WINZEMER, JUDITH ANN

A LEXICAL-EXPECTATION MODEL FOR CHILDREN'S COMPREHENSION OF WH-QUESTIONS

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A LEXICAL-EXPECTATION MODEL FOR CHILDREN'S COMPREHENSION OF WH-QUESTIONS

by

JUDITH A. WINZEMER

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May 4, 1981
date

D. Terence Langendoen
Chairman of Examining Committee

May 4, 1981
date

Martin L. Hoffman
Executive Officer

D. Terence Langendoen

Virginia Valian

Katherine Nelson
Supervisory Committee

The City University of New York

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Introduction

This study concerns young children's comprehension of wh-questions. A model for comprehension, called the lexical-expectation model, is proposed. The model assumes that knowledge of general rules and specific knowledge of lexical items are each necessary but only jointly sufficient for full comprehension of wh-questions. Neither kind of knowledge alone can account for the range of comprehension skills even of children under three years of age.

In recent years, the process of language acquisition has frequently been characterized as the gradual accretion of lexically specific information, later followed by the formulation of general rules (Maratsos, in press; Kuczaj & Brannick, 1979; Braine, 1976). This study attempts to demonstrate that the opposite phenomenon also operates in the course of language acquisition: children acquire and use general rules without having acquired all the lexically specific information necessary for accurate or complete comprehension. Comprehension errors result from the application of general rules without all the requisite lexical knowledge.

The dissertation is organized as follows: in section I, what wh-questions are and how linguists have derived them within transformational grammar is discussed. Arguments

that a transformational rule alone cannot account for comprehension are presented, and an analysis of other linguistic knowledge necessary for comprehension is detailed. The conclusion of the first section is that lexical knowledge is necessary for comprehension of wh-questions. In section II, the literature on children's comprehension is discussed. The child data provide independent support for the arguments made in the first section. In section III, the lexical-expectation model is presented. Sections IV and V describe an experiment designed to test the predictions of the lexical-expectation model. And finally, sections VI and VII present a discussion of the results of the experiment and the conclusions which can be drawn from it.

I. Linguistic Knowledge Necessary for Comprehension

The Transformational Account

A wh-question is a type of sentence in which a sentence-initial constituent containing a wh-word (e.g., what, where, when, whose book) stands in for or replaces a constituent missing somewhere else in the sentence. In order to comprehend a wh-question, the constituent that the wh-word replaces must be determined. For example, in (1) the wh-word, what stands

(1) What did you eat?

in for the direct object of the verb. To determine the

meaning of (1), and to be able to answer it, the listener must figure out that the wh-word stands in for the direct object.[1]

No simple formula for determining the constituent which a wh-word replaces is possible because, in many cases, there is no fixed relation between the wh-word and the constituent it replaces. For example, what does not always replace the direct object of a verb. It can also replace the subject of a sentence, the object of a preposition, and it can replace any of these constituents in any of the clauses of a sentence.[2]

Linguists represent the fact that wh-words replace constituents of varying types and underlying sentence positions by positing that at an earlier point in the derivation of a wh-question, the wh-word is located in the position of the constituent it replaces. A syntactic transformation operates leaving a gap where the wh-word was located in the underlying structure; in the surface form of the sentence, the wh-word appears in sentence-initial position only (Katz & Postal, 1964; Chomsky, 1977; Fodor, 1978).

There have been different proposals about the formulation of the wh-transformation. According to the traditional view, known as the standard theory, the wh-transformation moves the wh-word to sentence-initial position, leaving a gap in the underlying position from which the wh-word was

removed (Katz & Postal, 1964; Chomsky, 1965). According to a more recent view, known as the extended standard theory, the wh-transformation moves the wh-word and leaves behind a "trace" in the underlying position of the wh-word (Chomsky, 1977; Bresnan, 1976). According to yet another formulation of the rule, wh-words are directly generated in sentence-initial position in the underlying structure and a trace is also directly generated in the position of the constituent that the wh-word stands in for (Gazdar, 1980). On this view, movement is not involved.

However the rule is formulated, the wh-transformation captures the fact that wh-words stand in for constituents of varying types and underlying positions. Comprehension thus must, in some sense, involve performing the inverse of the wh-transformation, i.e., recovering the wh-word's position in the underlying structure.

Arguments for the Insufficiency of the Wh-transformation

Fodor (1978) argues that comprehension of a wh-question cannot be accomplished by merely performing the inverse of the wh-transformation.[3] For example, in (2), a formal statement of wh-movement is given (taken from Akmajian & Heny, 1975).

(2) Wh-movement

SD:	Q	X	WH	Y	
	1	2	3	4	
SC:	1	3	2		4

A transformation takes a linear string of abstract syntactic elements (called the structural description, SD) and performs some operation(s) on that string to produce another linear string (called the structural change, SC). Informally, the rule of wh-movement states that if a sentence meets the condition that it is a question (as indicated by Q), and that it has a wh-word located somewhere in the sentence (as indicated by WH), the wh-word is moved to sentence-initial position across the intervening material (as indicated by X). The variable X indicates that wh-words can move across any amount or type of intervening material (subject to certain constraints, see footnote 2). The formal statement of the rule does not indicate the underlying position from which the wh-word is moved; it could not do this because the underlying position of wh-words varies from sentence to sentence. Since the rule cannot state the underlying position of the wh-word, it is impossible to recover the underlying position of the wh-word by performing the inverse of the rule. This is a general property of rules that move an element from between two variables (i.e., unbounded movement rules). Recovering the underlying structure by performing the inverse of the transformation is impossible in such cases (Fodor, Bever & Garrett, 1974).

Fodor (1978) argues that in order to recover the underlying position of the wh-word, a series of inferential steps

involving other linguistic knowledge is necessary. Although the output of this process looks like applying the inverse of wh-movement, Fodor argues

> the computational steps by which the parser effects detransformation must be much more elaborate than is implied by the formal statement of wh-movement in the grammar of English...identification of a gap requires a rather intricate chain of inference based on a variety of facts about the deep structure and transformational potentialities of words in the sentence.

The rule of wh-movement captures the generalization that wh-words replace missing constituents.[4] This knowledge is necessary but not sufficient for comprehension. Knowing that wh-words stand in for missing constituents, however, is a prerequisite to comprehension; in order to properly determine which constituent is missing, you must first know that the sentence contains a missing constituent.

Other Linguistic Knowledge Necessary for Comprehension

If the knowledge that wh-words stand in for missing constituents is not sufficient for determining the missing constituent in a wh-question, what other linguistic knowledge is necessary? As I will now show, at least two kinds of additional knowledge are necessary: lexical knowledge and knowledge of other gap-creating rules besides the wh-transformation. Lexical knowledge can be further broken down into two kinds: knowledge of the syntactic and semantic properties of wh-words, and knowledge of verb

subcategorization. I will first give examples of each and then proceed to show how they collectively determine comprehension of wh-questions.

Properties of wh-words. Wh-words replace or stand in for phrases in a manner similar to the way pronouns replace or function as noun phrases. Like pronouns, wh-words do not refer to the same thing, person, or event in every sentence, and like pronouns, their possible reference is constrained by certain features of each word. A difference between wh-words and pronouns is that the reference of pronouns can be established by prior linguistic context while wh-words presuppose that the reference has not already been established (Culicover, 1976).

Wh-words have the following meaning components: (These are not intended to be formal definitions, only approximations to their meanings. The notation Q( ) expresses the fact that the terms enclosed in parentheses are queried.[5])

who	Q(someone)	why	Q(for some reason)
what	Q(some thing)	when	Q(at some time)
where	Q(some place)	how	Q(in some manner)

Wh-words differ not only in terms of their meanings but also in terms of the number and type of syntactic categories and relations they can replace. Table 1 summarizes the syntactic constituents wh-words can replace.

Table 1

Wh-Words and the Constituents They Replace

Wh-Word	Category/Relation	Sample Q	Sample A
Who	NP/Subj.,DO,IO, Obj. of a Prep.	Who did you see?	Jane
What	NP/(same as who)	What did you see?	a car
Where	PP,NP/Oblique Obj.	Where did he go?	to the store
	PP,NP/Adverb	Where did he eat?	at home
	NP/Obj of a Prep.	Where did he come from?	New York
Why	VP,PP/Adverb	Why did you go shopping?	to buy milk because I needed milk
When	PP,NP/Oblique Obj.	When did he leave?	at 2 o'clock
	PP,NP/Adverb	When did you eat?	" " "
How	Adj/Complement	How does he look?	good
	Adj/Adverb	How does he run?	fast
	PP/Adverb	How did you get to school?	by taking the bus
	PP/Instrumental Adverb	How did you cut yourself?	with a knife

Verb subcategorization. Verbs differ in terms of the number and type of syntactic contexts in which they can occur. For example, the verb eat is subcategorized as transitive. It can take a direct object. The verb go, on the other hand, is subcategorized as intransitive. It cannot take a direct object. Verbs like give can take both a direct object and an indirect object. In general, verb subcategorization specifies the syntactic contexts in which verbs can appear.

Other gap-creating rules. The wh-transformation is not the only transformation which creates a gap in a sentence. For example, in (3), there is a gap where the subject of the

(3) I want_ to go to the store

embedded sentence should be. Nevertheless, the subject of go is understood to be the same as the subject of want, namely I. This knowledge is captured by a transformational rule called EQUI-NP Deletion which deletes the subject of an embedded sentence when it is co-referential with a noun phrase in the higher sentence (Akmajian & Heny, 1975). This rule leaves a gap, as does the wh-transformation.

To demonstrate how these different kinds of knowledge interact in the comprehension of wh-questions, consider sentences (4)-(8).

(4) Who did the girl feed_?

(5) *Who did the girl go_?

(6) Where did the girl go_?

(7) When did the girl go_?

(8) Who did you want_ to leave(_)?

(4) and (5) demonstrate the role of verb subcategorization in comprehending wh-questions. These questions are identical except for the verb, yet (4) is grammatical while (5) is not. In (4), the verb feed obligatorily takes an animate object and since the only potential gap in the sentence (indicated by _) that who could fill follows the verb, who is interpreted as replacing the direct object. In (5), there is no potential gap that who could fill because go cannot take a direct object; thus (5) is ungrammatical.

(6) and (7) demonstrate the role of the lexical properties of the wh-word. These questions are identical except for the wh-word. The only potential gap in (6) and (7) follows the verb, but in (6) the constituent that would appropriately fill the gap is a locative phrase (either a prepositional phrase or a locative adverb), while in (7), the constituent must be a phrase or sentence indicating the time at which the activity took place (either a prepositional phrase, sentence or time adverb). These facts follow from the syntactic and semantic properties of where and when.

(8) demonstrates the interaction between verb subcategorization, the properties of wh-words, and knowledge of other gap-creating rules. (8) is ambiguous. Leave is a verb which is optionally subcategorized for taking a direct object. Under one interpretation of (8), there are two gaps in the sentence, one in place of the subject of leave and the other in place of the direct object of leave. Under this interpretation, who must fill the direct object gap since EQUI, the other gap-creating rule that must have applied in this sentence can only fill the subject gap. Under this interpretation, you want to leave someone and the question requests specification of who that someone is.

Under the second interpretation of (8), there is only one gap in the sentence in place of the subject of leave. The direct object is optional and on this interpretation, is not taken. Since there is only one gap, who must fill it and EQUI must not have applied. Under this interpretation, you want someone else to leave and the question requests specification of who is to leave.

(8) points up some important differences between the two gap-creating rules, EQUI and wh-movement. First, the gap created by EQUI can only be in place of the subject of an embedded sentence, whereas the gap created by wh-movement can occur in a variety of deep structure positions. This is why who can potentially fill both the subject and object

gaps in (8) but you can only fill the subject gap.

Second, if there is a wh-word in a sentence, there must also be a gap in the sentence. This is not, however, the case for EQUI: the presence of a NP in a higher sentence does not necessarily mean that there will be a subject gap in the embedded sentence. This is why, under the interpretation of (8) in which there is no direct object gap, who must fill the subject gap and EQUI must not have applied.

These examples illustrate the kinds of knowledge necessary for comprehension of wh-questions. They are each necessary but only jointly sufficient to account for the ability to comprehend the full range of wh-questions in English. The full range of wh-questions is emphasized because, for some questions, some of the knowledge is irrelevant. For example, knowledge of EQUI is irrelevant to the comprehension of single clause wh-questions. Notice, however, that even for single clause wh-questions both general syntactic information and specific lexical information are necessary for comprehension.

II. Children's Comprehension of Wh-questions

The data on children's comprehension of wh-questions suggest that the different kinds of linguistic knowledge necessary for full comprehension are acquired over time, and that the lack of some of this information limits

comprehension in systematic ways.

The most basic knowledge about wh-questions is that wh-words replace different constituents in the underlying structure. There seems to be an early stage in acquisition when children do not know this. Evidence comes from production and comprehension data. The first wh-questions that children produce are often unanalyzed routines such as What's that? and Where's NP? (Brown, 1968; Klima & Bellugi, 1966). In this early stage, there is no generality in the use of wh-words; what, for example, occurs only in sentences like What's that? but not in other questions. At this stage, comprehension is similarly limited. Klima & Bellugi report that children fail to comprehend varied what-object questions. These data suggest that children do not have a general understanding of the relation between a wh-word and a missing constituent.

Longitudinal data on spontaneous comprehension indicate that at some later point (Brown (1968) reports once MLU rises above 2.75), children appear to have more general knowledge of the relationship between a wh-word and a missing constituent as evidenced by their ability to answer varied wh-questions.[6] The responses indicate that children understand that a wh-word replaces various constituents, and that children can determine which constituent is being queried in many questions (examples from Klima & Bellugi,

1966):

Mother: Who were you playing with?

Child: Robin

Mother: What d'you hear?

Child: Hear a duck

Nevertheless, comprehension is still limited. Brown (1968) reports that children primarily answer questions involving who, what, and where, and these are answered correctly about 50 percent of the time.

Experimental studies of children's comprehension also suggest that once children have the general knowledge that wh-words stand in for missing constituents, there is a long period before a consistently high level of comprehension is attained on all wh-questions. What is the evidence at this stage that children have the general knowledge about wh-words and missing constituents? Children make certain comprehension errors which suggest that they have acquired the general knowledge but lack requisite lexical information about wh-words. Ervin-Tripp (1970) and Tyack & Ingram (1977) report that the youngest subjects in their studies (the youngest in Ervin-Tripp's study were 2;6; the youngest in Tyack & Ingram's study were 3;0) often answered wh-questions, particularly those involving why, when and how, by producing an incorrect constituent. For example, when asked Why is

the deer eating? or When will the deer eat?, children frequently answered incorrectly by producing a constituent that could be interpreted as the direct object of the verb. These constituent errors indicate that children know that wh-words replace missing constituents but do not know which type of constituent certain wh-words replace. This is constrained by the meanings of the wh-words. Children appear to learn the category membership of wh-words before they learn all the specific lexical information about the members of the class.

Constituent errors provide independent support for the claim made in the last section that knowledge that wh-words replace missing constituents, though necessary, underdetermines comprehension. The errors provide support for the claim that knowledge of the meanings of the wh-words is also necessary for comprehension. Without the knowledge that wh-words stand in for missing constituents, however, children could not make the errors in the first place.

In addition to the error data, evidence of the effect of the particular wh-word on comprehension comes from the frequency of correct comprehension for different wh-words. In general, when and how are the most difficult to comprehend; what and where are usually comprehended best, and who and why fall somewhere in between (Brown, 1968; Tyack & Ingram, 1977; Ervin-Tripp, 1970).

There is no satisfactory explanation of the order of difficulty of the wh-words. The argument has been made that the cognitive complexity of the concepts underlying the use of the terms determines the order of difficulty (Tyack & Ingram, 1977). No one, however, has provided an analysis of the conceptual content of the wh-words such that these are ranked in order of complexity. It is not clear why, for example, the concept of causality underlying use of why is less complex than the concept of time underlying use of when. It is clear that some conceptual understanding is necessary to comprehend the wh-words (i.e., in order to understand that why means for some reason, a child must have some notion of what a reason is), but it is not clear how the differences in conceptual content contribute to their differential complexity and, therefore, to their differential ease of comprehension. Despite the absence of a theory that explains the differences in difficulty of the wh-words, it is clear that the particular wh-word in a question affects ease of comprehension.

To summarize thus far, we have seen that at the first stage of comprehension, children do not appear to know the general relation between wh-words and missing constituents. Their knowledge is limited to holistic interpretations of certain wh-questions. At a later point, they appear to have the general knowledge but have difficulty comprehending

certain wh-questions because their knowledge of the properties of the individual wh-words is limited. These data support the earlier claims that the general knowledge underdetermines comprehension and that knowledge of the syntactic and semantic properties of wh-words is also necessary for comprehension.

There is also evidence in the literature on children's comprehension that the verb in a question affects comprehension. Tyack & Ingram (1977) report that there are within wh-word differences in comprehension depending on the type of verb in the question. They find, for example, that where questions involving intransitive verbs are easier to comprehend than where questions involving transitive verbs (94 percent correct response to the former, 67 percent correct response to the latter).

Their error data indicate that the verb determines which constituent the child produces when making a constituent error. Overall, incorrect constituents for transitive verbs were objects (e.g., producing food as an answer to When will the deer eat?). Incorrect constituents for intransitive verbs were usually locatives (e.g., producing here as an answer to When will the sailboat come?).

Although these observations suggest that transitivity of the verb is the factor determining differences between verbs in comprehension, on more careful examination of the

data, it appears that transitivity is not the relevant factor. Tyack & Ingram found verb by verb differences in frequency of correct response and in type of constituent error. For example, incorrect constituents for the transitive verb ride were most often locatives rather than objects. This suggests that aspects of the verb other than transitivity affect children's comprehension, aspects having to do with semantic properties of the verb. We will return to this issue below under the discussion of the lexical-expectation model.

Production data also suggest that semantic properties of verbs affect children's knowledge of wh-questions. Bloom (1978) and Wooten, Merkin, Hood & Bloom (1979) found that in the spontaneous speech samples of four children different populations of verbs occurred most frequently with different wh-words. What questions occurred most often with transitive verbs that take inanimate objects. Where questions occurred most often with verbs which Bloom calls locative action or state verbs (e.g., put, sit). How occurred most often with verbs that denote achievements and why with verbs that denote activities.

These differences suggest that the verb in a question influences which constituents may be more natural candidates for filling a gap in a wh-question. Semantic properties of a verb determine which constituent is most "expected" for

a verb. In the next section, a model for comprehension will be outlined which embodies the concept of an expectation.

III. The Lexical-expectation Model

Outline of the Model

The lexical-expectation model is an extension of a suggestion made by Fodor (1978) to account for her prediction that the gap in a sentence like (9) is easier to locate than in (10), and the gap in (11) is easier to locate than in (12).

(9) What did you read_ to the child?

(10) Who did you walk_ to the cafeteria?

(11) Who did you walk to the cafeteria with_?

(12) What did you read to the child about_?

Fodor argues that the gap in (9) is easier to locate than in (10) because listeners expect a direct object to follow read but do not expect an object to follow walk; walk is usually interpreted intransitively. The gap in (12) is more difficult to locate than in (11) because the listener is more likely to misinterpret (12) by falsely treating the post-verb position as the location of the gap. These predictions about ease of locating the gap follow from Fodor's judgments about the likelihood that different constituents will co-occur with different verbs. She suggests the following principle: the ease of detecting a gap created

by transformational removal of a constituent will be proportional to the expectation of that constituent in that location when no transformation has applied.

Fodor does not attempt to define what an expectation is or what properties of a verb determine expectations. The lexical-expectation model is an attempt to give substance to the notion of an expectation.

In a sentence, the verb can optionally be followed by a number of types of constituents or phrases. In our earlier terminology, verbs are subcategorized for occurring in a variety of phrase structure environments. For example, the verb eat can optionally be followed by a direct object (e.g., he ate the cake) or by a locative (e.g., he ate in the kitchen) or by a temporal adverb (e.g., he ate this morning) and so on. A lexical expectation is an estimate of which of these optional constituents is most likely to follow a verb.

The model claims that lexical expectations are based on properties of the semantic representations of verbs.[7] A semantic representation is the conceptual structure of a word. It is composed of components. A component of a semantic representation is a discrete, conceptual unit of meaning, which is necessary to explain certain semantic properties and relations such as antonymy, synonymy, entailment, and contradiction.

Some components of a semantic representation are arranged hierarchically. That is, some components are part of the internal structure of other components. For example, the semantic representation of the verb eat contains (among other components) the following components: "physical act," "object eaten," and "location." "Physical act" is a component because it is a contradiction to say He ate but he didn't perform a physical act. "Object eaten" is a component of the meaning of eat because to say He ate entails that he ate something. "Location" is also a component of the meaning of eat because to say He ate entails that he ate someplace.

The components "object eaten" and "location" are both subsumed by the component "physical act." They are both part of the internal structure of the component "physical act." They differ, however, in whether they are necessarily subsumed by the physical act component. "Object eaten" is not necessarily subsumed. Although the object eaten is part of the further specification of the physical act denoted by the verb, it is not necessary that because something is a physical act that an object is consumed. We will call components that are not necessarily subsumed by another component, non-redundant components. The term non-redundant is used because it refers to information that is not predicted on the basis of the

subsuming component.

The location component of the meaning of eat, on the other hand, is necessarily subsumed by the physical act component. This is because it necessarily follows from the fact that something is a physical act that the act takes place in space, and therefore, has location. In our example, since eat is a physical activity, it must take place in space. We will call components which are necessarily subsumed by other components, redundant components. Components are redundant in the sense that they are completely predicted on the basis of the subsuming component.

The model claims that lexical expectations are based on the following criterion:

> A constituent is expected for a verb if it specifies a non-redundant component of the semantic representation of a verb.

The criterion has two parts, both of which must be satisfied for a constituent to be expected for a verb. First, a constituent must specify a component of the semantic representation. Second, the component must be a non-redundant component; constituents specifying redundant components are not expected.

Below, the criterion for expected constituents is applied to arrive at a set of what, where, when, and how questions which query expected constituents, and a set of

questions with these wh-words which query constituents that are not expected. In the course of applying the criterion, I will draw on work that has been done on verb semantics (Katz, 1972; Schank, 1972; Miller & Johnson-Laird, 1976; Chafe, 1970; Fillmore, 1968). No one scheme for characterizing verb meaning will be adopted, however, because none of the systems are adapted for the purpose of determining lexical expectations.

What

What stands in for constituents denoting "some thing." The verbs for which what (where what queries the direct object of a verb) is expected are those whose meaning includes a non-redundant component specifying something acted upon or something resulting from an activity. The verbs for which what is not expected are those whose meaning does not include a component specifying something acted upon or resulting from an activity, thereby failing to satisfy the first part of the criterion. The verbs for which what queries an expected constituent correspond to verbs which require (semantically, not necessarily syntactically) cases which have been called Objective (Schank, 1972; Fillmore; 1968), Factitive (Fillmore, 1968), or Complement (Chafe, 1970). These cases have been described as "completing" the meaning of the verb (Fillmore, 1968; Chafe, 1970; Schank, 1972).

Verbs like eat, drink, read, and draw entail that

there is something eaten, drunk, read or drawn. Thus "something eaten, drunk," etc. is a component of the meanings of these verbs. The component is non-redundant because it is not predicted from any other component of the verbs' semantic representations.

There are other verbs, however, which may involve something acted upon but need not as a function of the verb's meaning. For these verbs, "something acted upon" is not a component of the semantic representation. This can occur for a variety of reasons. For example, the verbs move and turn have a reflexive sense. That is, you can move or turn something but you can also just move or turn. These verbs do not entail that some thing apart from the agent is acted upon. Since questions like What did you move? and What did you turn? query some thing which is not the agent, they query constituents that are not components of the semantic representations of move and turn.[8] Thus these questions do not query expected constituents because they fail to satisfy the first part of the criterion.

There are also verbs like stop and start which can take constituents denoting "some thing," where "some thing" refers to a physical object (e.g., I started the car, I stopped the check). These verbs differ from verbs like eat and drink, however, in that "some thing" can also refer to actions (e.g., I started playing the piano,

I stopped moving the furniture). For stop and start, then, "some thing," where "some thing" refers to a physical object, is not entailed by the verb and is thus not a component of the semantic representations. Questions like What did you stop? and What did you start? seem to query objects rather than actions; it is odd to answer What did you start? by saying playing the piano.[9] To query "something," where "some thing" refers to an action, one would ask What did you start doing? Thus since what in What did you start? and What did you stop? refers to a physical object, it does not query a constituent which is a component of the semantic representations of start and stop. Therefore, these questions do not query expected constituents.

In sum, the verbs for which a constituent queried by what is expected are those which entail something acted upon or resulting from an activity. For these verbs, "something acted upon" or "resulting from an activity" is a non-redundant component of the verbs' semantic representations.

Although the particular reasons differ from verb to verb, in general, the verbs for which a constituent queried by what is not expected are those verbs which do not have "something acted upon" or "resulting from an activity" as a component of their semantic representations. These verbs do not satisfy the first part of the criterion.

Where

Where stands in for constituents denoting the location, goal, direction or path of an activity. Two kinds of locative constituents can be distinguished: "location$_1$" which is a redundant component of the meanings of some verbs, and "location$_2$" which is a non-redundant component of the meanings of some verbs. "Location$_1$" is a component of the meanings of all verbs which denote physical activities; it is the spatial location in which an activity takes place. Since it necessarily follows that all physical activities have spatial location, "location$_1$" is a redundant component of the meanings of all physical activity verbs, and hence will not be an expected constituent for any verb.

For a subset of physical activity verbs, there is an additional sense of location, "location$_2$". "Location$_2$" is a part of the definition of the physical activity itself. That is, for some verbs, the activity denoted by the verb involves moving from one location to another (e.g., go, walk, ride, run), or involves resting or placing in some location (e.g., put, sit). For these verbs, location is a non-redundant component of the verbs' meanings; "location$_2$" does not necessarily follow from the fact that the verbs denote physical activities. For example, it is not a necessary consequence of the fact that go is a

physical activity that go means change of location.

"Location$_1$" and "location$_2$" specify different aspects of a verb's meaning. For example, in the sentence, In New York, I went to the movies, In New York specifies "location$_1$," the spatial location of the activity (i.e., the redundant component); to the movies specifies "location$_2$," the direction component of the meaning of go (i.e., the non-redundant component).

The verbs for which location is expected are those which have "location$_2$" as a component of their meanings. These verbs satisfy both parts of the criterion for expected constituents: location is a component of the verbs' meanings and is a non-redundant component. Location is not expected for verbs which only have "location$_1$" as a component of their meanings (e.g., eat, drink, read). This is because verbs which only entail "location$_1$" do not satisfy the second part of the criterion: location is not a non-redundant component of their meanings.

The distinction between verbs for which "location$_2$" is a component, and verbs for which only "location$_1$" is a component, has been drawn in other ways by differnt investigators. All of the ways of drawing the distinction (including the one outlined here) attempt to account for the fact that some locative phrases are more closely connected to the verb than others. The distinction has

been made at the syntactic level by Chomsky (1965), Fillmore (1968) and Miller & Johnson-Laird (1976), and at the conceptual level by Schank (1972).

Chomsky makes the distinction between locatives generated within the verb phrase (VP) and locatives generated outside the VP. The latter are generated within what Chomsky calls the Predicate Phrase, which expands, AUX VP (PLACE) (TIME). Locatives generated within the VP have greater "cohesion" with the verb and are more highly restricted in terms of the prepositions they can include. Locatives generated outside the VP modify the sentence as a whole. Miller & Johnson-Laird similarly distinguish between predicate and sentence adverbials. Fillmore proposes that some locatives are generated within the Propositional component of the sentence (i.e., the set of relationships between nouns and verbs), and others are generated within the Modality component (i.e., modifiers of the sentence as a whole such as tense, mood, aspect and negation). This view is similar to Chomsky's and Miller & Johnson-Laird's in that some locatives are in close relation to the verb while others are modifiers of the sentence as a whole.

Schank draws the distinction at the conceptual level. He distinguishes between the Directive case which is a

property of certain verbs, most notably those which express motion, and Location which is a property of conceptualizations as a whole and not a property of particular acts.

Schank's distinction at the conceptual level parallels the distinctions made by Chomsky, Fillmore and Miller & Johnson-Laird at the syntactic level. Although all of the characterizations attempt to account for the fact that some locatives seem to be in closer connection with the verb than others, none of them provide any criteria by which to decide which locatives fall into the "closely connected" category and which do not. For example, Chomsky gives no principle for deciding which locatives are generated within the VP and which are generated outside the VP. Similarly, Fillmore gives no principle for deciding which locatives are generated within the Propositional component and which are generated within the Modality component. The account proposed here attempts to provide such a principle, namely that locatives are more closely connected with the verb if they specify non-redundant components of the verb's meaning. Where questions query expected constituents for those verbs for which the locative is a non-redundant component of the verbs' semantic representations.

When

When stands in for constituents denoting "at some time."

Verbs which denote punctual actions or states, such as finish, start, leave, arrive, wake up, include the component "at some moment x," as part of their meanings (Miller & Johnson-Laird, 1976). For example, finish means that at some moment x, some action, state or event is completed. Wake up means that at some moment x, someone is no longer asleep.

Other verbs, such as draw, write and sleep take place in time because they are physical actions or states. However, a particular moment in time is not part of their meanings. For these verbs, time is a redundant component because it is a necessary consequence of the fact that these verbs denote physical actions or states. A time phrase (and, therefore, a when question) is only expected for verbs which have a particular moment in time as a non-redundant component of their meanings.

How

How stands in for constituents denoting "in some manner." How differs from the other wh-words in that its interpretation is more variable; the specification of manner appropriate to answering a how question varies from verb to verb.

There are at least three different ways in which how can be interpreted. Interpretation 1 is that how requests specification of an instrument. For example, How did you

cut the cake? could be answered by with a knife. Interpretation 1 is usually selected for verbs like cut, draw and write, which entail instruments.

Interpretation 2 is that how requests specification of the action performed. For example, How did you help her? could be answered by specifying the nature of the action by which someone was helped, e.g., I carried her packages. Interpretation 2 is usually selected for verbs in which the nature of the action is unspecified, namely verbs like help and make.

Interpretation 3 is that how requests specification of some qualification on the usual manner in which an action is performed. For example, a question like How did you read it? could be answered by I read it slowly and carefully. Such a question would not receive Interpretation 2 (e.g., answering with I moved my eyes across the page) because the nature of the action is already given by the meaning of the verb. Verbs like read usually select Interpretation 3 because they neither entail instruments nor are unspecified as to the nature of the action performed.

The verbs for which how queries expected constituents can only be those which select Interpretations 1 and 2. For verbs like cut and draw, which select Interpretation 1, how can query an expected constituent because these verbs entail instruments. The constituent specifying the

instrument is thus a non-redundant component of the meanings of these verbs, and satisfies both parts of the criterion.

For verbs like help and make, which select Interpretation 2, how can also query an expected constituent. These verbs entail that some unspecified action is performed. Since the activity component is a non-redundant component of the meanings of these verbs, it is an expected constituent. Since a how question can query the action performed, it can query an expected constituent for these verbs.

For verbs which select Interpretation 3, such as read, a how question cannot query an expected constituent. This is because qualifications on the manner in which an action is performed are never entailed by a verb; such qualifications are never components of the meaning of a verb. Thus they do not satisfy the first part of the criterion.

In sum, how queries an expected constituent for verbs which have an instrument as a non-redundant component of their meanings (verbs which select Interpretation 1), and for verbs which have an unspecified action as a non-redundant component of their meanings (verbs which select Interpretation 2).

Why

Why stands in for constituents specifying "for some reason." There are no verbs for which a constituent specifying a reason is a component of the verbs' meanings (i.e., to say He 'verbed' never entails that he verbed for

some reason). Thus there are no verbs which satisfy the first part of the criterion. Therefore, there ought to be no verbs for which why questions are expected. Constituents queried by why thus differ from the constituents queried by the other wh-words.

There may, however, be non-semantic factors which contribute to lexical expectations. For example, although a reason is not entailed by the meanings of verbs like cry, laugh or smile, it may be more natural to inquire about the reasons for these activities because they reflect emotional states whose causes are not habitual or self-evident. Why questions might thus be expected for verbs whose cause is less predictable. If so, the lexical expectations for why questions have a different, non-semantic, basis from the expectations for the other wh-words. According to the criterion, however, there are no expected constituents for why.

To summarize, expected constituents are those which specify non-redundant components of the semantic representations of verbs. By this criterion, there are expected constituents for what, where, when and how, but not for why. There may, however, be non-semantic factors which affect expectations, in which case, why may also query expected constituents for some verbs.

Pilot Data

To test the criterion for expected constituents, the following pilot experiment was performed. A list of thirty-nine question frames of the form __ did you 'verb' (NP)? were compiled. A sample of the question frames used is shown in (13). (See Appendix A for the complete list.)

(13) a. __did you sit?

b. __did you help her?

c. __did you read?

d. __did you leave?

Fifteen adults were asked to fill in the blank with one of the following question words, what, where, when, how and why. They were then asked to make up an appropriate answer to the question.

Subjects strongly preferred certain wh-words for certain verbs. Table 2 presents the four verbs most frequently chosen by subjects for each wh-word, and the four verbs which were least often chosen for each wh-word. As Table 2 shows, subjects' choices concurred with the types of verbs predicted by the criterion. The verbs for which what was chosen most frequently were verbs that have "something acted upon" or "resulting from an activity" as a non-redundant component of their semantic representations. The verbs for which where was most often chosen were those denoting change of location and resting in a

Table 2

Percentage of Subjects Choosing Wh-words for Different Verbs

	What		Where		When		How		Why	
Frequently Chosen	read	.73	ride	.47	start	.47	help her	.47	cry	.80
	write	.87	walk	.67	leave	.73	draw it	.47	wave	.80
	eat	.67	go	.73	finish	.73	make it	.60	smile	.87
	drink	.93	sit	.73	wake up	.73	cut it	.60	laugh	.87
	$\bar{x}$	.80	$\bar{x}$	.65	$\bar{x}$	.62	$\bar{x}$	.53	$\bar{x}$	.83
Infrequently Chosen	move	.07	draw	.00	laugh	.00	read it	.00	sing	.07
	whistle	.20	write	.00	go	.00	eat it	.00	walk	.13
	finish	.20	wave	.00	make it	.13	drink it	.07	write	.07
	start	.20	cry	.00	run	.07	drop it	.20	draw	.07
	$\bar{x}$	.17	$\bar{x}$	.00	$\bar{x}$	.05	$\bar{x}$	.07	$\bar{x}$	.08

location. These are verbs which have "location$_2$" as a non-redundant component of their meanings. The verbs for which _where_ was chosen were both transitive and intransitive. _Where_ was infrequently chosen for verbs which have "location$_1$" as a redundant component of their semantic representations. These verbs were also both transitive and intransitive. These data support the claim that transitivity is not the relevant factor in determining lexical expectations.

The verbs for which _when_ was most often chosen were, as predicted, verbs whose meaning includes the non-redundant component, "at some moment x." _How_ was most often chosen for verbs whose meaning includes the non-redundant component "action," e.g., _help_ and _make_, and for verbs that have the non-redundant component "instrument," e.g., _cut_ and _draw_.

Subjects' answers to _how_ questions for the four most frequently chosen verbs followed the predictions for the most part. One hundred percent of the answers to questions involving the verb _help_ were specifications of the nature of the activity (e.g., _I fed her cats_, _I carried her books_). For _make_, however, rather than answering by specifying the nature of the activity 67 percent of subjects specified the material out of which "it" was constructed (e.g., _with wood_, _with papier maché_.

For cut, 78 percent of the answers involved specifying the instrument (e.g., with a knife, with scissors). For draw, 71 percent of the answers involved specifying an instrument (e.g., with a pencil, with charcoal).

Three of the four verbs for which why was most often chosen are verbs which denote behaviors which reflect emotional states. This could occur for two reasons: (1) why is chosen because, for verbs reflecting emotional states, the cause for the activity is not self-evident, or (2) why is chosen because there is no other constituent expected for these verbs and why is plausible to ask about any verb.

There are two pieces of evidence for the second explanation. First, when there was no expected constituent, as in questions like __did you wave? or __did you eat it?, why was the most frequently chosen wh-word. Second, when there was an expected constituent for a verb, why was usually the second most frequently chosen wh-word. Thus why, unlike the other wh-words, seems to be a question which is plausible to ask about any verb and is used less selectively than the others.

Nevertheless, from the pilot data, one cannot decide between the two explanations. The comprehension study described in the next two sections provides data relevant to deciding between the two alternatives.

In sum, the pilot data support the criterion for expected constituents. What, where, when and how were most frequently chosen for those verbs whose semantic representations include a non-redundant component queried by one of these wh-words. What was chosen most often for verbs whose meanings include the non-redundant component "something acted upon" or "something resulting from an activity"; where was most often chosen for verbs which include the non-redundant component, "location$_2$"; when was most often chosen for verbs which include the component, "at some moment x"; how was most often chosen for verbs which include either the component "action" (where "action" is not further specified), or the component "instrument." Why was most often chosen for verbs reflecting emotional states. The reason for this is unclear. The data from the comprehension study described below provide relevant data for deciding between the two alternative hypotheses about why why was chosen.

Predictions for Children's Comprehension

The lexical-expectation model claims that once a child knows the meaning of a verb, s/he has the lexical expectations associated with that verb. The model further claims that, at an intermediate level of mastery of wh-questions, when children have acquired the general knowledge that wh-words replace missing constituents but have not yet

acquired all the specific lexical information about wh-words, lexical expectations affect children's comprehension of wh-questions. The model makes the following predictions about children's comprehension:

Prediction 1. Correct performance will be better on questions which query expected constituents than on questions which query not-expected constituents.

Prediction 2. Constituent errors, i.e., errors involving producing an incorrect constituent for a verb, will be more frequent on questions which query not-expected constituents.

If children are uncertain about the lexical properties of a wh-word, they will be unable to determine the missing constituent from the wh-word in the question, and they should use the lexical expectations for a verb to determine the missing constituent. For questions which query not-expected constituents, using lexical expectations to determine the missing constituent will result in an error; the child will produce an incorrect constituent as an answer. For questions querying expected constituents, however, using lexical expectations to determine the missing constituent will result in a correct response. Thus constituent errors should be more frequent on questions which query not-expected constituents.

Prediction 3. When the child makes a constituent error,

the incorrect constituent that the child gives will be the expected constituent for the verb.

Using lexical expectations to determine the missing constituent in a question will result in production of the expected constituent for a verb.

Prediction 4. Constituent errors on questions which query not-expected constituents should be less frequent the more a child knows about the lexical properties of a wh-word.

The more the child knows about the lexical properties of wh-words, the less the child will need to rely on lexical expectations to determine the missing constituent in a wh-question. Since using lexical expectations leads to constituent errors on questions which query not-expected constituents, the less the child needs to rely on lexical expectations, the fewer should be the constituent errors on those questions.

In the next few sections, an experiment is described which tests the predictions of the lexical-expectation model.

IV. Method

Subjects

Subjects were twenty children ranging in age from 2;1 to 2;10 (mean age, 2;5). There were thirteen girls and

seven boys. MLUs ranged from 2.36 to 5.11 morphemes (mean MLU, 3.71 morphemes). Children were included in the experiment if they satisfied the following conditions: (1) they gave evidence of comprehending all of the verbs in the experiment, as measured by their spontaneous comprehension and by their performance on the verb pretest described below, and (2) they answered (either correctly or incorrectly) at least 25 percent of the questions on the comprehension task, but did not answer all of the questions correctly.

A total of twenty-four children were seen at least once. Four children were excluded because they did not satisfy some of the above criteria.

Children were recruited through personally contacting mothers living in Manhattan, by referral from other mothers, and by responses to notices placed in apartment buildings and nursery schools. The children were, for the most part, from families in which one or both of the parents were professionals.

Materials and Procedure

The experiment was conducted in the child's home with the mother present for at least the elicitation task and, sometimes, for the entire duration of the experiment. At least two sessions, each lasting approximately one hour, were scheduled per child. For some children, a third

session was necessary. During the sessions, three tasks were performed with the children: (1) a verb pretest designed to assess whether children knew the meanings of the verbs used in the experiment, (2) an elicitation task designed to elicit production of wh-words, and (3) a comprehension task designed to assess the effect of the verb on comprehension.

The verb pretest consisted of instructions to act out all of the verbs used in the comprehension task. Table 3 lists the verbs used. The experimenter began informally by saying to the child, "I'd like to see you do some things. Can I see you run?" If the child then ran, s/he was credited with knowing the meaning of run. When the child's action was ambiguous or incorrect (e.g., walking instead of running), the request to perform the action was repeated. Where possible, verbs were uttered in isolation, without other accompanying verbal context (e.g., sit but not sit on the chair). This was done to insure that the child understood the verb itself, and was not using contextual information to interpret the verb. Occasionally a verb was used in spontaneous conversation, and the child responded in a manner that indicated s/he knew the meaning of the verb. In such cases, the child was also credited with knowing the meaning of the verb. For example, a child who was drawing might spontaneously label his/her

Table 3

Verbs Used in the Comprehension Task

	What	Where	When	How	Why
Expected	read	go	leave	help	smile
	paint	ride	stop	make	cry
	eat	sit	wake up	cut	laugh
	drink	drive	start	draw	yell
Not-Expected	stop	paint	go	read	walk
	start	cry	help	drive	draw
	yell	wave	laugh	eat	cut
	move	wake up	run	sit	sing

activity or a child who was drinking milk might, when asked What are you doing?, say I'm drinking milk.

The elicitation task consisted of requests to ask mommy various questions. The experimenter usually began by saying, "Will you ask mommy ..." The number of elicitation items varied from child to child, but in general, the items were designed to elicit what, where, when, how and why questions. The mean number of elicitation items per child was sixteen (what, 3.37; where, 5.67; when, 3.79; how, 3.74; why, 2.42). Examples of elicitation items are listed in (14):

(14) Ask mommy
the thing you'll eat for dinner (what)
the place you're going to (where)
the time daddy will come home (when)
the way to turn off the tape recorder (how)
the reason she cries sometimes (why)

In place of each of the wh-words is a noun phrase which expresses its meaning. If the elicitation task measures children's understanding of the meaning of the wh-words then ability to substitute the correct wh-word for the noun phrase is evidence that the child knows the meaning of the wh-word.

Typically, the verb pretest and elicitation tasks were given in the first session, preceded by a familiarization

period in which the child and experimenter played together. The verb pretest and elicitation tasks were rarely performed in their entirety at one time; the experimenter usually alternated between the two until both were completed. Frequently, more elicitation items were given in the second and third sessions.

The comprehension task consisted of forty pictures depicting various events. The child was asked one question about each picture. There were eight questions for each of the five wh-words, what, where, when, how, and why. Of the eight questions for each wh-word, four queried expected constituents and four queried not-expected constiuents.[10] Figures 1 and 2 present sample pictures from the comprehension task; Table 3 presents the verbs used, the wh-words they appeared in conjunction with, and whether the question queried an expected or not-expected constituent for each verb. Appendix B presents all of the questions and all of the pictures used in the comprehension task.

A total of twenty-five different verbs were used in the comprehension task. Fifteen of the verbs appeared in two questions. In one of the questions, an expected constituent was queried; in the other question, a not-expected constituent was queried. The remaining ten verbs appeared in only one question. For five of them, an expected constituent was queried; for the other five, a non-expected

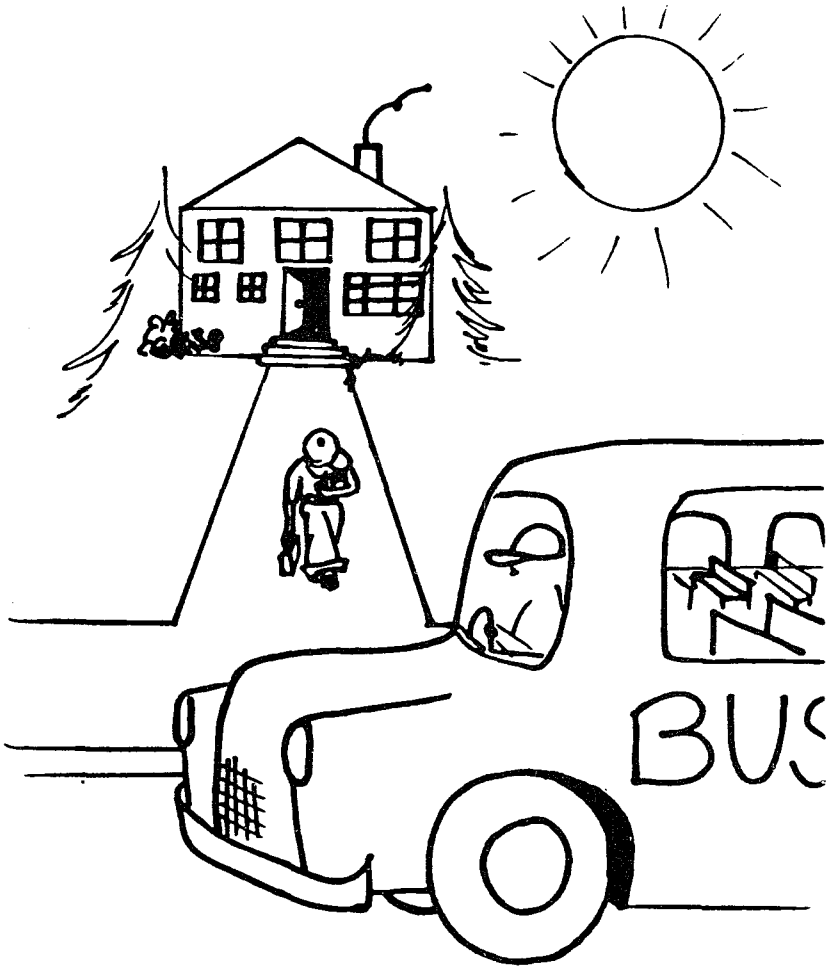


Figure 1. Picture used for the question When did the boy go?

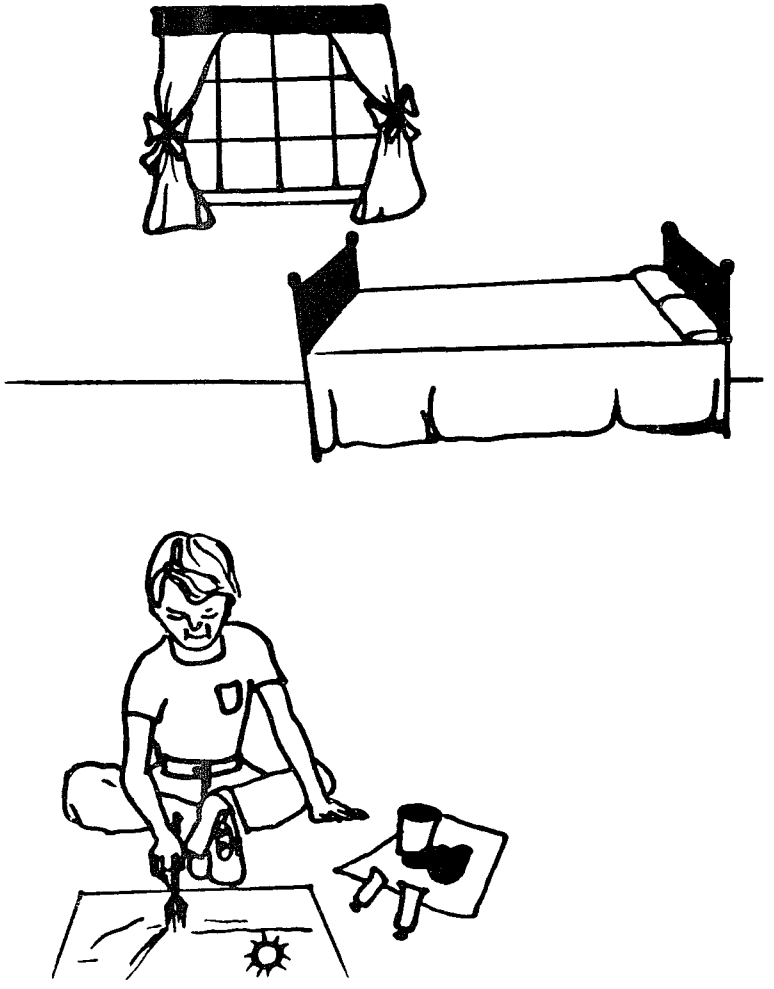


Figure 2. Picture used for the question Where is the boy painting?

constituent was queried. The ideal situation would have been to use twenty different verbs, each appearing in one expected and one not-expected question. However, it was difficult to find a plausible not-expected question for all twenty verbs used in expected questions. It was, therefore, necessary to use some new verbs in not-expected questions (e.g., sing, wave, run, move, and walk).

In addition, some of the verbs occurred in the past tense while others occurred in the present progressive. This was done in order to maximize the naturalness of the questions. Subsequent analyses revealed no differences between questions in the past tense and questions in the present progressive.

In where questions, four of the eight verbs were transitive (ride, drive, wave, and paint), and four were intransitive (cry, sit, go, and wake up). For two of the transitive and two of the intransitive verbs, an expected constituent was queried; for the other two transitive and intransitive verbs, a not-expected constituent was queried. Where questions were designed in this way to test Tyack & Ingram's hypothesis that locatives are expected for intransitive but not for transitive verbs, thus making intransitive where questions easier to comprehend than transitive where questions.

An unavoidable effect of using pictures in the compre-

hension task was that they varied in terms of whether the answers to the questions which were asked about them were depicted. A picture was said to depict the answer if, by simply labeling an object, set of objects, or event in the picture, the question could be correctly answered. For example, the correct answer to Where is the boy painting? is depicted in Figure 2 because floor and bedroom are objects that could be labeled in the picture and would be adequate as answers to the question. Out of a total set of forty pictures, twenty-six depicted the answer. Fourteen of these pictures accompanied questions which queried expected constituents[11] and twelve accompanied questions which queried not-expected constituents.[12]

A picture was said to not depict the answer if an inference from the picture was necessary in order to answer the question correctly. For example, in Figure 1, the sun is prominently displayed. Merely answering by labeling the sun, however, is not a sufficient answer to the question. The child must infer from the presence of the sun that it is daytime in order to answer the question. Out of the set of forty pictures, fourteen did not depict the answer. Of these, six pictures accompanied expected questions[13] and eight accompanied not-expected questions.[14]

To insure that depictability of the answer by the picture did not bias the results of the comprehension task,

separate analyses were made of questions whose answers were depicted and questions whose answers were not depicted.

Unavoidably, pictures also varied in terms of how many constituents were depicted in them. For example, in Figure 2, the location of the boy painting is depicted and so is the thing that the boy is painting. Thus the picture depicts the expected constituent (the object painted) and a not-expected constituent (the location). Other pictures depicted two not-expected constituents, while still others depicted only one constituent, either an expected or a not-expected one. To determine whether children randomly responded by picking whatever was depicted in the picture, separate analyses were performed on each question which depicted two constituents. If children consistently pick one constituent over the other, then response choice cannot be attributed to a bias in the pictures.

The comprehension task was usually performed in the second and third sessions. The experimenter introduced the task by saying, "I've brought some pictures. Would you like to look at them?" Then the experimenter and child proceeded to go through the pictures. Before asking each question, the experimenter usually said something about the picture, being careful not to provide any information relevant to answering the question. This was done in order to make the task more natural, and more consonant with the

child's usual experience of looking at pictures. For example, prior to asking When did the girl laugh?, the experimenter might say, "Oh look, there's a little girl and she's laughing."

Questions which the child failed to answer on the first try were repeated several times before going on to the next question. At the end of the forty items, questions which the child failed to answer were repeated once more.

Design

The data from the comprehension task were scored as follows: each child's responses were categorized as correct or incorrect. A correct response was one in which a child produced a semantically appropriate constituent. The constituent produced did not have to be the one depicted in the picture (if the answer was depicted). For example, although Figure 2 depicts a bedroom, if the child answered Where is the boy painting? by saying in school, the response was scored as correct. This is because, for the purposes of testing the predictions of the lexical-expectation model, it is only important that children know the types of constituents that are semantically appropriate for a verb, and not necessarily contextually appropriate.

All incorrect responses were categorized by type. The errors were classified as follows: (1) constituent errors, i.e., the child produces an incorrect constituent

(Q: Where is the boy painting? A: a picture); (2) imitation, i.e., repetition of all or some portion of the question without additions or substitutions (Q: When did the boy go? A: boy go); (3) routine, i.e., a phrase used repeatedly and indiscriminately without regard to the form of the question (answering with because she wanted to for a variety of questions); (4) label, i.e., description or label of some portion of the picture which is not an answer to the question (Q: Why is the baby laughing? A: Baby has clothes on); (5) asks a question (Q: Where is the boy painting? A: Why?); (6) rejects presupposition (Q: When did she laugh? A: She crying); (8) extraneous, i.e., child makes an irrelevant comment.

The errors of special interest to the model are constituent errors. Therefore, only constituent errors were included in the error analyses. Constituent errors were categorized as either Type E or Type NE. Type E errors are those in which the child produces the expected constituent for a verb; Type NE are those in which the child produces a not-expected constituent.

Each child received a correct score between 0 and 4 and a constituent error score between 0 and 4 for expected and not-expected questions for each wh-word. In all analyses, only the child's first response to a question was used, regardless of whether it was a response to the first time

a question was asked or a response to a later repetition of the question.

The correct data and the constituent error data were analyzed in separate two-factor repeated measure analyses of variance. Factors were Wh-word (five levels) and Expectation (two levels), both within-subjects factors. These data were also analyzed treating items as the random effect, and minF' statistics were obtained (see footnote 15).

Several control analyses were performed to insure that the pictures in the comprehension task did not bias the children to respond in certain ways. Two one-factor repeated measure analyses of variance were performed, one for questions whose answers were depicted, and one for questions whose answers were not depicted. Expectation (two levels) was the within-subjects factor in these analyses. In addition, chi square tests were performed for each question in which two constituents were depicted.

The elicitation data were categorized by type of response and the proportion of responses in each category calculated. Responses were categorized as follows: (1) answer, i.e., instead of asking the mother a question, the child answers it (Q: Ask mommy the thing you'll eat for lunch A: peanut butter and jelly); (2) imitation (A: thing for lunch) or imitation plus rising intonation (A: thing for lunch?); (3) wh-substitution, i.e., substitutes

what for the thing, where for the place, and so on; (4) other-substitution, i.e., substitutes what thing for the thing, what place for the place; (5) yes-no question (A: Are you eating lunch?); (6) tell, i.e., repeats some portion of the question as a command (A: eat lunch!).

On the assumption that the ability to make wh-substitutions is an independent measure of knowledge of the meanings of wh-words, the proportion of wh-substitutions for each wh-word was correlated with the correct scores for that wh-word in the comprehension task. Further comparison of the two tasks was made by dividing subjects into two groups: one group was composed of the ten highest scorers on the comprehension task; the other was composed of the ten lowest scorers. Two Fisher Exact tests, one comparing the two groups on the proportion of imitation in the elicitation task, and one comparing the two groups on the proportion of wh-substitutions in the elicitation task, were performed.

V. Results

Comprehension Task

Prediction 1 of the model is that correct performance will be better on questions which query expected constituents. Table 4 presents the mean number of correct responses in the comprehension task on questions querying expected

Table 4

Mean Number of Correct Responses on Expected and Not-Expected Questions for Each Wh-word

	Expectation		
Wh-word	Expected	Not-Expected	$\bar{X}$
What	3.7	2.3[a]	3.0
Where	3.6	3.1[b]	3.25
When	1.3	0.7[c]	1.0
How	2.1	2.0	2.05
Why	1.3	1.2	1.15
$\bar{X}$	2.4	1.9	

Note. Maximum score = 4.

[a] E > NE $p < .001$

[b] E > NE $p < .05$

[c] E > NE $p < .01$

constituents and on questions querying not-expected constituents for each wh-word. An analysis of variance confirmed a significant main effect of Expectation, minF' (1,42)=5.38, $p < .05$ ($F_1(1,19)=28.81$, $p < .001$; $F_2(1,30)=6.62$, $p < .05$). Questions in which an expected constituent was queried were answered correctly more often than questions in which a not-expected constituent was queried.

Seventeen of the twenty children responded correctly more often on questions which queried expected constituents. Two children responded equally well to questions querying expected constituents and questions querying not-expected constituents. Only one child performed better on questions querying not-expected constituents.

The main effect of Wh-word was also significant, minF'(4,56)=13.39, $p < .001$ ($F_1(4,76)=46.36$, $p < .001$; $F_2(4,30)=18.83$, $p < .001$). Post hoc tests using the Newman-Keuls procedure (Winer, 1962) revealed the following order of difficulty for the wh-words: where < what < how < why = when. Although minF' for the interaction between Expectation and Wh-word was not significant, F_1 for the interaction was significant, $F_1(4,76)=6.02$, $p < .001$. Subsequent one-way analyses of variance revealed that, for what, where, and when, performance on questions querying expected constituents was better than performance on questions querying not-expected constituents (for what,

$F(1,19)=32.67$, $p < .001$; for where, $F(1,19)=5.59$, $p < .05$; for when, $F(1,19)=7.12$, $p < .01$). For how and why, however, there was no significant difference between questions querying expected constituents and questions querying not-expected constituents. The status of this interaction is unclear, however, since significance was only obtained on F_1.

Table 5 presents the proportion of different types of comprehension errors. Constituent errors, i.e., producing an incorrect constituent, were the most frequent type, accounting for 26 percent of the errors. Imitations, i.e., repeating all or some portion of the question without additions or substitutions, were next most frequent, accounting for 17 percent of the errors.

Prediction 2 of the model is that constituent errors will be more frequent on questions which query not-expected constituents. Table 6 presents the mean number of constituent errors for expected and not-expected questions for each wh-word. An analysis of variance confirmed a significant main effect of Expectation, minF'(1,37)=8.83, $p < .01$ ($F_1(1,19)=81.98$, $p < .001$; $F_2(1,30)=9.89$, $p < .001$). Questions which queried not-expected constituents produced more constituent errors than questions which queried expected constituents. The effect of Wh-word was significant, minF'(4,46)=4.53, $p < .01$ ($F_1(4,76)=22.29$, $p < .001$;

Table 5

Types of Comprehension Errors

Type of Error	Proportion
Constituent Error	.26
Imitation	.17
Routine	.10
Label	.09
Asks Q	.03
Rejects Presupp.	.03
Extraneous	.12
Don't Know	.09
No Response	.12

Key

Constituent Error = child produces an incorrect constituent

Imitation = repeats all or some portion of the question without additions or substitutions

Routine = phrase used repeatedly and indiscriminately by child in answer to questions (e.g., because she wanted to as answer to a variety of questions

Label = describes or names some object or event in the picture which is not an answer to the question (e.g., Q: Why is the baby laughing?, A: Baby has clothes on

Asks Q = asks a question back

Rejects Presupp. = e.g., Q: When did she laugh?, A: She crying

Extraneous = irrelevant comment (e.g., Q: What did the policeman stop?, A: The post office, the post office)

Table 6

Mean Number of Constituent Errors on Expected and Not-Expected Questions for Each Wh-word

	Expectation		
Wh-word	Expected	Not-Expected	$\bar{X}$
What	.00	.25[a]	.13
Where	.00	.25[a]	.13
When	.35	1.85[b]	1.10
How	.15	.20	.18
Why	.20	.80[b]	.50
$\bar{X}$	.14	.67	

Note. Maximum score = 4.

[a] NE > E $p < .01$

[b] NE > E $p < .001$

$F_2(4,30)=5.69$, $p < .001$). Constituent errors were most frequent for *when*, followed by *why*, which in turn produced more errors than *what*, *where* and *how*, which did not differ from each other. *MinF'* for the interaction between Wh-word and Expectation was not significant, though F_1 was, $F_1(4,76)=14.17$, $p < .001$. Subsequent one-way analyses of variance revealed that for *what*, *where*, *when* and *why*, constituent errors were more frequent on questions which queried not-expected constituents, while for *how*, there was no difference (for *what*, $F(1,19)=6.33$, $p < .01$; for *where*, $F(1,19)=6.33$, $p < .01$; for *when*, $F(1,19)=37.17$, $p < .001$; for *why*, $F(1,19)=15.55$, $p < .001$).

Prediction 3 of the model is that when the child makes a constituent error on not-expected questions, the constituent produced should be the expected constituent for a verb. Constituent errors can be of two types: (1) Type E errors, i.e., giving as an answer an expected constituent for a verb, and (2) Type NE errors, i.e., giving as an answer a not-expected constituent for a verb. Table 7 presents examples of both types of errors. Prediction 3 can only be tested on those questions where it is possible to make both a Type E and a Type NE error. This excludes questions which query expected constituents because it is impossible to make a Type E error, and it excludes questions in which the verb has no expected constituent(s), again because it

Table 7

Sample Constituent Errors

Type E Errors	Type NE Errors
1. Adult: When did the little boy go?	1. Adult: How did the girl help?
Child: go in house	Child: when she's not feeling well
2. Adult: Where is he painting?	2. Adult: Why is the baby laughing?
Child: sun	Child: laughing on the bed
3. Adult: Why did she draw?	3. Adult: When did the truck stop?
Child: with a crayon	Child: outside

is impossible to make a Type E error. There were thirteen questions querying not-expected constituents in which it was possible to make both a Type E and a Type NE error. (For seven of the not-expected questions, it was not possible to make a Type E error because the verbs had no expected constituents.) Prediction 3 was tested on these thirteen questions.

The mean number of Type E errors on the thirteen questions was 2.6, while the mean number of Type NE errors was .55. This difference was significant, $\underline{\text{minF'}}(1,21)=4.46$, $\underline{p} < .05$ ($\underline{F}_1(1,19)=16.47$, $\underline{p} < .001$; $\underline{F}_2(1,12)=6.12$, $\underline{p} < .05$).

Nineteen of the twenty children made at least one Type E error (range- 1 to 5). Only one child failed to produce any Type E errors. Sixteen of the twenty children made more Type E errors than Type NE errors. Three children made equal numbers of Type E and Type NE errors. One child made neither type of error.

Tyack & Ingram's hypothesis that transitivity of the verb affects comprehension was examined in where questions. If their hypothesis were correct, where questions involving intransitive verbs should be easier to comprehend than where questions involving transitive verbs. The mean number correct for both transitive and intransitive verbs was 3.30. Thus there was no difference between transitive and intransitive where questions.

Control Analyses. To insure that the superior performance on expected questions, and the higher frequency of Type E errors on not-expected questions, was not due to a bias in the pictures used in the task, the following two sets of analyses were performed:

Analysis 1: Depicted and not depicted questions. Questions in which the correct answer was depicted in the picture were analyzed separately from questions in which the correct answer was not depicted in the picture. Frequency of correct response was the dependent measure in each analysis. Only what, where and when questions were included in these analyses for the following reasons: first, performance on expected questions appeared superior to performance on not-expected questions only for these wh-words. Second, how questions were excluded because there were unequal numbers of expected and not-expected how questions that fell into the depicted and not depicted categories. Including how questions would have produced a confounding between Expectation and Wh-word since the expected and not-expected categories would have been composed of different proportions of the different wh-words.

Seventeen what, where and when questions depicted the correct answer. There were nine expected questions and eight not-expected questions. For the nine expected questions, mean percent correct was 83.5. For the eight

not-expected questions, mean percent correct was 68.4. Eighteen of the twenty children performed better on the expected than on the not-expected questions. This difference was significant, $F(1,19)=20.12$, $p < .001$.

There were six *when* questions in which the answer was not depicted. There were three expected and three not-expected questions. Mean frequency correct for the expected questions was 1.1. For not-expected questions, the mean frequency correct was .35. This difference was significant, $F(1,19)=13.57$, $p < .001$.

The data for *what*, *where* and *when* questions indicate that when depiction of the answer by the picture is held constant, the effect of expectation is still significant. The verb in the question affects comprehension over and above the effect of the picture.

Analysis 2: Pictures with two constituents depicted. To test the claim that the pictures biased the children toward answering correctly, or toward making Type E (rather than Type NE) errors, an analysis of those questions for which the picture depicted two constituents was performed. If the picture, and not the question, determines children's responses, there should be an equal probability of choosing either of the two depicted constituents as an answer. If, instead, one constituent is chosen significantly more often than the other, response choice cannot be attributed to a

bias in the pictures.

Questions querying expected constituents. There were five questions querying expected constituents for which the picture depicted two constituents. In all cases, the picture depicted the expected constituent (i.e., the correct answer) and it also depicted a not-expected constituent (in all cases, the location of the activity). Table 8 presents, for each question, the two depicted constituents, the frequency with which each was chosen as an answer, and the chi square values for each question. If response choice is random, each constituent should be chosen 50 percent of the time. As can be seen in Table 8, children never produced the not-expected constituent that was depicted in the picture. All chi square values were significant.

One might argue that the location of the activity, which was the not-expected constituent depicted in all of the pictures, is a less salient feature of the picture. However, when location is the constituent being queried, children are very good at identifying location in the picture. This is true regardless of whether or not location is the expected constituent in the question. Children identified location correctly 3.25 times out of 4 in where questions. Thus location is not a less salient feature of the picture. These results suggest that children respond on the basis of the question asked, and not solely on the

Table 8

Number of Subjects Choosing Expected and Not-Expected Constituents When Both Depicted in Expected Questions

Verb	Expected Constituent	Frequency	Not-Expected Constituent	Frequency	n	χ^{a}
cut	manner	13	location	0	13	13
read	thing	19	location	0	13	13
make	manner	12	location	0	12	12
eat	thing	18	location	0	18	18
drink	thing	19	location	0	19	19

[a] $p < .001$

basis of what is depicted in the picture.

Questions querying not-expected constituents. There were two questions querying not-expected constituents in which the incorrect expected constituent was depicted as well as the correct not-expected constituent. For example, the picture accompanying Where is the boy painting? (Figure 2) shows a painting (the expected constituent) and a bedroom (a not-expected constituent). Table 9 presents the two constituents depicted in each question, the frequency with which each was chosen, and the chi square values for each question. As can be seen in Table 9, the chi square values were significant, suggesting, again, that the question, and not the picture alone, influence children's response choice.

In three other questions querying not-expected constiuents, two not-expected constituents were depicted. One was the correct answer to the question while the other was not. In none of the three questions was the expected constituent also depicted. For example, the picture accompanying What did the man start? did not depict the expected constituent (i.e., when) but did depict the correct answer (a man shaving his face) and also the location (a bathroom). Table 10 presents the two constituents depicted, the frequency with which each was chosen as an answer, and the chi square values for each question. As can be seen, all chi

Table 9

Number of Subjects Choosing Expected and Not-Expected Constituents When Both Depicted in Not-Expected Questions

Verb	Expected Constituent	Frequency	Not-Expected Constituent	Frequency	n	χ^2
paint	thing	3	location	15	18	8.00[a]
walk	location	3	reason	11	14	4.58[b]

[a] $p < .01$

[b] $p < .05$

Table 10

Number of Subjects Choosing Either of Two Not-Expected Constituents When Both Depicted in Not-Expected Questions

Verb	Not-Expected Constituent	Frequency	Not-Expected Constituent	Frequency	n	χ^{2} [a]
start	location	0	thing	12	12	12
eat	location	0	manner	13	13	13
stop	location	1	thing	13	14	10.28

[a] $p < .001$

square values were significant.

These data indicate that, for expected and for not-expected questions, when two constituents are depicted in the picture accompanying the questions, children's choice of constituent is not random. Thus children's responses are not controlled by the picture. Rather, children respond on the basis of the question asked.

Elicitation Task

Table 11 summarizes the proportion of different types of responses in the elicitation task. The most frequent type of response was to answer the question rather than ask it (26 percent). Next most frequent were imitations (17 percent), wh-substitutions (17 percent), and other-substitutions (17 percent).

Wh-substitutions, although accounting for 17 percent of the total number of responses in the elicitation task, were produced by only a subset of the children. Only seven of the twenty children produced at least 20 percent wh-substitution responses.

Elicitation and Comprehension Tasks Compared

The model predicts that as children know more about the properties of a wh-word, their performance on questions querying not-expected constituents will improve and they will produce fewer constituent errors. If the ability to produce wh-substitutions is a measure of knowledge of the

Table 11

Proportion of Different Types of Elicitation Responses

Type of Response	Proportion
Answer	.26
Imitation	.17
Wh-substitution	.17
Other-substitution	.17
Yes-No Question	.12
Imitation + ↑	.08
Tell	.04

Key

Answer = answers the question

Imitation = repetition of all or some portion of adult utterance without rising intonation

Wh-substitution = substitutes what for the thing, where for the place, etc.

Other-substitution = substitutes what thing for for the thing, what time for the time

Yes-No Question = asks a yes-no question

Imitation + ↑ = imitation plus rising intonation

Tell = tells some portion of the question (e.g., Ask mommy the time she'll wake up, Child: wake up!

meanings of wh-words, performance on the elicitation task should be positively correlated with performance on the comprehension task. The higher the child's wh-substitution score for a wh-word in the elicitation task, the higher should be the child's frequency correct score for that wh-word in the comprehension task. This relationship could only be tested for the seven subjects who produced at least 20 percent wh-substitution responses. Five Pearson product-moment correlations were obtained, one for each wh-word. None of them was significant.

A further comparison of the two tasks was made by comparing how the ten subjects with the highest comprehension scores, and the ten subjects with the lowest comprehension scores, performed on the elicitation task. The ten subjects who scored highest on the comprehension task were labeled high comprehenders; the ten subjects who scored lowest were labeled low comprehenders. Table 12 presents the comprehension scores for the high and low comprehenders, and the proportion of their responses on the elicitation task that were imitations. It can be argued that imitation is the least advanced response on the elicitation task that still takes into account the question asked. Imitation involves the least processing of the question. Thus, low comprehenders should use imitation more frequently than high comprehenders. Subjects were grouped into high and low

Table 12

Comparison of Comprehension Success and Elicitation Performance

For High and Low Comprehenders

	Child	Age	MLU	Comprehension Correct Score[a]	Elicitation Proportion Imitation	Elicitation Proportion Wh-Substitution
High Comprehenders	NY	2;9	4.31	35	.20	.80
	CG	2;3	4.20	26	.04	.16
	HM	2;6	2.77	26	.86	.09
	LBr	2;7	3.72	25	.04	.21
	DD	2;5	3.60	25	.04	.73
	JDe	2;6	4.34	24	.13	.00
	DK	2;5	4.00	24	.00	.38
	DL	2;5	2.36	23	.20	.00
	RB	2;1	4.16	22	.00	.00
	JR	2;2	3.81	22	.18	.00
	$\bar{x}$	2;5	3.73	25	.17	.24
Low Comprehenders	KS	2;6	3.61	20	.52	.04
	JK	2;10	5.11	20	.52	.34
	JDr	2;4	3.08	19	.00	.00
	MW	2;4	4.40	19	.00	.10
	MC	2;6	2.65	18	.00	.00
	JG	2;6	4.37	18	.33	.00
	KL	2;7	3.43	16	.18	.71
	AK	2;3	4.28	16	.45	.00
	LBl	2;5	2.81	12	.68	.00
	LW	2;5	3.27	10	.44	.31
	$\bar{x}$	2;6	3.70	17	.31	.15

[a] Maximum score = 40.

imitators. High imitators were those who produced 25 percent or more imitation responses; low imitators were those who produced less than 25 percent imitation. Of the high comprehenders, only one fell into the high imitator category; of the low comprehenders, six were high imitators. Using the Fisher Exact Test (Siegel, 1956), the difference in imitation between high and low comprehenders was significant.

As Table 12 shows, there were no differences between high and low comprehenders in terms of age and MLU.

Table 12 also presents the proportion of elicitation responses that were wh-substitutions for the high and low comprehenders. Children were grouped into high and low wh-substitution categories, again using the 25 percent criterion. Three of the high comprehenders were in the high wh-substitution category, and three of the low comprehenders were also in this category. Thus there was no significant difference between high and low comprehenders in terms of frequency of wh-substitution responses, although there was a tendency for high comprehenders to produce more wh-substitutions than low comprehenders (24 percent for the former, 15 percent for the latter). High comprehenders imitate significantly less than low comprehenders do, but do not substitute wh-words for their noun phrase equivalents significantly more often than low comprehenders do.

VI. Discussion

Comprehension Task

The results of the comprehension task support the predictions of the lexical-expectation model. Prediction 1 of the model is: comprehension will be better on questions which query expected constituents of verbs than on questions which do not. Children performed significantly better on questions which queried expected constituents. This effect was strongest for *what*, *where*, and *when* questions; there was no difference between expected and not-expected *how* and *why* questions.

No difference was predicted for *why* because there are no *why* questions which query expected constituents according to the model's criterion for expected constituents. This is because *why* queries constituents that are never components of the semantic representations of verbs. That is, there are no verbs for which a reason for the activity is entailed. All of the other wh-words do query expected constituents according to the criterion. Thus *why* would be expected to behave differently from the other wh-words.

Adult subjects in the pilot experiment preferred *why* as the wh-word for verbs which reflect emotional states such as *cry*, *smile* and *laugh*. This could have occurred for two reasons: (1) the reasons for the actions denoted by these verbs may be less evident, and thus more reasonable

to inquire about, or (2) since there are no other expected constituents for these verbs and since why is a plausible question to ask about any verb, why is most often chosen. The results of the comprehension task are more consistent with the second explanation since children found all why questions equally comprehensible, regardless of the verb in the question.

One reason why no difference was found between expected and not-expected questions for how may be that how has more varied meanings than the other wh-words. The types of constituents queried by how vary with the verb and thus, the expected constituents queried by how vary from verb to verb. For example, the expected constituent for cut and draw is an instrument; for help, however, the expected constituent is the activity component of the verb's meaning. Of the not-expected how questions, some could query instruments (e.g., eat) and some could not (e.g., read). Thus, expected and not-expected how questions are heterogeneous groupings. The variability within and across groups may account for the failure to find an effect of expectation for how questions.

Prediction 2 of the model is: constituent errors will be more frequent on questions which query not-expected constituents. Prediction 2 was also confirmed. Children produced significantly more constituent errors for

not-expected than for expected questions. The only exception was how. Constituent errors were not more frequent for the not-expected how questions. This is because there was less opportunity to make a Type E error on the not-expected how questions. It was possible to make a Type E error on only one of the four not-expected how questions. For the other wh-words, however, it was possible to make a Type E error on three what questions, two where questions, three when questions, and four why questions. Thus there were fewer opportunities to make Type E errors on how questions. Although Type NE errors could have been made on all four not-expected how questions, children so infrequently made Type NE errors that the overall frequency of constituent errors was greatly affected by the possibility of making a Type E error. Since the possibility of making a Type E error was less available for how questions, constituent errors as a whole were less frequent.

Prediction 3 is: when the child makes a constituent error, the incorrect constituent that the child gives will be the expected constituent for the verb (i.e., a Type E error). Prediction 3 was confirmed. For those questions in which it was possible to make both a Type E and a Type NE error, children made significantly more Type E errors.

Although the predictions of the model were confirmed, a question arises in connection with the results of the

comprehension task, namely, why, if lexical expectations are used to determine missing constituents, don't children perform better than they do on expected questions (particularly when and how questions), and produce more constituent errors on not-expected questions. On the average, children correctly answered 1.3 out of 4 expected when questions, and 2.1 expected how questions. If children always used lexical expectations to determine the missing constituent, they would correctly answer 100 percent of the expected questions. Similarly, using lexical expectations to comprehend not-expected questions should result in more than 26 percent constituent errors.

The most plausible reason that lexical expectations did not more frequently affect children's performance is that when children hear a wh-word they do not understand, they frequently do not process the rest of the question. In order to use lexical expectations for a verb to determine the missing constituent, the child must process the rest of the question for meaning. The child must at least do a semantic analysis of the verb, and of any constituents which follow the verb to see whether they are expected constituents. The responses children made outside of constituent errors placed less processing demand on them. For example, imitation does not require the child to do semantic processing. The other responses required even less processing or no

processing at all of the question. Thus, using lexical expectations necessitates a level of analysis that children may resist performing when the question contains a wh-word they have difficulty comprehending.

The predictions of the lexical-expectation model were confirmed when depictability of the answer by the picture was held constant. Children's performance was not due to a bias in the pictures.

It is still possible, however, that depictability of the answer is involved in children's ability to comprehend wh-questions. Children's performance was poorest on those wh-questions in which the answer is not readily depictable, namely how, when, and why questions. The difficulty involved in comprehending these questions is not, however, a direct consequence of the inability to depict answers to these questions. Rather, both difficulty of comprehension and difficulty of depiction stem from the same underlying property of these wh-questions, namely the greater abstractness of the concepts embodied by when, how and why. Answers are more difficult to depict because these wh-words query constituents that are more abstract and thus less amenable to pictorial representation. It is the greater abstractness of the concepts underlying when, how and why which both makes them more difficult to comprehend and makes their answers less depictable.

Elicitation Task and Comparison of Tasks

The elicitation task was intended to provide a measure of the child's knowledge of the meanings of the wh-words independent of his/her comprehension of wh-questions. If the child substitutes the correct wh-word for its noun phrase equivalent, this is evidence that the child knows the meaning of the wh-word. Failure to substitute the wh-word is not, however, evidence that the child does not know the meaning of the wh-word. This is because ability to make a wh-substitution in the elicitation task involves more processing steps than is involved in either comprehending or producing wh-questions. To produce or comprehend a wh-question, the child has to match up the wh-word (e.g., what) with its semantic representation (e.g., Q(some thing)). To produce a wh-substitution, however, additional steps are required. The semantic representation for the noun phrase in the elicitation sentence (e.g., the thing) must be combined with the semantic representation of ask (e.g., ask + the thing), which then must be matched up with the semantic representation for the wh-word (e.g., Q(some thing)), and then matched up with the appropriate wh-word (e.g., what). Thus it is not surprising that there was no relationship between children's production of wh-substitutions in the elicitation task and comprehension of wh-words in the comprehension task. The elicitation task failed to reveal what children

apparently knew about the lexical properties of the wh-words.

There was, however, a relationship between the extent to which children imitated in the elicitation task, and how well they performed in the comprehension task. High comprehenders imitated significantly less than low comprehenders. Mayer & Valian (1977) argue that imitation serves the conversational function of enabling children to make a verbal response when, for any reason, they are unable to fully process the input utterance. In this experiment, children who had more difficulty processing wh-questions appeared to rely more on imitation as a means of responding in the elicitation task.

Other features of the children's responses in the elicitation task are of interest. Whereas imitation is an inadequate response, other responses were available which were perfectly adequate but which required less processing on the child's part than a wh-substitution. Other-substitutions (e.g., substituting <u>what time</u> instead of <u>when</u> for <u>the time</u>) were adequate responses to the task, and they permitted the child to remain closer to the input form of the utterance, thus placing less of a processing demand on the child. Other-substitutions are, in a sense, a more sophisticated form of imitation. They do not require the child to make a different substitution for each wh-word. All that is required is for the child to substitute <u>what</u> for <u>the</u> in every case.

That some children who primarily made other-substitutions were able to, but did not, produce wh-substitutions is evidenced by the following sequence taken from the elicitation protocol of one child:

Experimenter: Ask mommy the reason she smiles.

Child: What reason do you smile?

Mother: (answers question)

Child: And why do you cry?

The most frequent response on the elicitation task was to answer the question rather than ask it. Answering the elicitation questions may have been the predominant response because children already knew answers to many of the questions. Pragmatically, questions are used to obtain information that the questioner does not already have. Asking the child to obtain information s/he already possessed may have been pragmatically odd.

Evidence that the answer response was due to the pragmatic oddity of the task is that this response occurred less frequently on those elicitation items for which the child clearly did not already know the answer. Items such as Ask mommy the way to turn off the tape recorder and Ask mommy the place I live in more often elicited question responses than items like Ask mommy the thing you'll eat for lunch. Thus, questions which the child could not answer more often elicited a question response.

The elicitation data do not support Chomsky's (1969) claim that children answer rather than ask elicited questions because they do not know what ask means, and misinterpret ask as tell. The children in this experiment who consistently answered rather than asked elicited questions were given several elicited yes-no questions to see whether they could properly interpret ask under other circumstances. For example, children were instructed to ask mommy if she likes peanut butter or if she wants to go outside. Children rarely answered, rather than asked, these questions. Thus they know what ask means and can appropriately ask questions in certain contexts.

VII. Conclusions

Children's Comprehension of Wh-questions

The lexical-expectation model is an attempt to explain the differences in ease of comprehension and the types of errors children make in comprehending wh-questions. The explanation is based on the notion of a lexical expectation, which is an estimate of the likelihood that a sentence constituent will follow a verb. The model claims that expectations are based on the following semantic property: a constituent is expected if it specifies a non-redundant component of the semantic representation of a verb.

The data from the comprehension task support the

correctness of the model's characterization of expected constituents, and do not support Tyack & Ingram's (1977) hypothesis that transitivity of the verb determines ease of comprehension and the types of errors children make. Other studies, for example, Bloom (1978), only describe but do not explain the differences in the distribution of verbs across wh-words. Bloom reports that, in spontaneous speech, what questions are most frequent with transitive verbs that take inanimate objects whereas where questions are most frequent with what she calls locative action or locative state verbs. Her data are in accord with the types of verbs found easiest to comprehend in this experiment. However, Bloom does not attempt to explain the distribution of verbs in different wh-questions. The lexical-expectation model explains Bloom's data on spontaneous production in the following way: the verbs occurring most frequently in wh-questions are those for which the wh-word queries a constituent which is a non-redundant component of the meaning of the verb. Locative action or state verbs occur most frequently in where questions because they are verbs whose meaning includes "location$_2$" as a non-redundant component; transitive verbs with inanimate objects occur most frequently in what-object questions because they are verbs whose meaning includes "something acted upon" or "something resulting from an activity" as a non-redundant component.

The data from the comprehension task also support the model's claim that children use lexical expectations to determine the missing constituent in a wh-question: children made significantly more constituent errors on questions which queried not-expected constituents, and when they made constituent errors, they made significantly more Type E errors, i.e., giving as an answer the expected constituent for a verb. These data provide evidence that (1) children know that wh-words stand in for missing constituents, and (2) that they use lexical knowledge to determine the missing constituent in a question. The data thus indicate that general and specific knowledge are both used in the comprehension process.

The data support the model's claim about the relationship between general rules and lexically specific knowledge in acquisition and use. The model claims that in language use both kinds of information are necessary for comprehension and production of wh-questions.

The model makes no claims, however, about the order in which both kinds of knowledge must be acquired. It is consistent with the model, for example, that children first acquire lexically specific information and then, at a later point, formulate the general rule. This kind of acquisition sequence has been suggested by Maratsos (in press), Kuczaj & Brannick (1979) and Braine (1976) for other

constructions. The data from the comprehension task indicate, however, that with respect to the acquisition of wh-questions, the opposite sequence occurs. The fact that children make constituent errors in answering wh-questions suggests that they acquire the general rule that wh-words replace missing constituents before they acquire the lexically specific information about which constituents wh-words replace.

In general, if comprehension and production of a sentence type involves both lexically specific information and general rules, it is likely that acquisition of the different kinds of knowledge will occur over a period of time, so that at a particular point in time acquisition of one kind of knowledge will be in advance of the other. Though it may appear that the earlier acquired knowledge is prerequisite to the other, no such causal sequence is entailed. In the case of wh-question acquisition, the observed sequence is not logically necessary.

Although it is not necessary, the observed sequence is reasonable, since a great deal more lexically specific information needs to be acquired about a wh-word than general information. Furthermore, the general rule can generalize to new cases, whereas the specific information cannot. For example, suppose that a child knows the general rule that a wh-word is a word that replaces a missing constituent,

and has some lexically specific information about the constituents replaced by certain wh-words. When the child encounters an unfamiliar wh-word, the general rule can be extended to the new case but the lexically specific information about the wh-words that the child already knows cannot be extended to the new wh-word. The lexically specific information about the new wh-word must be acquired separately and independently. Thus it is reasonable that general knowledge about wh-words will be acquired in advance of lexically specific information.

The lexical-expectation model assumes that children use lexical expectations to determine the missing constituent in a question when they lack information about the lexical properties of a wh-word. This assumption is necessary in order to explain the fact that children make constituent errors. Children should not make these errors if they fully understand the wh-words. The assumption that children lack lexical information about wh-words, however, was not independently tested in the experiment. The elicitation task was intended to provide such a test but, for the reasons given above, the task did not tap what the children knew.

Some evidence that children relied upon lexical expectations more when they understood less about the wh-word comes from the order of the wh-words in terms of frequency

of constituent errors. The frequency of constituent errors from least to most frequent was: where = what = how < why < when. This order roughly approximates the order of difficulty of wh-words found in other studies (Bloom, 1978; Cairns & Hsu, 1978; Brown, 1968; Tyack & Ingram, 1977; Ervin-Tripp, 1970).[16] Thus the most difficult wh-words, as determined from other studies of children's comprehension, produced the most constituent errors in this experiment. Despite this evidence, however, the assumption that children lack lexical knowledge of wh-words was neither confirmed nor disconfirmed in the experiment.

The lexical-expectation model is not specific about precisely how and why children's lexical knowledge of wh-words is incomplete. The model does not provide answers to the following two questions: (1) What do children know about each wh-word at the point when they make constituent errors? and (2) Why are some wh-words more difficult to master than others? A full model of children's comprehension would have to provide answers to these questions. There are thus several questions which should be addressed by future research.

Children's Comprehension of Other Constructions

The lexical-expectation model has consequences for children's comprehension of other constructions that involve a gap, such as embedded questions and relative clauses.

In embedded questions, the clause containing the wh-word is embedded within another clause. For example, in Can you tell me where the boy is going?, where the boy is going is the embedded wh-clause. As in matrix wh-questions, the wh-word in the embedded clause replaces a missing constituent. Comprehension of the embedded question requires determining the missing constituent replaced by the wh-word. The lexical-expectation model predicts that children who lack information about the lexical properties of wh-words will use lexical expectations to determine the missing constituent in embedded wh-questions. Correct performance will be better on embedded questions which query the expected constituent for the verb and Type E errors will be more frequent on embedded questions which query not-expected constituents.

Relative clauses, like embedded questions, contain an embedded clause in which there is a missing constituent. A relative pronoun, which is often a wh-word, replaces the missing constituent in the embedded clause. For example, in This is the man who John saw, who stands in for the object of see. Relative clauses differ from wh-questions or embedded questions in that relative clauses modify a noun phrase in the matrix clause. In the above example, who John saw modifies the noun phrase the man. The wh-word thus refers to a noun phrase in the sentence. In wh-questions, on

the other hand, the referent of a wh-word is not present in the sentence.

In relative clauses, as in wh-questions, to determine the missing constituent which a wh-word replaces, requires, among other things, knowledge of the lexical properties of the wh-word. If a child lacks knowledge of the lexical properties of wh-words, lexical expectations should affect comprehension of relative clauses. The child should use information about the verb in the relative clause to determine the missing constituent. For example, take the sentence Show me the place where the boy is going. If a child does not know the lexical properties of where s/he should use information about the meaning of go to determine the missing constituent. The lexical-expectation model predicts that a relative clause such as Show me the place where the boy is going should be easier to comprehend than a relative clause such as Show me the place where the boy is eating because the wh-word replaces an expected constituent of the verb in the former but not in the latter.

Comprehension of relative clauses differs from comprehension of wh-questions in that, in addition to using information about the meaning of the verb to determine the missing constituent, the child can also use information from the noun phrase which the relative clause modifies to determine the missing constituent. For example, in the sentence

Show me the book that the boy is reading, the presence of the noun phrase, the book, could provide further evidence that the missing constituent is the object of read.

Relative clauses thus contain additional information which can be used to determine the missing constituent in the sentence. Notice, however, that the extent to which the noun phrase "helps" to determine the missing constituent depends on whether the noun phrase is itself an expected constituent for the verb. The matrix noun phrase can either be an expected or a not-expected constituent for the verb in the relative clause. In the example Show me the book that the boy is reading, the book is an expected constituent for the verb read. In Show me the book that the boy is moving, however, the book is not an expected constituent for the verb move. Comprehension should be better on the former sentence because the noun phrase in the matrix sentence is an expected constituent for the verb in the relative clause.

Comprehension in Older Children and Adults

The lexical-expectation model has consequences for comprehension in older children who have acquired fuller knowledge of wh-words, and in adults. Although constituent errors should drop out with mastery of the wh-words, differences between wh-questions in ease of comprehension may persist in adults. The model predicts that lexical

expectations will affect comprehension in a number of different situations. For example, in a degraded stimulus situation where the wh-word is difficult to hear, questions which query expected constituents should be easier to comprehend. Constituent errors could occur if the listener restores the partially heard question by replacing the imperfectly heard wh-word with the wh-word which queries the expected constituent. One might also expect to find differences in ease of comprehension when listeners are constrained to answer questions under time pressure. Reaction time to expected questions should be faster than reaction time to not-expected questions. The model thus makes other predictions about comprehension which future research should address. In sum, the lexical-expectation model provides a beginning point for a model of children's comprehension of wh-questions, and serves as a source of hypotheses about comprehension in general.

Footnotes

[1]No claim is being made here that the listener represents the missing constituent as the direct object. Whether the missing constituent is represented in terms of syntactic or semantic categories is not at issue here.

[2]There are, however, environments from which wh-words cannot be removed. See Chomsky (1977) for a discussion of constraints on wh-movement.

[3]Jackendoff & Culicover (1971), for different reasons, argue the same thing.

[4]The rule of wh-movement does more than capture the generalization that wh-words stand in for missing constituents. More specific properties of the rule, such as that wh-movement is unbounded, will not, however, be examined in this study.

[5]This is not an exhaustive list of wh-words. It ignores wh-words that function as modifiers of noun phrases (e.g., whose, which and what in the sense of what book, and how in the sense of how many).

[6]Brown (1968) merely claims this but presents no data to substantiate the claim.

[7]This account owes its general form to Katz's (1972) semantic theory.

[8]An object apart from the agent is not entailed only if move and turn are treated as one lexical item having only one sense. On the view that move and turn each have two senses, with each sense having a separate lexical entry, an object apart from the agent is entailed on one of the senses.

[9]It is not clear what the source for the oddity of these questions is. It is not clear whether these questions are ungrammatical on the interpretation of what as referring to a physical object.

[10]As discussed above, why does not query expected constituents, according to the criterion. It was included in the experiment to see whether other, non-semantic, factors affect expectations.

[11]Broken down by wh-word, these were: four *what*, four *where*, one *when*, four *how* and one *why* question.

[12]Broken down by wh-word: three *what*, four *where*, one *when*, two *how* and two *why* questions.

[13]Broken down by wh-word: three *when* and three *why* questions.

[14]Broken down by wh-word: one *what*, three *when*, two *how*, and two *why* questions.

[15]According to Clark (1973), in order to generalize beyond the specific subjects *and* items used in a language experiment, two separate *F* statistics should be calculated, and a *minF'* statistic obtained. F_1 treats subjects as the random effect; F_2 treats items as the random effect. *MinF'* is a composite of the two. See Clark (1973) for the computational procedures.

[16]The exception is *how*, which, in other studies, is usually the most difficult or equal in difficulty to *when*. The reason why there were fewer constituent errors for *how* was suggested in section VI.

Appendix A

Pilot Experiment Materials

Fill in the blank with one of the following question words:

WHAT WHERE WHEN HOW WHY

Then in the space to the right of the question, make up an appropriate answer.

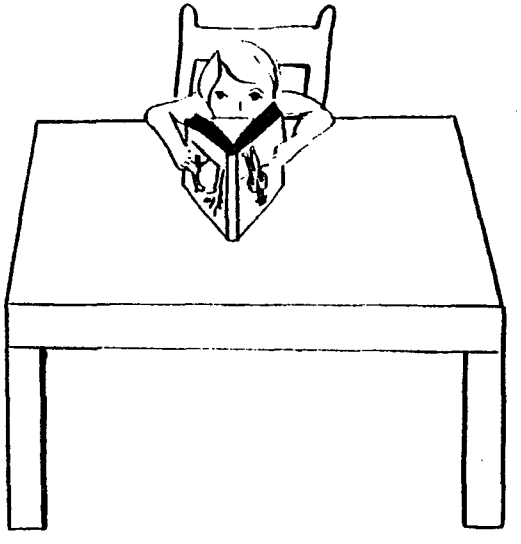
Example: where did you stay? at home

1. _____ did you sing? _____
2. _____ did you eat it? _____
3. _____ did you leave? _____
4. _____ did you help her? _____
5. _____ did you whistle? _____
6. _____ did you ride? _____
7. _____ did you read it? _____
8. _____ did you fall asleep? _____
9. _____ did you make it? _____
10. _____ did you draw? _____
11. _____ did you blow? _____
12. _____ did you finish? _____
13. _____ did you go? _____
14. _____ did you walk there? _____
15. _____ did you play it? _____
16. _____ did you drive? _____
17. _____ did you read? _____
18. _____ did you wake up? _____
19. _____ did you laugh? _____
20. _____ did you turn? _____
21. _____ did you open it? _____
22. _____ did you cut it? _____
23. _____ did you sit? _____
24. _____ did you drink? _____

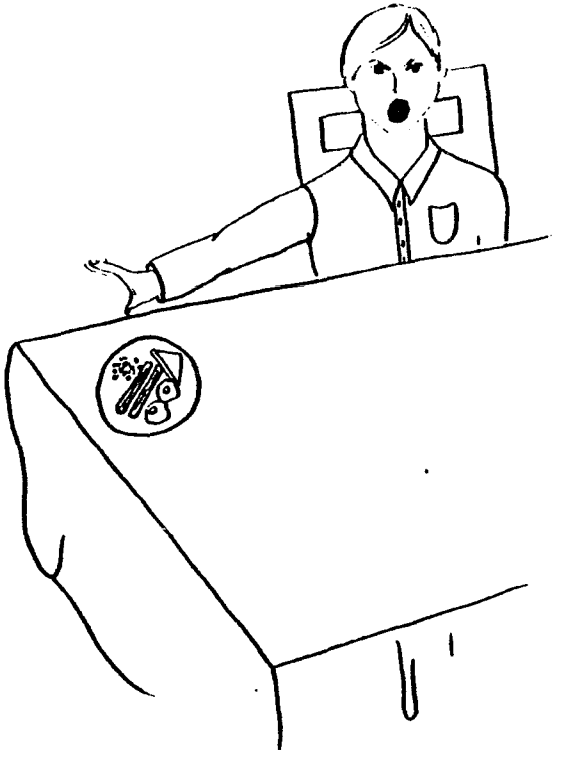
25. _____ did you arrive? _____
26. _____ did you move? _____
27. _____ did you walk? _____
28. _____ did you go there? _____
29. _____ did you smile? _____
30. _____ did you drop it? _____
31. _____ did you write? _____
32. _____ did you start? _____
33. _____ did you draw it? _____
34. _____ did you break it? _____
35. _____ did you wave? _____
36. _____ did you run? _____
37. _____ did you drink it? _____
38. _____ did you eat? _____
39. _____ did you cry? _____

Appendix B

Pictures and Sentences Used in Comprehension Task

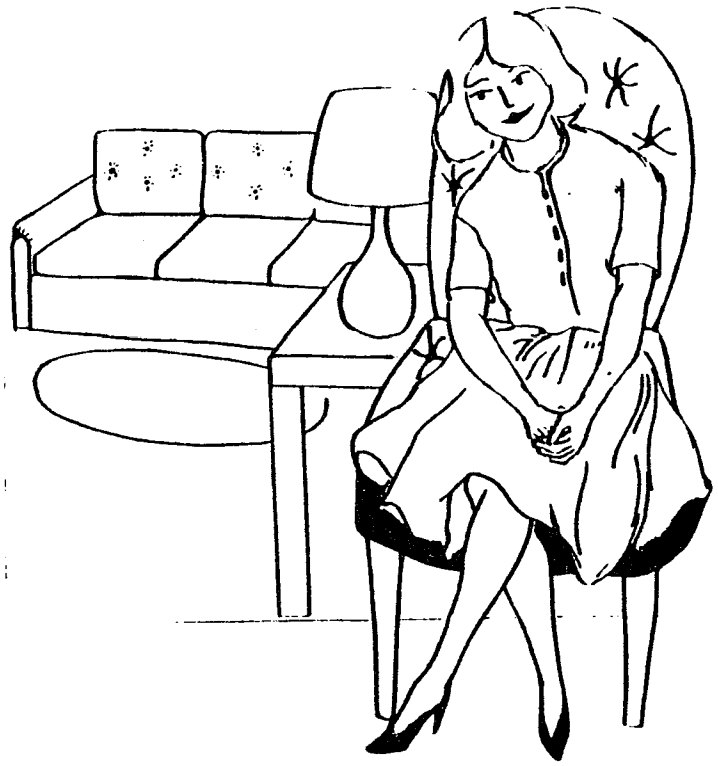


How is the boy reading the book?

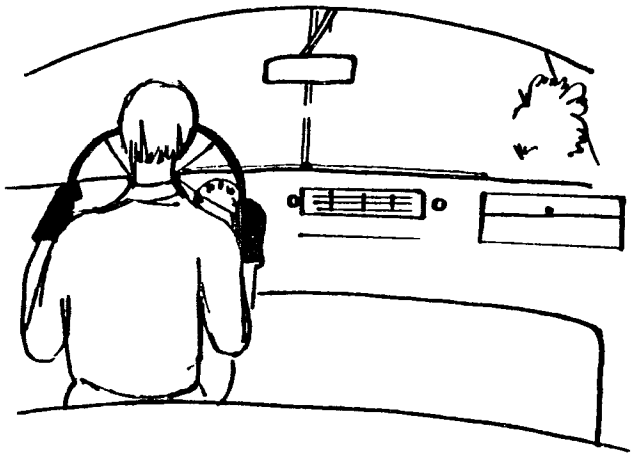


What is the boy yelling?

What did the policeman stop?

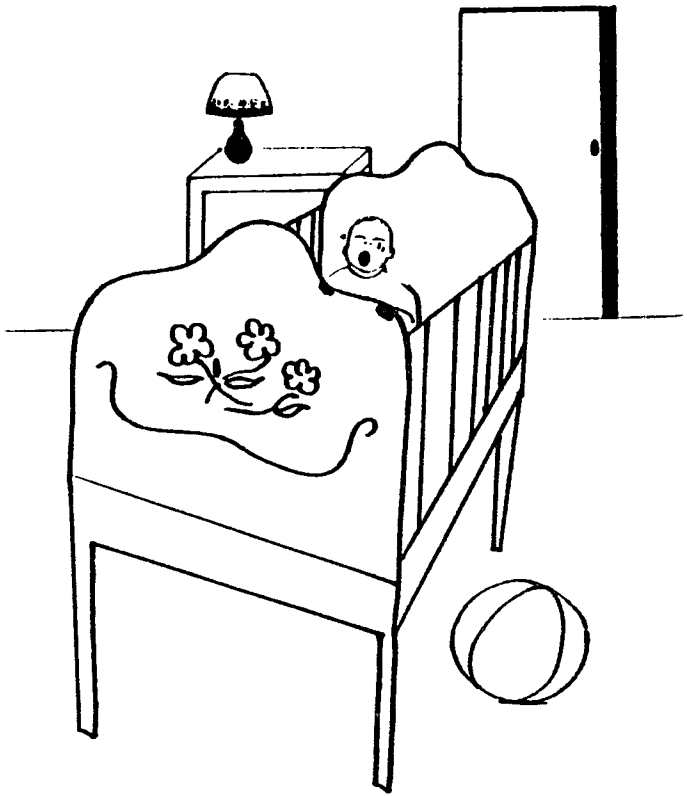


Where is the mommy sitting?



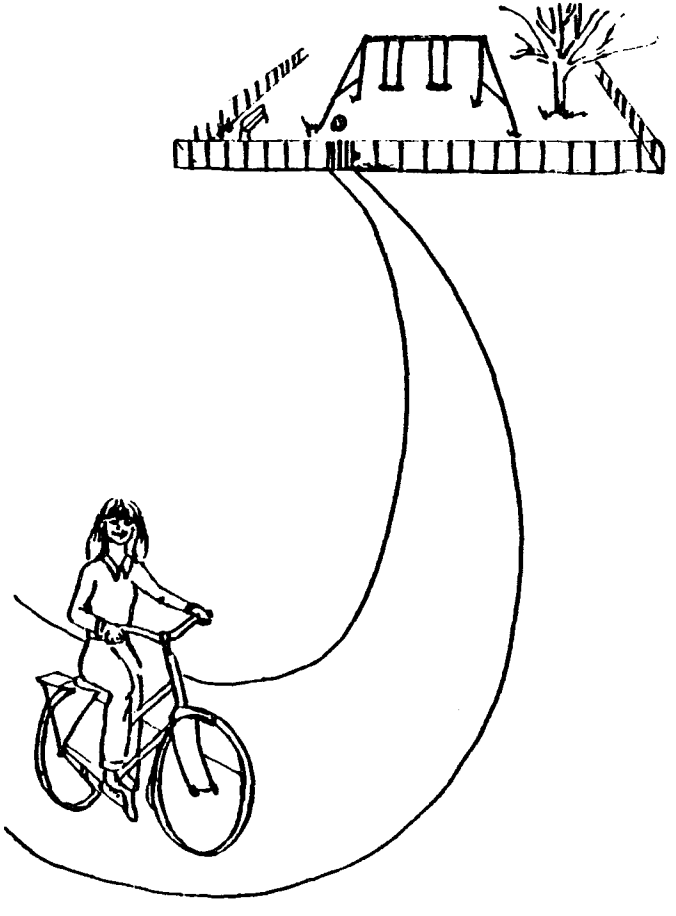
How is the man driving the car?

Why is the baby crying?

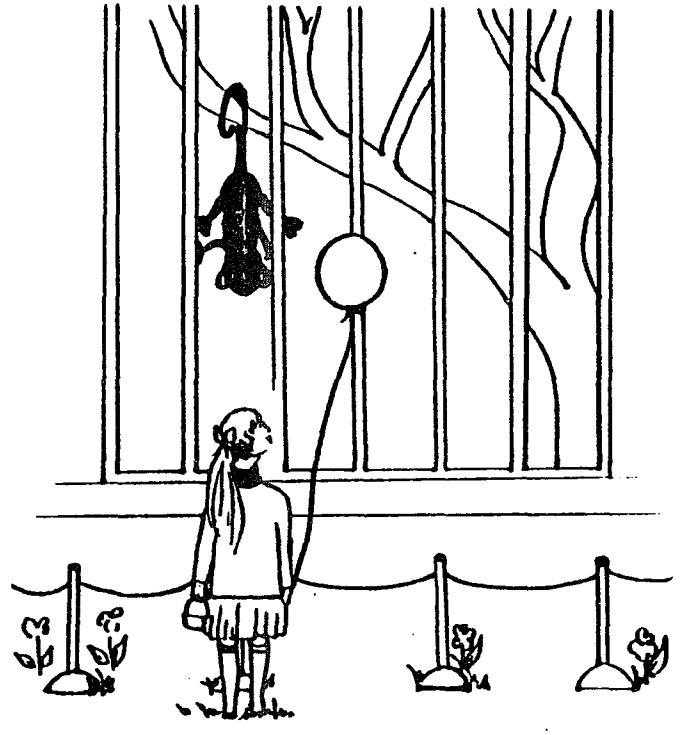


Where is the baby crying?

Why is the mommy smiling?

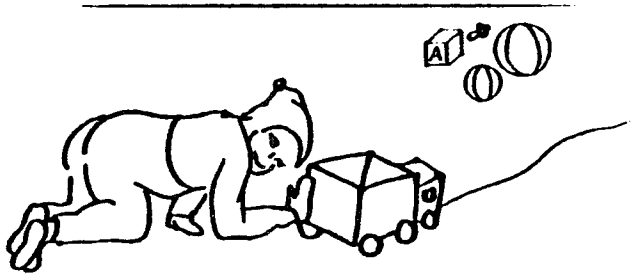


Where did the girl ride?

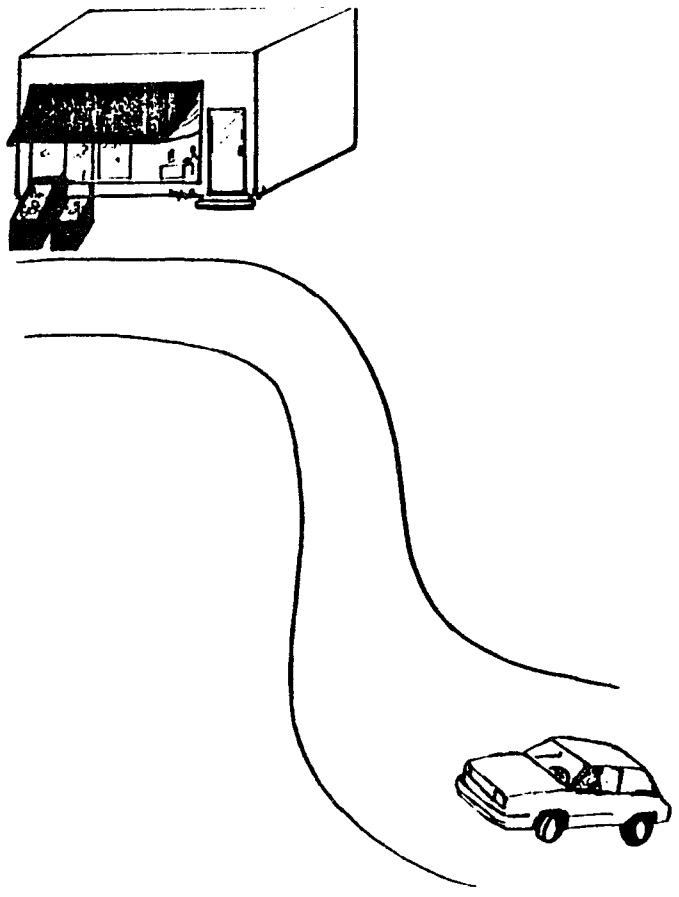


When did the girl laugh?

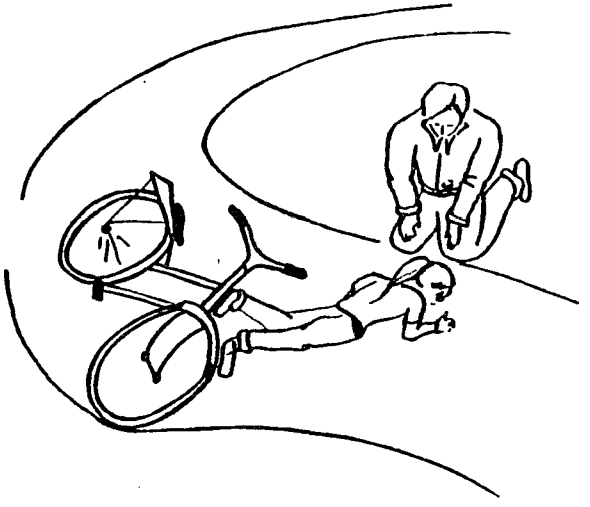
Why did the man yell?



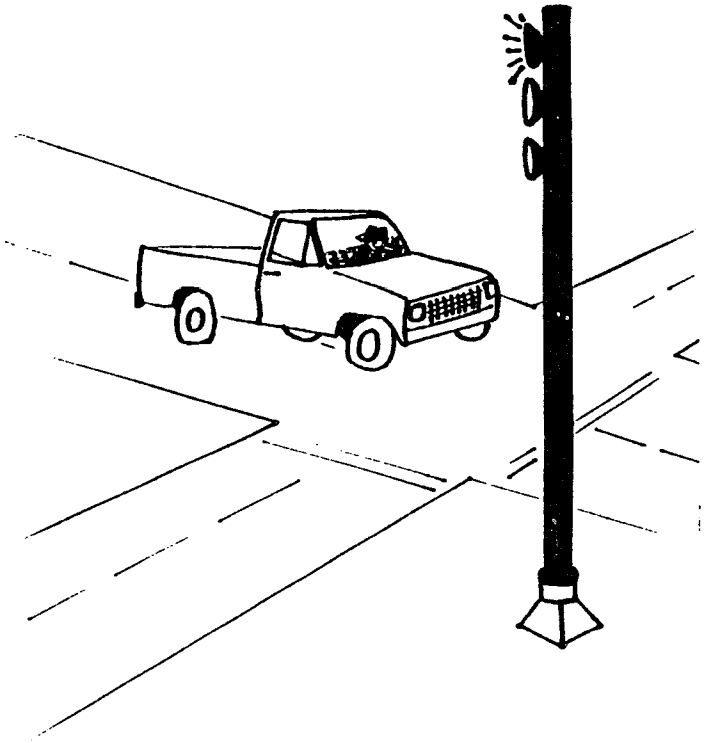
What is the baby moving?



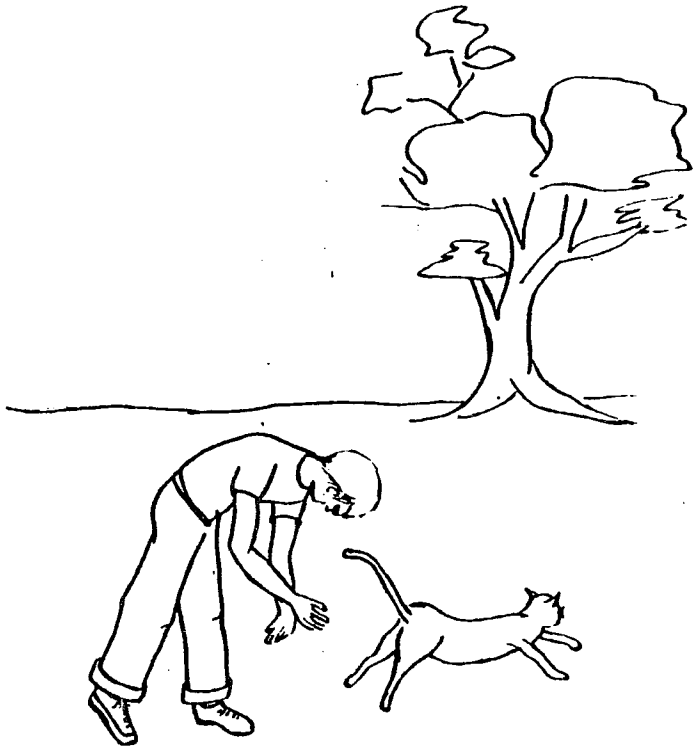
Where is the man driving?



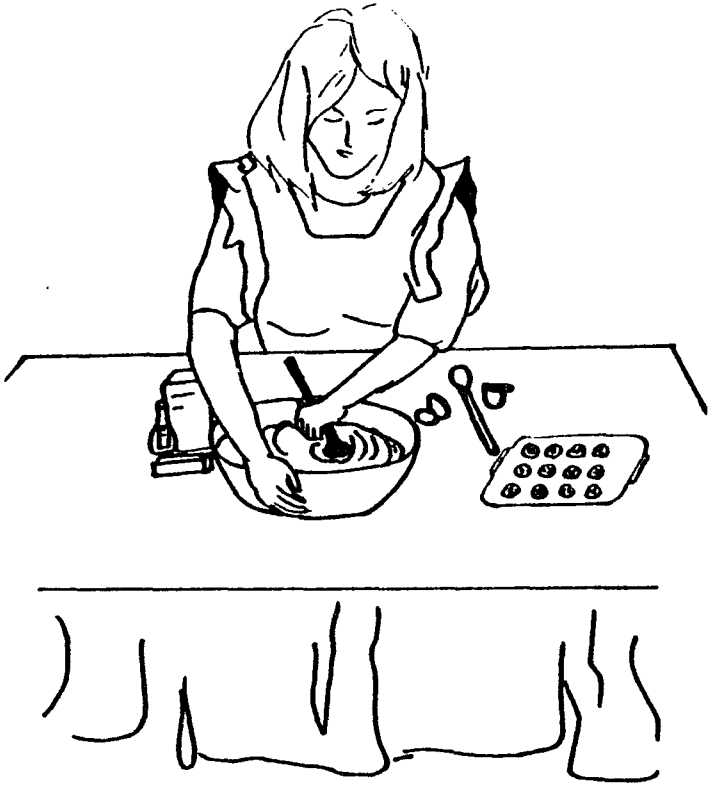
When did the daddy help?



When did the truck stop?

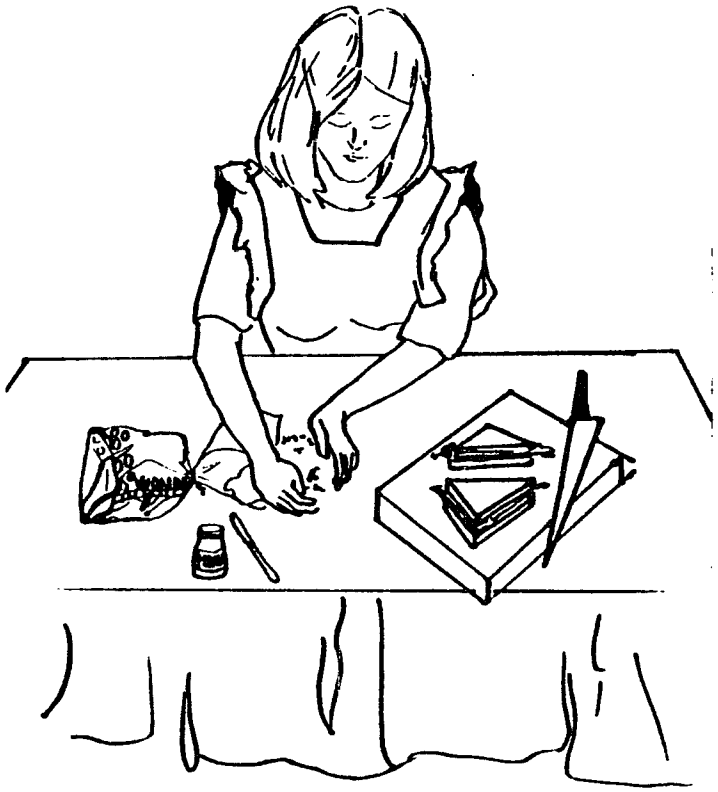


When did the kitten run?

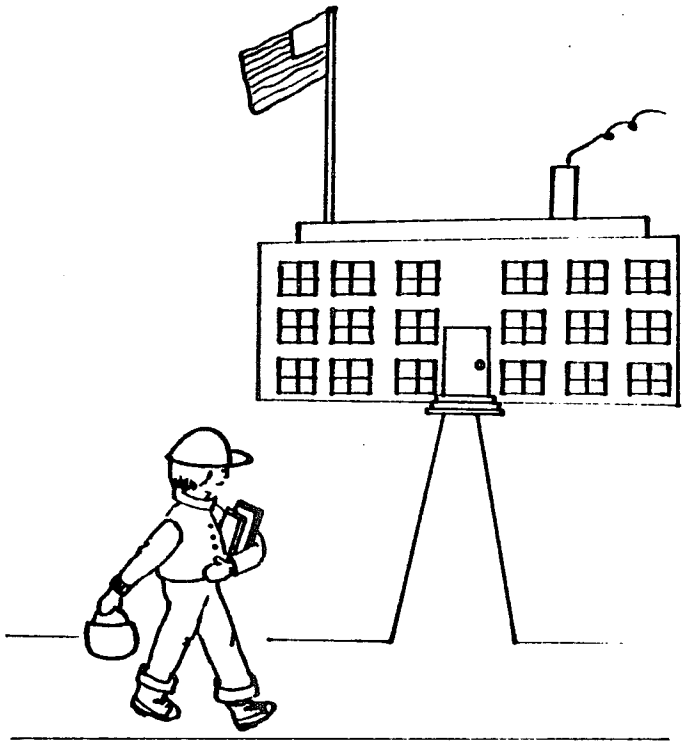


How is the mommy making cookies?

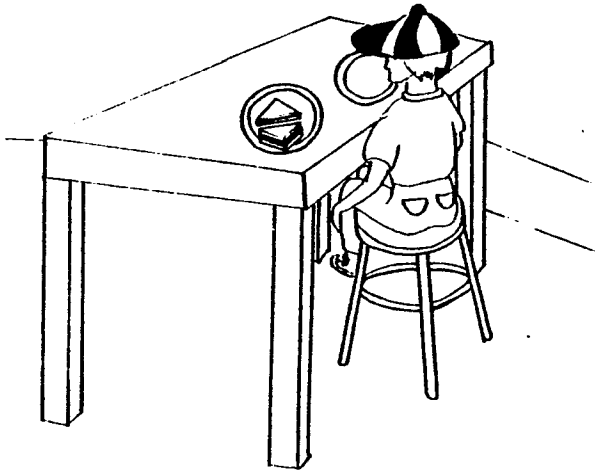
When did the boy wake up?



Why did the mommy cut the bread?



Where is the boy going?

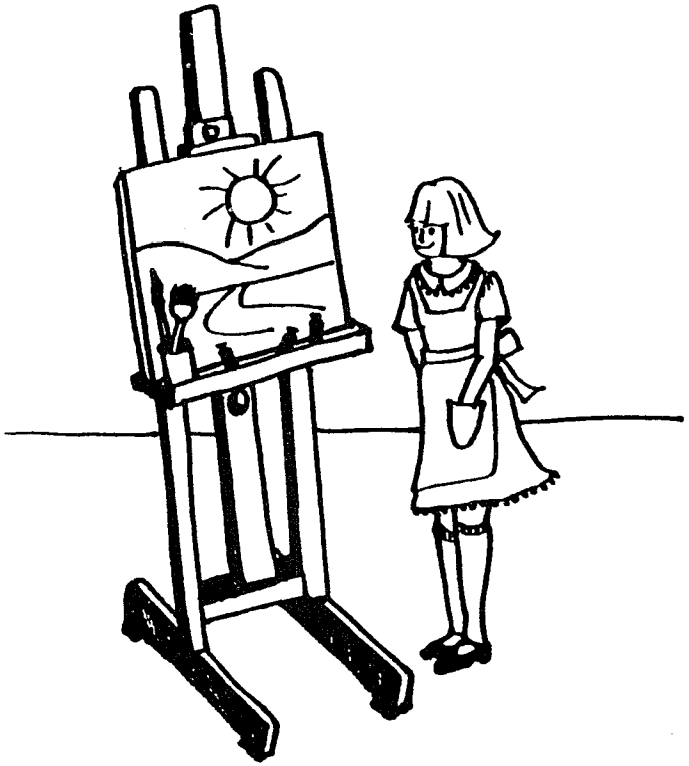


What did the boy eat?

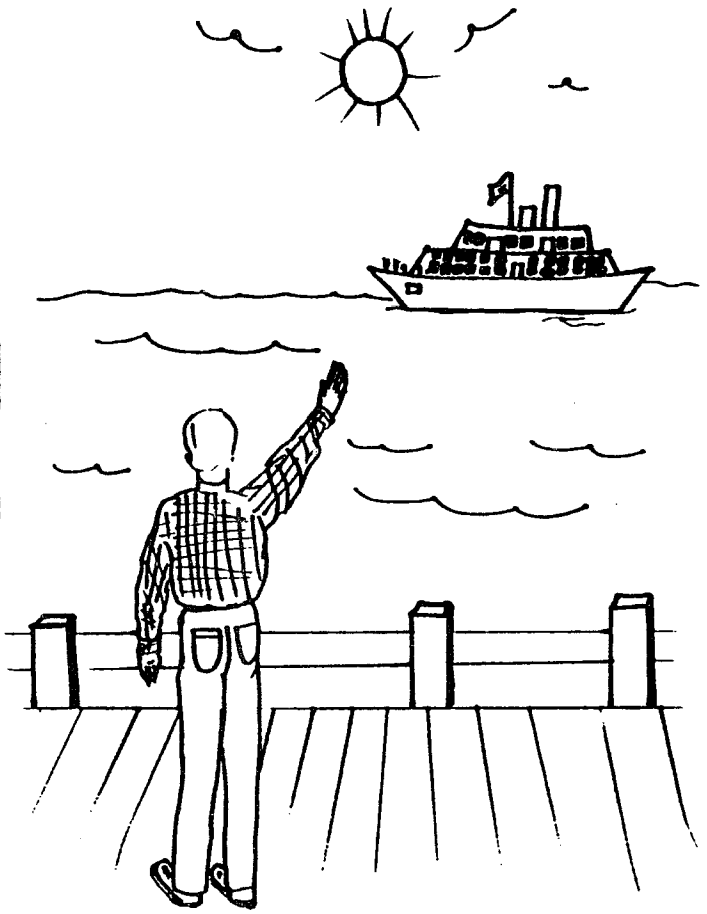
How is the girl helping the lady?

What did the man start?

What is the daddy reading?

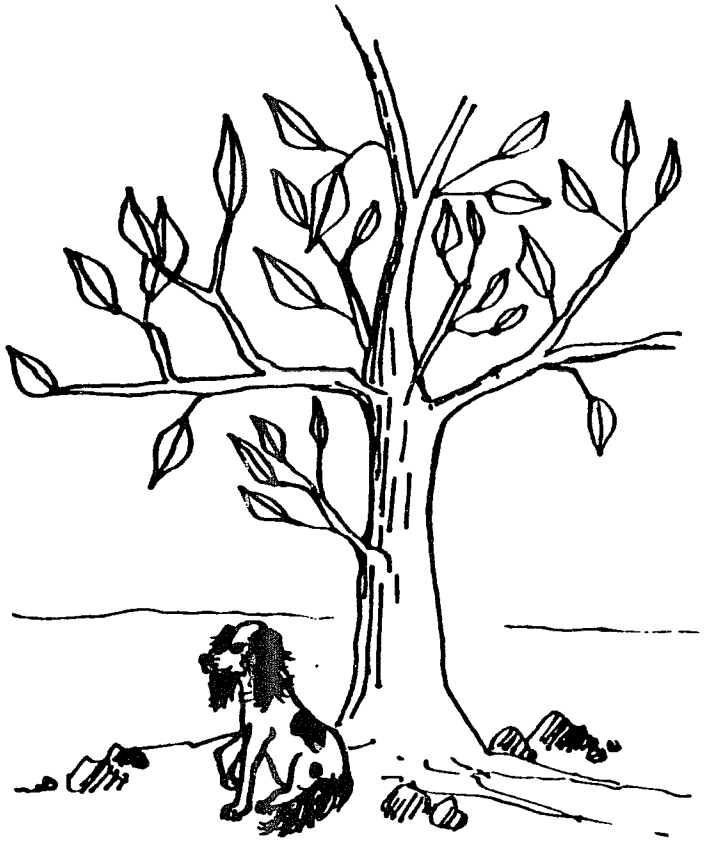


What did the girl paint?

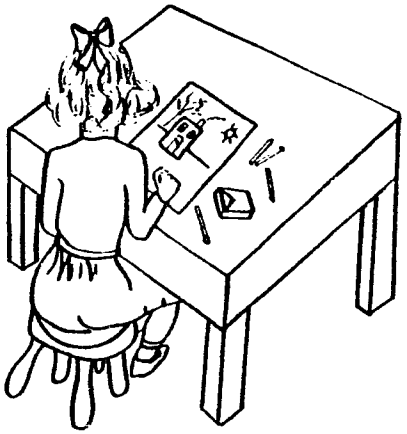


Where is the man waving?

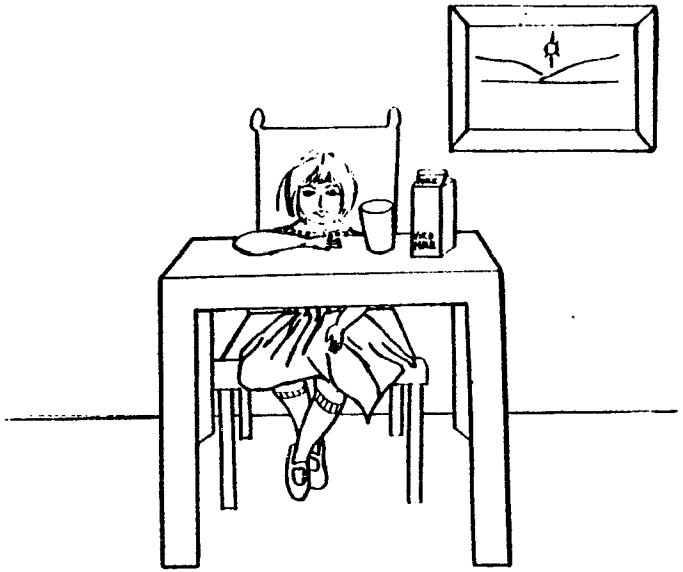
How is the dog sitting in the chair?



Where did the dog wake up?

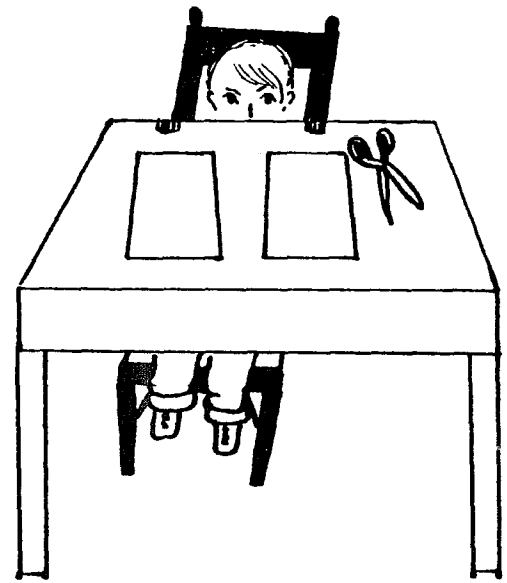


How is the girl drawing the picture?



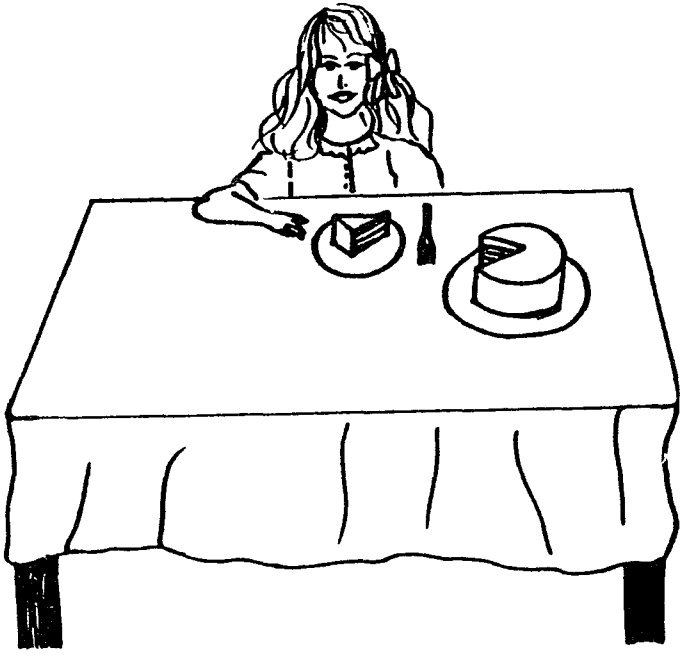
What did the girl drink?

Why did the girl draw?



How did the boy cut the paper?

Why are the children singing?

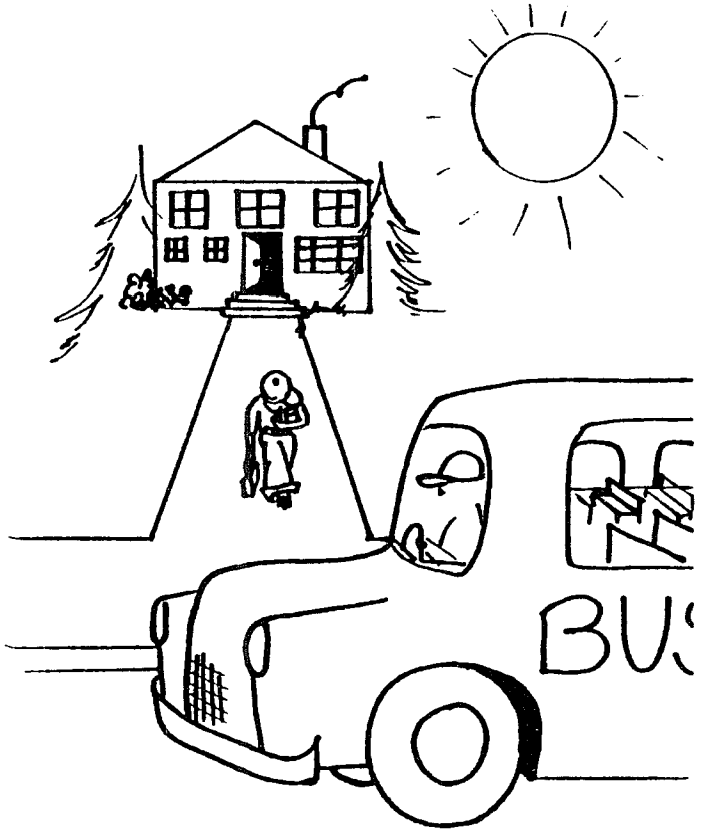


How is the girl eating the cake?

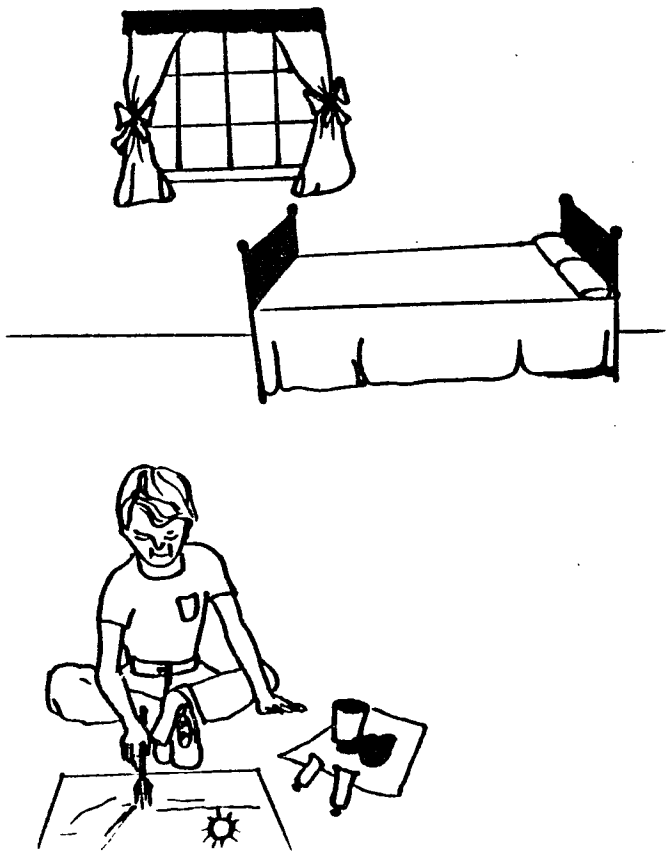
When did the music start?

When did the daddy leave?

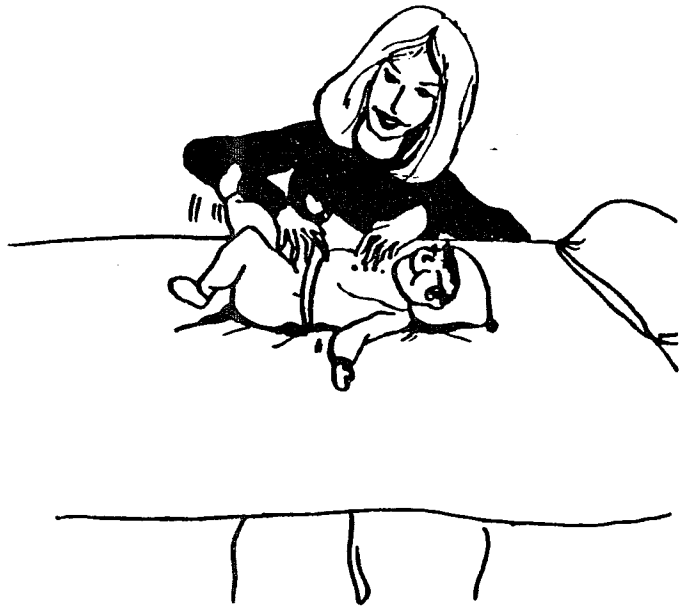
Why is the dog walking?



When did the boy go?



Where is the boy painting?



Why is the baby laughing?

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