wanna you go? (cf. Maratsos 1978:260-61). However, the non-occurrence of such a form seems to be due to pragmatic reasons. The subject of wanna or wanta in the early stages is almost always restricted to the speaker. Thus, Bloom et al.(1975), based on their naturalistic data from four children between 19 to 26 months of age, observe:

> [T]hey [utterances in the category "intention" with matrix verbs expressing intention (e.g., want, gonna, and hafta)--YO] were the first embedded sentences used by the children, and they were primitive in that the child was most often the agent of both the constituent and matrix verbs. Utterances such as "I want Lois button it" ... were rare, and utterances such as "I want comb hair" when the child wanted another to be the agent did not occur. The matrix verbs were used most often in situations where the child wanted to or was about to perform the action. (Bloom et al. 1975:17; my emphasis)

In the Appendix of the same monograph, there are 28 utterances containing want or wanta followed by a verb phrase (plus one instance of want Kathryn ə put in ə tank uttered when Kathryn was looking for a tank car to put a clown in), and in all the cases the subject is I. See also Limber (1973:174ff.)

If this observation is generally true, then it is natural that the occurrence of wanna in a question is very rare, if not non-existent. We never ask Do I want to go?, except as an echo question or a rhetorical question, both of which are as well very rare in children's speech. Notice also that if the child has the full syntax of wanna with VP complement,

and if, contrary to the above observation, the subject of wanna is not restricted to I, we would expect, for example, forms like Do you wanna go? or You wanna go? (with a rising intonation) from the child who is in the developmental period in question. To my knowledge, there are no such data.[6]

Maratsos' conception of language development can be examined from a slightly different point of view. Maratsos says that if the second position we saw above, i.e., the reanalysis position, is true, then:

> ... extensive reanalysis for the purpose of attaining uniform grammatical representations would require that the child greatly complicates analyses of form he had already captured with analysis closer to surface structure. (p.257)

This argument again is unwarranted. Even if the alleged reanalysis has to take place in the course of development, it does not follow that the child "complicates" his analysis. Since the reanalyzed system is optimal by assumption, the child actually simplifies his grammar by the reanalysis. Thus, if we are free from such an a priori assumption that development should always be gradual and cumulative, then Maratsos' argument on this point is at best very weak.

2.4 Innate Linguistic Endowment and Language Development

This section is devoted to the relationship between innate linguistic endowment, namely, properties of the Language Acquisition Device, and language development.

It is useful to begin by clarifying the concept of "innateness," since unclarity in this regard has often led to pointless debates. One common usage of the term is the following:

> (i) Innateness is predicated of an annatomical structure that is genetically determined and functioning at birth.

As pointed out by Marshall (1980), (i) has gained its current popularity largely because of the recent findings that anatomical right-left asymmetries in the human brain are associated with some of the classical speech areas. Recent development research has also revealed that several perceptual and cognitive systems function surprisingly well at or near birth. Bower (1979), for example, provides a comprehensive survey of this topic. In the domain of speech perception, some evidence has been presented indicating that auditory structures that analyze at least some phonetic distinctive features are available to the new born child (Eimas et al. 1971), although it has not been settled whether the child processes speech sounds in a different manner from the one in which he processes other acoustic stimuli (Mehler and Bertoncini 1979).

In spite of these findings, it is not necessary for <u>all</u> the properties that are genetically determined to be functioning at birth. Therefore, a need arises for another definition of "innateness," such as the following:

> (ii) Innateness is predicated of structures that are genetically determined.

Definition (ii) but not (i) subsumes the case of maturation. Following Gleitman (1981:A36), by "maturation," we mean "[a] pre-programmed growth process based on changes in underlying neural structures that are relatively unaffected by environmental conditions (e.g., flying in sparrows and walking in humans)." Those maturationally controlled properties will not manifest themselves until the child reaches a certain developmental state. Puberty is another example. (See the papers in Part One of Caplan (1980) for details.)

There is another class of cases in which genetically determined properties become manifest only later in development. These are the properties whose function is logically dependent on the presence of other properties, innate or non-innate, that appear only later in development. Let us illustrate this point by the following example.

Suppose that C is an innate linguistic constraint that prohibits a certain association between an element in a matrix clause and another element in an embedded clause. By definition, C cannot function until the child's grammar generates sentences that contain embedded clauses. The functioning of C is thereby delayed on logical grounds until that time. The experiments to be reported in Part II of this dissertation are examples of this kind. See also Roeper (1978a) for another example.

Bearing these distinctions in mind, let us consider the following hypothetical case. Suppose P is a proposed linguistic universal principle, and suppose also that a researcher produced the following findings:

(A) At a developmental state S_1, the child acquires linguistic structures that are relevant to P.

(B) However, the child will not honor P until a later developmental

state S_2. In other words, there is a period during which the child violates P.

Under this situation, what conclusions can the researcher draw about the innateness of P, assuming the correctness of his results? One possibility is of course that P is not innate, but learned. However, as is clear from the previous discussion, there is another possibility that is consistent with the hypothesis that P is innate, namely, that the emergence of P is maturationally controlled, and thus will not appear until S_2.[7]

2.5 State of the Art in Linguistic Theory and Experimental Research

We have discussed that one of the most interesting and important problems in language acquisition is to test when and how the child recognizes and makes use of innate linguistic properties. A question then will arise: How much do we know for certain about these properties? Surely, there have been a large number of porposals concerning these properties in recent years, but none of them are conclusive. In fact, considering our present knowledge about the nature of natural language, Chomsky is not only honest but rational when he writes:

> [The current scene in the study of Universal Grammar] is something new and quite important, even though surely no one expects that any of these current proposals are correct as they stand or perhaps even in general conception. (Chomsky 1981:3; emphasis mine)

The important point here is that, in spite of this "inconclusive" state of linguistic theory today, research in the last couple of decades has revealed some important sets of generalizations that any linguistic theory that aims at explanatory adequacy must capture. An extremely interesting and important research topic in the field of language development is when and how the child starts making use of these generalizations in the course of language development.

Let us take an example. Consider the following sentence which is ungrammatical (taken from Ross 1967:11):

(2.7) *Here is the snowball which I chased the boy who threw at our teacher.

Compare (2.7) with grammatical sentence (2.8):

(2.8) Here is the snowball which I believe the boy threw at our teacher.

Based on other similar examples, Ross (1967) has proposed the following constraint:[8]

(2.9) No element contained in a relative clause may be moved out of the noun phrase that contains the relative clause by a transformation.

Since the structure underlying (2.7) is roughly as (2.10), (2.9) correctly blocks the generation of (2.7).

(2.10) here is [the snowball]$_{\underline{i}}$ I chased [$_{NP}$ the boy [$_{\text{Relative Clause}}$ who threw [the snowball]$_{\underline{i}}$ at our teacher]] ($\underline{i}$ is a referential index.)

Partly because the proposed constraint (2.9), or Ross' original constraint given as (ii) in footnote 8, is "descriptive" in the sense that it does not explain why such a constraint exists, a number of attempts have been made to capture this generalization in more explanatory terms. The Subjacency Condition, which we will discuss in Chapter 4, is one of these attempts (that look promising to us). However, the Subjacency Condition itself at its present formulation undoubtedly has problems of various sorts (as we will see briefly in 4.1), and no rational researcher expects it to be correct as it stands. However, it is an interesting and important research topic to test when and how the child starts making use of the generalization that the Subjacency Condition is attempting to capture. Our experiments to be reported in Chapter 4, as well as the

experiments about Binding Theory to be reported in Chapter 5, should be understood as such an attempt.

This line of research suggested above is in a sense "theory neutral." Such a remark does not of course preclude the possibility of research that is "theory specific." In fact, the distinction between these two is not always as clearcut as it might seem, because a certain investigation that is theory neutral at a certain level could well be theory specific at a different level. Considering the state of the art in linguistic theory and language development research, it seems to us of utmost importance at present to accumulate research that is theory neutral, and gain some important insights into the nature of language development in children. However, this is only a general guideline for research, and should not be taken as a rigid principle.

2.6 Methodology

Finally in this chapter, we discuss methodology in developmental psycholinguistic experiments. We start with a brief historical review. A research method initially employed to study language acquisition was to collect (sometimes a huge amount of) children's utterances, and analyze them paying attention mainly on distributional facts. Later, the importance of supplementing such data with the information about the context of the utterances has been recognized (e.g. Bloom 1970), but this method has been used quite extensively under a fairly misleading rubric of the "naturalistic" method. Brown (1973) is a representative work in this category.[9]

The problem of depending on this method alone has been sharply criticized by Chomsky as early as in 1961.

> [I]t seems to me that, if anything far-reaching and real is to be discovered about the actual grammar of the child, then rather devious kinds of observations of his performance, his abilities, and his comprehension in many different kinds of circumstance will have to be obtained, so that a variety of evidence may be brought to bear on the attempt to determine what is in fact his underlying linguistic competence at each stage of development. Direct description of the child's actual verbal output is no more likely to provide an account of the real underlying competence in the case of child language than in the case of adult language, ability to multiply, or any other nontrivial rule-governed behavior. (Chomsky 1964:36)[10]

> My feeling is that this [the assumption that the determination of competence can be derived from description of a corpus by some sort of sufficiently developed data-processing techniques --YO] is hopeless and that only experimentation of a fairly indirect and ingenious sort can provide evidence that is at all critical for formulating a true account of the child's grammar (as in the case of investigation of any other real system). (Chomsky 1964:39)

Characteristically, many of the studies on language acquisition using

the "naturalistic" method treat early periods of language development. One reason for this might have been the then dominant idea that we can obtain much insight about Universal Grammar by looking carefully at the early period of language development, because language development proceeds from universals to particulars (e.g., McNeill 1966, 1970). However, as Chomsky (personal communication, 1977) has pointed out, the major reason for having focused the research on the early stages of development seems to lie in the fact that by using the "naturalistic" method alone one cannot hope to be able to know the intricate system of the language faculty of the children who are beyond the very early period of language development.

The major breakthrough came when Carol Chomsky in her 1968 dissertation, which has been later published as C. Chomsky (1969), came out. Among several experimental techniques that Chomsky has introduced for investigating the child's knowledge of grammar, the toy movement task, in which the subject will be given a sentence and asked to act out what the sentence means by using the toys, has been most extensively used in the literature that treats the development of more intricate aspects of the language faculty. The other methods commonly used in this field are neatly summarized in Kennedy (1970, Chapter II).

Although we have gained much more insight about the development of the language faculty thanks to these techniques than in the "naturalistic" days, there still remain problems that appear to be important. First, most of the methods that have been developed are those that test the subject's <u>interpretation</u> of the stimulus sentences. For example, the most commonly used methods to assess the child's knowledge about relative clauses are: (i) toy movement, (ii) picture identification, and (iii)

question asking. Thus, in each case the subject will be given a sentence containing a relative clause such as (2.11):

(2.11) The monkey kissed the tiger that jumped over the elephant.

In (i), the subject will be asked to act out what (2.11) means by using the given toys. In (ii), he will be shown more than one picture one of which matches (2.11), and asked which one matches (2.11). (Or, alternatively, he will be shown one picture, and asked whether the picture is true or false.) In (iii), he will be asked, for example, "Tell me who jumped over whom," and the like. In each case, what is being asked is the child's interpretation of the given sentence.

However, what is really crucial is usually not the information per se about how children interpret sentences, but the information about what syntactic structure he would assign to sentences. In the case of adults, there are ways to obtain the latter kind of information in addition to simply asking how the sentences are interpreted. One can expect fairly reliable metalinguistic judgment of other kinds from adult informants. For example, there are various kinds of syntactic tests devised to examine constituency, e.g., movement (i.e., only constituents can be moved). There are also semantic tests including those concerning synonymity and ambiguity. Furthermore, there are psycholinguistic experiments such as the click location experiment (Fodor, Bever, and Garrett 1974). Thus, we are able to have a sufficient data base to do serious grammatical investigations.

On the other hand, obtaining grammatical information from children is much more difficult. Although eliciting metalinguistic judgment from children is not totally impossible (e.g., Gleitman, Gleitman, and Shipley 1972), the situation is not at all comparable to the adult's case. It is

also difficult to conduct psycholinguistic experiments to test how children process sentences, although there are some recent studies on this topic. See, for example, Tyler and Marslen-Wilson (1978, 1980) and Cooper and Paccia-Cooper (1980:231-33). We do not know much about children's processing capacity in general. For instance, there is a debate about whether it is the short term memory or processing strategies that increases with age. See, for example, Huttenlocher and Burke (1976) and Chi (1976, 1977).

In this situation, how can we proceed toward establishing a theory of language development? One obvious answer is to develop elicitation techniques that are appropriate for children, and we pointed out earlier that such research is in fact beginning to emerge. However, we need not wait until such techniques become available. The answer lies in the guiding principle that has led the studies of generative grammar, i.e., to establish a theory with explanatory power. In spite of the technical difficulties of various sorts(e.g., although we can obtain information about linguistic competence only through some form of linguistic performance, we know little about the nature of performance), linguistic research in that tradition has made tremendous progress toward establishing a theory with explanatory power by looking very closely at crucial aspects of the grammars of various languages. (Which aspects are crucial is in turn defined by a theory with explanatory power.) In the pursuit of a theory of language development, we can make use of the properties of such a linguistic theory as guiding principles of the research, because linguistic theory by definition is part of a theory of language development. In fact, when one gets developmental data that are in conformity with a linguistic theory with explanatory power, he can claim greater significance for the

data over those that are not, unless someone comes up with a counter-theory that explains the latter data. See Roeper and Otsu (forthcoming) for more discussion. There have already been some important studies in this area along this line, some of which are conveniently assembled in Goodluck and Solan (1978) and Tavakolian (1981).

Notes to Chapter 2

[1]One apspect of the interaction between grammar and other subsystems has often been referred to as the "degenerate" nature of the data. Notice how degenerate the data are is not an issue here. See Chomsky (1976=1977a:167, n.6) for discussion. It is also important to make a distincition between the following two notions: "poverty of the stimulus," i.e., fragmentary nature of the data, and "degeneracy of the stimulus." See Chomsky (1980e:42) for discussion. In some recent discussion on "motherese," there is confusion based on the failure to make this distinction. See, for example, Snow (1977). See Newport et al. (1977) for a more reasonable view about the implications of motherese research for a theory of language development. See also Wexler and Culicover (1980).

[2]Keil (1980) presents a piece of evidence for the task-specificity of a linguistic skill at the psychological level by studying the development of the ability to perceive linguistic and pictorial ambiguities.

[3]The page references in this section are all to Maratsos (1978), unless otherwise indicated.

[4]Maratsos actually discusses four--prenominal adjectives, possessives, passives, and subjectless complements.

Maratsos also discusses word order in early acquisition, more specifically, the claim that "the child adopts strict word order that for expressing logical relations--the uniform order that is represented in deep structure in classical models of transformational grammar" (pp.249-50), and concludes that "the theory that children, universally, form uniform grammatical representations of identical logical relations as a primary hypothesis about the structure of language does not receive straightforward empirical support" (p.250). We do not discuss this point because evidence referred to in order to support this claim seems rather fragmentary.

[5]Representations such as (2.2) are misleading, since deep structure is not actual sentences. Accounts in what follows are sometimes abbreviated to the extent that does not cause serious confusion.

[6]It might be worth pointing out that not all modal auxiliaries appear in questions. For example, Jackendoff (1972:102-103) points out that (ii) "strongly favors the root interpretation," although (i) is ambiguous between root and epistemic interpretations.

(i) Max { must / should / may } leave soon.

(ii) { Must / Should / May } Max leave soon?

Although it seems difficult to relate this fact with the problem in question (because wanna, or gonna for that matter, should be classified as having "root" interpretation), it is interesting how the child reaches the above generalization. See also Ota (1972:51ff.). I am indebted to Keiji Konomi for reminding me of this point.

[7]In reality, the situation is yet more complicated because of the interaction among different components of the mind.

[8]The constraint proposed by Ross is actually more general so that it can also account for the ungrammaticality of (i):

(i)*The hat which I believed the claim that Otto was wearing was red.

Ross' original constraint named the Complex NP Constraint is formulated as follows:

> No element contained in a sentence dominated by a noun phrase with a lexical head may be moved out of that noun phrase by a transformation. (Ross 1967:70)

[9]Although most "naturalistic" studies are also longitudinal and most "experimental" studies (about which we will discuss shortly) are also cross-sectional, the "naturalistic"-experimental distinction and the longitudinal-cross-sectional distinction are logically independent.

[10]Chomsky (1964) is a published version of his remarks he made in a conference held in 1961.

PART II

Chapter 3 General Remarks

3.1 Logic of the Experiments

The experiments reported in this dissertation share the same logic. In this section, we take up this logic.

The aim of these experiments is to test when and how the child recognizes the linguistically significant generalizations that two allegedly universal linguistic constraints, i.e., the Subjacency Condition and Binding Theory, are to capture. In the tradition of language acquisition theories that identify linguistic universals, at least partially, with innate linguistic knowledge (see Chapter 2), we assume--for the purpose of partial experimental testing--the innateness of these conditions. What does this amount to? It might amount to the following:

> (H) As soon as the child masters a structure that is relevant to a universal condition P, then he honors P with respect to that structure.

Notice that (H) is not strictly implied even if we assume the innateness of P. For example, as we discussed in Chapter 2, it is logically possible that the emergence of P is maturationally conditioned, and that it appears later in development. Therefore, even if P is innate, the mastery of a structure that is relevant to P would not be a sufficient condition for the emergence of P. However, we choose, for test purposes, the simplest hypothesis that we can think of, i.e., (H).

In each of the experiments, we inculded: (i) a test for whether young children honor P (to be called the P-Test here), and (ii) a test for whether they know a structure that is relevant to the application of P

(to be called the Syntax Test). Hypothesis (H) makes the following prediction about the results:

(Pr) Those who pass the Syntax Test will also pass the P-Test.

The following should also be true:

(Q) Those who fail the Syntax Test will also fail the P-Test.

Thus, if we classify the results of the experiments in a 2x2 contingency table in the following way, subjects should tend to fall in either A or D-cell.

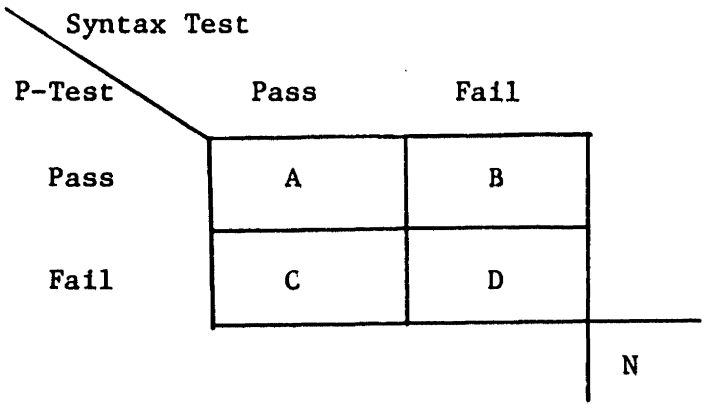


TABLE 3-1

This logic of our experiments will be repeated when we describe each experiment.

3.2 Experimental Groups

The experiments reported in this dissertation are divided into three groups in terms of the dates when the experiments were conducted.

(I) Experimental Group I: The experiments reported in 4.3 belong to this group. They were conducted during the summer of 1980. The subjects were 72 children ranging from 3 to 10 years of age, each age group having 8 subjects, with the exception of the 6-year-old group in which there were 16 subjects. The younger subjects, 3 to 6-year olds, were children attending day-care centers and nursery schools in the greater Boston area. The older subjects, 6 to 10-year olds, attended West Tisbury School on Martha's Vineyard, Massachusetts. Half of the sixteen 6-year olds were children living in the greater Boston area, and the rest were from Martha's Vineyard.

In addition to these children, we also tested 24 adults. Eight of them were M.I.T. undergraduates (non-linguistics/psychology majors), another eight were M.I.T. secretaries, and the remaining eight were adults in Burlington, Massachusetts with no academic affiliation.

(II) Experimental Group II: Experiments 1 and 2 belong to this group. They were carried out during the winter of 1981. There were 60 subjects ranging from 3 to 7 years of age, each age group consisting of 12 subjects. These children attended day-care centers and elementary schools in the greater Boston area.

These experiments were conducted in two sessions. There was 3 to 6-day interval between the two sessions.

(III) Experimental Group III: The experiment reported in the Appendix B to Chapter 4 belongs to this group. It was conducted during the spring of 1981. The subjects were 60 children ranging from 3 to 7 years of age, each age group having 12 subjects. These children attended day-care centers and elementary schools in the greater Boston area.

Chapter 4 Subjacency Condition and Syntactic Development in Children

4.1 Subjacency Condition

It has been observed that a general grammatical process is sometimes blocked, and as a result we get ungrammatical sentences. One such case is an extraction out of a relative clause. Thus, wh-movement, which is responsible for deriving (4.1b) from (4.1a) is blocked in (4.2b), i.e., (4.2a) is ungrammatical.

(4.1) a. Here is the snowball which the boy threw at our teacher.

b. here is [the snowball]$_i$ [$_{\overline{S}}$ the boy threw [the snowball]$_i$ at our teacher]

(4.2) a.*Here is the snowball which I chased the boy who threw at our teacher.

b.*here is [the snowball]$_i$ I chased [$_{NP}$ the boy [$_{\overline{S}}$ who threw [the snowball]$_i$ at our teacher]]

(i is a referential index.)

Ross (1967) has attempted to account for this fact in terms of his Complex NP Constraint, which runs as follows:

> (4.3) No element contained in a sentence dominated by a noun phrase with a lexical head noun may be moved out of that noun phrase by a transformation. (Ross 1967:70)

Another example in which a general grammatical process is blocked is rightward movement, e.g., PP-Extraposition. PP-Extraposition, applied to (4.4a), derives (4.4b):

(4.4) a. A book by Julia Child came out.

b. A book came out by Julia Child.

In his attempt to give principled explanation to these and many other facts, Chomsky (1973) has proposed a set of conditions imposed on the application of transformations. The Subjacency Condition (SC) is one of them. The SC can be roughly formulated in the following way:

(4.8) X and Y in the following configuration may not be associated with each other:

$$\ldots X \ldots [_{\alpha} \ldots [_{\beta} \ldots Y \ldots] \ldots] \ldots X \ldots$$

where α and β are bounding nodes.

In the above formulation the notion bounding node is used in place of cyclic node. Since the nodes that are relevant for the bounding and for the cyclicity could logically be different, we will use the former notion in the formulation of the SC. We assume here for expository reasons that NP, S, and $\overline{S}$ are bounding nodes. But see (B) below.

(4.8) correctly excludes (4.2a) and (4.5b) as ungrammatical, the latter with the intended meaning. See the following:

(4.9) a.*here is the snowball $[_{S}$I chased $[_{NP}$the boy $[_{\overline{S}}$ who threw t at our teacher]]]

(t is the trace of the snowball.)

b.*$[_{NP}$a review of $[_{NP}$a book t]] came out by Julia Child

(t is the trace of by Julia Child.)

Chomsky (1977b) attempts to explain the ungrammaticality of (4.10a) in terms of the SC.

(4.10) a.*Who did John destroy a book about?

b.*who $[_{S}$did John destroy $[_{NP}$a book about t]]

However, the rule cannot be applied to (4.5a) so as to derive (4.5b). ((4.5b) is grammatical, but is not synonymous with (4.5a).)

(4.5) a. A review of [a book by Julia Child] came out.

([] indicates a partial constituent structure.)

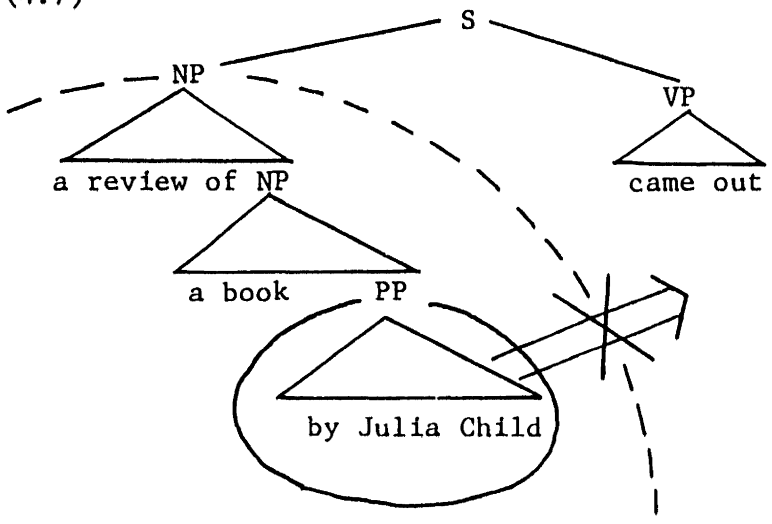
b. A review of a book came out by Julia Child.

Ross (1967) has proposed a constraint, which has come to be known as the Right Roof Constraint later, to account for this fact. The following is a version modified by Akmajian (1975):

(4.6) No element may be extraposed more than one cycle up from the cycle containing it. (Akmajian 1975:119)

NP and S are considered as being cyclic nodes. The following diagram shows how (4.5b) is blocked by (4.6). (4.6) prescribes that the circled PP should not be extraposed out of the dotted domain; otherwise, the resulting sentence is ungrammatical.

(4.7)



Since Chomsky (1973), there have been a number of discussions concerning the nature of the SC. The following is a brief summary:

(A) Chomsky's (1973) and the subsequent frameworks assume the successive cyclic application of wh-movement. However, there have been arguments against this, i.e., arguments for the existence of unbounded rules. See, for example, Bresnan (1977) and Hasegawa (forthcoming).

(B) There has been discussion about the choice of bounding nodes in various languages. It has been claimed that there are parameters involved. Rizzi (1978), for example, argues that in Italian, $\overline{S}$, and not S, is a bounding node. See Chomsky (1981) for discussion.

(C) In Chomsky (1973), the SC is considered as a condition on movement transformations. Later, it is also argued that the SC is a filter. See Freidin (1978). See also Huang (1980).

(D) The extraction of an element out of the object NP has been discussed extensively. There are positions, among others, where: (i) extraction out of the object NP is in principle not allowed, but sometimes allowed because of the syntactic restructuring (e.g., Chomsky 1977b); and (iii) extraction out of the object NP is in principle allowed, but sometimes prohibited by a separate semantic principle (e.g., Woolford 1980). For more data, see Rodman (1977) and Cattell (1979).

There are other important problems around the SC. For example, various languages, including Swedish (Engdahl 1980a, b) and Chinese (Huang 1980), provide crucial data. See Marantz (1980), Woolford (1980), and Hasegawa (1980, forthcoming) for alternatives.

For the purpose of the experiments in this chapter, the informally formulated version (4.8) is adopted. As we mentioned above, we also assume that the presence of S and $\overline{S}$ in addition to NP in the set of bounding nodes is the unmarked case; langauges may differ from this unmarked case. See for example the Italian case mentioned above. Notice that if this assumption is correct, then the child exposed to any language would first assume that $\{NP, S, \overline{S}\}$ is the set of bounding nodes of his language. Then, "negative" information is never required to fix parametric values in the course of language development. For instance, in the case of a child who is learning Italian, he would drop S from the unmarked set when he hears a "positive" sentence that is a violation of wh-island.

The prohibition of the extraction of elements from relative clauses will be the topic of Experiment 1, from object NPs the topic of 4.3, and the Right Roof Constraint will be the topic of the experiment to be reported in the Appendix B to this chapter.

4.2 Experiment 1

Experiment 1 is intended to test when and how the child gets to know the Subjacency Condition (SC) with respect to the extraction of elements from relative clauses.

In the tradition of language acquisition theories (see Chapter 2) that identify linguistic universals, at least partially, with the innate endowment, we assume--for the purpose of a partial experimental test--the innateness of the SC and the unmarked specification of bounding nodes discussed in the previous section). The innateness of the SC so conceived might amount to the following:

(H) As soon as the child masters structures that are relevant to the SC, he honors the SC with respect to those structures.

Notice that, as we discussed earlier, (H) is not strictly implied even if we assume the innateness of the SC. However, we choose here the simplest hypothesis we can think of, i.e., (H).

In the experiment to be discribed in this section, we included (i) a test for whether young children honor the SC (to be called the SC Test) with respect to the extraction of elements from relative clauses and (ii) a test for their knowledge of relative clauses (to be called the Syntax Test). (H) makes the following prediction about our data:

(P) Children who pass the Syntax Test will also pass the SC Test.

The following must also be true:

(Q) Children who fail the Syntax Test will also fail the SC Test.

Method

Subjects

The subjects were 60 children ranging in age from 3;1 (three years and one month) to 7;11. There were 12 subjects in each age group. The details are given in 3.2. Each subject was tested individually in a quiet room at his school.

Procedure and Materials

This experiment, as mentioned before, is intended to test the Subjacency Condition with respect to relative clauses from a developmental point of view. As for relative clauses, there have been a large number of developmental studies. The Appendix A to this chapter provides a summary of some of these studies. The following is of importance for us at this point: Relative clauses can be classified into four types depending on the grammatical function of the head noun of the relative clause in the matrix clause, and of the relative pronoun in the relative clause. Following Sheldon (1972, 1974), we will call them SS, SO, OS, and OO. The first letter represents the grammatical function of the head noun in the matrix clause (Subject or Object), and the second represents the grammatical function of the relative pronoun in the relative clause. The following are examples of these four types of relative clauses:

SS: The boy who kissed the girl met the man.

SO: The boy who the girl kissed met the man.

OS: The man met the boy who kissed the girl.

OO: The man met the boy who the girl kissed.

Many of the studies summarized in the Appendix A have taken up the problem of the relative order of acquisition of these four types of relative clauses.[1] However, the data on the relative order of "acquisition" among them are quite contradictory. See Bowerman (1979) for review. In some studies, e.g., Smith (1974 a,b) and de Villiers et al. (1979), OS is the first, or one of the first, type that is acquired by the child. In others e.g., Sheldon (1974) and Tavakolian (1977, 1981), OS is claimed to be acquired later than some other types. In this experiment, we will consistently use OS relative clauses.

Whatever the true relative order of the "acquisition" may be, the crucial thing for us is when the child acquires the rule NP $\rightarrow$ NP $\bar{S}$, because that structure is crucial for the application of the SC.[2] Let us assume for the moment that Tavakolian's (1977, 1981) Conjoined-Clause Analysis is correct. Then, at the initial stage the child will get the correct grammatical relations about SS in the way as indicated below, but that does not mean that the child at this stage has acquired NP $\rightarrow$ NP $\bar{S}$.

$$[_S\ [_S \overset{\uparrow}{NP} - \underline{that} - V - NP]\ [_S \Delta - V - NP]]$$

The arrow indicates a coreferential relation.

Let us now assume that Sheldon's (1974) Parallel Function Hypothesis holds at some point in development. Then, it will also give the correct grammatical relations to SS, but that again does not mean that the child

has acquired NP -> NP $\overline{S}$.

Thus, we cannot decide for certain when the child acquires NP -> NP $\overline{S}$ from his interpretation of the sentences containing relative clauses alone. Cooper and Paccia-Cooper (1980:232-33), referring to Martha Danley's 1978 research proposal, which unfortunately she decided not to pursue, suggest a possibility of testing the child's analysis of relative clauses by using a speech timing analysis. It certainly deserves a try.

Why then have we chosen OS for our test under this solution? Notice that SS and SO are not appropriate for our purposes, because extraction out of <u>any</u> sentential complement in the subject position is not allowed, whatever the reason may be, as the following example shows:

(4.11) a. [$_{\overline{S}}$that Bill likes <u>who</u>] is obvious

b.*who is that Bill likes obvious?

Compare (4.11) with the following, where the sentential complement is not in the subject position although the "meaning" is the same as (4.11):

(4.12) a. it is obvious [$_{\overline{S}}$that Bill likes who]

b. Who is it obvious that Bill likes?

(This is what Ross (1967) has called the <u>Sentential Subject Constraint</u>.) Furthermore, Goodluck and Tavakolian (1979) have shown nicely that the 4- and 5-year olds who got the grammatical relations in OS correct have already acquired NP -> NP $\overline{S}$. See the Appendix to this chapter. Considering these facts, OS seems to be a reasonable choice for our experiment.[3]

(I) SC test: The subject was first told six stories, each consisting of two sentences, with a picture accompanying each story that depicts the situation described in the story. In the first round, which we will call the listening session, the subject merely listened to the stories and looked at the pictures. After all the stories were presented, then the experimenter came back to the first story, and told it with the accompanying picture shown. This time, however, a question followed the story. The subject was told that the story can be repeated as many times as he wished.

The reason for having the listening session is as follows. In another experiment, in which there was no such a session, the results, as will be reported in the next section, seemed to have been distorted by some performance variable(s) -- possibly memory. Namely, the subjects who were given the stories in such an order that the correct target NP was in the first sentence of the story tended to make mistakes by picking up the NP in the second sentence. On the other hand, the subjects who were given the stories in the reverse order tended to get them correct. If our guess that the results had been distorted mainly by memory is correct, then when the subject is given the opportunity to familiarize himself with the stories before getting into the test session, he would be less influenced by the order of the sentences in the stories. The listening session was intended to bring that effect.

Two of the six stories were for practice. They were always placed prior to the test stories. They are (4.13) and (4.14):

(4.13) Roger wants to enter the room.

He is opening the door with a key.

(Question) What is Roger opening the door with?

(4.14) Susan is washing her doll with a cloth.

She likes the doll very much.

(Question) What is Susan washing the doll with?

Both (4.13) and (4.14) contain two simplex sentences, only one of which contains a with-phrase. The order of sentences in these stories was fixed. (4.13) has the correct target NP for the question that follows in the second sentence, and (4.14) in the first sentence. The order between (4.13) and (4.14) was randomized.

In this experiment, we focus our attention on (OS) relative clauses which have the following structure:

(4.15) *wh $[_S \ldots [_{NP} \ldots [_{\bar{S}} \ldots \underline{t}]]]$

$\underline{t}$ is the trace left behind by wh-movement.

Table 4-1 lists all the stories used, and Figures 4-1 - 4-6 show the pictures that accompanied the stories.

TABLE 4-1

FIGURES 4-1-4-6

Let us take Story 1 as an example for illustrating the logic of this task.

(4.16) Jane is drawing a monkey with a crayon.

The monkey is drinking milk with a straw.

(Question) What is Jane drawing a monkey that is drinking milk with?

The crucial point is that the question could be ambigous, were it not for the SC.

P(ractice)-1	Roger wants to enter the room. He is opening the door with the key. What is Roger opening the door with?
P-2	Susan is washing her doll with a cloth. She likes the doll very much. What is Susan washing the doll with?
1	Jane is drawing a monkey with a crayon. The monkey is drinking milk with a straw. What is Jane drawing a monkey that is drinking milk with?
2	Jim is catching a cat with a net. The cat is climbing up a tree with a ladder. What is Jim catching a cat that is climbing a tree with?
3	Mary is photographing a boy with a camera. The boy is bandaging a dog with a handkerchief. What is Mary photographing a boy who is bandaging a dog with?
4	Ben is looking at a man with binoculars. The man is stopping a girl with a broom. What is Ben looking at a man who is stopping a girl with?

TABLE 4-1

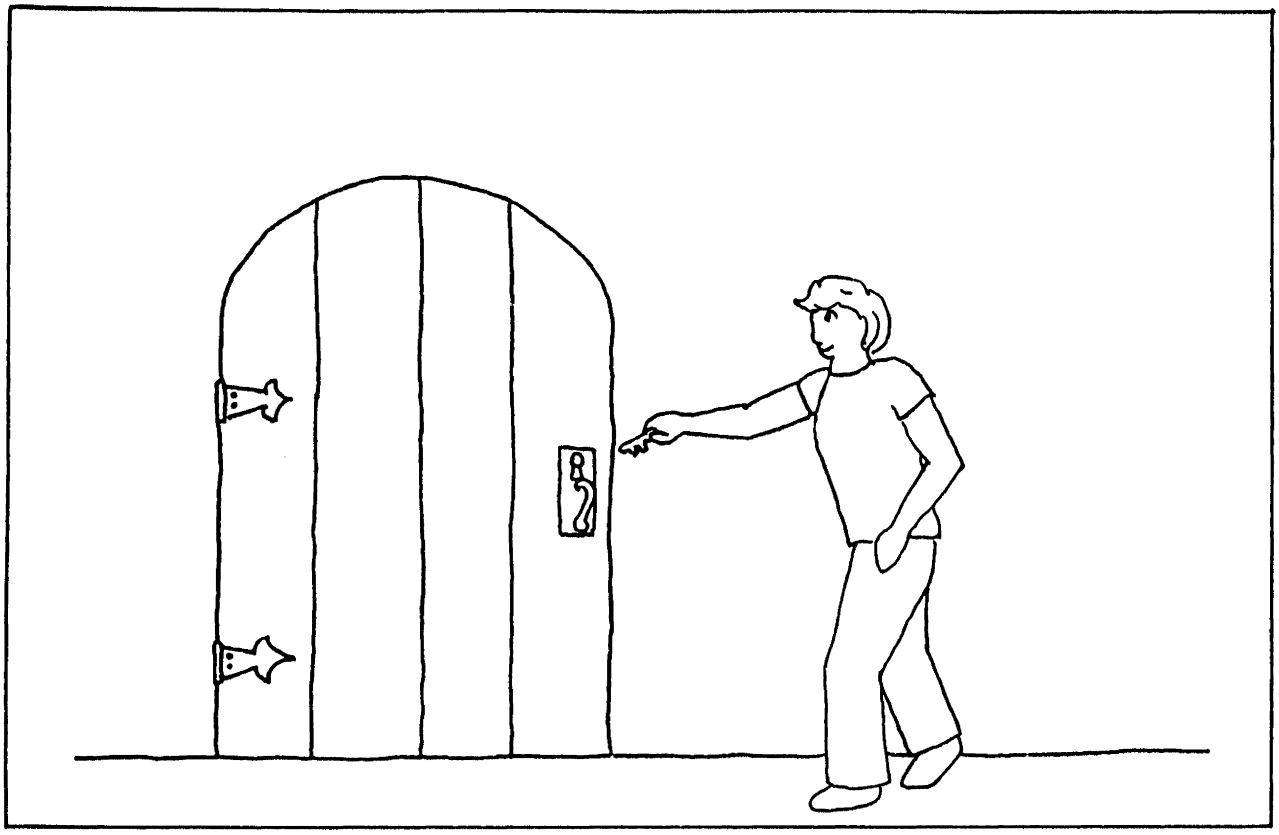


FIGURE 4-1

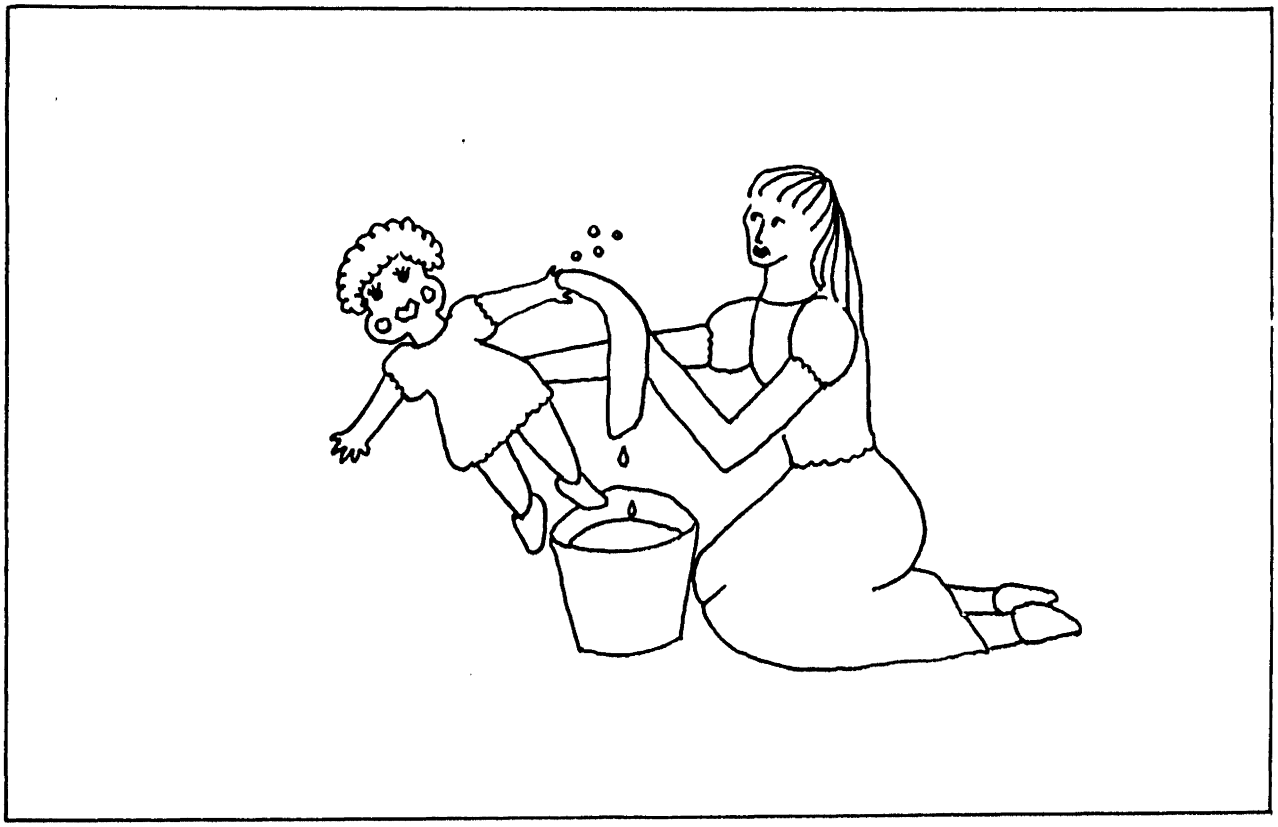


FIGURE 4-2

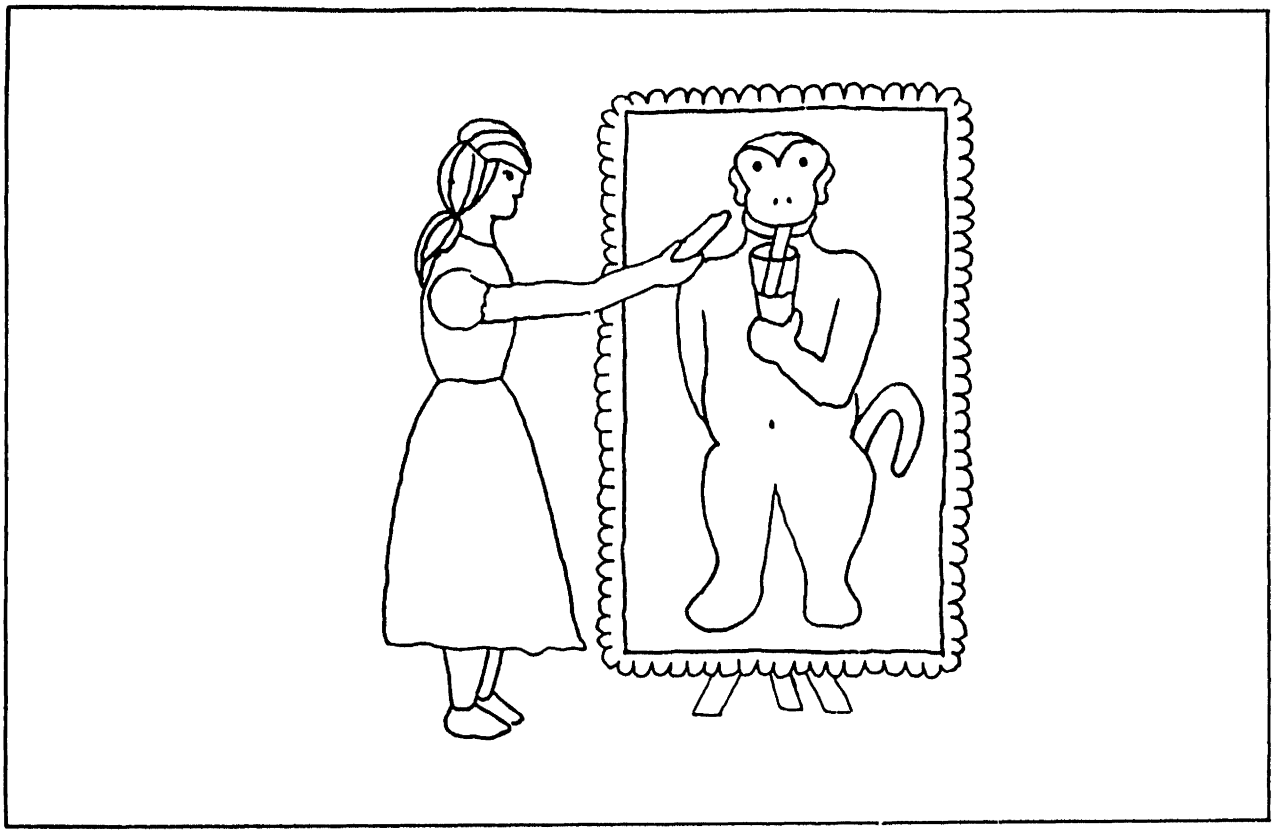


FIGURE 4-3

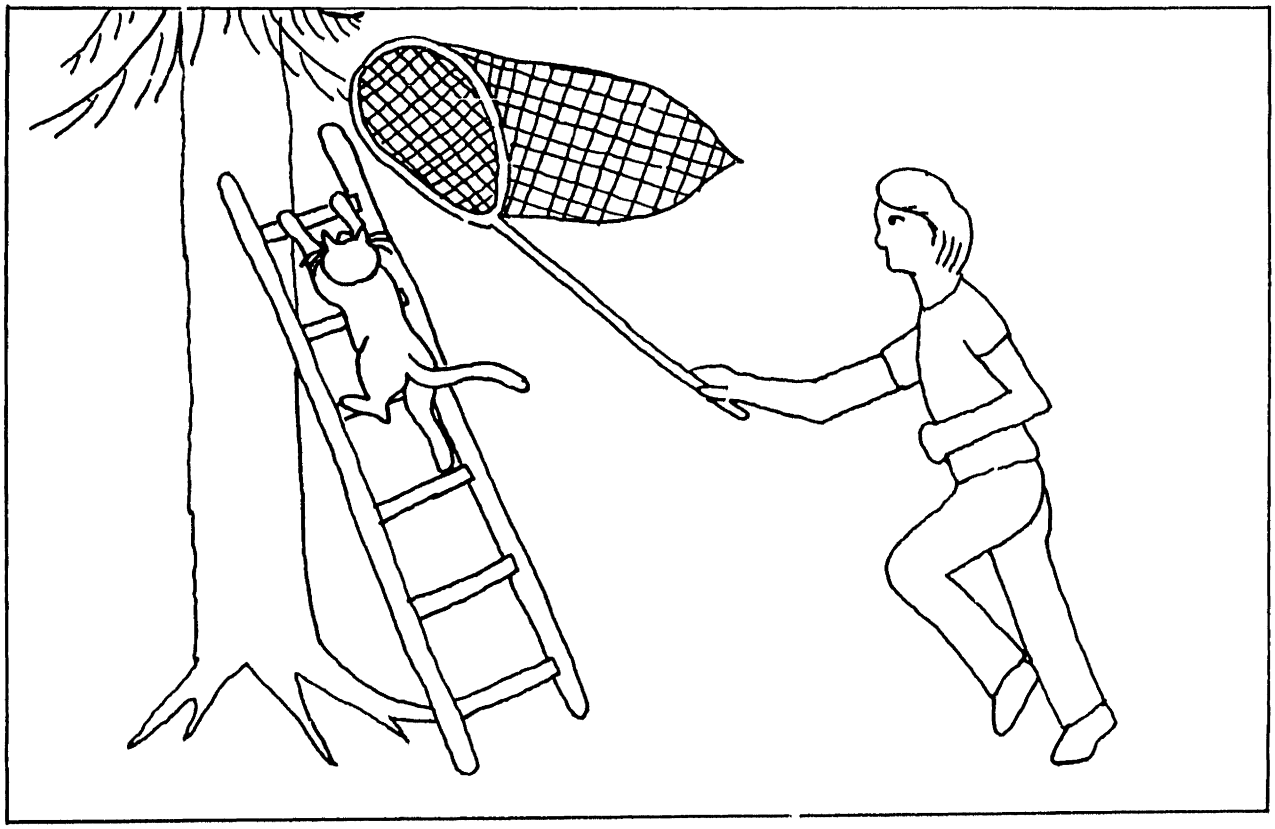


FIGURE 4-4

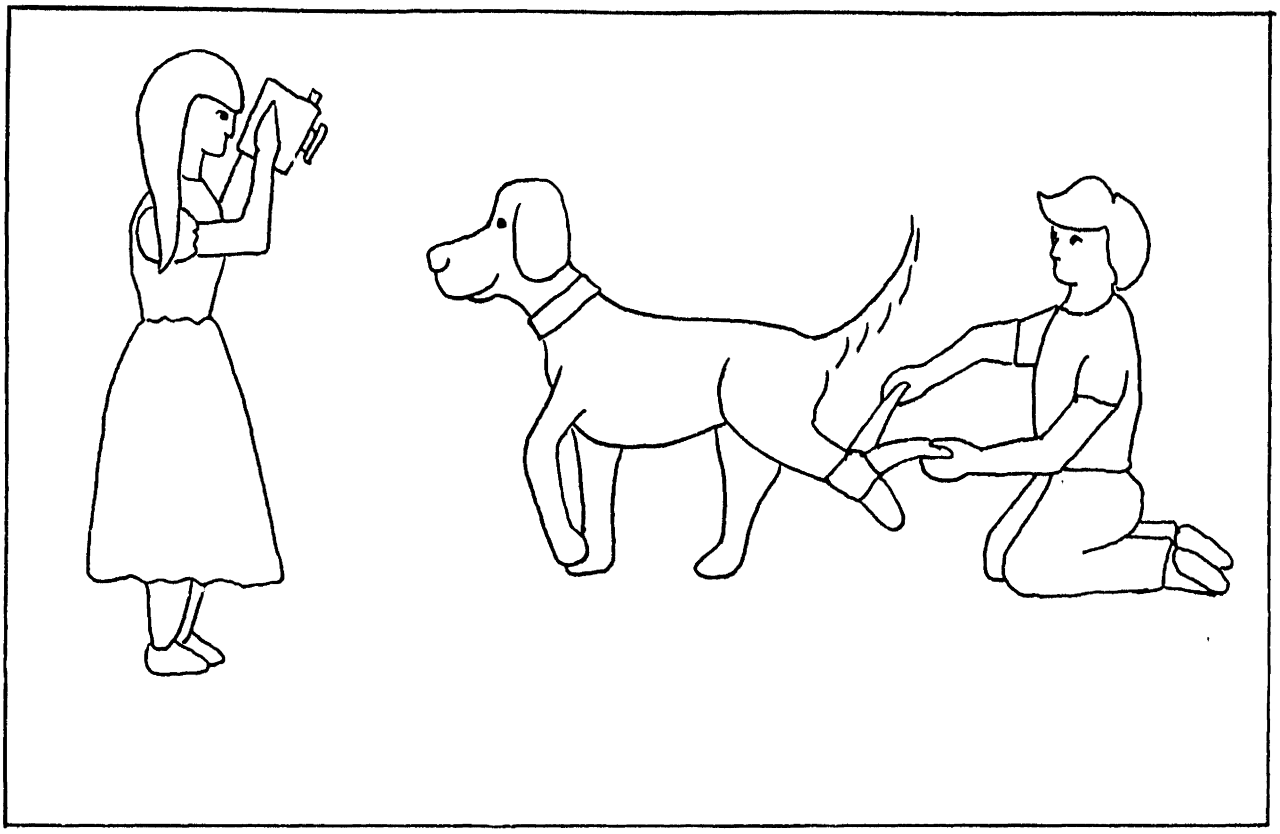


FIGURE 4-5

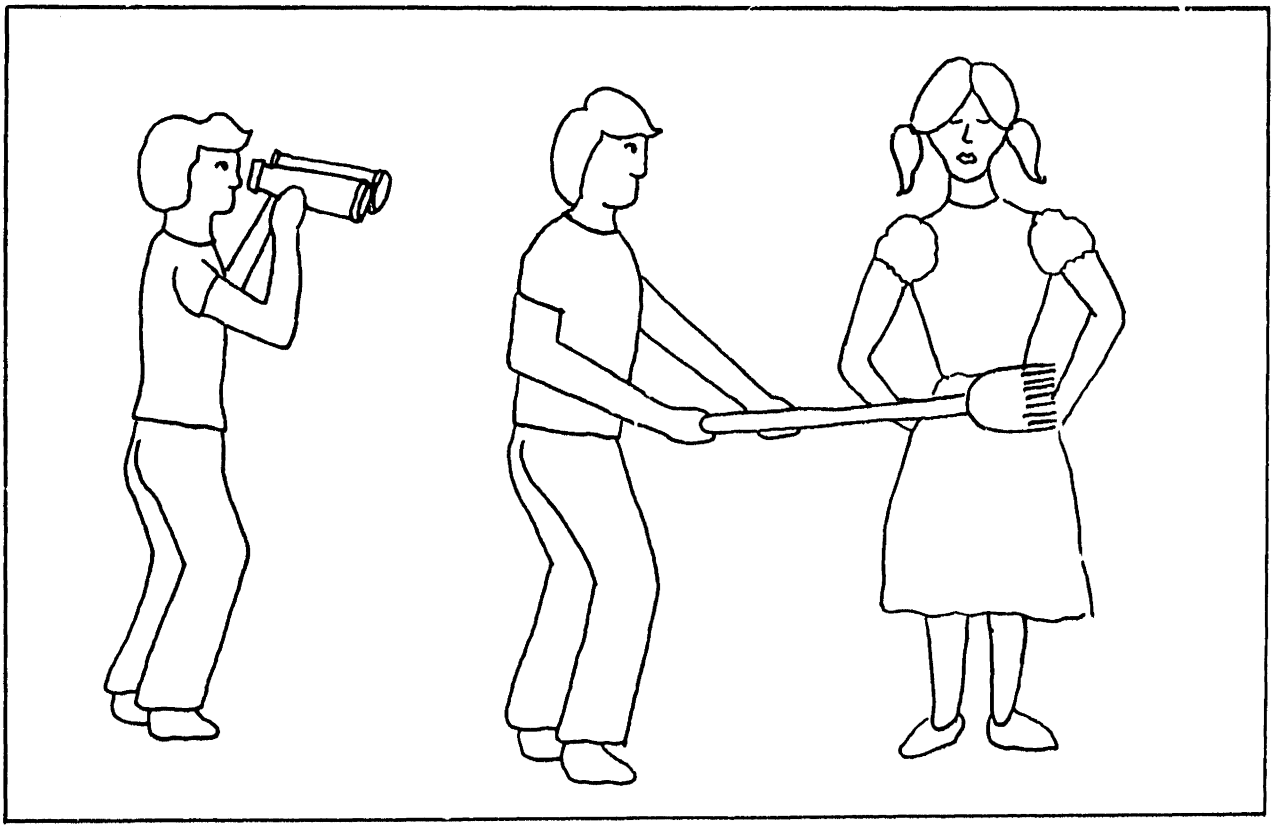


FIGURE 4-6

(4.17) a. what [$_S$ is Jane drawing [$_{NP}$ a monkey [$_{\overline{S}}$ that is drinking milk with t]]]

b. what [$_S$ is Jane drawing [$_{NP}$ a monkey [$_{\overline{S}}$ that is drinking milk]] with t]

However, because of the SC, the question in (4.16) can only have structure (4.17b). Thus, if the subject knows the SC, the only possible answer is a crayon.

Each subject received two stories in the order in which the correct target NP is in the first sentence of the story (to be called the S1 order), and the remaining two stories, in the order in which the correct target NP is in the second sentence of the story (to be called the S2 order). The combination of the stories and the orders (i.e., S1 or S2 order) was randomized, and the order of stories was also randomized.

(II) Syntax test (1): The subject was given six sentences containing relative clauses, and was asked to act out what they meant by using the toys located in front of him. We used only OS relative clauses. Three sentences contained relative clauses in which the verb is transitive (complex), and the rest contained relative clauses in which the verb is intransitive (simple). The following are examples of each:

(4.18) a. complex: The cow kissed the horse that jumped over the elephant.

b. simple: The elephant bumped into the cow that was sleeping.

The nouns, verbs, and verb phrases (for the relative clauses of the simple cases) were randomized. The following is a list of the words and phrases used:

(4.19) nouns: cow, horse, elephant

verbs: kiss, jump over, push, bump into

verb phrases: be in the pond, be standing on the bench, be sleeping

The subjects were asked to perform a toy moving task. That is, they were asked to act out with toys the meaning of each of the sentences of the form described above. Before the test session itself, each subject was given a warm-up session. He was first asked to identify each animal, a bench, and a pond that were on the table in front of him. Each animal was made of plastic, and was easily identifiable. The bench and the pond were made of paper. Then, he was asked to act out six simplex sentences (i.e., sentences containing no embedded clauses), each containing the verbs and verb phrases listed above. The subject was told that he could ask the experimenter to repeat the sentences as many times as he wished. No subject had any difficulty in passing this warm-up session.

In the test session, six sentences of the form described above were given in a random order. On the table were the animals, the bench, and/or the pond that were mentioned in the sentences, and other objects were hidden beyond the fence that was made of paper. Based cn Hamburger and Crain's (forthcoming) and Crain's (1980) following observation (see also the Appendix A to this chapter), we used two toy animals corresponding to the head noun of the relative clause:

> For a sentence (or other form of expression) to be appropriate and correctly interpretable, it must meet certain 'felicity conditions.' The idea of felicity conditions is closely related to that of conversational maxims. The maxims guide sentence choice, given a meaning and context, while the felicity conditions state, for a given sentence (on a particular reading), what should true of the context. In the earlier

> example, the maxim of brevity says that with one horse available (17a) [=The cow bumped the horse that tickled the cat.--YO], being redundant, is inappropriate. The felicity conditions of the relative clause, on the other hand, specify conditions under which (17a) may be used, specifically that there should be more than one horse available. We believe that four- and five-year-old children might be sensitive to such felicity conditions, and hence perform better if those conditions were met. (Hamburger and Crain, forthcoming: 23-24)

(Using their revised format, they have obtained results that deserve serious consideration. See the Appendix A to this chapter for details.) Thus, for (4.20), the objects listed in (4.21) were put on the table.

(4.20) The cow kissed the horse that was in the pond.

(4.21) a. one cow

b. two horses

c. a pond

(III) Syntax test (2): The subject was given four sentences that contain OS relative clauses which are of the same length wordwise as the questions in the SC Test and the pictures were shown simultaneously that depict the situation. As in the SC Test, the subject was asked to listen to the four sentences first, and when he heard all the sentences, the experimenter came back to the first sentence and asked the subject to repeat the sentence. The subject was told that the sentence can be repeated as many times as he wished by the experimenter. However, the subject was told to repeat the whole sentence, and was never allowed to ask the experimenter to repeat the sentence in the middle of his own repetition and resume the repetition from that point on after he heard the experimenter's repetition. The following are the sentences and pictures.

1. John is painting a dog that is eating lunch with a fork.

2. Jill is patting an elephant that is stopping a lion with his trunk.

3. Susan is chasing a boy who is hitting a rat with a stick.

4. Tom is pointing at a girl who is drying a dog with a towel.

TABLE 4-2

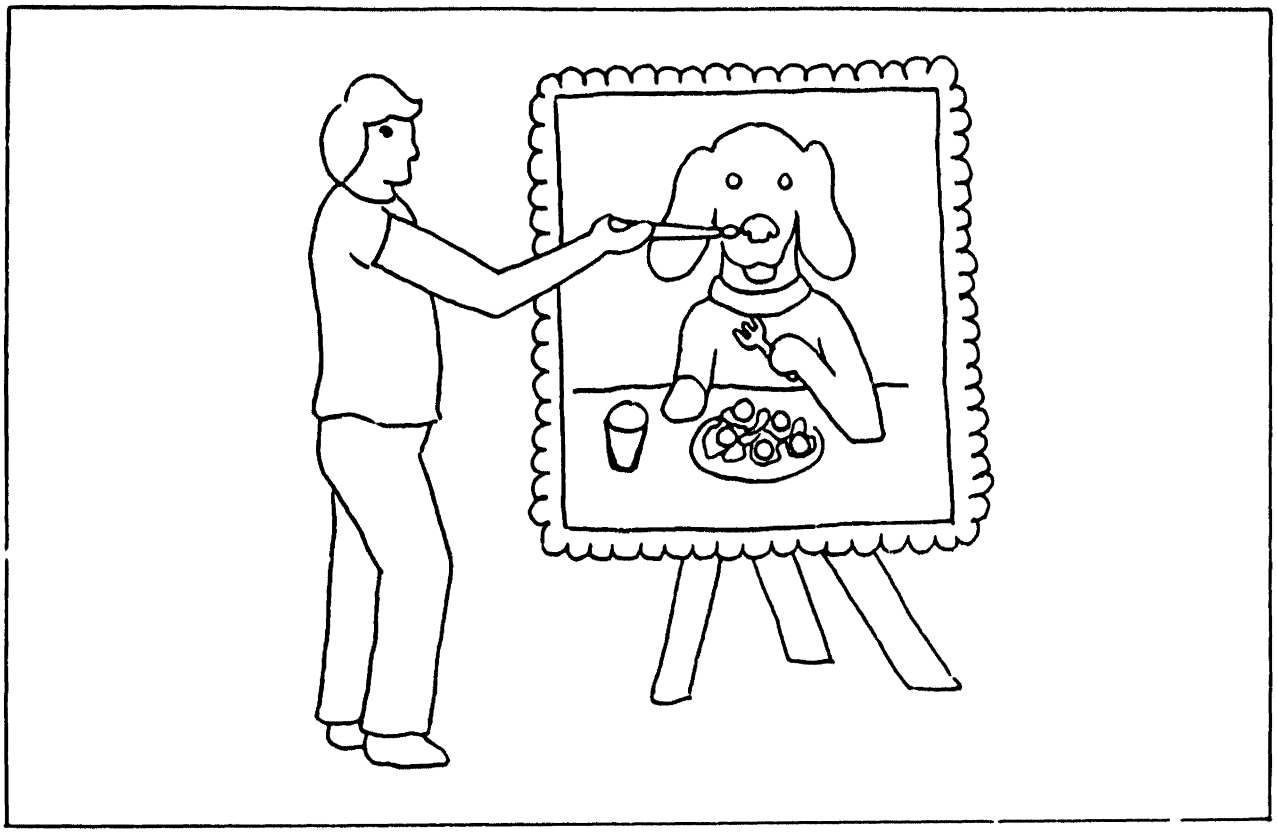


FIGURE 4-7

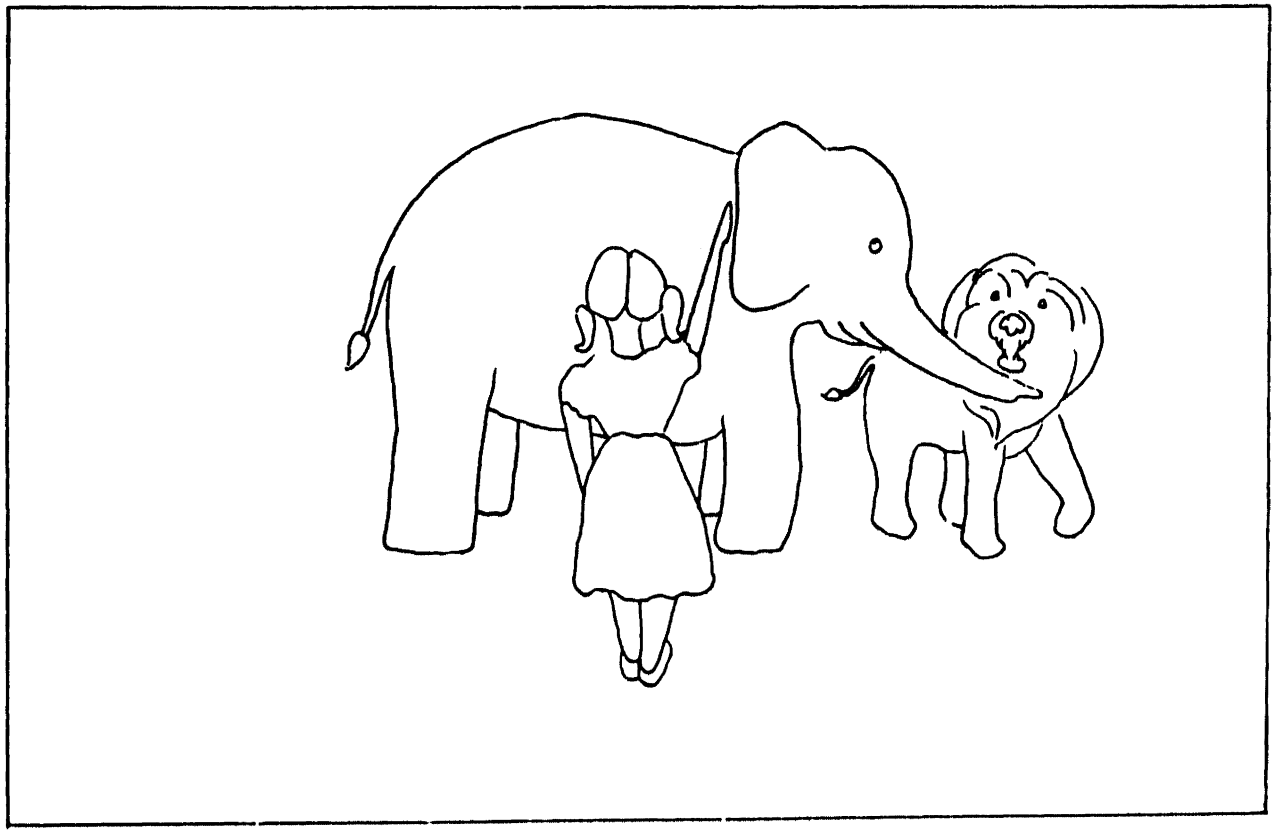


FIGURE 4-8

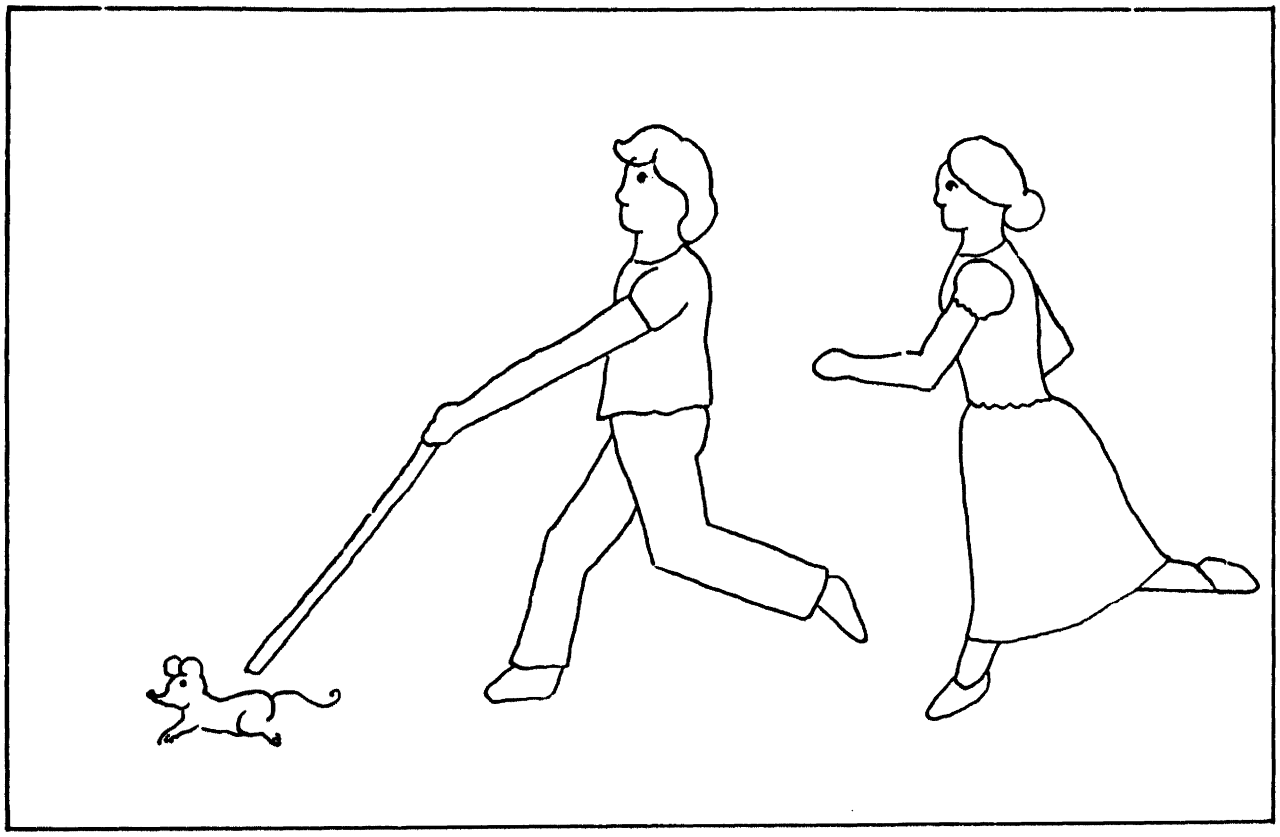


FIGURE 4-9

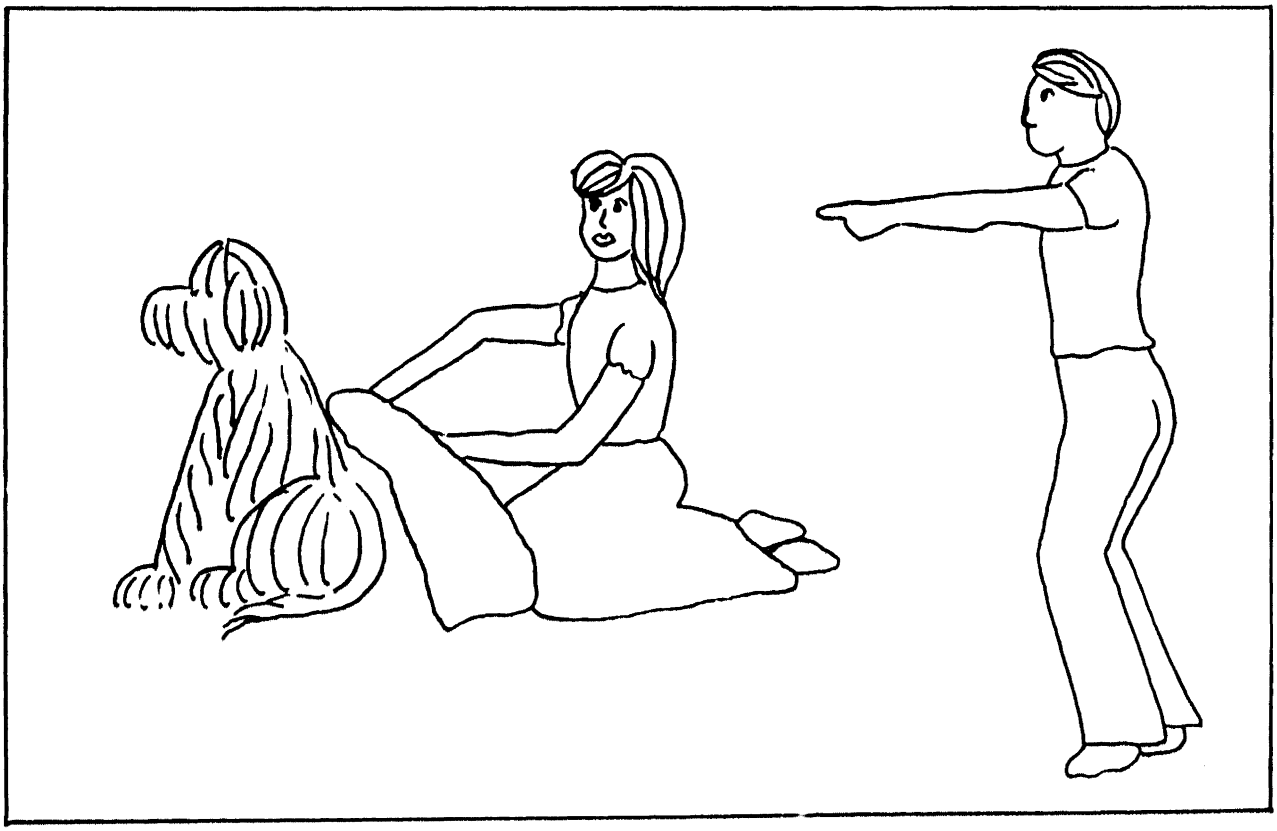


FIGURE 4-10

The order between the SC and two syntax tests was counterbalanced.

Results and Discussion

Results

(I) SC test: The results of the SC test are given in Table 1 in the Appendix at the end of the dissertation. There were three types of answers. First, some subjects correctly picked up the target NP (4.22a). Second, some subjects wrongly picked up the non-target NP that is in the with-phrase of the sentence not containing the target NP (4.22b). Third, some subjects picked up NP other than the two mentioned above (4.22c). (In Table 1 in the Appendix, these answers are coded as 1, 0, and 2, respectively.) Only the first is considered as being correct.

The following are examples:

(4.22) Story: Jane is drawing a monkey with a crayon.
The monkey is drinking milk with a straw.
Question: What is Jane drawing a monkey that is drinking milk with?
Answers: a. A crayon (correct)
b. A straw
c. Milk/Picture/etc.

Table 4-3 shows the percentage of the correct answers for each of the stories.

TABLE 4-3

Age \ Story	1	2	3	4
3	.25	.75	.08	.33
4	.58	.92	.58	.5
5	.5	.83	.5	.5
6	.83	1.0	.67	.58
7	.58	.92	.67	.75
Total	.55	.88	.5	.53

TABLE 4-3

(II) Syntax test (1): The results of the toy-moving task are given in Table 2 in the Appendix at the end of this dissertation. There were seven types of answers for this task. First, some subjects performed the matrix clause action, and then the relative clause action (4.23 below). Second, some subjects performed the two actions in the reverse way (4.23). Third, some subjects performed only the matrix clause action (4.23). When these subjects were asked by the experimenter, they knew the content of the relative clause. Fourth, some subjects performed the matrix clause action, and then the relative clause action with matrix subjects as its antecedent (4.23). Fifth, some subjects only performed the matrix clause action, and they did not remember what was said in the relative clause when asked by the experimenter (4.23). Sixth, some subjects only performed the relative clause action, and they did not remember what was said in the matrix clause when asked by the experimenter (4.23). Seventh, others (4.23). The following are examples:

(4.23) Sentence: The cow pushed the horse that jumped over the elephant.

(In the following, V(X,Y) indicates that X is the agent of the action denoted by V, and Y is the patient. Z;W indicates that the subject performed Z first, and then W.

a. push (cow, horse); jump over (horse, elephant)

b. jump over (horse, elephant); push (cow, horse)

c. push (cow, horse)

(Did the giraffe do anything? Can you show me?)

jump over (horse, elephant)

d. push (cow, horse); jump over (cow, elephant)

e. push (cow, horse)

(Did the giraffe do anything? Can you show me?)

No, he didn't.

f. jump over (horse, elephant)

(Did the cow do anything? Can you show me?)

No, he didn't.

g. others

These answers are coded in Table 2 in the Appendix at the end of this dissertation as 1, 2, 3, 4, 5, 6, and 7, respectively. The first three answers are considered as correct, and the rest as wrong.

Table 4-4 shows the percentage of the correct answers for each sentence. Table 4-5 shows the breakdown for each response type.

TABLES 4-4 and 4-5

(III) Syntax Test (2): The results of the repetition task are given in Table 3 at the Appendix at the end of this dissertation. There were four types of answers for this task. First, some subjects repeated the given sentence correctly (4.2a below). Second, some subjects repeated the matrix clause only, omitting the relative clause (4.24b). Third, some subjects repeated the relative clause only, omitting the matrix clause (4.24c). The fourth category includes all other response types (4.24d). This includes the case in which subjects repeated the given sentence that contains a relative clause as conjoined clauses. The following are the examples:

Age \ Type	Complex (3 Sentences)	Simple (3 Sentences)
3	.17	.58
4	.39	.83
5	.53	.94
6	.69	.89
7	.94	1.0
Total	.54	.85

TABLE 4-4

Response Type	correct			wrong				
	1	2	3	4	5	6	7	Total
Age								
(a) complex								
3	4	1	1	9	10	6	5	36
4	7	5	2	7	6	4	5	36
5	7	9	3	11	3	1	2	36
6	16	9	0	8	0	0	3	36
7	18	10	6	2	0	0	0	36
Total	52	34	12	37	19	11	15	180
(b) simple								
3	2	19	0	1	8	5		36
4	0	27	3	0	5	0	1	36
5	2	29	3	0	1	0	1	36
6	4	28	0	2	1	0	1	36
7	2	28	6	0	0	0	0	36
Total	10	131	12	3	15	5	4	180

TABLE 4-5

(4.24) Sentence: John is painting a dog that is eating lunch with a fork.

Answers: a. John is painting a dog that is eating lunch with a fork.

b. John is painting a dog.

c. A dog is eating lunch with a fork.

d. John is painting a dog and it is eating lunch with a fork./ John is painting a dog eating lunch with a fork.

These answers are coded in Table 3 in the Appendix at the end of this dissertation as 1, 5, 6, and 7, respectively. Only the first one is considered correct; the rest are considered wrong. Table 4-6 shows the percentage of the correct answers for each sentence. Table 4-7 shows the breakdown for each response type.

TABLE 4-6 and 4-7

(IV) Correlations: To test Hypothesis (H), we tabulated a 2x2 contingency table. This table displays the degree of association between success in the Syntax Test and success in the SC Test. If (H) is correct, then the subjects should tend to fall in the pass-pass and fail-fail cells.

The criterion for passing the SC test is getting more than 3 stories correct out of 4. The criterion for passing the Syntax Test is getting more than 2 correct out of 3 complex cases for the toy-moving task and getting more than 3 correct out of 4 for the repetition task. The reason for taking only the complex cases into consideration for the toy-moving task is that the questions in the SC Test contain analogously complex relative clauses.

Sentence / Age	1	2	3	4	Total
3	0	0	0	.08	.02
4	.58	.5	.5	.58	.54
5	.83	.83	.67	.75	.77
6	.83	.83	.92	.75	.83
7	.92	1.0	.92	1.0	.96
Total	.63	.63	.6	.63	.63

TABLE 4-6

Response Type / Age	correct	wrong			Total
	1	5	6	7	
3	1	9	9	29	48
4	26	3	1	18	48
5	37	0	0	11	48
6	40	0	0	8	48
7	46	1	0	1	48
Total	150	13	10	67	240

TABLE 4-7

Table 4-8 shows the degree of association between success in the Syntax Test and success in the SC Test.

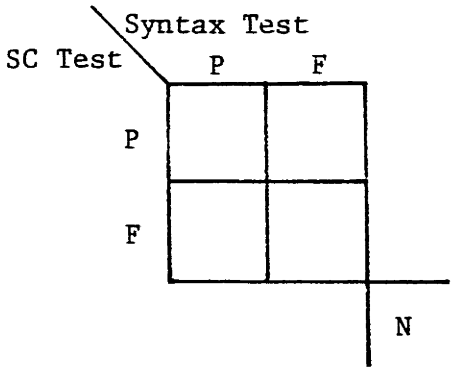
SC Test \ Syntax Test	P	F	
P	21	9	30
F	7	23	30
	28	32	60

TABLE 4-8

The association in Table 4-8 is statistically significant at the .05 level (χ^2=11.32, 1df) with Yates' correction for continuity.

Tables 4-9 - 4-13 show the results broken down by age groups. Since the number of subjects in each age group is relatively small (i.e., 12), we do not think that statistical analysis of each of these tables would be meaningful. Rather, these tables are to show the developmental sequence across the ages with respect to the SC.

TABLES 4-9 - 4-13



3-year olds

0	1	1
0	11	11
0	12	12

TABLE 4-9

4-year olds

3	3	6
0	6	6
3	9	12

TABLE 4-10

5-year olds

4	2	6
2	4	6
6	6	12

TABLE 4-11

6-year olds

7	2	9
2	1	3
9	3	12

TABLE 4-12

7-year olds

7	1	8
3	1	4
10	2	12

TABLE 4-13

Discussion

Table 4-9 and the statistical analysis on it show that our hypothesis (H) has been borne out. Namely, the results of the experiment show that as soon as the child masters relative clauses, he honors the SC with respect to them. In other words, the child knows that extraction out of relative clauses is not allowed as soon as he masters relative clauses. Of course, we have not proved the innateness of the SC. However, our findings give strong empirical support for the claim that the SC is part of the innate schematism that allows language acquisition.

There are other interesting findings as well. We enumerate them below:

(A) Various types of responses to OS relative clauses reported in previous studies, particularly in Hamburger and Crain (forthcoming), were also found in our experiment. However, our results differ from Hamburger and Crain's in the following way: They have found that there are developmental stages with respect to the comprehension of relative clauses. The predominant pattern of the 3-year olds was to act out the matrix clause first and then the relative clause. The predominant pattern of the 4-year olds was to act out the relative clause first and then the matrix clause. The predominant pattern of the 5-year olds was to act out only the matrix clause (on the basis of the children's knowledge that relative clause carries presupposition). Our results did not show this developmental sequence. Rather, they show that there were a great many individual differences among the subjects. We do not have a good account of the source of this difference. The one thing that might deserve mention here is that the number of subjects in Hamburger and Crain's study was

relatively small (i.e., 18). The developmental sequence among their subjects might simply be true within this limited population. Whatever the reason may be, the data that Hamburger and Crain have obtained are worth examining carefully. In our experiment, their developmental stages did not show up.

(B) The subjects performed substantially better for the simple (OS) relative clauses than for the complex ones. This result is in conformity with Goodluck and Tavakolian's (1979) result.

(C) Our results show that the child's performance in the repetition task was better than his performacne in the toy-moving task. The combination of the child's performance in the repetition and toy-moving tasks seems to provide us with more reliable data concerning his knowledge of relative clauses.

(D) There were nine subjects (Subject ##4, 10, 12, 13, 17, 21, 35, 38, and 39) who repeated the sentences containing relative clauses as conjoined clauses as in the following manner:

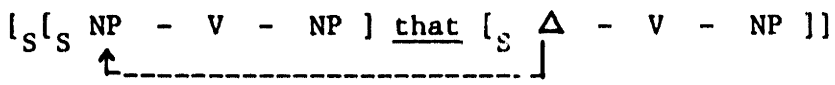
(4.25) Given Sentence: John is painting a dog that is eating lunch with a fork.

Repeated as: John is painting a dog and it is eating lunch with a fork.

Notice that the subject that these children have supplied for the second clause was <u>it</u> (referring to <u>a dog</u> that is the object of the first clause). This is different from what Tavakolian's (1977, 1981; see also the Appendix A to this chapter) Conjoined-Clause Analysis would predict. See the following which we have borrowed from Tavakolian (1981:171):

(4.26) a. Conjoined-Clause Schema

b. OS Relative Clauses



If the above analysis had been made, the children would have repeated the sentence as John is painting a dog and he (=John) is eating lunch with a fork.

As far as we can see, there are two possible accounts for the children's repetition of this type. First, they knew relative clauses, and comprehended the given sentence correctly, but the given syntactic form (i.e., relative clause) had already been forgotten when they attempted to repeat. And so, they expressed the meaning of the given sentence in an alternative syntactic form. Second, they attempted the Conjoined-Clause Analysis, but since the information from the picture did not match the information they obtained from the Conjoined-Clause Analysis (i.e., it is not John who is eating lunch with a fork), he switched the subject of the second clause to the dog. It could well be that some subjects reached the (4.25) type of response by the first alternative, and others by the second.

4.3 Other Related Experiments

In this section, we report informally some of the other related experiments we conducted in the course of this study.

4.3.1 Experiment A

This experiment was conducted before Experiment 1 chronologically, and served in a sense as a pilot experiment. The design of this experiment is almost the same as Experiment 1.

(A) There were two parts: the Syntax Test and the SC Test

(B) The Syntax Test tested the subjects' knowledge of the structures that are relevant to the SC. The task was toy-moving. There were six sentences containing relative clauses: two sentences containing simple OS relative clauses (i.e., the verb in the relative clause was intransitive); two sentences containing complex OS relative clauses (i.e., the verb in the relative clause was transitive); and two sentences containing OO relative clauses.

(C) The SC Test tested whether the subject honored the SC. The task was the same as the SC Test in Experiment 1, except for the point that will be mentioned in (a) below.

(D) The logic of the experiment is the same as the other experiments reported in this dissertation. The hypothesis to be tested is:

(H) As soon as the child masters a structure that is relevant to the SC, he honors the SC with respect to that structure.

(H) makes the following prediction about our data:

(P) Those who pass the Syntax Test will also pass the SC Test.

The following should also be true:

(Q) Those who fail the Syntax Test will also fail the SC Test.

The following points are different from Experiment 1:

(a) There was no listening session in the SC Test.

(b) The five structural types that we list below were included in the test items in the SC Test.

(i) *wh $[_S \ldots [_{NP} \ldots t]]$ (t is the trace left behind by wh.)

E.g., *What color ribbon is John looking at a cat with?

(ii) *wh $[_S \ldots [_{\bar{S}} [_S \ldots [_{NP} \ldots t]]]]$

E.g., *What color ribbon does Susan think John is looking at a cat with?

(ii) *wh $[_S \ldots [_{NP} \ldots [_{NP} \ldots t]]]$

E.g., *What color ribbon is John drawing a picture of a cat with?

(iv) *wh $[_S \ldots [_{NP} \ldots [_{\bar{S}} [_S \ldots t]]]]$ (OS Relative Clause)

E.g., What color straw is John drawing a monkey that is drinking milk with?

(v) *wh $[_S \ldots [_{NP} \ldots [_{\bar{S}} [_S \ldots t]]]]$ (OO Relative Clause)

E.g., *What color stick is John catching a rat that Susan is hitting with?

(c) Each subject received all the stories in the SC Test either in the S1-order (i.e., the order in which the correct target NP is in the first sentence of the story) or in the S2-order (i.e., the order in which the correct target NP is in the second sentence of the story) across the board.

(d) The crucial structure for (i) to (iii) in (b) above is $[_{NP} \ldots PP]$. The Syntax Test for this structure was the following:

(4.27) John saw a dog with a long nose.

Tell me what John saw.

If the subject answered a dog with a long nose, we took it as demonstrating the knowledge of $[_{NP} \ldots PP]$.

(e) Two sentences containing OO relative clauses were included in the Syntax Test. See (B) above.

(f) There was no repetition task in the Syntax Test.

Subjects

The subjects were 72 children ranging in age from 3 to 10 years. Twenty-four adults were also tested. See 3.2 for details.

Stories and Pictures

Table 4-14 lists all the stories used in the SC Test, and Figures 4-11 - 4-20 are the pictures that accompanied the stories.

TABLE 4-14

FIGURES 4-11 - 4-20

Some of the sentences in the stories are potentially ambiguous (e.g., Bill is pointing at a girl with flowers.), but they were disambiguated by the information from the accompanying pictures in the test situation.

STORY SET A

1. Bill is pointing at a girl with flowers.
   He is pointing at a girl with his finger.

   What is Bill pointing at a girl with?

2. Mary heard that Jim was hitting a rat with a long tail.
   She heard that he was hitting a rat with a big stick.

   What did Mary hear that Jim was hitting a rat with?

3. James is painting a picture of a boy with a book.
   He is painting a picture of a boy with a brush.

   What is James painting a picture of a boy with?

4. A monkey is drinking milk with a straw.
   Jane is drawing the monkey with a crayon.

   What is Jane drawing a monkey that is drinking milk with?

5. An elephant is squirting a wolf with his trunk.
   Dick is patting the wolf with his hand.

   What is Dick patting a wolf that an elephant is squirting with?

STORY SET B

1. John is bandanging a cat with a broken leg.
   He is bandaging a cat with a handkerchief.

   What is John bandaging a cat with?

2. Ned said that Ellen was stopping a boy with a red T-shirt.
   He said that she was stopping a boy with a broom.

   What did Ned say that Ellen was stopping a boy with?

3. Jill is writing a book about a dog with a long tail.
   She is writing a book about a dog with a green pencil.

   What is Jill writing a book about a dog with?

4. A cat is climbing a tree with a ladder.
   Christopher is catching the cat with a net.

   What is Christopher catching a cat that is climbing a tree with?

5. A pony is pushing a giraffe with his head.
   Carol is drawing the giraffe with a pencil.

   What is Carol drawing a giraffe that a pony is pushing with?

[Each subject received all these ten stories.]

TABLE 4-14

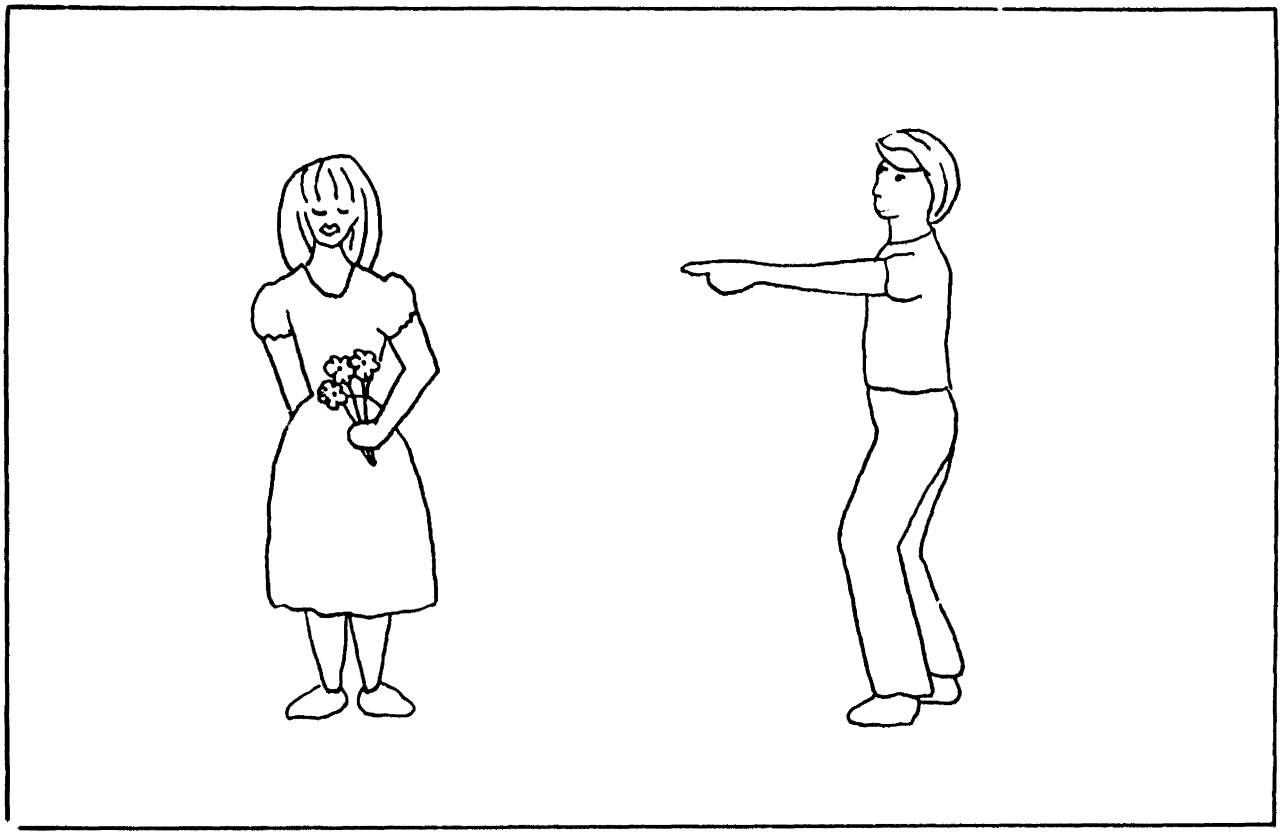


FIGURE 4-11

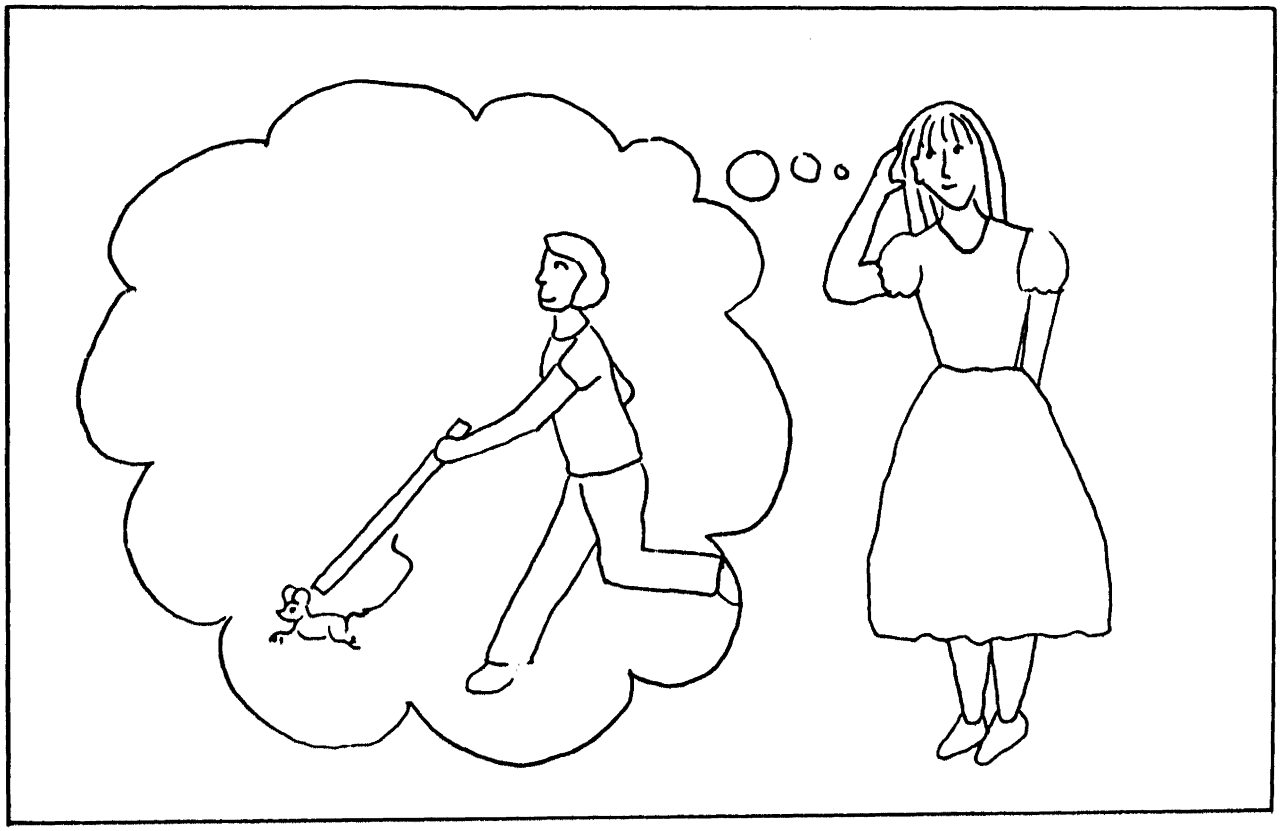


FIGURE 4-12

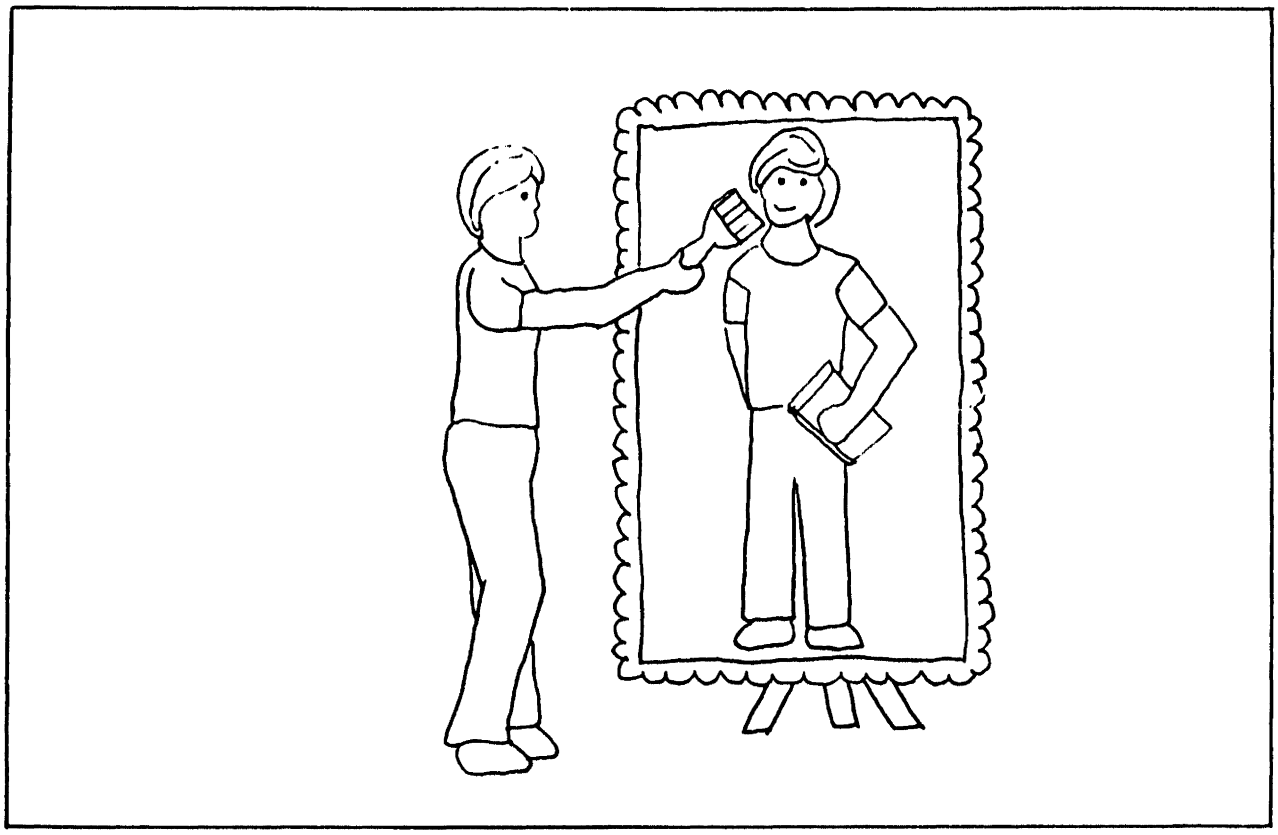


FIGURE 4-13

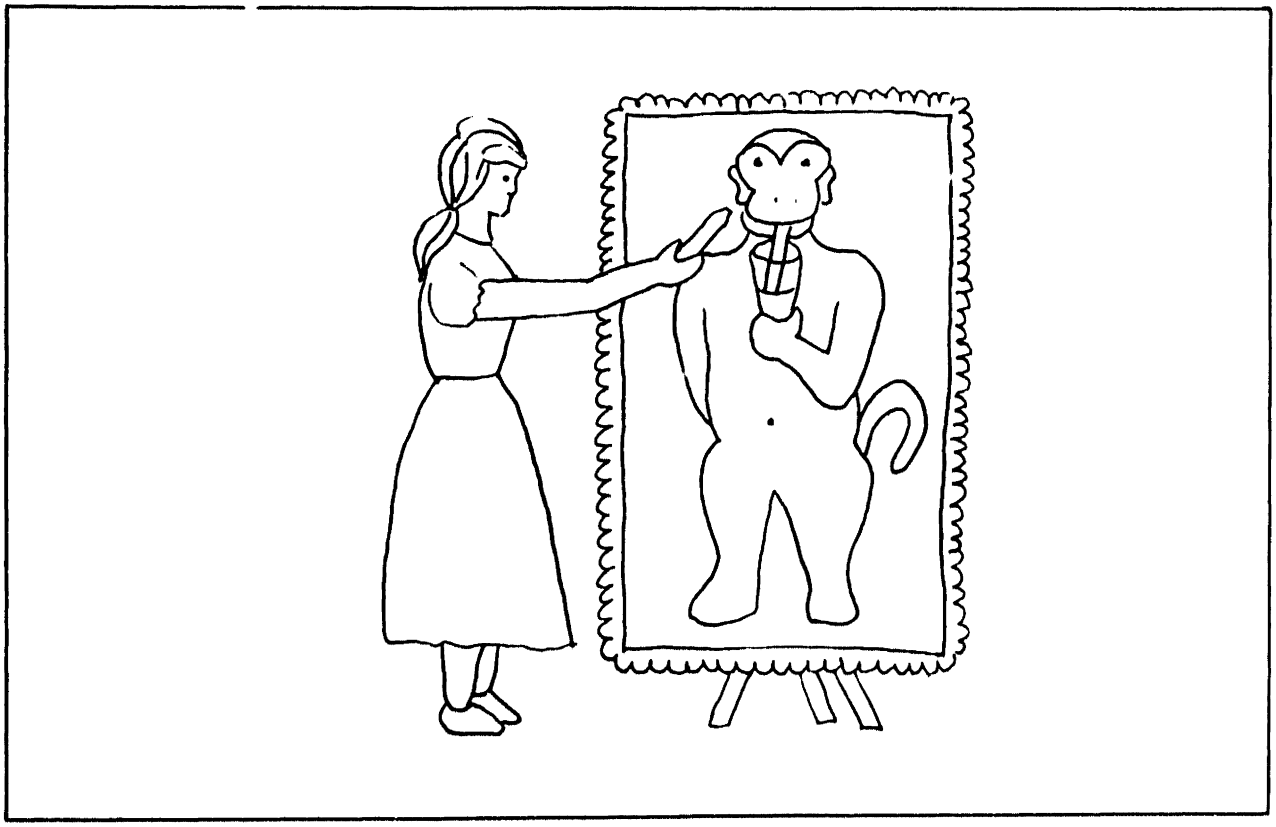


FIGURE 4-14

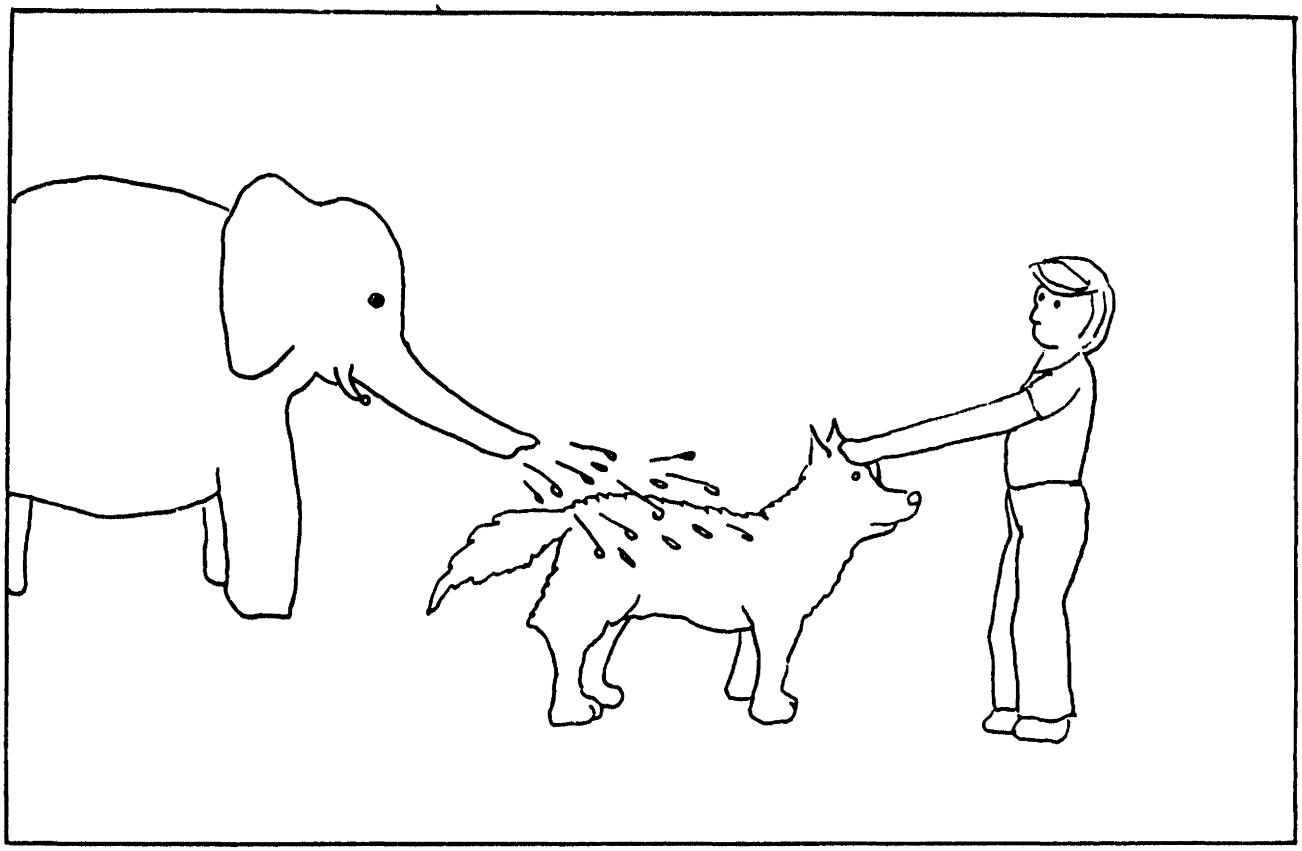


FIGURE 4-15

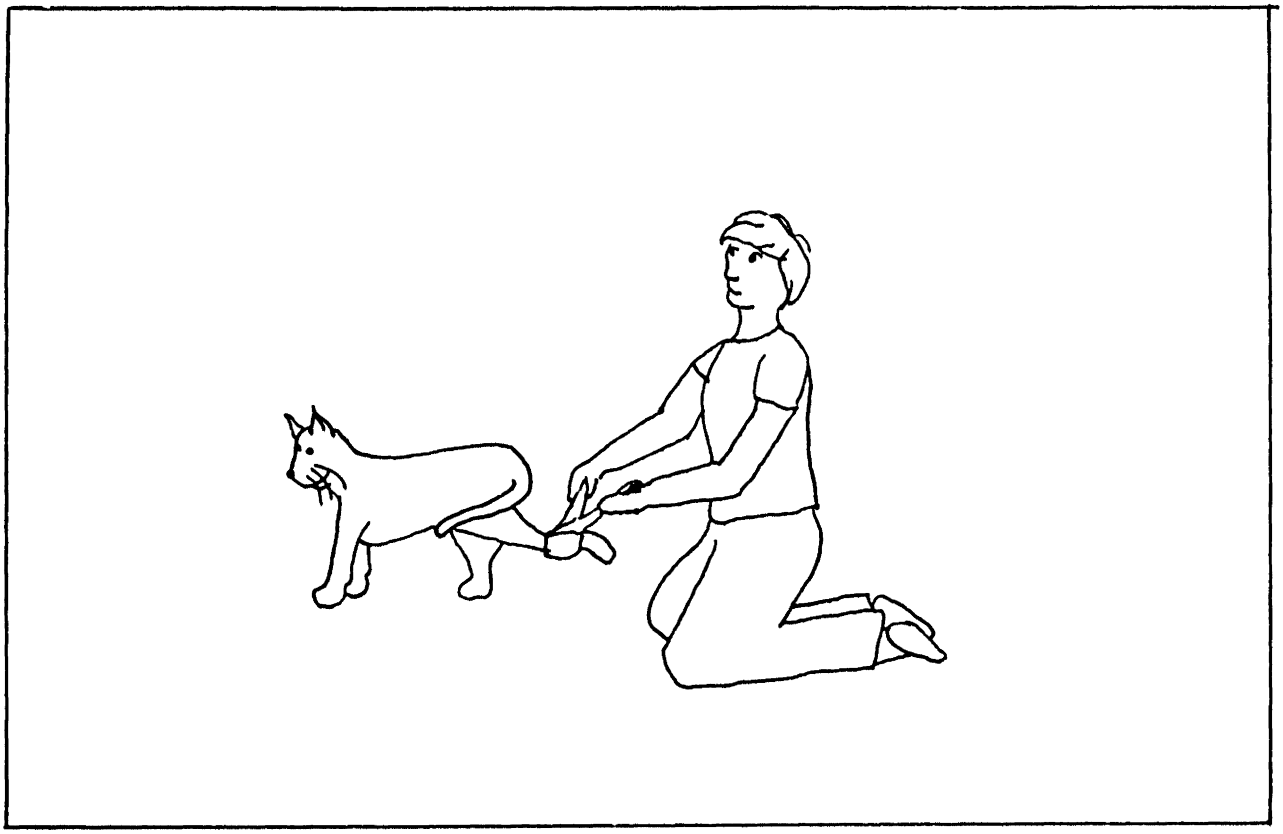


FIGURE 4-16

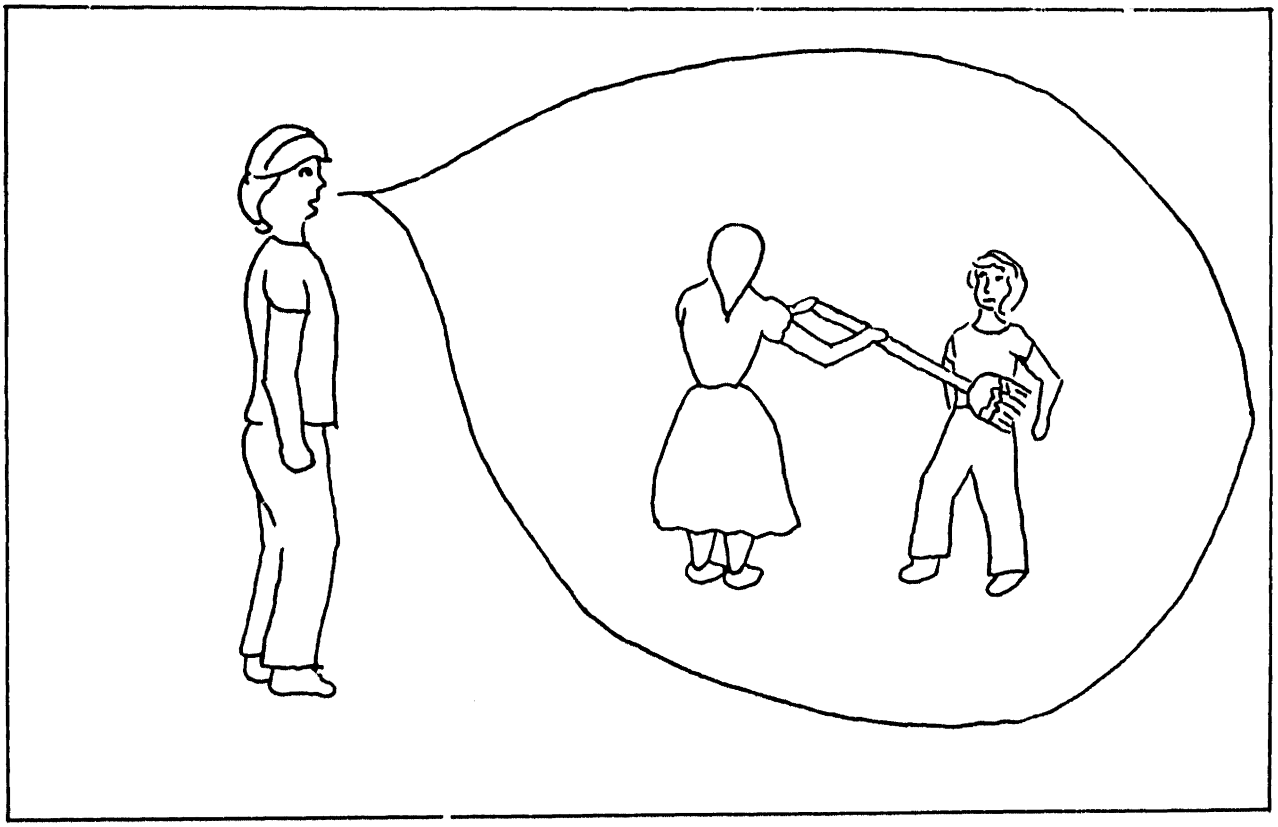


FIGURE 4-17

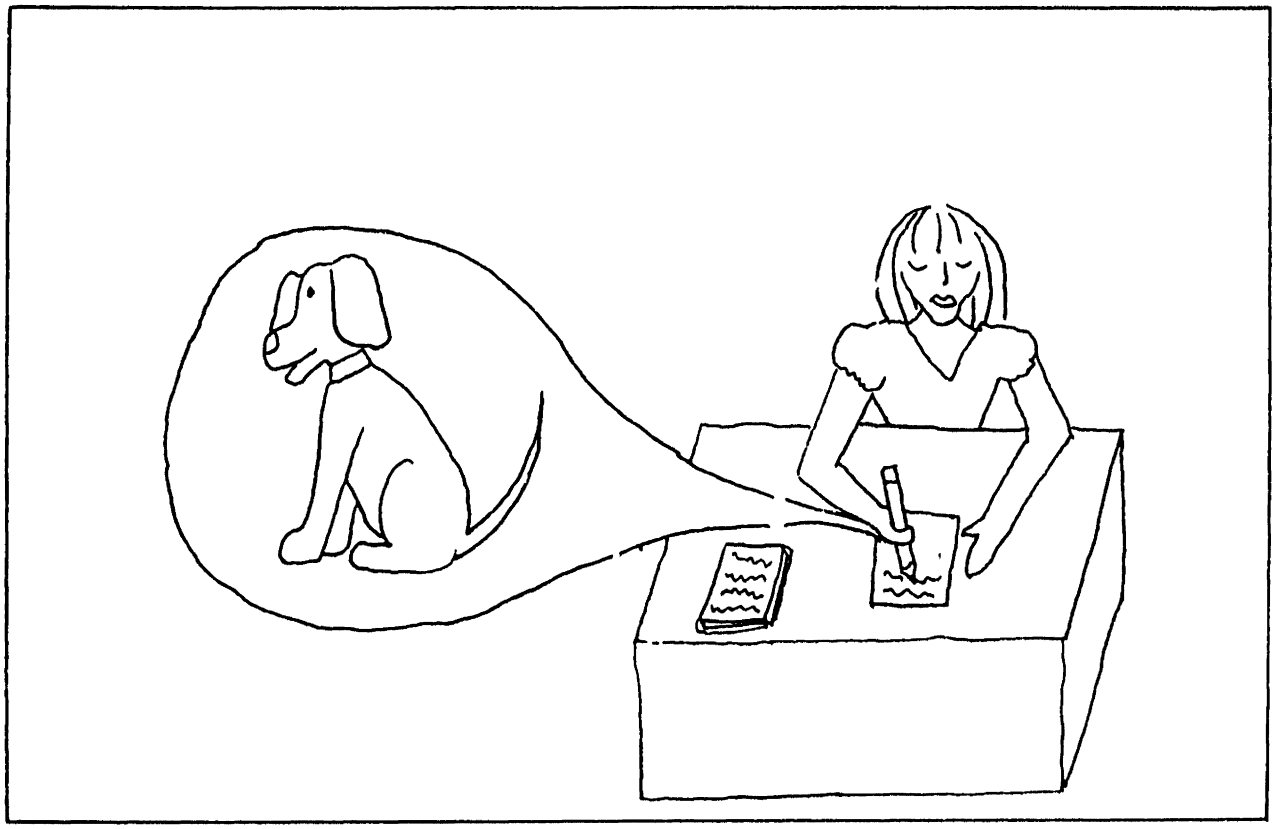


FIGURE 4-18

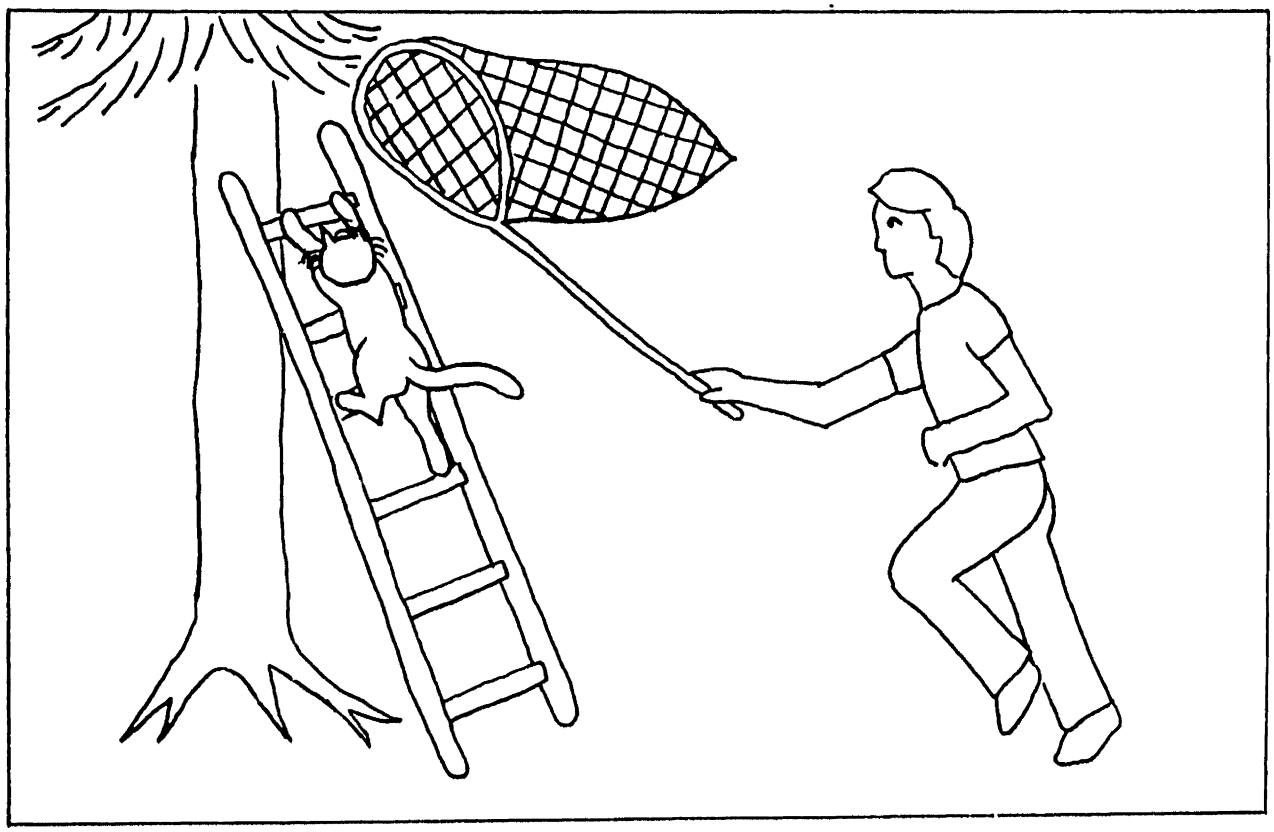


FIGURE 4-19

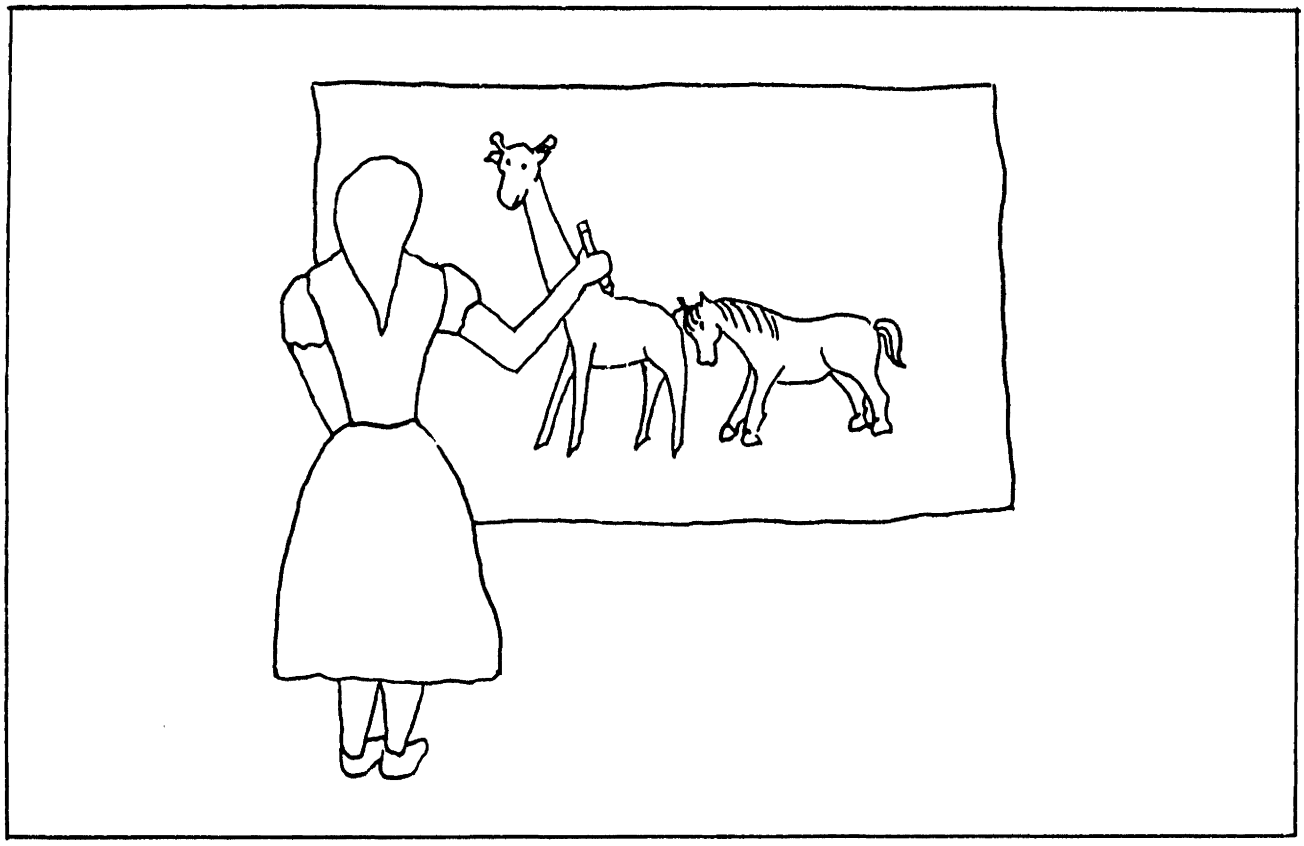


FIGURE 4-20

Results

Let us first consider the criteria for passing the tests. As for the non-relative clause cases (i.e., types (i)-(iii)), the criterion for passing the Syntax Test is obvious, since there was only one test item. For all other cases, i.e., the relative clause Syntax Test (6 test items), the non-relative clause SC Test (6 test items), and the relative clause SC Test (4 test items), the criteria for passing are not self-evident. Notice that we do not know the probability of passing each test item by guessing. Even in the SC Test where there were two crucial NPs given in each story, the subject could pick up almost anything as the answer to the question that follows. In fact, there were subjects who answered in the following manner:

(4.28) Dick is patting a wolf with his hand.
An elephant is squirting the wolf with his trunk.
Question: What is Dick patting a wolf that an elephant is squirting with?
Answer: Water.

Thus, the binomial distribution table does not suggest itself as an appropriate tool in these cases. We therefore decided to use the second most stringent criterion. Namely, we allow the subject to make one, and only one, mistake for passing. The most stringent one, of course, is to allow no mistakes. However, since our task requires a great deal of attention on the part of the subject, and since the (crucial) subjects are children under ten whose attention span is more constrained than adults', it seems reasonable to use the second most

stringent criterion.

It is necessary to comment further on the criterion for passing the SC Test for the non-relative clause cases. Look at Table 4-15 which shows the correct response percentage for each item in the SC Test.

TABLE 4-15

As the table shows, children did very poorly in the two stories in the Story Set A among the non-relative clause cases.

(4.29) Bill is pointing at a girl with flowers.
He is poinging at a girl with his finger.
--What is Bill pointing at a girl with?

(4.30) James is painting a picture of a boy with a book.
He is painting a picture of a boy with a brush.
--What is James painting a picture of a boy with?

Some possible explanations for the children's poor performance in these two cases suggest themselves. First, the first sentence in (4.29) is potentially ambiguous, i.e., between (4.31a) and (4.31b).

(4.31) a. Bill $[_{VP}$is pointing at $[_{NP}$a girl $[_{PP}$with flowers$]]]$
b. Bill $[_{VP}$is pointing at $[_{NP}$a girl$][_{PP}$with flowers$]]$

In (4.29), (4.31a) is the intended structure, and the picture that accompanies the story will tell the subject that it is so. However, since the sentence itself is potentially ambiguous, the ambiguity might have affected the subjects' performance. However, this account does not apply

Story / Age	A1	B1	A2	B2	A3	B3	A4	B4	A5	B5
3	.5	.75	1.0	1.0	.75	.75	.13	.63	0	.75
4	1.0	.88	1.0	1.0	.63	.75	.5	.5	0	.5
5	.87	1.0	.75	1.0	.75	1.0	.5	.88	.25	.88
6 (Boston)	.5	1.0	.75	.75	.75	.75	.63	.88	.38	.63
6' (MV)	.63	1.0	.75	.75	.75	.75	.63	.88	.38	.75
7	.5	.88	.5	.75	.5	1.0	.88	1.0	.38	.75
8	.5	1.0	.63	.75	.5	.75	.75	1.0	.5	.88
9	.5	.88	.63	.5	.63	.5	.75	.88	.38	.63
10	.38	.75	.38	.63	.4	.63	.75	.88	.5	.75
Total	.6	.9	.71	.79	.63	.76	.61	.83	.31	.72

TABLE 4-15

to (4.30). Although the first sentence and the second sentence as well could be ambiguous, there is a strong pragmatic disambiguating factor toward the intended readings.

The second possibility is that the children's poor performance had something to do with the fact that the possessive relationship expressed in the first sentences in (4.29) and (4.30) is "alienable." However, the subject did well with the following case in which the first sentence also contains the alienable possession.

(4.32) Ned said that Ellen was stopping a boy with a red T-shirt.
He said that she was stopping a boy with a broom.
--What did Ned say that Ellen was stopping a boy with?

Notice that the boy in the picture that was shown to the subject along with (4.32) (i.e., Figure 4-17) is wearing a red T-shirt, and the T-shirt looks like a part of his body. Because of this, the subject might have taken the possessive relationships expressed in the first sentence of (4.32) as inalienable. See Guéron (1978) for a relevant discussion.

Another possibility was suggested by Ken Hale (personal communication). He observed that the relative information content of the correct answer is very small in (4.29) and (4.30). Thus, people usually point at something with their finger, and people usually paint something with a brush. Compare these cases with (4.32), in which the correct answer to the question, i.e., with a broom, carries much more information. Therefore, if the child has already established a conversational convention to the effect that the one who asks a question is expecting to obtain information from the answer, and if this convention overrides the SC, then he would

answer with flowers and with a book in (4.29) and (4.30), respectively, which carry more information content.

Notice also that the children's performance on (4.29) and (4.30) was worse between 7 and 10 years of age. If this is true, it is an interesting research topic, although it is beyond the scope of this study.

Because of the peculiarity of these two cases, i.e., (4.29) and (4.30), we decided not to include them in our analysis. Therefore, there are four stories for the non-relative clause cases, and in accordance with the second most stringent criterion for passing that we mentioned above, the criterion for passing is getting three out of the remaining four stories correct.

The following two tables show the degree of association between success in the Syntax Test and success in the SC Test.

TABLES 4-16 and 4-17

The association in Table 4-16 is statistically significant at the .05 level (χ^2=6.42, 1df) with Yates' correction for continuity. The association in Table 4-17 is also statistically significant at the .05 level (χ^2=5.84, 1df) with Yates' correction for continuity.

Discussion

Table 4-16 shows that most of the subjects (62 out of 72) passed both the Syntax and SC Tests. This suggests the need for lowering the age range of the subject in order to include subjects who would fail the Syntax Test. Hypothesis (H) predicts that they would also fail the SC

SC Test \ Syntax Test	P	F	
P	62	0	62
F	8	2	10
	70	2	72

TABLE 4-16: Non-Relative Clause Cases

SC Test \ Syntax Test	P	F	
P	30	7	37
F	18	17	35
	48	24	72

TABLE 4-17: Relative Clause Cases

Test. However, this is technically difficult, because average two-year olds cannot perform the present tasks in a consistent manner.

However, the fact that most of the subjects who passed the Syntax Test also passed the SC Test (62 out of 70) is, we think, significant. Recall at this point the following argument put forth by Chomsky in a number of his writings: When we find a principle of grammar that could hardly be the results of "learning," it is reasonable to assume that it is innate. Now, we have gone down to the (English) grammar of three-year olds. If our results are correct, and the relevant portion of the SC is in the head of three-year olds, there is every reason to believe that it is innate.

As for the relative clause cases, although Table 4-17 turned out to be statistically significant, there was a problem. The problem is that 20 out of 30 subjects who passed both the Syntax and SC Tests received the stories in the S2-order, and therefore the correct target NPs were in the second sentences of the stories. On the other hand, 14 out of 18 who passed the Syntax Test but failed the SC Test received the stories in the S1-order, and therefore the correct target NPs were in the first sentences of the stories. This would suggest that the subjects' performance in the SC Test in this experiment was strongly affected by the order of the sentences within a story. Some performance variable(s)--possibly memory--should be responsible for this result.

It must be pointed out that the performance variable(s) in question comes into play only when the task exceeds the subjects' processing capacity. Note that in the non-relative clause cases 62 subjects passed both the Syntax and SC Tests although half of the subjects were given

the stories in the S1-order.

Experiment 1, which is reported in 4.2, was designed to solve this problem.

4.3.2 Experiment B

This experiment was designed to test children's knowledge of a subpart of the Subjacency Condition (SC) using an experimental task that is different from the one adopted in Experiments 1 and A.

This experiment consists of two parts: (i) Reaction Times (RT) Test, and (ii) Syntax Test. For the latter, we will use the same data we used in Experiment A. The RT Test was intended to test the subjects' knowledge of the SC.

The logic of this experiment is the same as in the other experiments in this study. To repeat briefly, the hypothesis to be tested is:

(H) As soon as the child masters a structure that is relevant to the SC, he honors the SC with respect to that structure.

(H) makes the following prediction about our data:

(P) Those who pass the Syntax Test will also pass the RT Test.

The following must also be true:

(Q) Those who fail the Syntax test will also fail the RT Test.

Subjects

The subjects were 72 children ranging from 3 to 10 years of age. Twenty-four adults were also tested. See 3.2 for details. Each subject was tested individually in a quiet room at his school.

Procedure and Materials

(I) RT Test: At the beginning of the session, the experimenter told the following to the subject:

> Now I'm going to show you some pictures. I'll then ask you a question about each of them. Please answer the questions as quickly as you can, but the answer must be accurate. OK?

The subject was then shown the first picture. Figures 4-21 - 4-24 show the pictures used in this task.

FIGURES 4-21 - 4-24

The experimenter also described each picture. Let us take Figure 4-21 for example.

> (Pointing to the girl) This is Jane. (Pointing to the cat) This is a cat. Jane is looking at the cat, and the cat is looking at Jane. (Pointing to Jane's binoculars) Do you know what they are? Do you know what color they are? (Pointing to the cat's binoculars) What are they? Do you know what color they are? Jane and the cat are both wearing ribbons.

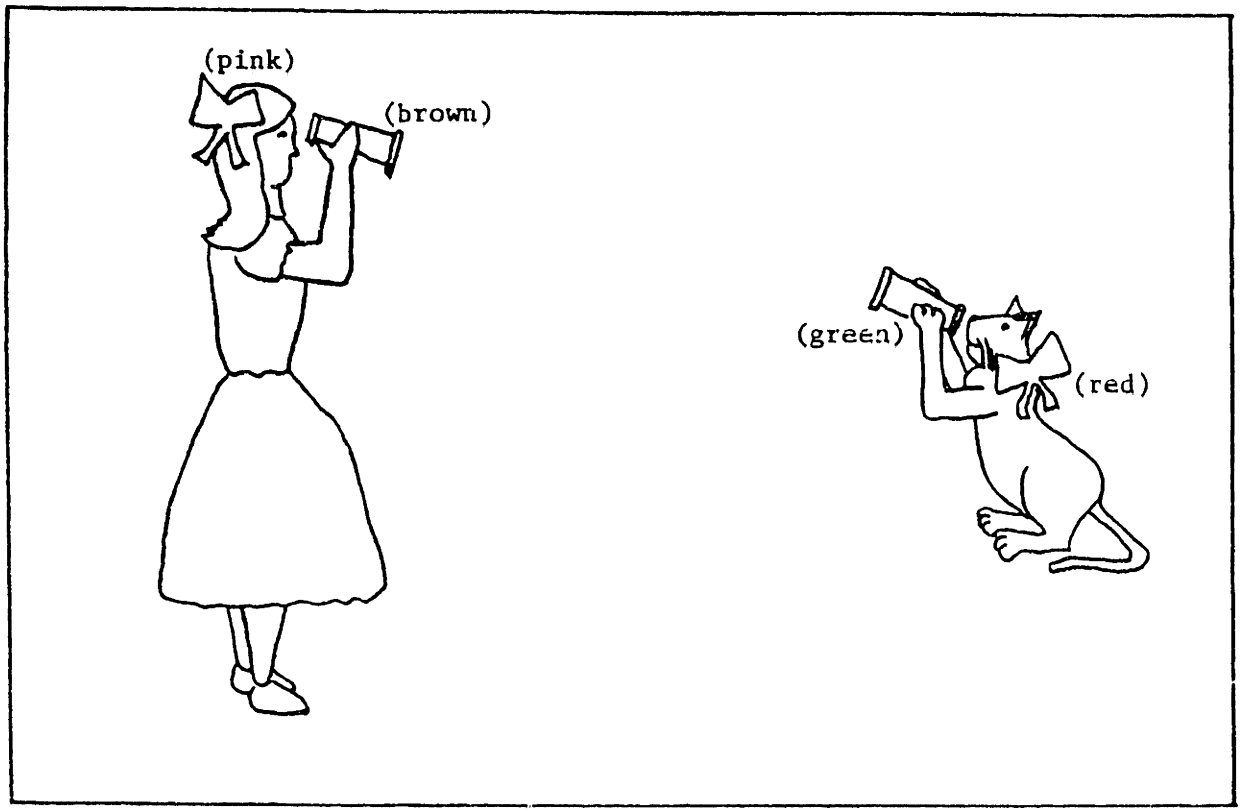


FIGURE 4-21

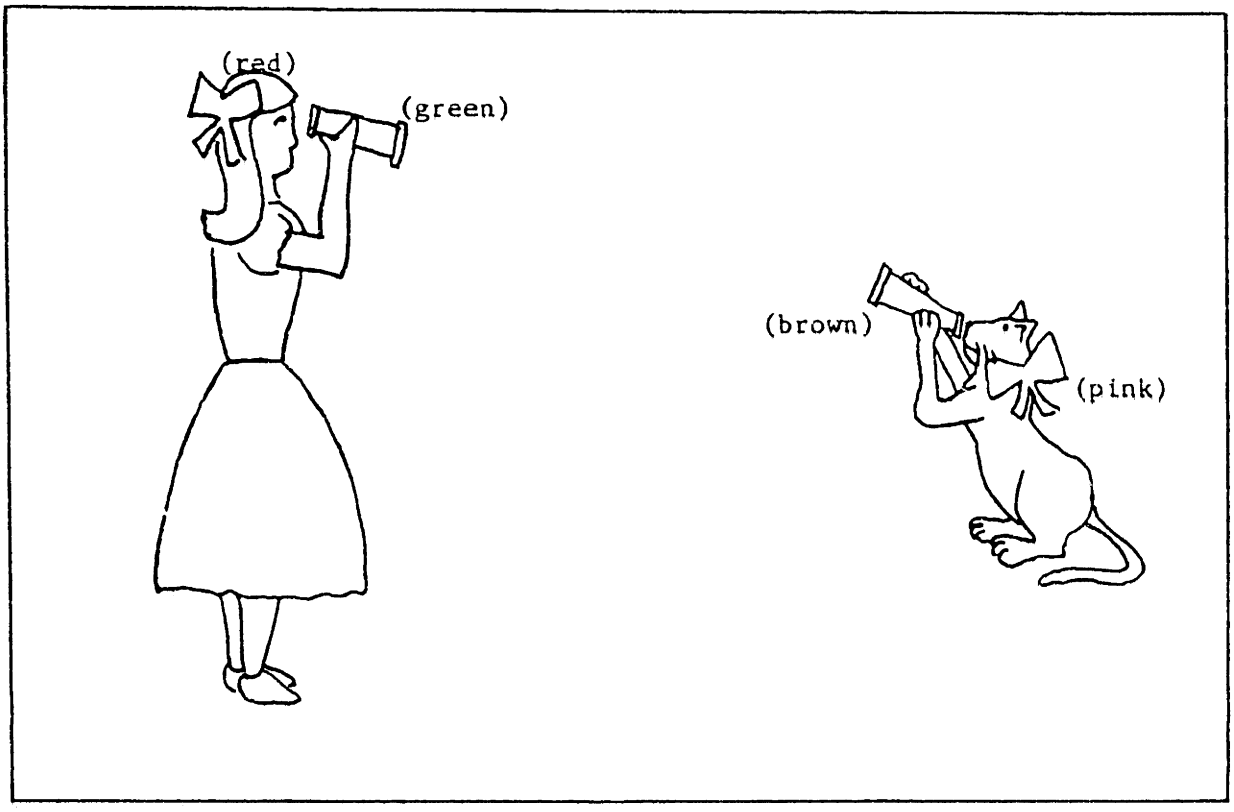


FIGURE 4-22

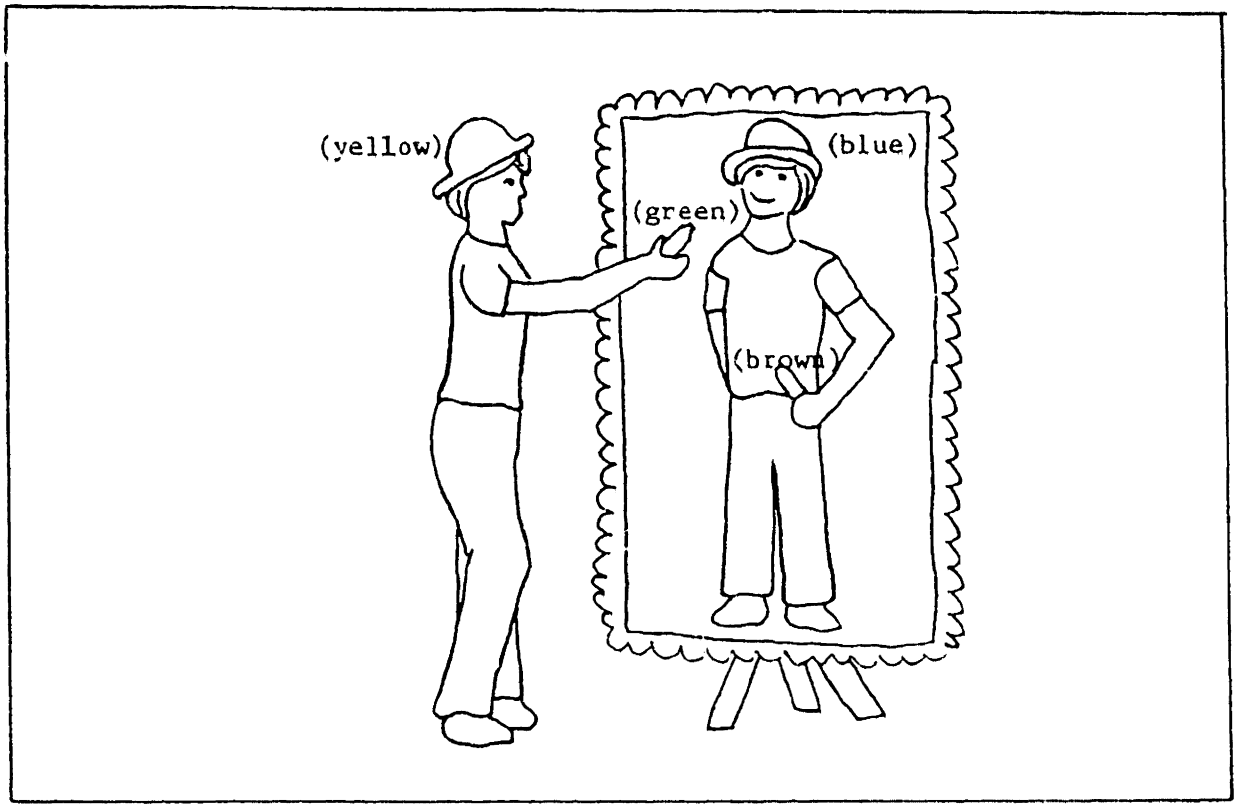


FIGURE 4-23

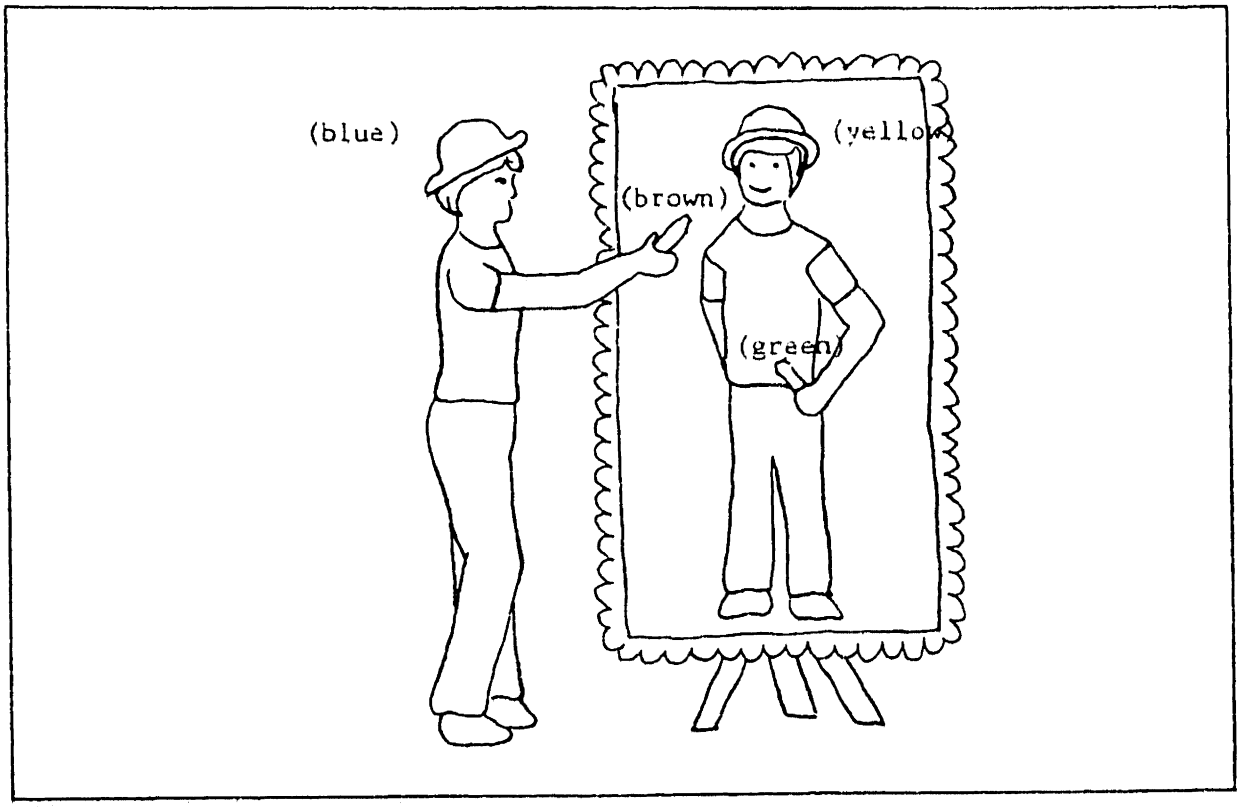


FIGURE 4-24

(Pointing to Jane's ribbon) What color is it? (Pointing to the cat's ribbon) What color is it?

After describing the picture in this way, the experimenter asked a question about the picture. There were four questions corresponding to the four pictures shown in Figures 4-21 - 4-24.[4] The four questions had the following structures.

(4.33) a. *wh $[_S \ldots [_{NP} \ldots t]]$

*What color ribbon is Jane looking at a cat with?

b. wh $[_S \ldots [_{\bar{S}} [_S \ldots [_{NP} \ldots] t]]]$

What color binoculars is Kate looking at a cat with?

(4.34) a. *wh $[_S \ldots [_{NP} \ldots [_{NP} \ldots t]]]$

*What color hat is Bill drawing a picture of an artist with?

b. wh $[_S \ldots [_{\bar{S}} [_S \ldots [_{NP} \ldots [_{NP} \ldots]] t]]]$

What color crayon do you think Jack is drawing a picture of an artist with?

As indicated, there were two pair of questions. Both members of each pair were grammatical apart from the SC. For the grammatical structure in each pair, i.e., (4.33b) and (4.34b), an extra sentence embedding, i.e., do you think, was added in order to make the number of embeddings equal in each pair.

The logic of the RT Test is as follows. In general, there are at least the following three processes involved in answering a question: (I) the process for parsing the question (Parsing Process); (II) the process for searching for the answer (Searching Process); and (III) the process for producing the answer (Production Process). The first two processes,

particularly the first, are crucial here. We assume that (III) is essentially the same in answering either grammatical or ungrammatical questions. When the subject hears a question, the first job is to assign a proper structural description to the input sentence.[5] There will be no problem for parsing a grammatical question unless the question is difficult to parse for extra-grammatical reasons. However, when the question is ungrarmmatical, the following is likely to take place. The parsing mechanisms will tell the subject that they cannot assign a grammatical structure on the input string. If this happens, there are several possibilities to follow. First, the subject might adjust the ungrammatical input to become grammatical by changing part of it, e.g., by deleting. Let us call this Adjustment. After the Adjustment is done, the subject will go through the parsing processes from the beginning. Second, the subject might make a compromise, if he can, i.e., assign an ungrammatical structure to the input, knowing that it is actually ungrammatical, and go on to the searching processes. Let us call this Compromise. Third, the subject might mention that the question is ungrammatical, e.g., "That's weird," "That does not make sense," etc. Notice that this requires meta-linguistic awareness on the part of the subject. Let us call this (meta-linguistic) Comments. Fourth, the subject might have his own way of making the question grammatical, and adopt it. Let us call this Alternative.

When the Comments option takes place, we can straightforwardly conclude that the subject knows the ungrammaticality of the question. When the Alternative happens, we can infer that the subject knows the ungrammaticality of the question from the way he answers. For example, shown Figure 4-21, and given the question What color ribbon is Jane looking

at a cat with?, the subject might attach with to the VP or the top-S (see the Appendix A to this chapter) and pick up the color of the ribbon that Jane is wearing, which did in fact happen. When the other options were selected, we can infer whether the subject knows the ungrammaticality of the question by comparing the reaction times of that question with the reaction times of its grammatical counterpart. The idea is that because of the Adjustment or Compromise process, it takes more time to reply ungrammatical questions than to reply their grammatical counterparts.

On the other hand, if the subject does not know the ungrammatical nature of the question, he will naturally treat it as grammatical, and none of the four extra processes mentioned above will take place.

Recall that an extra sentence embedding was added to the grammatical question in each pair in (4.33) and (4.34). By making the number of embeddings equal, we can eliminate the possibility of attributing the longer reaction times of ungrammatical questions to the extra embedding in them.

The reaction times were measured strictly from the point where the experimenter finished the question to the point where the subject started to answering. The session was audio-recorded, and the reaction times were measured with a stopwatch by two testers. When the relative measurement of the reaction times differed between the two testers, a third tester measured the reaction times, and made the decision.

(II) Syntax Test: We will use the same data we used in Experiment A. The task was as follows. The subject was given the following problem:

(4.35) John saw a dog with a long nose. Tell me what John saw.

If the subject answered a dog with a long nose, we took it as demonstrating knowledge of the structure $[_{NP} \ldots PP]$.

Results

(I) RT Test: The results are given in Table 4-18.

TABLE 4-18

There were five response types. First, it took more time to answer an ungrammatical question than to answer its grammatical counterpart. Second, the subject picked up a "wrong" answer possibly by the Alternative process. For example, given (4.33a), some subjects answered the color of Jane's ribbon. Third, the subject mentioned in some fashion that the question was ungrammatical. The typical ways were by saying "That's wierd," and "That doesn't make sense." When this happened, the experimenter asked the explanation after the entire session. You will find some of their comments in Table 4-19.

TABLE 4-19

These three types are considered to show that the subject knew the ungrammatical nature of one member in (4.33) and (4.34). These are coded in Table 4-18 as 1, 2, and 3, respectively. Fourth, it took more time or as much time to answer grammatical questions than to answer their ungrammatical counterparts. This is taken as showing that the subject did not know the ungrammaticality of one member in (4.33) and (4.34).

Subject No.	Age (Months)	Pair 1	Pair 2
1	36	4	4
2	38	4	4
3	40	2	2
4	44	2	2
5	44	2	0
6	46	2	0
7	46	1	1
8	47	4	1
9	52	2	2
10	55	2	1
11	56	0	0
12	57	2	1
13	57	0	2
14	58	4	2
15	58	4	1
16	59	2	0
17	63	2	2
18	63	2	1
19	65	1	0
20	66	2	2
21	66	2	2
22	68	2	0
23	70	2	0
24	70	1	1
25	75	1	0
26	76	1	1
27	76	2	2
28	76	2	2
29	78	2	2
30	78	2	2
31	78	2	1
32	82	0	2
33	72	4	0
34	74	2	1
35	76	3	0
36	76	2	1
37	77	2	2
38	77	4	1
39	77	2	2
40	79	0	0
41	85	2	0
42	86	1	1
43	87	4	2
44	87	1	0
45	89	2	2
46	90	1	1
47	90	1	0
48	93	3	1
49	96	0	1
50	101	0	0
51	101	2	2
52	101	1	1
53	102	1	2
54	102	3	3
55	105	0	4
56	107	3	3
57	109	1	2
58	110	2	0
59	113	2	0
60	114	3	2
61	117	4	0
62	117	4	1
63	118	2	2
64	119	4	0
65	120	4	0
66	120	0	2
67	122	2	1
68	123	4	4
69	124	2	1
70	127	2	2
71	127	0	1
72	131	2	1

TABLE 4-18: 1. The significance of the numbers herein is explained in 4.3.2.
2. Subjects 1-32 were tested in the greater Boston area, and Subjects 33-72 were tested on Martha's Vineyard.
3. For Pair 1, see (4.33). For Pair 2, see (4.34).

CASE 1: Subject #35: She was shown Figure 4-21, and asked What color ribbon is Jane looking at a cat with? The following are the comments she made.

Experimenter: What color ribbon is Jane looking at a cat with?
Subject: ...
Experimenter: Does that seem like a funny question at all?
Subject: Yeah. Kind of weird.
Experimenter: Why?
Subject: Because it doesn't really make sense to me.

CASE 2: Subject #42: She was shown Figure 4-22, and asked What color ribbon is Jane looking at a cat with?

Experimenter: What color ribbon is Jane looking at a cat with?
Subject: Red. Wait. ... OK, I think it's pink.
Experimenter: Does the question sound weird?
Subject: Yeah, because I think you said that she was looking at the cat's ribbon, and what color was it.
Experimenter: Is it a hard question?
Subject: Yeah. Kind of.

CASE 3: Subject #48: She was shown Figure 4-21, and asked What color ribbon is Jane looking at a cat with?

Experimenter: What color ribbon is Jane looking at a cat with?
Subject: Pink. No, I mean ... Ribbon?
Experimenter: What color ribbon is Jane looking at a cat with?
Subject: Red?
Experimenter: Do you think that's a funny question?
Subject: Yeah. You can't look through a ribbon.

CASE 4: Subject #54: He was shown Figure 4-22, and asked What color ribbon is Jane looking at a cat with?

Experimenter: What color ribbon is Jane looking at a cat with?
Subject: What color RIBBON!!
Experimenter: Does that seem like a strange question?
Subject: Yeah.
Experimenter: Why does it sound strange to say What color ribbon is Jane looking at a cat with?
Subject: Because you can't look at a cat with a ribbon.

TABLE 4-19 (To be continued)

CASE 5: Subject #56: She was shown Figure 4-23, and asked What color hat is Bill drawing a picture of an artist with?

Experimenter: What color hat is Bill drawing a picture of an artist with?
Subject: That's weird. It's like he drawing a picture of an artist with a hat. He's drawing a picture with a hat.

CASE 6: Subject #60: She was shown Figure 4-21, and asked What color ribbon is Jane looking at a cat with?

Experimenter: What color ribbon is Jane looking at a cat with?
Subject: What color RIBBON? ... What color ribbon? ... Oh, red. ... I don't know. ... God. ... Weird.
Experimenter: Does the question sound funny?
Subject: Well, she is not using a ribbon to look at. You said it was binocular. Doesn't make sense.

TABLE 4-19

This is coded as 0 in Table 4-18. Fifth, the subject picked up a wrong answer to a grammatical question. This is coded as 4 in Table 4-18.

Table 4-20 shows the distribution of these response types.

TABLE 4-20

(II) Syntax Test: 70 out of 72 subjects passed the Syntax Test. (The subjects who failed were Subject ##1 and 2.)

(III) Correlation: As pointed out in the previous section, all of our subjects, except two (Subjects ##1 and 2), knew the structure $[_{NP}$ ... PP]. Therefore, it is not possible to test whether our hypothesis (H) has been borne out by making a 2x2 contingency table as we did for Experiment 1.

However, the results from this experiment suggests that even 3-year-olds have an awareness of the ungrammatical nature of the questions such as what color ribbon is Jane looking at a cat with?. Again we can use the following argument of Chomsky's: When we find a principle imposed on (adult) grammar that could hardly be the results of "learning," it is reasonable to assume that it is innate. Now we have gone down to the (English) grammar of 3-year-olds. If our results are correct, and the relevant portion of the SC is in the head of 3-year-olds, there is every reason to believe that it is innate.

Age	Type	0	1	2	3	4	Total
3		2	3	6	0	5	16
4		4	3	7	0	2	16
5		3	4	9	0	0	16
6	(Boston)	2	4	10	0	0	16
6'	(MV)	4	3	6	1	2	16
7		3	7	4	1	1	16
8		4	4	3	4	1	16
9		4	2	6	1	3	16
10		3	4	6	0	3	16
Total		29	34	57	7	17	144

TABLE 4-20

Appendix A Development of Complex Structures in Children: A Survey of Recent Research and Our Theory

In this Appendix A, we summarize important recent research on the development of complex structures in children with special emphasis on those that are relevant to the discussion in the text of this chapter. See also Bowerman (1979) for a compact review. In the end of this Appendix, we summarize the major findings of these studies, and present a theory that explains them.

4.A.1 Menyuk (1969) and Limber (1973)

Menyuk (1969) and Limber (1973, are among the few who recognized the importance of studying the development of complex structures in children in the early years of developmental psycholinguistics.

Menyuk (1969), on the basis of her analysis of sentences produced by children from ages 2 to 7 years, remarks as follows:

> The 87 per cent of children using the Relative Clause construction are using the type I construction [i.e., relative clauses attached to the matrix object--YO]. Few of the children in the nursery school population are using the type II construction [i.e., relative clauses attached to the matrix subject--YO] (six children), significantly more in the kindergarten group are using this type (eighteen children), and all of the children using Relative Clause construction in first grade are using both types (forty-six children). Only 46 per cent of the children in the total population are using the second type of construction and 66 per cent of these are in the first grade. (Menyuk 1969:95)

Limber (1973) has made the following remarks, based on his data that came from children between the ages of 1;6 and 3;0 who participated in a longitudinal study:

> The general trend in the development of the clear relatives seems to be as follows: first on the abstract adverbial nouns, place and way (but not time); next on various empty noun heads, e.g., thing, one, kind; and finally on common nouns like ball or cheese. These latter forms in fact are quite rare up to 3. Compared with complement constructions, use of relative clauses is very infrequent. Furthermore there is a curious gap in the relative clause distribution: There are no subject relatives or any relative clauses attached to subject NPs. ... One more thing deserves mention. Although I have referred to relative clauses as wh-constructions, in fact no wh-morphemes were observed up to 3. The order of embedding morpheme is Ø, then that. (Limber 1973:181)

As for the "curious gap" he has mentioned in the above quotation, Limber says as follows:

> These observations [(i) that the vast majority of the subject NPs in simplex sentences that the children produced are personal pronouns or names, and (ii) object NPs, in contrast, play the entire range of the child's vocabulary and simple syntactic combinations--YO], taken together with the assumption that complex sentences will be formed from the child's repertoire of simple sentences, clearly suggest that pragmatic factors alone may suffice to explain the lack of relatives involving subject NPs. There is simply no opportunity for a relative clause in environments where the NP is typically a name or pronoun--hence no relatives on subject NPs. Similarly one does not expect to see many subject relatives on object NPs when relative clause formation requires that the matrix and constituent NP be coreferential but not a name or pronoun. (Limber 1973:184)

4.A.2 Sheldon (1972, 1974)

Sheldon is one of the first who recognized the importance of controlling both the grammatical function of the head noun of a relative clause in the matrix clause and that of the relative pronoun in the relative clause.[6] Thus, the following four types of relative clauses will be considered:

(A.1) SS: The boy who kissed the girl met the man.

(A.2) SO: The boy who the girl kissed met the man.

(A.3) OS: The man met the boy who kissed the girl.

(A.4) OO: The man met the boy who the girl kissed.

"SS," for example, indicates that the grammatical function of the head noun of the relative clause in the matrix clause, i.e., the boy in (A.1), is the Subject, and that the grammatical function of the relative pronoun in the relative clause is also the Subject. Other three types should be understood in a similar fashion. Sheldon has used the toy-moving task for children between 3;8 and 5;5. As a result, the order of difficulty turned out to be SS, OO, OS, and SO, in the order of increasing difficulty. Based on this result, Sheldon has proposed a Parallel Function Hypothesis, which stipulates that the relative clause types in which the grammatical functions of the head noun in the matrix clause and of the relative pronoun in the relative clause match, i.e., SS and OO, are easier than other types in which those two grammatical functions do not match, i.e., OS and SO. See also Ferreiro et al. (1976) for related data and discussion.

4.A.3 Tavakolian (1977, 1981)

Tavakolian (1977, 1981) has tested 24 children between 3 and 5 years of age. The task was toy-moving. She has obtained the essentially the same pattern of relative easiness among the four types of relative clauses as Sheldon. However, based on the detailed analysis of children's mistakes, Tavakolian has provided an account in terms of the Conjoined-Clause Analysis. She says:

> Consider a schematized string such as
> (1) NP ... V ... NP ... V ... NP
> where the ellipses indicate that material such as a relative pronoun or a conjunction (but not a noun phrase or a verb) may intervene between the noun phrase and the verb. I propose that a child's first hypothesis about the structure

> of such a string is that it consists of two conjoined simplex sentences. The structure shown in (2) will be assigned to string (1).
> (2) $[_S[_S NP - V - NP]\ [_S \Delta - V - NP]]$
> ... I propose that the child postulates this phonologically null form [missing subject indicated by Δ , in the second clause of (2)--YO] as the subject of the second clause and interprets it as being coreferential with the subject of the first clause, as shown by the arrow. (Tavakolian 1981:168)

See also Menyuk (1968:96) for a similar claim.

The Conjoined-Clause Analysis would give the following structure (A.6) to the string (A.5) that actually contains an SS relative clause, and therefore provides the correct information concerning the grammatical relations in (A.5):

(A.5) The sheep that jumps over the rabbit stands on the lion.

(A.6) $[_S[_S$the sheep that jumps over the rabbit$][_S \Delta$ stands on the lion]]

Tavakolian has noted that when the Conjoined-Clause Analysis is applied to the string that contains an OS relative clause, such as (A.7), it would give structure (A.8) to it.

(A.7) The sheep jumps over the rabbit that stands on the lion.

(A.8) $[_S[_S$the sheep jumps over the rabbit] that $[_S \Delta$ stands on the lion]]

If this happens, the child will end up with an incorrect reading for (A.7). Namely, he will take the sheep as the subject of stands on the lion, and that is exactly what many of her subjects did.

As compared with SS and OO, children's interpretation of SO and OO

does not have more or less general error patterns. Tavakolian argues that this is because the Conjoined-Clause Analysis cannot be applied in a straightforward way to the strings that contain these types of relative clauses.

4.A.4 Roeper and Tavakolian (1977), Roeper (1978b), and Solan and Roeper (1978)

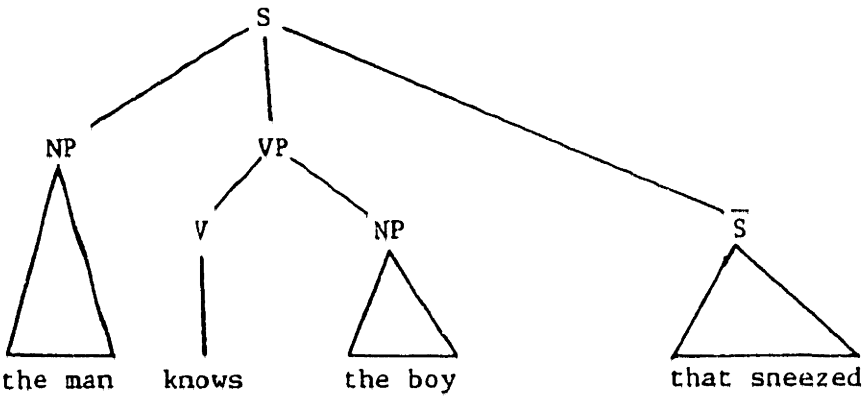
Roeper and Tavakolian (1977), Roeper (1978b), and Solan and Roeper (1978) argue that the Conjoined-Clause Analysis is, at least for the OS relative clauses, a subcase of a more general S-node Principle. The principle says:

(A.9) New clauses are attached to the topmost S.

Thus, given (A.10), the principle would assign the structure (A.11).

(A.10) The man knows the boy that sneezed.

(A.11)



Assuming also the universality of the following C-command Condition, which is very roughly formulated as follows:

(A.12) a. The antecedent of a relative clause must c-command the relative clause.

b. A controller must c-command the missing subject position.

one must interpret the antecedent of the relative clause in (A.11) as being the subject of the matrix clause, i.e., the man, rather than the matrix object, i.e., the boy. This interpretation correctly matches the one that young children would give to the OS relative clauses.

Roeper and his colleagues have devised an ingenious experiment, using sentences with put as the matrix verb, in order to demonstrate that "children interpret multiclausal sentences solely on the basis of the syntactic structure they assign" rather than "on the basis of functional relations in the sentence and other general parsing strategies" (Solan and Roeper 1978:112). The task used was toy-moving. The following two sentence types are crucial:

(A.13) The boy pushed the dog that kicked the horse.

(A.14) The boy put the dog that kicked the horse in the barn.

Given (A.13), young children would give the reading in which the matrix subject, i.e., the boy, is the antecedent of the relative clause. Let us call this reading the subject reading. The "structural" S-node Principle, along with (A.12), predicts this result by attaching the relative clause to the topmost S. Let us now consider (A.14). If the child gives the subject reading to (A.13) through non-structural analysis, such as the

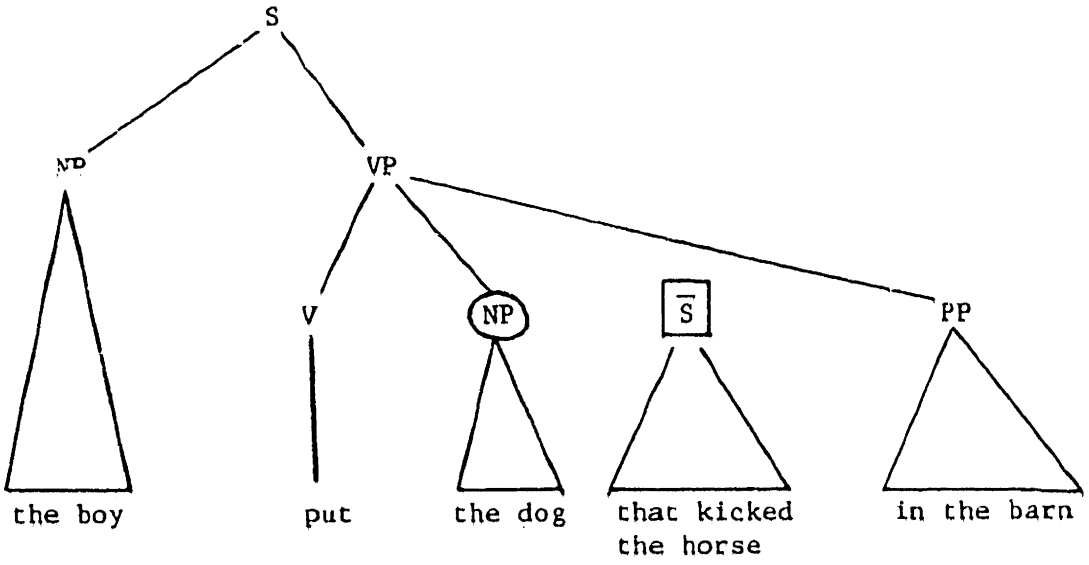
Parallel Function Hypothesis, he should be able to do the same for (A.14), thereby getting the reading in which the matrix subject the boy is the antecedent of the relative clause. However, if the child gets the subject reading by the S-node Principle, we predict a different result. Notice that the matrix verb put in (A.14) requires a locative in its subcategorization frame. Thus, (A.15) is ungrammatical, while (A.16) is grammatical.

(A.15)*The disc jockey put the disc.

(A.16) The disc jockey put the disc on the turntable.

Assuming that the child knows this, he would assign the following partial structure to (A.14):

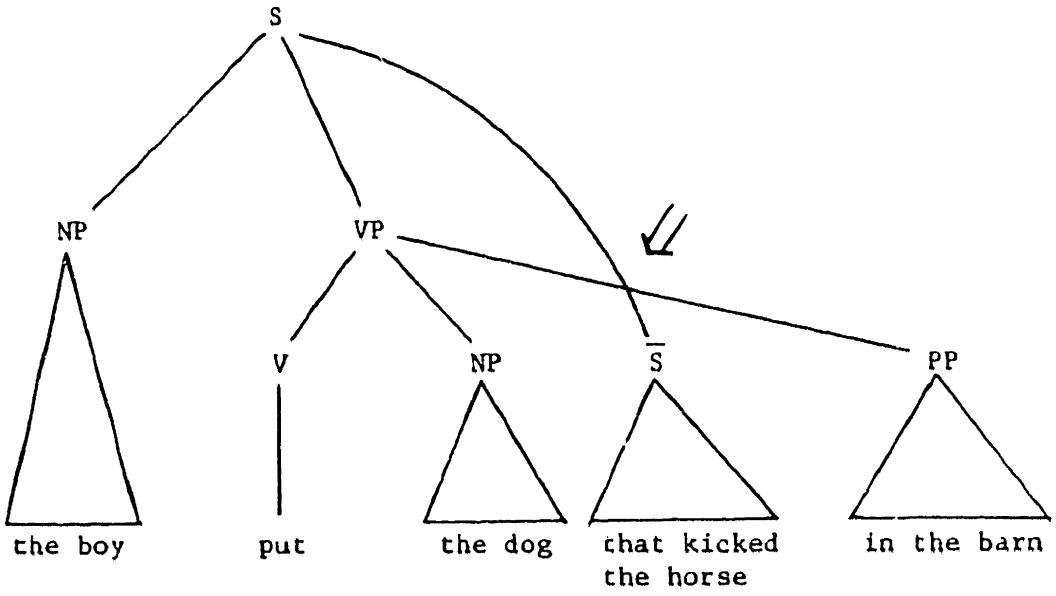
(A.17)



Now, let us consider where the child would attach the squared $\bar{S}$ in (A.17), i.e., the relative clause. In accordance with the S-node Principle, he

would try attaching this $\bar{S}$ to the topmost S. However, unlike the case of (A.13), he could not do this, because in order to do so he has to create a syntactic structure that is not allowed by a universal principle. Informally, the principle prohibits the crossing lines in a syntactic tree. See (A.18).

(A.18)



Therefore, in this case the child is forced to attach the relative clause to other node. Since the circled NP in (A.17) is the only possible candidate, it is reasonable to expect that he would attach the relative clause to it in this case. Otherwise, he might omit the relative clause altogether in the toy-moving task. This prediction was borne out nicely. The table on the next page shows this.

	Subject Interpretation	Failure to Interpret the Relative Clause
Sentences with *put*	0	42
Sentences with *push*	40	6

TABLE A-1 Number of each type of structural errors out of 600 responses (300 for the *put* sentences; 300 for the *push* sentences)

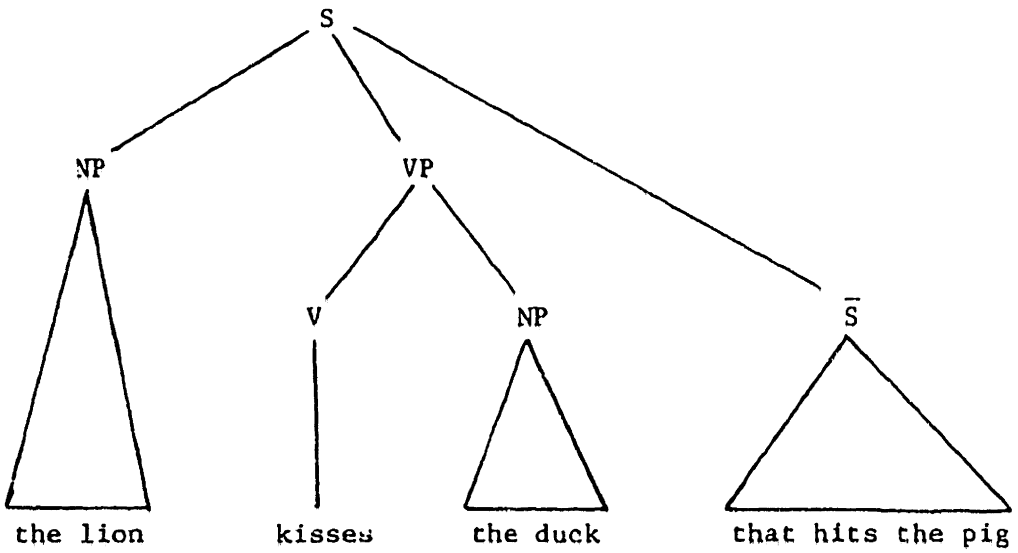
See Roeper (1980) for a slightly different interpretation of the same results.

4.A.5 Goodluck and Tavakolian (1979)

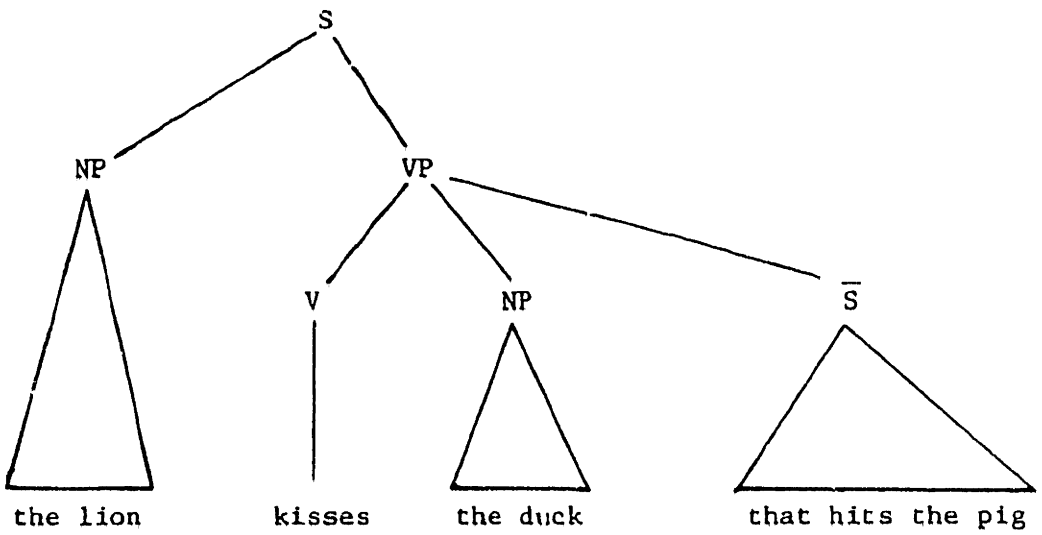
Goodluck and Tavakolian (1979) have observed that, assuming the availability of the C-command Condition (A.12) to the young child, (A.22) as well as (A.21) would give the correct object relative reading to (A.19).

(A.19) The lion kissed the duck that hits the pig.

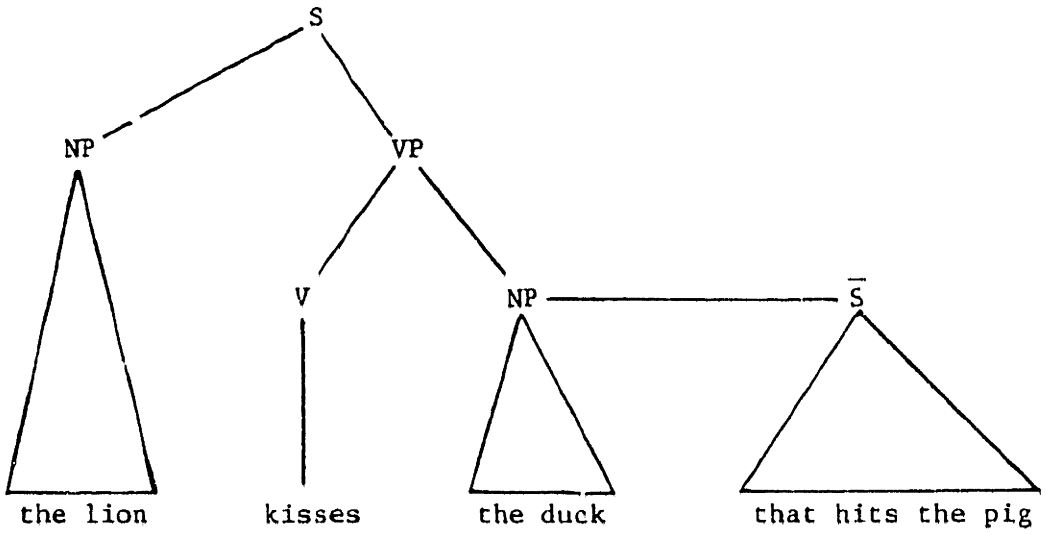
(A.20)



(A.21)



(A.22)



If the young child gets the subject reading by assigning (A.20) to (A.19), it does not seem too unreasonable to assume that the child at the next

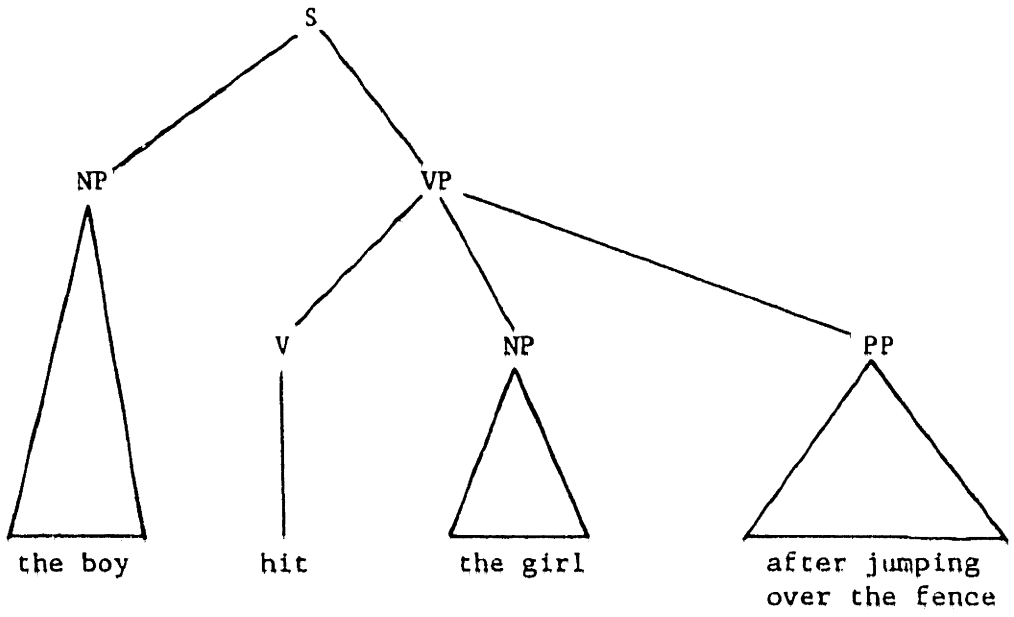
stage assigns (A.21) to (A.19).

In order to test which of (A.21) and (A.22) the young child would give to (A.19) to get the object relative reading, Goodluck and Tavakolian have devised an experiment that we will describe below. Before discussing this experiment, however, we have to review Goodluck's (1978, 1981) study. Goodluck reports that children aged 4 to 5 years interpret the girl as the subject of jump over in about 50% of their responses to sentences such as (A.23).

(A.23) The boy hits the girl after jumping over the fence.

Goodluck accounts for this result by assuming that the child misanalyzed the complement clause as a constituent of the matrix VP node. The resulting structure looks like the following:

(A.24)



Because of the C-command Condition (A.12), the girl can be the subject of

jump over in (A.24).

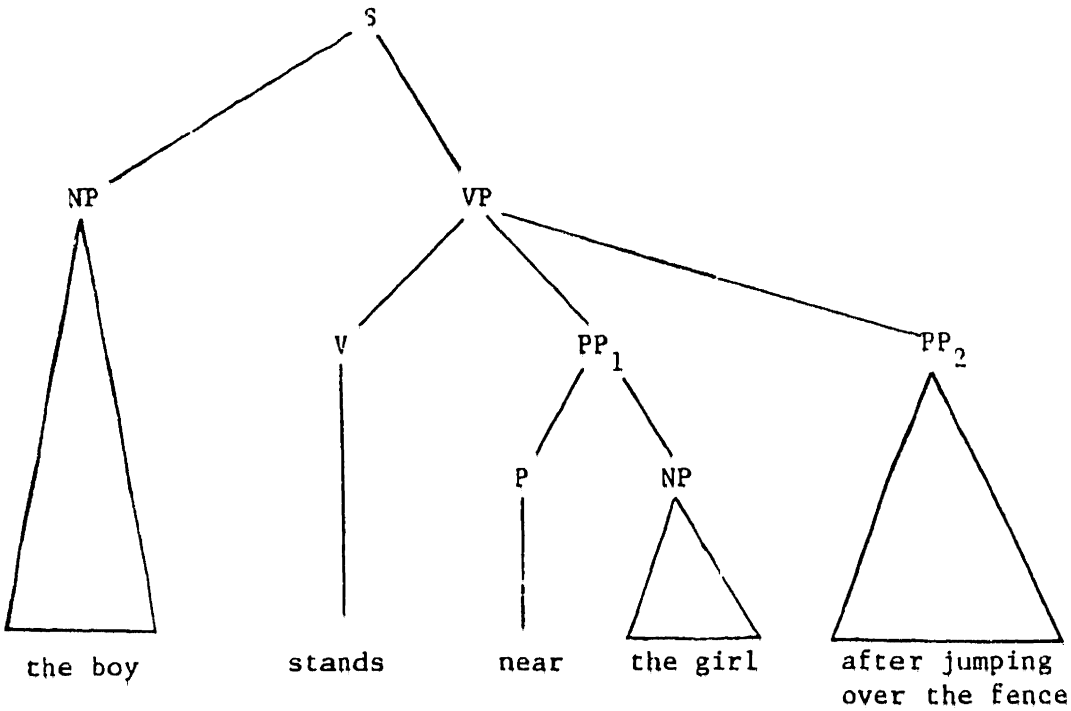
Goodluck has ingeniously shown that this is what has actually happened by adding the following two sentences:

(A.25) The boy stands near the girl after jumping over the fence.

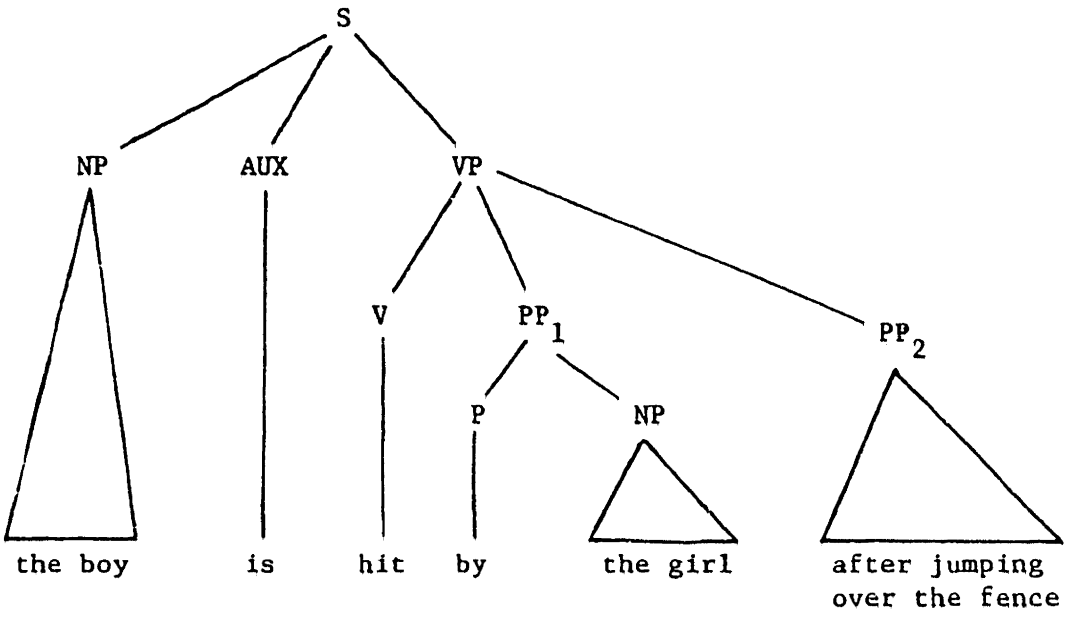
(A.26) The boy is hit by the girl after jumping over the fence.

The result was that only 25% or less of the total responses was the one that takes the girl as the subject of jump over, making a sharp constrast with the result about (A.24). Goodluck explains this difference in the following way. The child who attached the complement in (A.23) to VP, thus giving (A.24) to (A.23), would reasonably attach the complement in (A.25) and (A.26) to VP, thus getting (A.27) and (A.28), respectively.

(A.27)



(A.28)



Notice that, in (A.27) and (A.28), the first branching node that dominates the girl is PP_1, which does not dominate PP_2, in which the subject of jump over is missing. Thus, assuming the C-command Condition (A.12), the girl cannot be the subject of jump over in these cases.

Using the same logic, Goodluck and Tavakolian (1979) have conducted an experiment with the following four types of sentences:

(A.29) a. The boy hits the girl after jumping over the fence. (=A.23)

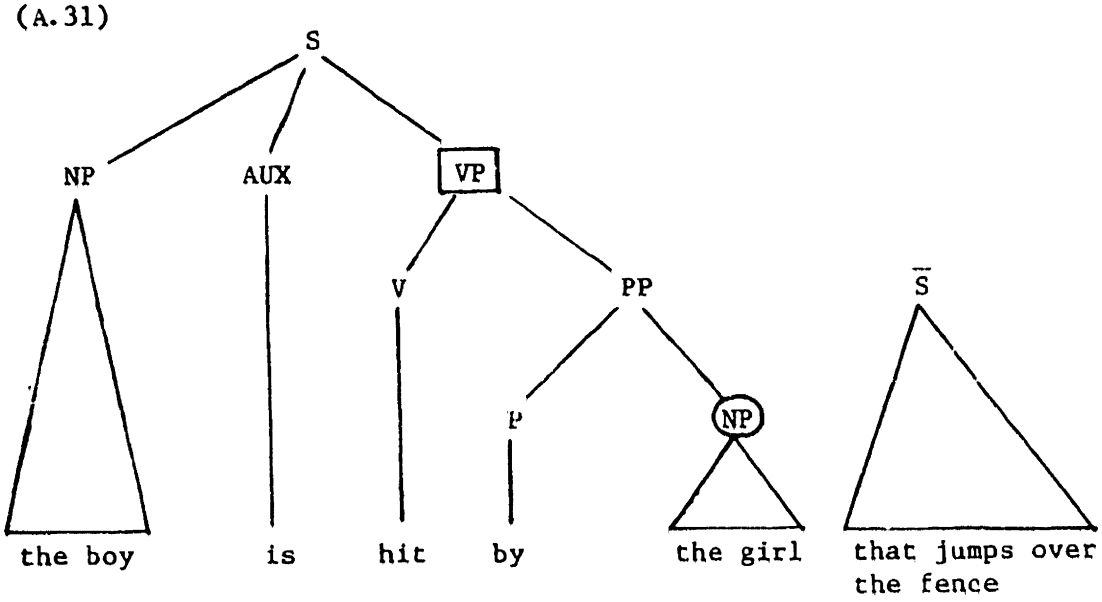
b. The boy is hit by the girl after jumping over the fence. (=A.26)

(A.30) a. The boy hits the girl that jumps over the fence.

b. The boy is hit by the girl that jumps over the fence.

The partial structure of (A.30b) is as follows:

(A.31)



The question is whether those who get the correct object relative reading for (A.30a) get it by attaching the relative clause to the object NP, like adults do, or to VP. See (A.21) and (A.22). If the child attaches the relative clause to NP, then it is reasonable to expect him to do the same for (A.31), thus attaching the relative clause to the circled NP in (A.31). If this happens, then the girl can be the antecedent of the relative clause by the C-command Condition. However, if he attaches the relative clause to VP for (A.30a), and does the same for (A.31), i.e., attaching $\bar{S}$ to the squared VP, then because of the C-command Condition, the girl cannot be the antecedent of the relative clause, since the first branching node that dominates the girl in (A.31) is PP, which does not dominate the relative clause if it is attached to VP. Therefore, the following prediction was made:

> [I]f the child has recursion in the NP, the presence of a PP node in the matrix VP should not significantly lower the proportion of correct responses the child gives for OS relatives. If the child's grammar does not allow recursion in the NP, we would expect fewer correct responses and a

> pattern of matrix subject responses similar to that observed for participial complements such as [A.25] and [A.26]. (Goodluck and Tavakolian 1979:10)

The task used was toy-moving. The subjects were 12 four and 12 five-year olds. For sentences such as (A.29a), about 50% of the children's responses took the matrix object as the subject of jump over. For sentences such as (A.30a), about 60% took the matrix object as the subject of jump over. The crucial finding was that "[i]n the passive conditions [such as (A.29b) and (A.30b)--YO] [Goodluck and Tavakolian] find a trend towards coreference between the matrix and subordinate subjects only for sentences with temporal complement [such as (A.29b)--YO]" (Goodluck and Tavakolian 1979:14). Thus, they obtained results showing that their subjects already had recursion in the NP.

In the other experiment reported in the same paper, Goodluck and Tavakolian have conducted a toy-moving task with 10 four and 10 five-year olds, using, among others, sentences which have an inanimate object in the relative clause, such as (A.32), and an intransitive verb in the relative clause, such as (A.33).

(A.32) The dog kicks the horse that knocks over the table.

(A.33) The dog kicks the horse that hops up and down.

They have obtained results showing a strong facilitating effect of an inanimate object and an intransitive verb in the relative clause. They argue, based on the results with which we are not concerned here, that these results can be best accounted for in terms of processing load involved.

4.A.6 Hsu, Cairns, and Fiengo (1980)

Hsu et al. (1980) have observed that Goodluck's VP attachment theory (see (A.24)) conflicts with Tavakolian's Conjoined-Clause Analysis (see 4.A.3). They have hypothesized that this apparent conflict is due to their selection of narrow age ranges, and anticipated that "selection of a wider range would reveal a progression in the development of grammar types" (p.3). They have tested 64 children ranging from 3 to 8 years of age. The task was toy-moving. In the test materials, they have included, among others, sentence types such as the following:

(A.34) The lion tells the bear to climb up the ladder.
(Tell + infinitival complement)

(A.35) The lion pushes the bear that is climbing up the ladder.
(OS relative clause)

(A.36) The lion pushes the bear after climbing up the ladder.
(direct object + adverbial participial)

Hsu et al. have found that there are five grammar types, including adults', that appear in the course of language development concerning the interpretation of missing complement subject and antecedent of relative clauses. The first three types are of greater importance for us, and therefore deserve careful consideration.

The first type is termed the "subject oriented" type. The child with this type of grammar takes the matrix subject as the controller of missing complement subject and the antecedent of relative clauses. Hsu et al. argue that this is due to the Conjoined-Clause Analysis in the sense of Tavakolian (1977, 1981).

The next grammar type is called the "object oriented." The child

with this type of grammar consistently designates the matrix object as the controller of missing complement subject and the antecedent of relative clauses. Hsu et al. argue that this is due to the VP attachment in the sense of Goodluck (1978, 1981). However, contrary to Goodluck, they claim that the C-command Condition may not operate from the beginning, and at the early stages "an additional rule similar to Chomsky's [Carol Chomsky (1969)--YO] minimal distance principle was predicted to operate" (p.5).

The third type is call "mixed subject-object." Hsu et al. argue that "[m]ixed subject-object grammars are characterized by variable attachment of individual complements to either the S or the VP" (p.5). They further argue that "the c-command constraint may become operational during this stage or it may be fully established" (p.5).

The following is their partial results adopted from their Table 1 (p.7).[7]

Grammar Type	Mean Age	N
Subject Oriented	4.06	2
Object Oriented	5.21	28
Mixed Subject-Oriented	5.70	10

TABLE A-2

4.A.7 Smith (1974a, b) and de Villiers, Flusberg, Hakuta, and Cohen (1979)

Smith (1974a, b) and de Villiers et al. (1979) argue for the children's use of heuristic strategies to account for the acquisition of relative clauses. De Villiers et al., for example, have tested 114 children between 3 and 7 years of age. The task was toy-moving. They claim that

a strategy that parses an N-V-N string to agent-action-object plays an important role. See Bever's (1970:298) Strategy D. According to their results, the subjects did better for the OS relative clauses than many other studies. They account for this result in terms of the above strategy. Thus, given a string (A.37), the strategy would give, they claim, the interpretation given in (A.38).

(A.37) the kangaroo kissed the camel that shoved the elephant

(A.38) the kangaroo kissed the camel that shoved the elephant

N V N

agent action object

N V N

agent action object

It would be worth noting that although the subject reading was not so popular among their subjects as among Tavakolian's, it constituted 36% of the responses. As for why they got different results, we simply do not have a good answer.

4.A.8 Legum (unpublished)

Legum (unpublished) has used three different tasks in order to assess young children's interpretation of relative clauses in which first and second grade children participated. The tasks were toy-moving, picture-choice, and sentence-questions. The first one is a familiar toy-moving task, about which we need no explanation. The second one is a task in which four pictures are shown to the subject with a test sentence, one of which depicts the correct interpretation of the sentence. The subject is asked to pick up the picture which he thinks is the right one. The last

task was the one in which the subject is given a sentence and then asked questions about the grammatical relations in the sentence. The following table shows the results:

Task	N	SS	SO	OS	OO
Toy Movement	38	4.11	1.74	2.45	3.39
Picture Choice	49	3.65	2.31	2.57	2.43
Sentence-Question	48	1.31	1.96	2.38	1.88

TABLE A-3 Mean Responses to the Three Tasks. The maximum possible score in each cell is 5.

As is clear from the table, "the sentence type that is the easiest on one task may well be the hardest on another task" (Legum, unpublished:18).

Based on these data, he concludes as follows:

> The vast difference in response pattern across the three relative clause tasks should make us realize that all experimental data needs to be treated cautiously and needs to be crossvalidated by data from multiple sources gathered by varying techniques. (Legum, unpublished:19)

Legum himself attempts to account for the child's better performance on SS over the ohter types of relative clauses in the toy-moving task by the following "bird-in-the-hand strategy."

> During toy movement tasks there is a tendency to keep the first toy picked up (usually the first noun mentioned in the sentence) in hand after using it to complete the first action (almost always the first verb mentioned) and to use it as the agent of the second action. (Legum, unpublished:1)

4.A.9 Hamburger and Crain (forthcoming) and Crain (1980)

Hamburger and Crain (forthcoming) and Crain (1980) raise several important questions about the previous research on the acquisition of relative clauses. Some important points are the following:

(I) There has been little attention in the previous research to the distinction between restrictive and non-restrictive relative clauses. Thus, given sentence (A.39), there will be a lion, a tiger, and an elephant present in front of the subject if the task is toy-moving.

(A.39) The lion kissed the tiger that jumped over the elephant.

If there is only one tiger in front of the subject, he might well take the relative clause in (A.39) as a non-restrictive relative clause. This has been pointed out independently by Katsuki (1980) and Kurihata (1979).

(II) Previous research has paid no attention to the order of performing the two actions, i.e., the matrix action and the embedded action. Pointing out that a relative clause conveys presupposition rather than assertion, Hamburger and Crain claim that when the child discovers these distinctions he might perform the relative clause action first, or he might even omit the relative clause action since it is presupposed and thus should already have taken place. See also Ferreiro et al. (1976:246).

(III) The present tense with nonprogressive aspect as in the sentence the lion jumps over the tiger that kisses the elephant , which is used by Sheldon (1974) and Tavakolian (1977), "is normally used for definitions and recurrent events, but is unnatural, hence somewhat obscure, in the situation of the experiment" (Hamburger and Crain, forthcoming:20)

In their experiment, which has involved eighteen subjects aged 3, 4, and 5 years, Hamburger and Crain have tested the subjects' interpretation of the OS relative clauses using toy-moving. Corresponding to the three points they made above, the following three innovations were introduced:

(I') There are more than one object of the type referred to by the head of the relative clause. For example, three tigers in addition to one lion and one elephant are present for (A.39).

(II') The order of the subjects' performing actions was recorded as well as their contents.

(III') The past tense was used.

Their results were as follows:

	Response Type (All Correct)			
Age	Matrix-Relative	Relative-Matrix	Matrix Only	Total
3 years	42%	27%	0%	69%
4 years	18	43	13	74
5 years	5	35	55	95

TABLE A-4

Thus, the results show that 95% of the five-year olds can comprehend OS relative clauses, and it "strongly suggests that the previous failures in this age group were an experimental artifact" (Hamburger and Crain, forthcoming:41). It is also interesting to note that there is a shift of the predominant response type across ages. Hamburger and Crain claim that this is due to the child's recognition of the nature of assertion and

presupposition in the course of development.

4.A.10 Summary and Our Theory

In this section, we summarize what we have seen in the above survey of the recent literature. We will add to it some recent findings in theoretical linguistics and psycholinguistics. At the end, we will present our theory. For the ease of exposition, we first list the sentence types that will be discussed below.

(1) Sentences with post VP adverbial participles:

The boy kissed the girl after jumping over the fence.

(2) Sentences with tell as the matrix verb and infinitival complement:

The boy told the girl to jump over the fence.

(3) Sentences with OS relative clauses with a transitive verb (with an animate object noun in the relative clauses):

The boy kissed the girl who bumped into the woman.

(4) Sentences with OO relative clauses with a transitive verb in them:

The boy kissed the girl who the woman bumped into.

(5) Sentences with OS relative clauses with an intransitive verb in them:

The boy kissed the girl who was sleeping.

(6) Sentences with OS relative clauses with an inanimate noun as the object of the relative clause:

The boy kissed the girl who jumped over the bench.

Now, our summary:

O(bservation) 1: The child initially takes the matrix subject as the controller of the missing complement subject of post VP adverbial participials in (1), and as the antecedent of OS relative clauses in (3).[8] [Hsu et al. (1980); Tavakolian (1977, 1981)]

02: For OS relative clauses, the child in the second stage shows mixed responses, i.e., he sometimes takes the matrix subject and sometimes the matrix object as the antecedent of OS and OO relative clauses in (3) and (4). [Hsu et al. (1980); Tavakolian (1977, 1981); Goodluck and Tavakolian (1979); etc.]

03: For OS relative clauses, the child eventually arrives at the adult stage where he consistently takes the matrix object as the antecedent of the relative clause.

04: The child in the second stage with respect to the kind of OS relative clauses as exemplified in (3) can get the correct object relative readings for the kind of OS relative clauses as exemplified in (5) and (6). [Goodluck and Tavakolian (1979); Hamburger and Crain (forthcoming)]

05: A precursor of relative clauses has been observed at around 24-28 months. Furthermore, when appropriate experimental settings are given, 3-year olds show their knowledge of OS relative clauses. [Limber (1973); Hamburger (1980); Hamburger and Crain (forthcoming)]

06: For post VP adverbial participials in (1), the child, after the stage described in (01), shows mixed responses, i.e., he sometimes takes the matrix subject and sometimes the matrix object as the controller of the

missing complement subject. [Goodluck (1978, 1981); Hsu et al. (1980); etc.]

07: For post VP adverbial participials in (1), the child eventually arrives at the adult stage where he consistently takes the matrix subject as the controller of the missing complement. (However, some adult speakers permit the matrix object to be the controller. See Elliot et al.(1969).)

08: For sentences with tell and its infinitival complement in (2), the child almost always takes the matrix object as the controller of the missing complement subject. [C. Chomsky (1969); Maratsos (1974); Goodluck (1978, 1981); etc.]

The following is a list of assumptions concerning child grammars we will make in constructing our theory:

A(ssumption) 1: From a very early stage, the child does structural analysis in order to obtain information relevant to the "semantics" of sentences. [Solan and Roeper (1978); and lots others] The evidence for this assumption is overwhelming over non-structural positions represented, for example, by Sheldon (1972, 1974) and de Villiers et al. (1979), although it does not preclude the possibility that these "strategies" play some role when the child comprehends sentences containing relative clauses.

A2: The child has the notion "c-command" from a very early stage. [Solan (1978, 1981); Goodluck (1978, 1981); etc.]

A3: The child tends to flatten the structure, possibly for ease of processing.

[Matthei (1979); Cooper and Paccia-Cooper (1980: 231-35); etc.]
This structure flattening tendency has also been suggested for adults. See for example Chomsky and Halle (1968: 371-72).

A4: The child has the VP node in his grammar as a daughter of S from a very early stage. [Solan and Roeper (1978)][9,10]

We will also make the following assumptions for adult grammar:

A5: The controller must c-command the missing complement subject.[11] [Rosenbaum (1967); Goodluck (1978, 1981); Chomsky (1980a), etc.]

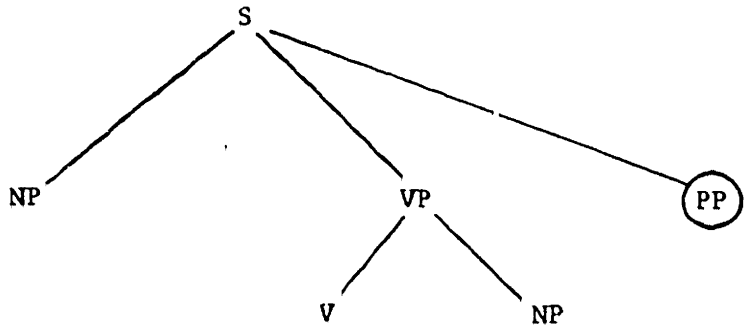
A6: Terazu (1979), after examining previous literature on the derived structure of extraposition (Williams (1974, 1975) and Reinhart (1976) in particular), has shown that none of these proposals as they stand are correct. She argues that "the derived structure of sentences with extraposed clauses is determined not merely by the types of Extraposition, but by the position of the extraposed clause before the application of the rule" (Terazu 1979:89). Her observation is that if the extraposed clause originates in the subject position, it is attached to S, whereas if it originates in the object position, it is attached to VP. She formulates the principle in the following way:

> (*) An extraposed clause in the derived structure must c-command and be c-commanded by the major category which immediately dominates its head. (Terazu 1979:98)

Asakawa (1979) independently arrived at a similar conclusion. See also Guéron (1980). In the following, we assume that (*) is correct,

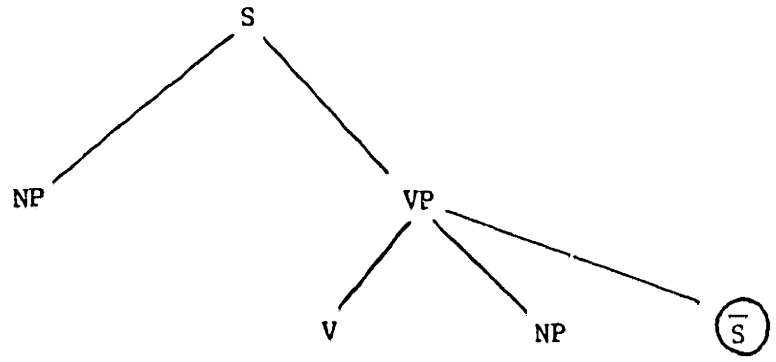
A7: The adult structure for sentences with post VP adverbial participials like (1) is essentially as follows:

(A.40)



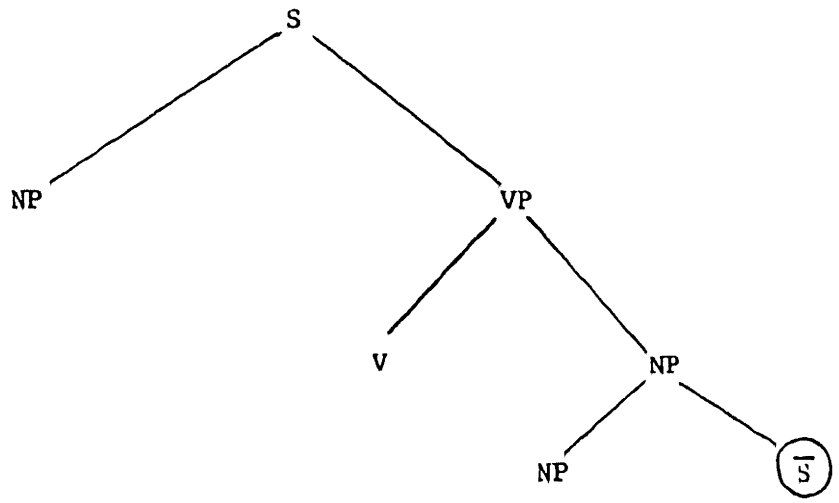
A8: The adult structure for sentences with tell as the matrix verb and its infinitival complement like (2) is essentially as follows:

(A.41)



A9: The adult structure fo sentences with OS and OO relative clauses like (3) and (4) is essentially as follows:

(A.42)



Now, presentation of our theory is in order. We are fully aware of the fact that the observation we listed above is made based on experiments using different groups of subjects. However, it seems clear that there is a developmental pattern concerning the acquisition of the structures discussed here, which our theory attempts to explain.

I. For relative clauses, the child can locate a relative clause within NP from a very early stage (Goodluck and Tavakolian 1979). However, because of his processing capacity limitation, he might attach the relative clause that comes after the direct object to the topmost S, thereby flattening the structure for the ease of processing (A3). When the relative clause is attached in this way, the C-command Condition (A6) chooses the matrix subject as the antecedent of the relative clause (O1). The mixed responses (O2) are result of attaching the relative clause

variably to either topmost S or NP.

II. For post VP adverbial participials, the child initially attaches them to the topmost S in order to get a flatter structure for the ease of processing (A3). When this is done, the C-command Condition (A5) chooses the matrix subject as the controller of the missing complement subject (01). However, when the child started attaching a relative clause to the object NP, which is lower than the topmost S, he would temporarily attach the adverbial participial to VP, which is also lower than the topmost S, as result of overgeneralization. When this happens, the C-command Condition (A5) chooses the matrix object as the controller. As a result of this variable attachment of adverbial participials to either topmost S or VP, the child variably chooses the matrix subject or object as the controller (07).

III. For the controller of the infinitival complement of tell, the child would never make mistakes once he learns subcategorization frame for tell because the position of the infinitival complement is determined in the subcategorization frame (08).

Finally, let us consider significance of the above theory, if correct.

A. The child a priori has knowledge about linguistic structure, including the notion "c-command," and makes use of it in analyzing sentences from a very early stage.

B. Children's mistakes concerning a controller of a missing complement subject or an antecedent of a relative clause are explained in terms of the child's misanalysis of the structure (possibly due to

processing loads or overgeneralization).[12]

C. Although we still do not have a "theory of overgeneralization," it is interesting if overgeneralization also takes place at a very abstract level as our theory claims. See also C. Chomsky (1969).

There still remain problems. For example, Legum's (unpublished) demonstration must be considered carefully. However, the amount of evidence we have and, more importantly, the explanatory force of the kind of theory we described above make our theory look very promising.

Appendix B A Related Experiment in Progress

This is an interim report of an experimental study that Maya Amy Honda and the present author are conducting based on an idea developed by the latter. I acknowledge here Honda's permission for reporting the results of the pilot work in this dissertation.

The topic of this experiment is when and how the child gets to know the Subjacency Condition with respect to (PP-)Extraposition. The logic of the experiment is the same as other experiments reported in this dissertation. The hypothesis to be tested is the following:

(H) As soon as the child masters $[_{NP}...[_{NP}...PP]]$, he honors the SC with respect to PP-Extraposition from this structure, i.e., he knows that Extraposition of the PP to the outside of the larger NP is not allowed.

There are two parts of this experiment: (i) the Syntax Test for testing whether young children know the structure $[_{NP}...[_{NP}...PP]]$; and (ii) the SC Test for testing whether they know the SC with respect to Extraposition of the PP from that structure. Hypothesis (H) makes the following prediction about our data:

(P) Those who pass the Syntax Test will also pass the SC Test.

The following should also be true:

(Q) Those who fail the Syntax Test will also fail the SC Test.

Method

Subject

60 subjects between three and seven years of age were tested: twelve subjects from each age group. The children's ages ranged from 3;0 to 7;10 years.

Procedure and Materials

Tasks

(I) Pre-Test: Before proceeding with the SC and Syntax Tests (described below), each subject was required to succeed at two pre-test tasks.

(i) In the SC and Syntax Tests, pictures of animals (i.e., elephant, turtle, bird, and cat) were used. To ensure the subject was familiar with these animals, the experimenter asked him to identify pictures of them in a picturebook.

(ii) Crucial to our test of the SC is an understanding of the relationship referred to by the preposition on. The pre-test for the on-relation involved manipulating plastic blocks. The experimenter placed three colored blocks (red, blue, and yellow) in front of the child. The subject was first asked to identify the colors. Then, he was asked to place one of the blocks on another. For example:

(B.1) Put the red block on the blue block.

This procedure was repeated twice with different color combinations.

(II) Subjacency Condition (SC) Test: The subject was told a "short story" consisting of one sentence. Then, he was shown a picture which "popped up" from a "special box" of pictures. The subject was asked to determine whether the particular picture matched the story he had just heard.

The task had four simple, warm-up items. These items were considered simple in that the target PP was adjacent to the target NP within a conjoined subject. For example:

(B.2) A cat with a ribbon on its neck and a turtle popped up.

The picture shows a cat sitting on a turtle with a ribbon on the cat's neck. Of the four warm-up items, a cat wears the ribbon in two of the stories and a turtle does in the other two; half of the pictures match the story told and half do not. The order of presentation of the items was varied for each subject.

Next, there were three test items of the following structure:

(B.3) NP PP VP PP PP

For example:

(B.4) A cat on a turtle popped up with a ribbon on it neck.

In the first of the three test items the subject was told this "story" and then shown a picture in which the ribbon is worn by the turtle (Figure B.1). This item required the subject to reject the picture: it does not match the story. In the last two test items, the subject was asked to listen to a "story" and make a picture for the "pop-up game" by placing a

sticker (of either a ribbon or a star) on the appropriate animal (Figure B-2). For example, given:

(B.5) A cat on a turtle came up with a star on its neck,

the child who understands the SC would be expected to place the star-sticker on the cat, i.e., the matrix subject.

(III) Syntax Test: The subject was instructed that he would hear a "short story" and that he should repeat or "tell the story back" to the experimenter. The subject was also told he could hear the story again if he wished.

There were three test items which directly map the structure of the test items in the SC Test, such as (B.6):

(B.6) John drew a cat on an elephant with a ball on its neck.

Order of presentation was varied for each subject. No pictures were used in this task.

Procedure

The experiment was conducted at the day-care centers and schools the children attended. Subjects were tested individually. The experiment took approximately five to ten minutes. The order of task presentation was counterbalanced: half of the subjects received the SC Test first, the other half were given the Syntax Test first.

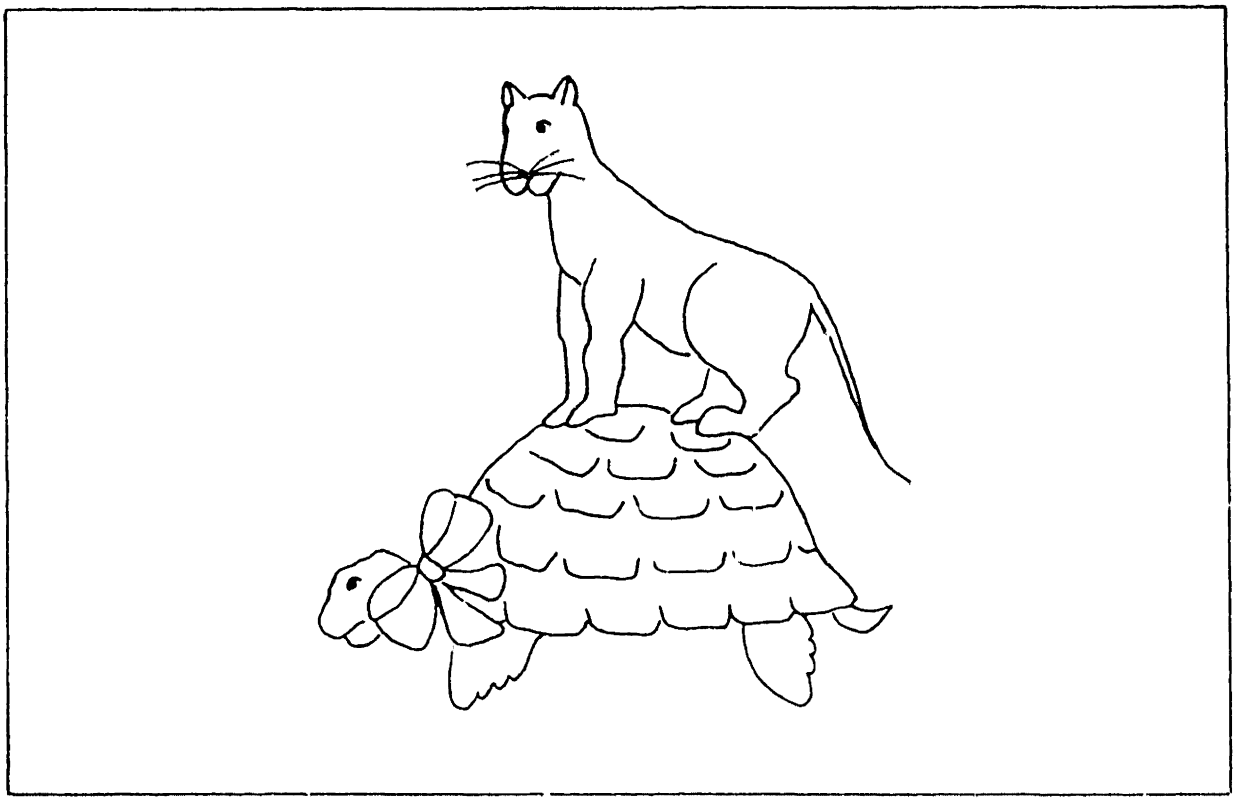


FIGURE B-1

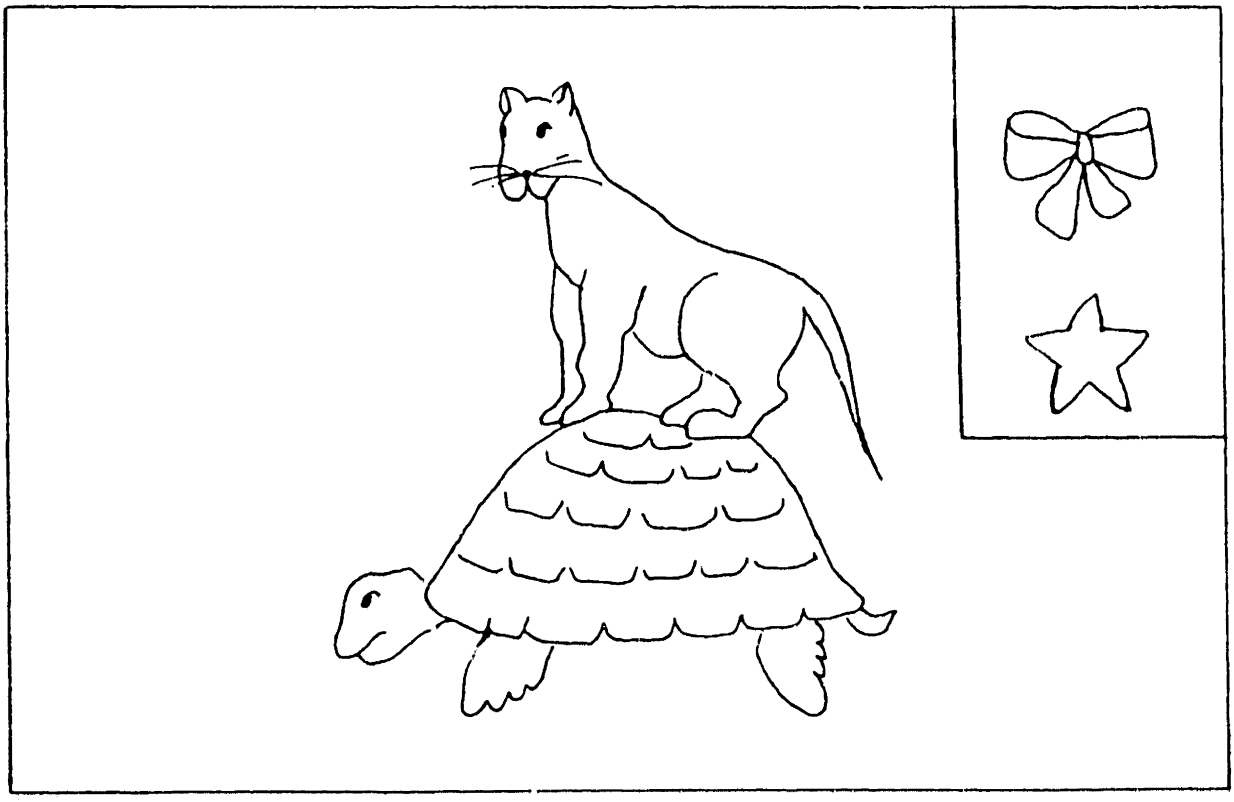


FIGURE B-2

Results and Discussion

Results

To test the hypothesis (H), we tabulated a 2x2 contingency table, as in Table B-1.

Syntax Test / SC Test	P	F	
P	27	8	35
F	10	15	25
	37	23	60

TABLE B-1

The criterion for passing either Test is getting more than two items (out of three) correct.

The association between success in the Syntax Test and success in the SC Test, shown in Table 4.B-1 above, is statistically significant at the .05 level (χ^2=7.09,1df) with Yates' correction for continuity. Thus, the obtained results support the hypothesis (H).

Honda and the present author are now in the process of refining the Syntax Test so that we can obtain a better picture of young children's knowledge of the structure $[_{NP}\ldots[_{NP}\ldots PP]]$.

Notes to Chapter 4

[1]There is a similar observation about the appearance of determiner in children's speech. For example, Menyuk (1969:34) observes that in an early stage only the object NP, not the subject NP, takes determiners. Kajita (1977:46) suggests the possibility that "the two rule-schema (i.e., NP -> N/ __ V and NP -> (Det) N/ V __, or alternatively, NP_1 -> N and NP_2 -> (Det) N) are replaced by a single rule-schema (i.e., NP -> (Det) N)." However, it is also possible to assume that the child acquires a single rule-schema NP -> (Det) N at a certain point without its precursors of the kind Kajita suggests, but the application of the expanded version of the schema, i.e., NP -> Det N, is delayed by performance reasons. One conceptual problem in Kajita's suggestion is that we have to assume a developmental period at which the child's phrase structure grammar needs context-sensitive rules. Even if we assume the two rules NP_1 -> N and NP_2 -> Det N, they are notational variants of the context-sensitive rules we just discussed. The choice is still open, however.

[2]The rule NP -> NP $\bar{S}$ is used here and elsewhere in this dissertation only for expository purposes. We are not concerned with the correct relative clause structure here. The crucial part for the SC is NP -> ...$\bar{S}$, i.e., $\bar{S}$ within NP.

[3]It might be necessary to refer to Ferreiro et al. (1976). Based on their results from the toy-moving task, they say:

> No child of 4 is capable of giving correct solutions to all four sentences [SS, SO, OS, and OO--YO], whereas by the age of 9 or 10 most children are in fact capable of doing so. A gradual change has taken place, which can only be attributed to a growing syntactic competence. Both the patterns of errors and those of successes suggest the existence of a 'primitive' role-conserving strategy [similar to Sheldon's (1972, 1974) Parallel Function Hypothesis--YO] which can be considered as non-syntactic, in the sense that it is not based on an adult-type syntactic analysis. ... It could therefore be supposed that until the age of 6 or 7 the children are not capable of dealing with relative clauses in an adequate syntactic way, and that between the ages 6 and 9 different syntactic approaches come to replace the earlier strategies. (pp. 240-41)

The description is so vague (particularly about the interaction between "syntactic competence" and "non-syntactic strategies" in children who are not yet capable of "dealing with relative clauses in an adequate syntactic way") that it evades serious discussion. If their claim is that children below 6 have not acquired NP -> NP $\bar{S}$, it is unconvincing since there is evidence that young children handle relative clauses on the basis of their syntactic analysis. See for example Goodluck and Tavakolian (1979), and Solan and Roeper (1978). See also the Appendix A to this chapter.

[4]In order to avoid an effect on the reaction times by the choice of the colors and the persons' names, half of the subjects were asked (4.33a) with the accompanying picture Figure 4-21, and (4.33b) with Figure 4-22. The rest of the subjects were asked (4.33a) with the accompanying picture Figure 4-22, and (4.33b) with Figure 4-21.

[5]We leave open the problem of the exact nature of the output representation.

[6]The reason why we wrote "Sheldon is one of the first ..." rather than "Sheldon is the first ..." is that there is Rowe (1967), which has remained unpublished, in which the author included, among others, the four types of relative clauses to be discussed below. His findings are generally compatible with Sheldon's.

[7]There is a dissertation coming out by Hsu. The data and discussion that are more detailed than Hsu et al. (1980) will be included there.

[8]We do not have sufficient data to examine whether the same applies to OO relative clauses. Our theory that will be described shortly predicts that it does. (OO relative clauses are not included in Hsu et al. (1980).)

[9]Notice that if the child does not have the VP node the difference between the push-sentences and the put-sentences in Solan and Roeper (1978) cannot be explained.

[10]See Bowerman (1973:178-83) for a relevant discussion.

[11]Notice that this is only a necessary condition, and not a sufficient one.

[12]This point is one of the major claims of a series of research done by Roeper, Tavakolian, Goodluck, Solan, and others.

Chapter 5 Binding Theory and Syntactic Development in Children

5.1 Binding Theory

Chomsky (1973) proposed a set of conditions on transformations, two of which are: the Tensed S Condition (later called the Propositional Island Condition) and the Specified Subject Condition. In the course of the subsequent revision of the theory, these conditions have undergone much revision. One important stopover from the 1973 framework to the most recent one is the so-called "On-Binding" framework (Chomsky 1980, originally written in 1978). In the most recent framework, the facts that have been captured by the conditions mentioned above are now explained in terms of Binding Theory (BT) (Chomsky 1981).

Before explaining what BT is, it seems necessary to point out that the remarks in the preceding paragraph might be misleading for those who are not familiar with the recent development of generative grammar. Namely, the changes that have been made concerning the grammatical constraints in question must be understood in the whole perspective of the theory. These changes have been made to solve conceptual as well as empirical problems of the preceding framework. In particular, they have aimed at eliminating redundancies in theory, and at enhancing the explanatory power of the theory. This point will be left unclear in the following exposition of BT, because we will sketch only part of the theory. We will come back to this point shortly.

Binding Theory (Chomsky 1981) is partially given as follows:

Binding Theory (BT):

(A) An anaphor is bound in its governing category.

(B) A pronominal is free in its governing category.

Reflexives and reciprocals are considered to be anaphors, and pronouns to be pronominals here.

The definition of the governing category is given as follows:

> Governing Category: α is the governing category for β if and only if α is the minimal category containing β and a governer of β, where α =NP or S.

As for the notion government, we will adopt the definition given in the original Pisa lectures by Chomsky (Chomsky 1979b) rather than the one given in Chomsky (1981) solely for expository reasons.

> Government: α governs β if and only if α minimally c-commands β.

The notion minimal c-command is in turn defined as follows:

> Minimal c-command: α minimally c-commands β if and only if α c-commands β and there is no γ such that α c-commands γ and γ c-commands β and not γ c-commands α.

We will now show how BT explains the following facts:

(5.1) a. Mary knew that the children loved each other.

b. Mary knew that [$_S$the children loved each other]

(5.2) a.*The parents knew that Mary loved each other.

b.*the parents knew that [$_S$Mary loved each other]

(5.3) a. Mary knew that Tom shaved himself.

b. Mary knew that [$_S$Tom shaved himself]

(5.4) a. *Tom knew that Mary shaved himself.

b. *Tom knew that [$_S$Mary shaved himself]

(5.5) a. Tom knew that Mary liked him.

b. Tom$_i$ knew that [$_S$Mary liked him$_i$]

(5.6) a. *Mary knew that Tom liked him.

b. *Mary knew that [$_S$Tom$_i$ liked him$_i$]

(5.7) a. Mary saw Tom's picture of himself.

b. Mary saw [$_{NP}$Tom's picture of himself]

(5.8) a. *Tom saw Mary's picture of himself.

b. *Tom saw [$_{NP}$Mary's picture of himself]

(5.9) a. Tom saw the boys' pictures of each other.

b. Tom saw [$_{NP}$the boys' pictures of each other]

(5.10) a. *The boys saw Tom's pictures of each other.

b. *the boys saw [$_{NP}$Tom's pictures of each other]

(5.11) a. Tom saw the boys' picture of him.

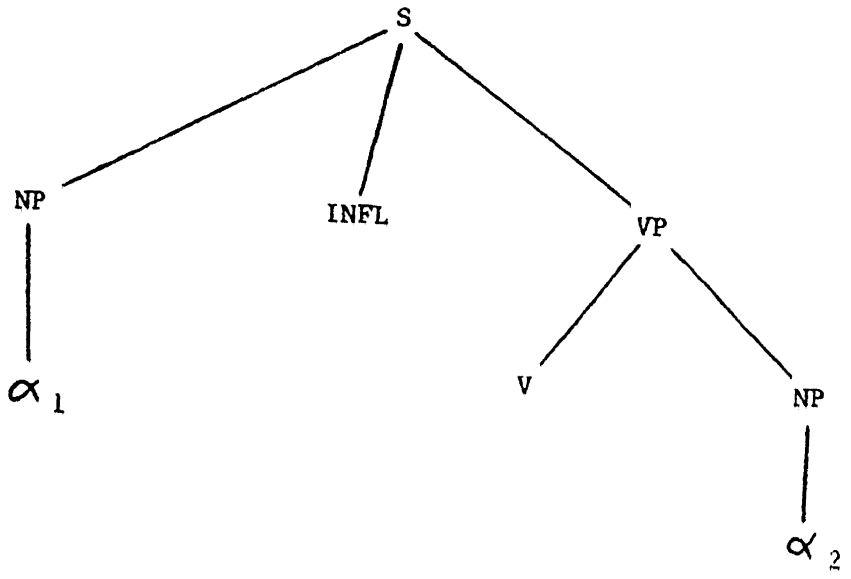
b. Tom$_i$ saw [$_{NP}$the boys' picture of him$_i$]

(5.12) a. *The boys saw Tom's picture of him.

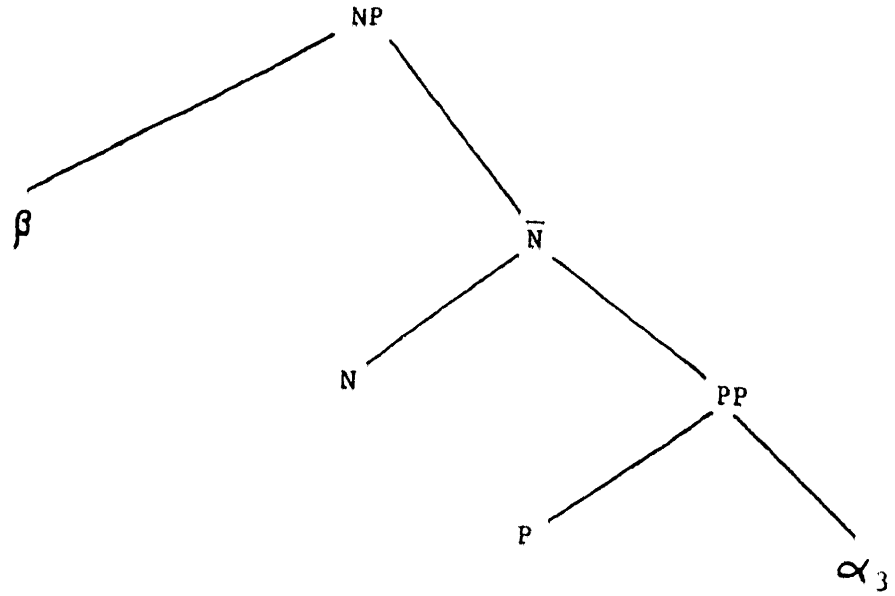
b. *the boys saw [$_{NP}$Tom's$_i$ picture of him$_i$]

The two structures that are relevant are the following:

(5.13)



(5.14)



In (5.13), INFL is the inflectional system that contains [+tense] and AGR(eement), the latter of which contains the features person, number, gender, and Case.

Let us take (5.13) first. Assume that reciprocal each other or reflexive himself occupies the α_2 position. Then, V governs this element, and, therefore, S is the governing category for α_2. Thus, due to BT(A), each other and himself must be bound in this S. Assume, instead, that pronoun him is in the α_2 position. Then, according to BT(B), him must be free in this S.

Notice that (5.1)-(5.6) contain a tensed embedded clause whose internal structure is the same as (5.13). Furthermore, each other, himself, and him occupy the embedded object position, i.e., the α_2 position in (5.13). The explanation for the facts is straightforward. As we have seen just now, each other and himself must be bound in the embedded S according to BT(A). In (5.1) and (5.3), that is possible, because there is a potential antecedent within the embedded clause in each case. However, in (5.2) and (5.4), there is no such element, and hence the sentences are ruled out as ungrammatical. On the other hand, him in the embedded object position must be free in the embedded S. Thus, (5.5) with the intended reference indicated by indecies is grammatical, while (5.6) is not.

Let us now take (5.14). Assume that reciprocal each other or reflexive himself is in the α_3 position. Then, P governs this element, and NP is the governing category for α_3. BT(A) stipulates that each other or himself must be bound in this NP. If instead pronoun him is in the α_3 position, then due to BT(B), him must be free in NP.

Note that (5.7)-(5.12) contain the NP whose internal structure is the same as (5.14), and that each other, himself, and him occupy the α_3 position.

The explanation is exactly analogous to the one we gave concerning (5.1)-(5.6). BT thus correctly explains all the data in (5.1)-(5.12).

We have pointed out that our brief exposition of BT might be misleading in that the explanatory power of the theory will not be adequately demonstrated, since we are, in this dissertation, only interested in part of BT. To remedy this situation a little, we will give one more example that is explained naturally by BT. Assume that <u>each other</u> is in the α_1 position of (5.13) with INFL=[[+tense], AGR]. Then it is governed by INFL, and its governing category is S. BT(A) then requires <u>each other</u> be bound in S, but this is impossible. Hence, such a sentence becomes ungrammatical. See the following sentence:

(5.15)*They expected that each other would win.

More interesting cases are those sentences that contain elements that are without phonetic content, i.e., PRO and trace, but to discuss such cases requires the linguistic setting that is beyond the bounds of this dissertation. See Chomsky (1981).

5.2 Some Previous Studies

5.2.1 Matthei's (1981) Experiment[1]

Matthei (1981) has taken up BT[2], and conducted an experiment in order to test children's interpretation of complex sentences containing each other. His major concern is whether there is any developmental stage where the child does not honor BT. Although his paper is a pioneering study about the relationship between universal conditions imposed on grammar and syntactic development in children, there are some problems with it. We will summarize Matthei's study and point out its problems.

5.2.1.1 Brief Description of Matthei's (1981) Experiment

Subjects The subjects were 17 children ranging from 4;2 to 6;6 years of age.

Methods and Materials A row of toy animals and people was set up between the child and the experimenter. There were two of each animal. The child was asked to show the xperimenter "what happened" by taking the animal mentioned in the sentence and "making them do it." After a practice session using simple, declarative sentences and one-clause sentences containing reciprocals, the test sentences were given to the subject. As test sentences, four types of matrix verbs, each of which takes a different kind of complement, were used. The following is a list of the four types with examples.

(5.16) a. Verbs that take that complement:

The horses said that the cows jumped over each other.

b. Verbs that take "deleted" that complement:

The horses said the cows jumped over each other.

c. Verbs that take infinitival complement:

The horses wanted the cows to jump over each other.

d. Verbs that take gerundive complement:

The horses noticed the cows jumping over each other.

The inclusion of these various types of matrix verbs was to test whether or not the choice of the matrix verb makes any difference about the interpretation of the test sentences, and, in particular, whether or not the presence of a complement marker, that and to, for example, would help children to apply BT correctly since such markers would signal the beginning of the embedded clause.

Matthei found in his pilot experiment that the children appeared to find it easier to understand reciprocals when the antecedent is a coordinate NP, the cow and the chicken, for example, than when the antecedent is a simple, namely, non-coordinate, plural NP, the pigs, for example. Based on this observation, Matthei varied the subject NPs in both the matrix clause and the embedded clause so that some were simple plural NPs while others were coordinate NPs.

In order to avoid the "language-as-fixed-effect fallacy" in the sense of Clark (1973), verbs in both the matrix and the complement were inserted randomly into sentence frames so that each child received a different set of sentences.

Results 64.4% of the total number of responses were the ones in which the children would interpret a sentence like (5.17) as meaning that the pigs tickled the chickens and vice versa (p.197).

(5.17) The chickens said that the pigs tickled each other.

There was no significant effect of complement types on the children's responses.

Conclusion Matthei interprets the children's mistakes mentioned above as showing that they chose the matrix subject as the antecedent of each other, violating BT.

5.2.1.2 Problems of Matthei's (1981) Experiment

There are several problems in Matthei's study. In the following, we will claim (i) that his results do not support his conclusion, and (ii) that there are various problems in his experiment.

Matthei's conclusion, which we mentioned above, is factually false. If the child had wrongly taken the matrix subject, the chickens in (5.17) as the antecedent of each other, then the resulting interpretation of (5.17) would be analogous to that of (5.18).[3]

(5.18) Each of the chickens said that the pigs tickled the other chicken.

Thus, if there are two chickens, call them C_1 and C_2, then C_1 said that the pigs tickled C_2, and C_2 said that the pigs tickled C_1. This is not what Matthei's subjects did.

There are other problems. First, a glance at the list of matrix verbs used in the experimental materials reveals that many of them are not factive verbs, for example, say, think, expect, ask, imagine, suggest, and so on. Thus, (5.19) is a perfectly legitimate sentence.

(5.19) The chickens said that the pigs tickled each other, but { it was not true / that did not happen }.

Compare (5.19) with the following in which a factive verb remember is used as the matrix verb.

(5.20)*The chickens remembered that the pigs ticked each other,

but { it was not true / it did not happen }.

Yet, the instruction given to the subject was to show the experimenter what happened by making the animals do it. Therefore, if the subject knows the factive-nonfactive distinction and is loyal to it, it is conceivable that he would be confused with the instruction.[4]

Second, Macthei used coordinate NPs in some of the test sentences--the reason for which we mentioned before--such as the following:

(5.21) The chickens remembered that the pig and the lamb tickled each other.

However, there are two of each animal in front of the subject, and there is no information given to him as to decide which is, for instance, the pig. Maratsos (1976) shows that even the youngest of his subjects, 32 months old, has some knowledge of the difference between definite and indefinite reference. Thus, it is conceivable that the child who knows the definite property of the would have been confused by the instruction.

Third, we have learned from our pilot experiments that some, if not most, children attempt to act out the matrix portion as well as the embedded portion when the instruction is simply "show me what happened." Thus, if the given sentence is (5.22):

(5.22) The lambs saw the chickens jump over each other,

some subjects attempt to act out the seeing portion as well as the jumping portion. This sometimes happens even if the matrix verb is such as think whose meaning is quite difficult to act out if not impossible. Since what Matthei wanted to know was, for example in (5.22), who jumped over whom, his instruction was not an appropriate one.

The combination of these problems in Matthei's experiment might have confused the subjects and made the task far more complicated than it should have been.

Incidentally, White (1980) gives the following explanation to Matthei's results:

> [S]uppose that in learning "each other" the child has to realize that it is reciprocal and anaphoric (referring to an antecedent) and bound (controlled by that antecedent). In that case, it is possible that the child reaches a stage where he knows that "each other" is reciprocal and anaphoric but does not realize that it is bound. (p.26)

Thus, such a child will treat each other as ordinary pronouns. He will consider each other in (5.23) just as them in (5.24):

(5.23) The lions remembered that the tigers jumped over each other.

(5.24) The lions remembered that the tigers jumped over them.

Note that the application of the Disjoined Reference rule in the sense of Chomsky (1975 and other writings) to the lions and them in (5.24) is blocked because of BT. Therefore, White claims that, since the child in that developmental stage treats each other in (5.23) like them in (5.24), he will pick up the lions as the antecedent of each other in (5.23) just like them can be coreferential with the lions in (5.24). She continues:

> This explains the case of the pigs being made to tickle the chickens [for the chickens want the pigs to tickle--YO]. The fact that the children also made the chickens tickle the pigs suggest they have some understanding of the concept of a reciprocal. (p.26)

This explanation is unacceptable, since the child's mistake in question is not taking the matrix subject as the antecedent of each other as we pointed out earlier.

5.2.2 Other Studies

Potts et al. (1979) is a large-scale study of language production of 3, 4, and 5-year olds. The reciprocal was used as one of the test items (pp. 83-87). The task was sentence completion. The following was used for the reciprocal:

(5.25) Sometimes when dogs see other dogs, they bark.
These dogs are barking at _____.

Subjects were asked to supply an appropriate item in the blank. Notice that the first sentence is a general statement using non-progressive simple present tense. However, the second sentence that uses progressive present tense is a description of a particular event. Thus, these dogs in the second sentence does not have an appropriate referent in this discourse, and hence the discourse is odd.

The following table shows part of their results:

	Middle-class White			Lower-class White			Lower-class Black		
Age:	3	4	5	3	4	5	3	4	5
N:	98	97	104	19	24	27	21	34	26
Percentage of the Correct Answer	25	37	63	4	8	37	0	20	31

TABLE 5-1

The results suggest that "[t]he reciprocal construction showed increasing use with development in all of [their] groups" (p.87).

Although Potts et al. ultimately decided not to test reflexives, they point out one interesting observation.

> The problem was that middle-class 3-year-olds on the pilot test tended to use the correct himself in the frame He can dress _____ (himself) as often as did the 5-year-olds. In between, however, the 4-year-olds were using it less than were the 3-year-olds. The reason appeared to be that the form hisself was increasing at this age (and still occurred frequently among 5-year-olds). This finding, if replicated, suggests that some 3-year-olds may be imitating a lexical item himself, which they have heard as an individual word, but that the older children are integrating it into a reflexive pronoun system. (p.84)

Reed and Hare (1979) tested children's interpretation of reflexives using 266 subjects between 6;3 and 12;11. The subject was given a sentence containing a reflexive, and then asked a question about it. There were sixteen sentences. They tested the clause-bound nature of reflexives using sentences including the following:

(5.26) Bert said that Ernie spilled some paint on himself today.

--Who got paint all over himself?

Their results show that even some of the youngest children knew the clause-bound nature of reflexives, and that all of the age groups performed better than chance (p.107). However, the results also show that only about 30% of the youngest group subjects honored the clause-bound constraint consistently.

This last point might be due to the nature of their task and materials. As they pointed out, the sixteen-question session requires a lot of memory and patience that might be beyond the young children's capacity (p.107). Furthermore, a glance at the list of test questions reveals that the structures of the sentences and questions used were quite heterogeneous. The following partial list would make this clear:

(5.27) Cookie Monster made Oscar wash himself.

--Who was washed?

(5.28) Ernie let Big Bird choose a new red shirt for himself.

--Who was the shirt for?

The youngest children simply might not have learned causative constructions, or they might have had a problem with passive questions. Note also that the point we made about the use of non-factive verbs in the matrix clause in the previous section applies to (5.26) above, because to say is non-factive.

Solan (1978:III.6) reports the results of the experiment using twenty-two 5 and 6-year old children. The task was toy-moving. The sentences used were of the following form:

(5.29) The boy thought that the man hurt himself.

The form of instruction is not given in Solan (1978), but the author informed me that it was something like: "I'm going to tell you a story, and I want you to make that happen." The result was that the 5-year olds acted out 89% of the sentences correctly, and that the 6-year olds acted out 87% correctly (p.101). A list of the matrix verbs used (p.113) contains some non-factive verbs, and the point we made in the previous section concerning the use of these verbs also applies to this case.

5.3 Experiment 2

This experiment was designed to test when and how young children recognize BT with respect to reciprocals, reflexives, and pronouns.[5]

The logic of the experiment is as mentioned in 3.1.
The hypothesis to be tested is:

(H) Once the child masters each other/himself/him and the English complementation system, he always honors BT.

The experiment has three parts: (i) a test for whether young children honor BT (to be called the BT Test), and (ii) a test whether they know each other/himself/him (to be called the A(anaphor)-Test[6]), and (iii) a test for whether they know the English complementation system (to be called the Syntax Test). Hypothesis (H) makes the following predictions about our data:

(P_1) Those who pass both the A-Test with respect to each other and the Syntax Test will also pass the BT Test.

(P_2) Those who pass both the A-Test with respect to himself and the Syntax Test will also pass the BT Test.

(P_3) Those who pass both the A-Test with respect to him and the Syntax Test will also pass the BT Test.

The following should also be true:

(Q_1) Those who fail the A-Test with respect to each other and/or the Syntax Test will also fail the BT test with respect to each other.

(Q_2) Those who fail the A-Test with respect to himself and/or the Syntax Test will also fail the BT Test with respect to himself.

(Q_3) Those who fail the A-Test with respect to him and/or the Syntax Test will also fail the BT Test with respect to him.

Thus, if we classify the results of the experiment in a 2x2 contingency table in the following way for each of each other/himself/him, subjects should tend to fall in either the A or D cell.

Syntax Test / A-Test & BT-Test	Pass	Fail
Pass	A	B
Fail	C	D

N

TABLE 5-2

Method

Subjects

The subjects were 60 children ranging in age from 3;1 to 7;1. There were 12 subjects in each age group. Each subject was tested individually in a quiet room at his school.

Procedure and Materials

(I) BT Test and A-Test: The task was toy-moving, namely, the subject was asked to answer a question which follows each sentence by manipulating the toys located on the table in front of him.

The animals used were: two monkeys, two elephants, and two hippos.[7] These are stuffed toys of similar size and type. The subject was asked to identify each animal before the test. Passing this was the prerequisite for participating in the test. None of the subjects failed this task.

The subject then was told as follows:

> We are now going to play a game with these animals. I will tell you short stories about them, and then ask you questions about those stories. Please answer them by using the animals. OK?

Sentence used in the BT Test and A-Test, about [illegible], will describe in more detail below, have each of the following four types:

Type 1: NP V each other/himself/him

E.g., The elephants patted each other.

Type 2: NP_1 V_1 that NP_2 V_2 each other/himself/him

E.g., The hippos remembered that the monkeys tickled each other.

Type 3: NP_1 next to/beside NP_2 V each other/himself/him

E.g., The elephant next to the hippo tickled him.

Type 4: NP next to/beside NP went away

E.g., The monkey beside the elephant went away.

The following is a list of nouns and verbs used:

Nouns: monkey(s), elephant(s), hippo(s)

Verbs for $\underline{V}$ in Types 1 and 4, and $\underline{V_2}$ in Type 2: patted, slapped, tickled, hugged

Verbs for $\underline{V_1}$ in Type 2: learned, knew, forgot, remembered

Verbs for $\underline{V}$ in Type 3: sat on, touched, kissed

These verbs and nouns used for the experiment were arranged randomly from subject to subject in order to avoid the "language-as-fixed-effect fallacy" (Clark 1973).

Prior to the BT Test, the A-Test was administered. This consists of six simplex sentences of Type 1; two containing each other, two containing himself, and two containing him.[8] For the him sentences, a context was given. For example:

The monkey walked with the elephant. The elephant hugged him.

The instruction given after each sentence was: "Show me who Ved who," where V is the verb used in the given sentence. The order of these sentences was randomized.

Within the BT Text, there were four group of items. First, test sentences. These are of Type 2. The subject was given a sentence, and then asked to act out who V_2ed who. For example:

The hippos remembered that the monkeys patted each other.

Show me who patted who.

Both NP_1 and NP_2 are singular when himself or him is chosen. In this case, three animals were put in front of the subject, i.e., one monkey, one hippo, and one elephant. When each other is chosen, both NP_1 and NP_2 are plural. In this latter case, all six animals were located in front of the subject. Notice that the verbs used in the V_1 position are all factive verbs. See 5.2.1 for discussion for the use of factive verbs.

Second, catch sentences. Everything is the same as the test sentences except that the instruction that follows the sentence was: "Tell me who V_1ed the V_2ing." For example:

The hippo remembered that the monkeys patted each other.

Tell me who remembered the patting.

These sentences were added in order to avoid the children's developing a strategy to pay attention only to the embedded clause ignoring the matrix clause.

Third, control sentences. These are of Type 3. The instruction was: "Tell me who Ved who." They are added to test whether the child is interpreting the sentences in terms of a distance principle of the following sort:

(5.30) Choose to closest plural/singular NP as the antecedents of each other/himself.[9,10]

Thus, the subject is following the distance principle (5.30), he would pick up the monkeys as the antecedent of each other in the following example:

The hippos next to the monkeys patted each other.

Tell me who patted who.

Fourth, two other sentences of Type 4 were added to test whether the child knows the head status of, say, monkey in the monkey next to the elephant.

(II) Syntax Test: The task was repetition. The subject was given eight sentences, and asked to repeat them. Six sentences were of Type 2; two with each other, two with himself, and two with him. The remaining two sentences were of Type 3; one with each other, and the other with himself. The subject was told that the sentences could be given as many times as he wished, but that he was only allowed to repeat the whole sentence. Again, the verbs and nouns used were arranged randomly from subject to subject. The order of sentences were randomized.

The test described above were divided into two parts in the following way:

	PART I	PART II
A-Test	2 Ss with e.o.	2 Ss with himself
	2 Ss with him	
BT Test		
Test Items	3 Ss with e.o.	3 Ss with himself
	3 Ss with him	
Catch Items	2 Ss with e.o.	2 Ss with himself
	2 Ss with him	
Control Items	2 Ss with e.o.	2 Ss with himself
Other Items		2 Ss

(to be continued)

Syntax Test

Type 2	2 Ss with e.o.	2 Ss with himself
	2 Ss with him	
Type 3	1 S with e.o.	1 S with himself

[In this table, e.o. = each other, and S = sentence.]

Each part was administered on different days, there usually being three to five days in between. The order of the two parts was counter-balanced. The order between Syntax and BT Tests was also counter-balanced.

Results and Discussion

Results

The results of the three tests in this experiments are given in Table 4 at the end of this dissertation.

(I) A-Test: Most of our subjects got these items correct. There were six children (Subject ##1, 7, 17, 30, 34, and 43) who failed to act out the reciprocality of each other. Thus, given (5.31), they would make one of the lions pat the other one.

(5.31) The lions patted each other.

For reflexives, three subjects (Subject ##1, 7, and 12) took himself as a non-reflexive pronoun. Thus, given (5.32), they would make the hippo hug another animal, e.g., the monkey.

(5.32) The hippo hugged himself.

As for pronouns, four subjects (Subject ##7, 10, 20, and 21) too him as a reflexive. Thus, given (5.33), they would make the elephant tickle himself.

(5.33) The monkey walked with the elephant.
The elephant tickled 'im.

(II) BT Test: There are a number of response types for the test items. We describe major error types below.

For the each other sentences, there were three major error types: (i) some subjects failed to act out the reciprocality although most of them succeeded in the practice sentences. For example, given (5.34), they failed

to make the hippos pat each other, and would make instead one of the hippos pat the other.

(5.34) The monkeys remembered that the hippos patted each other.

The second type of error was making the matrix clause subject and the embedded clause subject do the reciprocal action. Thus, given (5.34), they made the monkey(s) and hippo(s) pat each other.

The third type was making the matrix subject do the reciprocal action. Thus, given (5.34) they made the monkeys pat each other.

These errors are coded as 2, 3, 4 in Table 4 at the end of this dissertation.

For himself sentences, there were two major error patterns. Namely, some subjects acted as if the given sentence contained 'im instead of himself. Thus, given (5.35), they made the hippo tickle the elephant.

(5.35) The elephant learned that the hippo tickled himself.

Some other subjects made the elephant tickle himself, given (5.35). The first type was coded as 5, and the second as 6 in Table 4 at the end of this dissertation, respectively.

For the 'im sentences, there was one major error pattern. Namely, some subjects acted out as if the given sentence contained himself instead of 'im. Thus, given (5.36), they made the monkey slap himsalf.

(5.36) The elephant knew that the monkey slapped 'im.

This error type is indicated as 7 in Table 4 at the end of this dissertation.

As for the catch sentences, many subjects made the same mistakes. Given the sentence (5.36) and the arrangement of the animals as shown in (5.37), they made the monkey and the elephant that are sitting next to each other (i.e., $monkey_2$ and $elephant_1$ in (5.37)) pat each other.

(5.36) The monkeys next to the elephants patted each other.

(5.37) $Monkey_1$ $Monkey_2$ $Elephant_1$ $Elephant_2$

↑↑

Subject

Given (5.38), which contains <u>himself</u>, some subjects made the hippo tickle himself.

(5.38) The monkey next to the hippo tickled himself.

(III) Syntax Test: There were many error types in this task. The major types are discussed below. First, some subjects omitted the matrix clause. Thus, given (5.39), they repeated it as (5.40).

(5.39) The monkey forgot that the hippo tickled him.

(5.40) The hippo tickled him.

Second, some subjects omitted the embedded clause. Given (5.39), they repeated it as (5.41).

(5.41) The monkey forgot.

Third, some subjects omitted the matrix verb, <u>that</u>, and the embedded subject. Given (5.39), they repeated it as (5.42).

(5.42) The monkey tickled him.

Fourth, some subjects repeated him as himself.

Fifth, some subjects repeated himself as him.

These are coded as 2, 3, 4, 5, and 6, respectively in Table 4 at the end of this dissertation.

As Potts et al. (1979) noted (see 5.2.2), many younger subjects repeated himself as hisself.

(IV) Correlation: To test the hypothesis (H), we tabulated 2x2 contingency tables, as in Tables 5-3, 5-4, and 5-5. Table 5-3 summarizes

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TABLES 5-3, 5-4, and 5-5

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the results about the each other sentences, Table 5-4 about the himself sentences, and Table 5-5 about the him sentences. The criterion for passing the Syntax Test is to repeat both of the given sentences correctly. The criterion for passing the BT Test is to get two out of the three test items correct, and get both of the catch sentences correct. Of course, passing the A-Test is a prerequisite for passing.

These tables display the degree of association between success in the Syntax Test and success in the BT Test. The association in Table 5-3 is statistically significant at the .05 level (χ^2=36.74, 1df) with Yates' correction for continuity. The association in Table 5-4 is also statistically significant at the .05 level (χ^2=14.95, 1df) with Yates' correction for continuity. The association in Table 5-5 is statistically significant at the .05 level (χ^2=7.63, 1df) with Yates' correction for continuity as well.

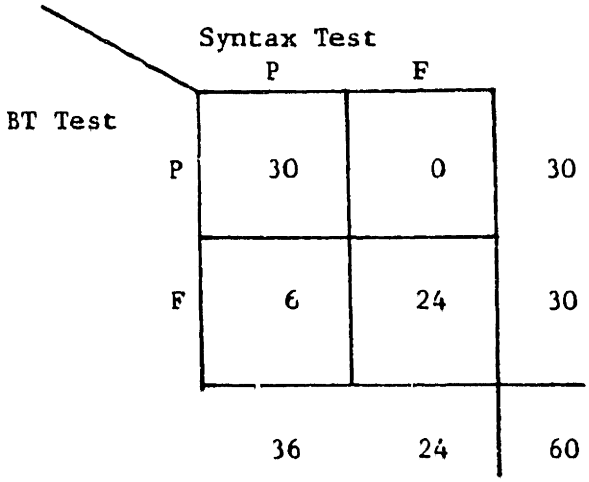


FIGURE 5-3: Each Other

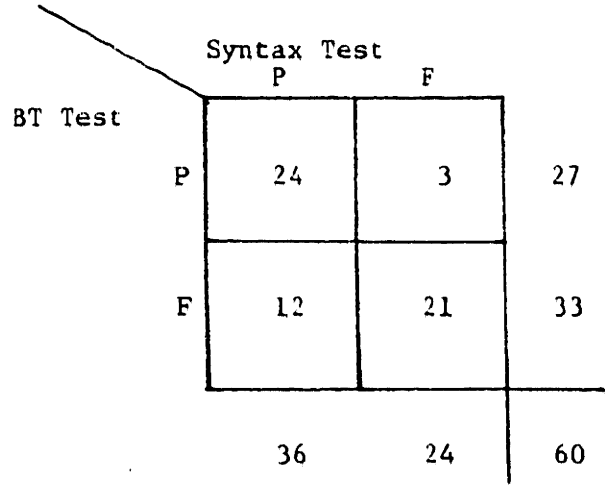


FIGURE 5-4: Himself

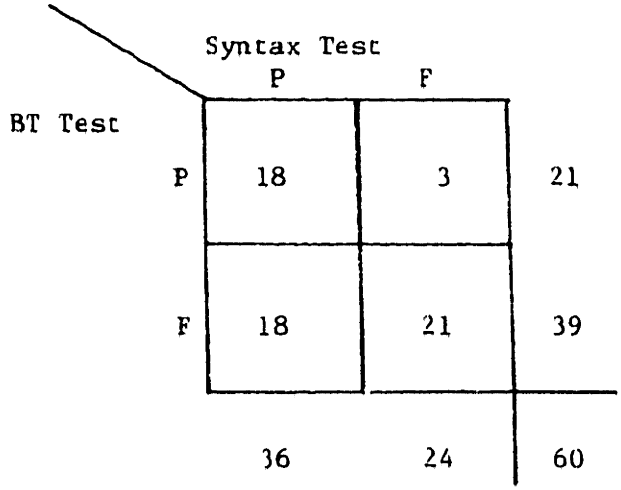


FIGURE 5-5: Him

Tables 5-6 - 5-20 show the results broken down by age groups. Since the number of the subjects in each age group is relatively small (i.e, 12), we do not think that statistical analysis of each of these tables would be meaningful. Rather, these tables are to show the developmental sequence across the ages.

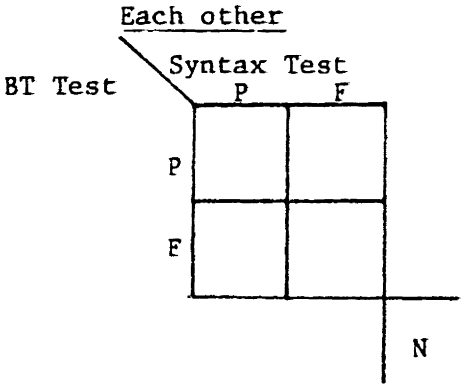
TABLES 5-6 - 5-20

The subjects' performance on the control items, particularly the sentences with each other, was very poor across the ages. Table 5-21 shows the percentage of the correct responses for the control items.

TABLE 5-21

Discussion

The tables for each other and himself (i.e., Tables 5-6 and 5-4, respectively) support our hypothesis (H) with respect to these items. A curious point is the subjects' poor performance on the catch items. Since many of the errors made about the catch items with each other are the kind we discussed in the Results section above, the poor performance on these items does not seem to be due to the distance principle we discussed earlier. There seem to be some unknown complicating factors about these sentences. Notice also that many of the subjects who did poorly on these items seemed to know that X is the head of the phrase [$_{NP}$the X next to the Y], sice they could correctly perform the



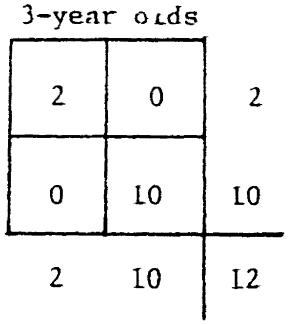


FIGURE 5-6

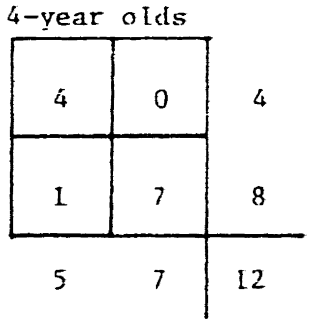


FIGURE 5-7

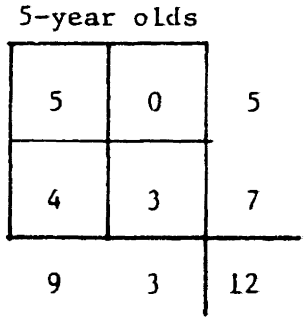


FIGURE 5-8

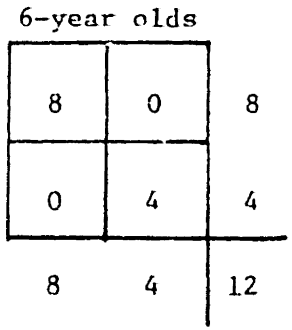


FIGURE 5-9

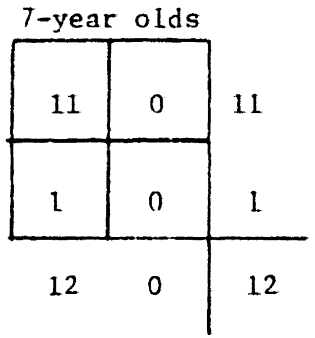
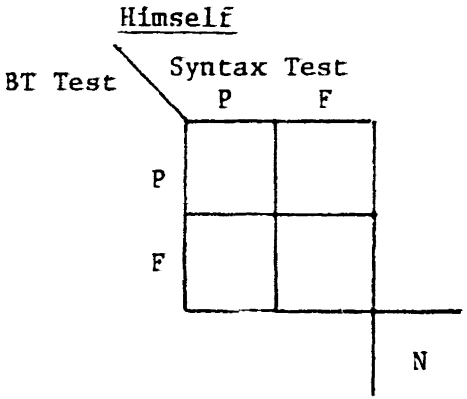


FIGURE 5-10



3-year olds

0	1	1
0	11	11
0	12	12

FIGURE 5-11

4-year olds

4	0	4
3	5	8
7	5	12

FIGURE 5-12

5-year olds

6	1	7
3	2	5
9	3	12

FIGURE 5-13

6-year olds

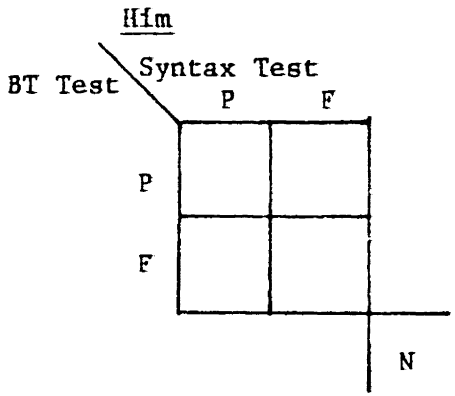
4	0	4
5	3	8
9	3	12

FIGURE 5-14

7 year olds

10	1	11
1	0	1
11	1	12

FIGURE 5-15



3-year olds

0	0	0
L	LL	12
L	LL	12

FIGURE 5-16

4-year olds

4	0	4
4	4	8
8	4	12

FIGURE 5-17

5-year olds

5	0	5
4	3	7
9	3	12

FIGURE 5-18

6-year olds

4	2	6
4	2	6
8	4	12

FIGURE 5-19

7-year olds

5	1	6
5	1	6
10	2	12

FIGURE 5-20

Age	Control Items with: each other	Control Items with: him
3	.04	.21
4	.46	.79
5	.33	.,9
6	.13	.83
7	.17	.71
Total	.23	.67

TABLE 5-21

meaning of (5.43).

(5.43) The elephants next to the monkeys went away.

That the children's poor performance on the catch items with each other may not be due to the distance strategy is also supported by the fact that the children did much better with the catch items with himself. They chose the head noun of the subject NP as the antecedent of himself, although there was a noun closer to himself.

Somewhat surprising are the results concerning the sentences containing 'im. Given (5.44), many subjects made the hippo tickle himself.

(5.44) The monkey knew that the hippo tickled 'im.

There are a few possible ways to account for this fact. First, there are "exceptions" concerning BT(B) (see 5.1), which we repeat below:

(5.45) A pronominal is free in its governing category.

Some curious examples are given in (5.46) (taken from Kuno (forthcoming)).

(5.46) a. John$_i$ looked around $\left\{ \begin{array}{l} \text{him}_i \\ *\text{himself}_i \end{array} \right\}$

b. John$_i$ saw a snake near $\left\{ \begin{array}{l} \text{him}_i \\ *\text{himself}_i \end{array} \right\}$

c. John$_i$ hid the book behind $\left\{ \begin{array}{l} \text{him}_i \\ \text{himself}_i \end{array} \right\}$

(There are semantic differences between the two alternatives in c.)

(i is a referential index.)

Therefore, the child has to figure out what the correct generalizations are about the proper use of pronouns, and will take some time to reach the correct generalization. This might be the reason for the children's poorer performance on the sentences containing pronouns in our experiment.

Second, the children's poorer performance on the sentences containing pronouns may be due to their misperception of these sentences. There were many children who repeated 'im in these sentences as himself in the Syntax Test.

Larry Solan (personal communication) informed me that the same kind of mistakes were observed in Spanish-speaking children. Miller (1981) also reports similar results concerning her experiment using the picture identification task. To examine why this happens is an interesting research topic.

Our results as a whole are consistent with our hypothesis (H), and thus support the claim that BT is innate. Of course, we have not proved the innateness of BT. However, the finding that as soon as the child masters the structures and other linguistic properties that are relevant to BT, he honors BT with respect to those structures supports the claim that BT is part of the innate schematism that allows language acquisition.

Notes to Chapter 5

[1]This section is a slightly modified version of Section 3 of Otsu (1981).

[2]Matthei's paper is based on, in large part, Chomsky (1973), and talks about the Tensed S Condition (TSC) and the Specified Subject Condition (SSC) discussed there. The differences between the framework of Chomsky (1973) and that of Chomsky (1981), the latter of which this study is largely based on, do not affect the present discussion.

[3]This was pointed out to me by Noam Chomsky.

[4]Although there is a growing literature concerning children's understanding of factivity, the issue of when the child becomes aware of factivity has not been settled. See Macnamara et al. (1976), Bennett and Falmagne (1977), Hopmann and Maratsos (1978), Scoville and Gordon (1980), Phinney (1981b), and the references cited there.

[5]The results of the pilot experiment are reported in Otsu (1981).

[6]This term is misleading, because technically pronouns are not members of the set of anaphors in the linguistic framework on which this study is based, i.e., Chomsky (1981). That is the reason why the test is called the A-Test instead of the Anaphor Test.

[7]During the experiment, the experimenter called a hippopotamus a hippo. Even so, some children consistently called it a hippopotamus.

[8]Throughout the experiment, the unstressed form 'im was used for him in order to avoid the reading in which the reference can go beyond the sentence boundary.

[9]We assume that distance is defined on a terminal string rather than in terms of the number of branches between the two elements, as Rosenbaum's (1967) Minimum Distance Principle.

[10]Chomsky (personal communication) suggested to me that the strategy in question could be: Choose the nearest c-commanding plural/singular NP as the antecedent of each other/himself. The control for this would be sentences such as (i).

(i) The men told the women about each other.

PART III

Chapter 6 Epilogue and Prologue: Implications of Our Findings[1]

The experiments reported in Part II all seem to point to the same conclusion: as soon as the child masters a structure that is relevant to a universal condition P, then he honors P with respect to that structure. In this final chapter, we discuss implications of this finding.

First, as pointed out before, this conclusion is nothing but Hypothesis (H), announced in 3.1, and based on the assumption that P is innate. Of course, we have not proved the innateness of the conditions we considered, but our findings give empirical support for the claim that they are innately programmed in the child.

Recent studies have also indicated that other universal properties such as "c-command" play a role in children's grammar from early stages in development (see the Appendix A to Chapter 4; see also Phinney (1981a) for the relevant data and discussion). If these recent findings (including our own) are true, then such universal properties restrict the class of grammars available to the child from his early stages, thereby facilitating the acquisition of grammar. This constitutes one step toward the construction of a theory of language development.

These findings are also in conformity with recent findings in other areas of development. As mentioned in 2.4, recent research has revealed that several perceptual and cognitive systems function surprisingly well at or near birth. In a domain closer to the present study, there is some evidence indicating that auditory structures that analyze at least some phonetic distinctive features are available to the new born child. Altogether, these data indicate that a human child is born with sophisticated endowments that are ready to function on appropriate data given from

his environment.

Our findings also give support to the instantaneous model of language acquisition. Generative grammar has revealed genuine universal properties of natural language; assuming the validity of the instantaneous model, these properties may be equated with properties of the LAD. Our findings, as well as other recent findings discussed above, show that (at least part of) these universal properties start functioning as soon as it is logically possible, and continue functioning through development. This indicates that the instantaneous model of language acquisition is not too far from the actual process of language acquisition.

Let us now consider the problem of task-specificity. Osherson and Wasow (1976: 208) point out that answers to each of the following two questions could logically be different: (i) Does the mature linguistic faculty rest upon intellectual components that are specific to language?; and (ii) Does the acquisition mechanism for language include components that are specific to language? (In their paper, however, they intentionally confounded these two questions.) To the extent to which the Subjacency Condition and Binding Theory are unlikely to have analogues in other components of the human mind, our finding would constitute evidence for the task-specificity of language acquisition mechanism.

Studies in generative grammar has revealed much about our language faculty. Particularly, their recent development has made it clear that a set of parameterized principles constitute the core of human language faculty. This situation in linguistic theory is extremely exciting not only for its own development, but also for the construction of a theory of language development. As long as we continue the effort of connecting studies of linguistic theory and that of language development, we will

certainly be able to learn a substantial amount from such enterprises. This dissertation should be understood as one such an initial attempt.

Note to Chapter 6

[1]The title of this chapter "Epilogue and Prologue" has been borrowed from Chomsky and Halle (1968).

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Abbreviation: LI = Linguistic Inquiry

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APPENDIX

Subject No.	Age (Months)	Story 1	2	3	4
1	37	(0)	(1)	0	1
2	38	0	1	(0)	(1)
3	39	0	(1)	(1)	1
4	39	0	(0)	0	(0)
5	41	1	(1)	0	(0)
6	41	(0)	0	(0)	1
7	41	(0)	1	(0)	0
8	41	1	1	(0)	(0)
9	41	(0)	(1)	0	0
10	44	1	(1)	(0)	0
11	45	(0)	0	0	(0)
12	46	(0)	1	0	(0)
13	48	(1)	(1)	1	0
14	49	0	1	(0)	(0)
15	50	1	1	(0)	(0)
16	51	1	(1)	(1)	1
17	54	(0)	(1)	1	0
18	54	(0)	0	0	(1)
19	54	(1)	1	(1)	1
20	57	(0)	1	(1)	1
21	57	1	(1)	0	(0)
22	57	(0)	1	1	(0)
23	59	1	(1)	(0)	1
24	59	1	(1)	1	(1)
25	60	1	(1)	(1)	0
26	60	(0)	0	(0)	1
27	63	1	(1)	0	(0)
28	64	0	(1)	(0)	0
29	65	(0)	0	(0)	0
30	66	(0)	(1)	1	1
31	67	1	(1)	1	(1)
32	67	0	1	(0)	(0)
33	68	(1)	(1)	1	1
34	69	(1)	1	1	(1)
35	69	(0)	1	0	(0)
36	70	1	1	(1)	(1)
37	73	1	(1)	(1)	1
38	73	1	(1)	1	(1)
39	73	(0)	1	0	(1)
40	75	1	1	(1)	(1)
41	77	(1)	(1)	1	1
42	77	(1)	1	(0)	0
43	78	(1)	(1)	0	0
44	79	(0)	1	0	(0)
45	79	1	1	(1)	(1)
46	81	(1)	1	(1)	0
47	82	1	(1)	1	(0)
48	82	1	(1)	(1)	1

Subject No.	Age (Months)	Story 1	2	3	4
49	84	1	(1)	1	(1)
50	85	1	(1)	(1)	1
51	86	(1)	1	(1)	1
52	87	0	1	(0)	(0)
53	89	(0)	1	(0)	1
54	90	1	1	(0)	(0)
55	90	1	(1)	1	(0)
56	91	(0)	1	1	(1)
57	91	1	(1)	(1)	1
58	92	(0)	(1)	1	1
59	95	(1)	1	1	(1)
60	95	(0)	(0)	0	1

TABLE 1: SC Test (Experiment 1)

0: fail; 1: pass

Circle indicates the stories given in the SI-order.

Subject No.	Complex 1	2	3	Simple 1	2	3
1	6	6	6	6	6	6
2	6	7	7	2	5	5
3	1	1	4	5	2	2
4	5	5	6	2	2	1
5	1	4	4	4	5	5
6	5	5	3	2	1	2
7	6	7	5	7	6	6
8	5	5	1	5	5	2
9	2	4	4	2	2	2
10	5	5	7	2	2	2
11	4	4	7	2	2	5
12	4	4	5	2	2	2
13	2	1	1	2	2	2
14	4	7	4	2	2	2
15	2	5	7	2	2	2
16	1	3	3	3	3	3
17	4	7	4	2	2	2
18	4	4	6	2	2	2
19	2	4	5	2	2	2
20	5	6	5	5	5	7
21	6	7	6	5	5	2
22	5	7	5	2	5	2
23	2	2	1	2	2	2
24	1	1	1	2	2	2
25	1	1	6	2	2	2
26	1	5	2	2	2	1
27	4	5	5	2	2	2
28	4	4	1	2	2	2
29	4	4	4	5	2	2
30	7	2	2	2	2	2
31	1	1	1	2	2	2
32	2	2	2	2	2	2
33	4	4	4	7	2	2
34	3	3	3	3	3	3
35	4	7	4	2	2	2
36	2	2	2	2	2	1
37	2	2	2	2	2	2
38	4	4	4	2	2	1
39	7	7	4	5	2	2
40	2	2	2	2	2	2
41	1	1	1	2	2	2
42	4	1	1	7	1	1
43	4	4	4	4	4	1
44	1	1	1	2	2	2
45	1	1	1	2	2	2
46	2	7	2	2	2	2
47	1	1	1	2	2	2
48	2	1	1	2	2	2
49	2	1	1	2	2	1
50	2	1	1	2	2	2
51	1	2	1	2	2	2
52	3	3	3	3	3	3
53	4	1	4	2	2	2
54	2	2	2	2	2	2
55	1	2	1	2	2	1
56	1	1	1	2	2	2
57	2	2	2	2	2	2
58	1	1	1	2	2	2
59	1	1	1	2	2	2
60	3	3	3	3	3	3

TABLE 2: Syntax Test (1)
(Experiment 1)

The significance of the numbers herein is explained in 4.2.

Subject No.	Repetition 1	2	3	4
1	6	5	7	6
2	7	7	7	7
3	5	5	5	5
4	5	7	7	5
5	7	7	7	7
6	7	7	7	6
7	7	7	7	1
8	6	6	5	7
9	7	7	7	7
10	7	7	7	7
11	5	7	7	6
12	6	6	7	6
13	6	7	7	7
14	1	1	7	1
15	7	1	1	1
16	1	1	1	1
17	1	7	1	1
18	5	7	7	7
19	1	7	1	1
20	7	5	7	5
21	7	7	7	7
22	1	1	7	7
23	1	1	1	1
24	1	1	1	1
25	1	1	1	1
26	1	1	1	1
27	1	1	7	1
28	1	1	1	1
29	7	7	7	7
30	1	1	1	1

Subject No.	Repetition 1	2	3	4
31	1	1	1	1
32	1	1	1	1
33	1	1	1	1
34	1	1	7	7
35	7	7	7	7
36	1	1	1	1
37	1	1	1	7
38	1	7	1	1
39	7	1	7	7
40	1	1	1	1
41	1	1	1	1
42	7	1	1	1
43	1	7	1	7
44	1	1	1	1
45	1	1	1	1
46	1	1	1	1
47	1	1	1	1
48	1	1	1	1
49	1	1	1	1
50	1	1	1	1
51	1	1	1	1
52	1	1	1	1
53	1	1	1	1
54	1	1	1	1
55	1	1	1	1
56	7	1	5	1
57	1	1	1	1
58	1	1	1	1
59	1	1	1	1
60	1	1	1	1

TABLE 3: Syntax Test (2) (Experiment 1)
The significance of the numbers appearing herein is explained in 4.2.

Subj. No.	Age (Mo.)	A-Test e.o. 1	A-Test e.o. 2	A-Test self 3	A-Test self 4	A-Test 'im 5	A-Test 'im 6	Test-Items e.o. 7	Test-Items e.o. 8	Test-Items e.o. 9	Test-Items self 10	Test-Items self 11	Test-Items self 12	Test-Items 'im 13	Test-Items 'im 14	Test-Items 'im 15	Control e.o. 16	Control e.o. 17	Control self 18	Control self 19	Syntax Test e.o. 20	Syntax Test e.o. 21	Syntax Test self 22	Syntax Test self 23	Syntax Test 'im 24	Syntax Test 'im 25
1	37	0	0	0	0	1	1	8	8	8	5	5	5	1	8	1	0	0	0	0	2	2	2	2	2	2
2	38	1	1	1	1	1	1	4	4	4	8	8	8	1	1	8	0	0	0	0	4	7	2	7	7	3
3	39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	4	1	2	2
4	39	1	1	1	1	1	1	4	4	4	8	5	5	8	8	8	0	0	1	1	1	7	7	1	1	7
5	41	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	7	2	7	5	5
6	41	1	1	1	1	1	1	8	8	8	8	8	8	1	8	8	0	0	0	0	2	4	4	3	3	3
7	41	1	1	1	1	1	1	8	8	8	8	8	8	8	8	8	0	0	0	0	7	7	7	7	7	7
8	41	1	1	1	1	1	1	1	1	1	1	8	5	7	1	7	0	1	1	1	1	1	7	1	1	1
9	41	1	1	1	1	1	1	4	4	4	8	8	1	8	7	8	0	0	0	0	7	7	7	7	2	7
10	44	1	1	1	1	1	0	4	2	2	1	8	8	1	1	7	0	0	0	1	7	7	2	4	1	7
11	45	1	1	1	1	1	1	2	4	4	5	5	5	8	8	8	0	0	0	0	2	2	7	7	2	2
12	46	1	1	0	0	1	1	4	8	4	5	5	8	7	1	8	0	0	0	0	2	2	7	7	2	2
13	48	1	1	1	1	1	1	1	8	8	1	6	1	1	8	1	0	0	0	0	7	7	7	7	2	1
14	49	1	1	1	1	1	1	8	8	8	1	1	1	1	8	1	0	0	1	1	1	7	1	1	7	7
15	50	1	1	1	1	1	1	1	8	1	8	8	6	8	1	1	1	1	1	1	7	1	1	1	1	1
16	51	1	1	1	1	1	1	1	1	1	8	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
17	54	0	0	1	1	1	1	8	8	8	1	6	6	8	1	1	0	0	0	1	1	1	7	7	1	1
18	54	1	1	1	1	1	1	1	4	1	6	1	1	7	1	7	1	1	1	1	3	7	1	7	5	3
19	54	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
20	57	1	1	1	1	0	1	1	1	8	1	8	1	1	1	1	1	1	1	1	7	7	1	1	1	1
21	57	1	1	1	1	0	0	1	8	1	1	1	1	7	7	7	1	1	0	1	1	7	1	7	1	1
22	57	1	1	1	1	1	1	1	1	1	8	8	8	1	1	1	1	0	1	0	7	7	7	2	7	7
23	59	1	1	1	1	1	1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1
24	59	1	1	1	1	1	1	1	1	1	1	1	8	1	1	1	0	0	1	1	1	1	1	1	1	1

TABLE 4: Experiment 2: 1. A-Test and Controls: 0 - failure; 1 - success
2. Test-Items: 1 - success; 2-7 - see 5.3; 8 - other response types
3. Syntax Test: 1 - success; 2-6 - see 5.3; 8 - other response types

Subj. No.	Age (Mo.)	A-Test e.o. 1	2	self 3	4	'im 5	6	Test-Items e.o. 7	8	9	self 10	11	12	'im 13	14	15	Control e.o. 16	17	self 18	19	Syntax Test e.o. 20	21	self 22	23	'im 24	25
25	60	1	1	1	1	1	1	1	1	4	1	1	1	1	1	1	0	0	1	1	1	7	1	1	1	1
26	60	1	1	1	1	1	1	1	1	1	1	1	1	1	8	1	0	0	0	0	7	7	1	1	7	1
27	63	1	1	1	1	1	1	1	1	4	1	1	1	7	1	1	1	1	1	1	1	1	1	1	1	1
28	64	1	1	1	1	1	1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1
29	65	1	1	1	1	1	1	1	1	1	1	1	1	1	8	1	0	0	1	0	1	1	1	1	1	1
30	66	0	0	1	1	1	1	2	2	2	1	1	1	7	7	7	0	0	1	1	1	1	1	1	1	1
31	67	1	1	1	1	1	1	1	1	1	8	1	1	8	8	1	0	0	1	1	1	1	1	1	1	1
32	67	1	1	1	1	1	1	1	1	1	1	1	1	7	7	7	0	0	1	1	1	7	1	7	1	1
33	68	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1		1	1	1
34	69	0	0	1	1	1	1	2	2	2	8	1	8	1	8	8	0	0	1	1	1	1	7	1	1	7
35	69	1	1	1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	0	0	1	1	7	1	1	7
36	70	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
37	73	1	1	1	1	1	1	1	1	1	1	1	1	1	8	1	0	0	1	1	1	1	1	1	1	1
38	73	1	1	1	1	1	1	1	4	4	1	8	1	1	8	8	0	0	1	1	7	7	6	7	1	7
39	73	1	1	1	1	1	1	8	1	4	8	1	5	1	1	1	0	0	0	1	1	7	6	1	1	1
40	75	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1	0	0	1	1	1	1	1	1	1	1
41	77	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1	0	0	1	1	1	1	1	1	1	1
42	77	1	1	1	1	1	1	1	8	8	1	8	8	1	1	1	0	0	0	1	1	7	7	7	1	1
43	78	0	0	1	1	1	1	8	8	8	1	6	6	8	8	8	0	0	1	1	7	7	1	1	7	1
44	79	1	1	1	1	1	1	1	1	1	1	1	1	7	7	7	0	0	1	0	1	1	1	1	1	1
45	79	1	1	1	1	1	1	1	1	1	1	1	1	1	8	1	1	0	1	1	1	1	1	1	7	1
46	81	1	1	1	1	1	1	4	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
47	82	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48	82	1	1	1	1	1	1	1	1	8	1	1	8	1	1	1	0	0	1	1	1	1	1	1	1	7

TABLE 4 (2)

Subj. No.	Age (Mo.)	A-Test						Test-Items									Control				Syntax Test					
		e.o.		self		'im		e.o.			self			'im			e.o.		self		e.o.		self		'im	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
49	84	1	1	1	1	1	1	1	1	1	1	1	1	1	7	1	0	0	0	0	1	1	1	1	7	1
50	85	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
51	86	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
52	87	1	1	1	1	1	1	1	1	1	1	1	1	7	7	7	0	0	1	1	1	1	1	7	5	5
53	89	1	1	1	1	1	1	8	8	1	8	5	5	1	1	1	0	0	0	1	1	1	1	1	1	1
54	90	1	1	1	1	1	1	1	8	1	1	1	8	1	1	1	0	0	1	1	1	1	7	7	1	1
55	90	1	1	1	1	1	1	1	1	1	1	1	1	7	1	1	0	0	1	1	1	1	1	1	1	1
56	91	1	1	1	1	1	1	1	1	1	1	6	1	1	1	1	0	0	0	0	1	1	1	1	1	1
57	91	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
58	92	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
59	95	1	1	1	1	1	1	1	1	8	6	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
60	95	1	1	1	1	1	1	1	1	1	1	1	1	7	7	7	0	0	0	0	1	1	1	1	1	5

TABLE 4 (3)

Biographical Note

The author was born in Tokyo on February 1, 1948. After obtaining his first B.A. in economics from Rikkyo University, Tokyo, he started studying English linguistics, originally with the hope of improving the English teaching in Japan, at Tokyo University of Education, where he earned his second B.A. and M.A. There he met inspiring teachers and colleagues, and developed interest in the theory of transformational-generative grammar. He taught at Wako University, Tokyo, from 1975 to 1977. In the fall of 1977, he entered the Ph.D. program in linguistics at Massachusetts Institute of Technology. He has accepted a position as Associate Professor (Jokyoju) at Tokyo Gakugei University.

The author's academic interst has invariably been psycholinguistics. His publications include, among others:

1977. "Dative Questions and Perceptual Strategies." Studies in English Linguistics 5.

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1981. "Opacity Condition and Syntactic Development in Children." Proceedings of NELS XI. Amherst, Mass.: Department of Linguistics, University of Massachusetts.

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