Gentner, D. (1975). Evidence for the psychological reality of semantic components: The verbs of possession. In D. A. Norman, D. E. Rumelhart, & the LNR Research Group (Eds.), Explorations in cognition (pp. 211-246). San Francisco: Freeman.

CHAPTER V

Evidence for the Psychological Reality of Semantic Components: The Verbs of Possession

DEDRE GENTNER

This chapter is concerned with the way verbs are stored and processed. I use a set of possession verbs as illustrative examples. The first section of the chapter deals with the structural representation of these verbs. The remainder of the chapter is concerned with issues of processing and with experimental tests of the theory.

In this chapter I use the terms "components" and "chunks" to refer to the underlying semantic units of verbs, rather than the term "primitive elements," which is used iii the other chapters of this book. 1 make this change to emphasize that the components analyzed in this chapter need not necessarily represent the members of some universal set of innate semantic features. If such a set exists, most of the components that are described in this chapter are probably combinations of the innate features.

The two main linguistic treatments of the possession verbs are those by Bendix (1966) and Fillmore (1966). Bendix proposed a general analysis of verbs of possession, and in a critique of this work, Fillmore suggested some alternative representations. Schank and his collaborators have also studied verbs of possession (Schank, Goldman, Rieger, and Riesbeck, 1972). My treatment differs from all three of these approaches, although it has some points in common with each.

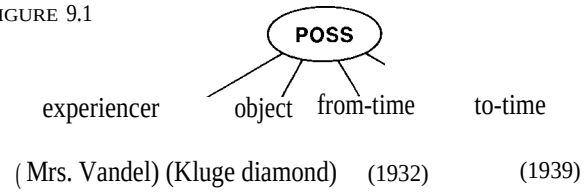
REPRESENTATION OF THE POSSESSION VERBS

Possession: **POSS**

The first element needed to represent the family of possession verbs is some expression of the state of possession. This stative, which I call **POSS,** indicates possession of an object by a person from some initial time to some final time. For example, the sentence

(1) Mrs. Vandel owned the Kluge diamond from 1932 to 1939.

FIGURE 9.1



is represented by the structural network shown in Figure 9.1. In this chapter **POSS** represents the intuitive notion of ownership. This does not imply that **POSS** is an unanalyzable whole. It seems clear that **POSS** shares elements of meaning with other statives. One such stative is location (see E. Clark, 1970). Another is "inalienable possession," which is inherently nontransferable "possession," as in sentence 2 (see Kimball, 1973):

(2) Mrs. Vandel had an imposing appearance.

Knowledge of the components that make up **POSS, LOC,** and the other statives enables us to represent the semantic similarities among these statives and also offers us an analytical approach to the problem of multiple senses of verbs.

Multiple Senses: Metaphorical Extension of **POSS**

A major difficulty in the representation of verbs is the fact that most verbs have many meanings. For example, consider the verb "have"

in the following sentences:

(3A) Sam has a large kettle.

(3B) Sam has a nice apartment.

(3C) The kettle has an enamel coating.

(3D) Sam has good times.

One way of dealing with verb senses is to formulate a definition that serves equally well for all uses of the verb. Bendix's approach is essentially this one (Bendix, 1966). The disadvantage of such an approach is that the resulting definitions are so general that they lose their usefulness for specific instances. For example, a paraphrase of "have" for sentences 313 and 3C would need to omit the notion of ownership; yet ownership is important in the meaning of "have" in sentence 3A.

A second way of handling multiple word senses is to choose one sense as the meaning of the word. Fillmore's claim is that "have" is a real verb when it means "possess" but serves a merely syntactic function in its other senses (Fillmore, 1966). This approach avoids the difficulties presented by an all-inclusive definition. However, it also tends to obscure the semantic relations among the different senses of the verb.

In this chapter the verbs are defined in their basic possessive senses. In my view the other senses of these verbs are not a separate class but are metaphorical extensions of the meaning of the basic sense. In each of these extensions some, but not all, of the elements that characterize **POSS** are preserved.

For example, in sentences 3A and 3B,

(3A) Sam has a large kettle.

(3B) Sam has a nice apartment.

the verb "has" conveys the idea that Sam has the right to use the objecf as it is normally used: to live in the apartment, to cook with the kettle. However, the right to transfer possession of the object is present in sentence 3A but not in sentence :313. Sam can sell the kettle if he wants to, but not the apartment. In sentence 3D,

(3D) Sam has good times.

very few of the elements of **POSS** remain.

Moreover, notice that although we can speak of transfer of good times, as in

(4) Sam gave Chlorette a good time.

the transfer differs from the normal transfer of **POSS** in that Sam can continue to have a good time himself after the transfer. Had he given Chlorette a zircon the situation would be different. **POSS** conveys exclusive possession; if Chlorette owns something, Sam does not. It is understood, though, that the relation between Sam and good times in sentence 3D is not the full **POSS,** but something more like "experiences." The properties of the transfer (giving a good time) are inferred from the properties of the state of having a good time.

The analysis of **POSS** into more primitive components should allow us to describe the elements that take part in a given metaphorical extension. However, in the remainder of the chapter I will be concerned only with the basic possessive senses of the verbs. In this context **POSS** can be treated as simple ownership of concrete objects.

Transfer of Possession: **TRANSF**

TRANSF is a higher-level component that stands for change of possession of an object from one person to another. The argument structure of **TRANSF** is shown in Figure 9.2.[1] The **TRANSF** chunk is similar to the *transfer-of-possession* that Schank and his co-workers call **ATRANS** (Schank, 1973b). The chief difference is that **ATRANS,** like the other primitive verbs in Schank's system, is defined as a unitary action, whereas the **TRANSF** component used here consists of a **CHANGE** component acting on a stative of possession (see Figure 9.2). I prefer the **TRANSF** analysis; first, because it makes apparent the relation between stative verbs like "have" and verbs of change like "give"; and second, because explicit representation of the stative components of verbs helps clarify metaphorical extension.

TRANSF *and Causality: The Abstract Act* **DO.** The **TRANSF** chunk does not specify any causal agency for the change of possession. However, many verbs include a statement about the causal agent as part of their meanings.

[1] In this (and later) figures in this chapter, shaded nodes indicate a repetition of a node shown elsewhere in the figure, but duplicated for clarity.

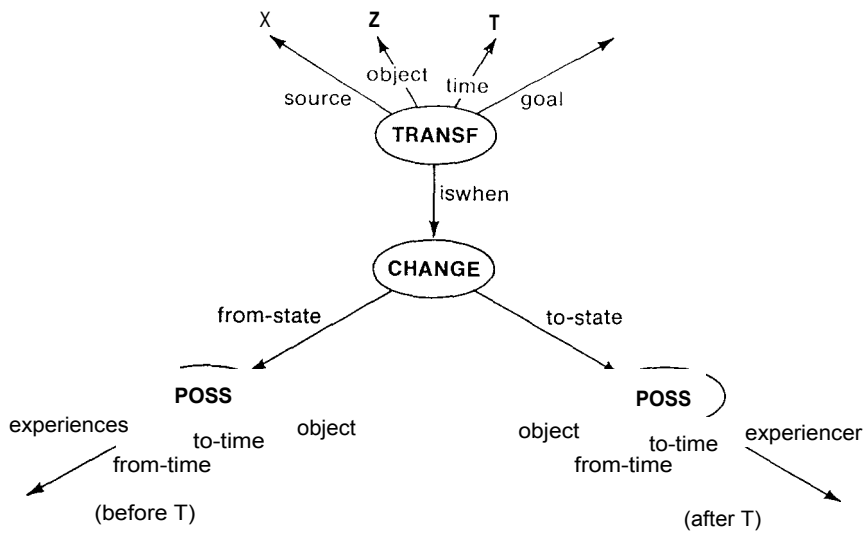


FIGURE 9.2
Transfer of possession: Object Z passes from the possession of person X to the possession of person Y at time T.

Consider the transfer of object Z from X to Y:

If X instigated the action, we can say X gave Z to Y.
If Y instigated the action, we can say Y took Z from X.

A few verbs of possession, such as "grab," "seize," and "hand," specify not only the agent of the transfer but also the action that was performed to cause the transfer to occur. However, in general, the possession verbs tend not to specify actional components. What is specified is which transfers take place and who instigates them, and sometimes why; rarely is it important to know exactly how the transfers are accomplished. Thus, the abstract causal act **DO** is normally used in this chapter to represent the event by which the agent caused the change in possession to occur. This is in keeping with the analyses presented in the other chapters of this book.

Using the components discussed to this point, it is possible to define such verbs as "give" and "take." The structural representations for "give" and "take" are shown in Figure 9.3.

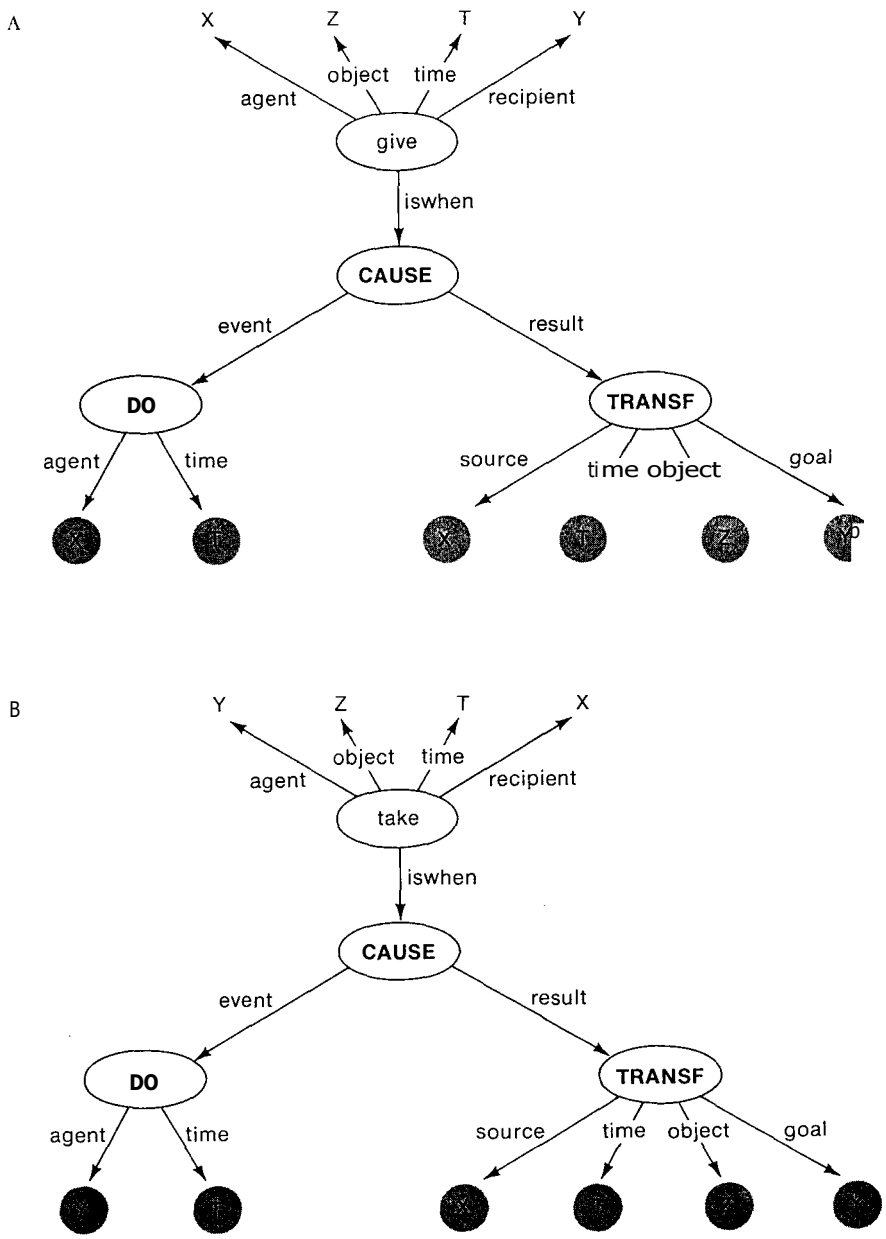


FIGURE 9.3
Structural representations for "give" and "take":
A "X gives Y a Z at time T."
B "Y takes Z from X at time T."

TRANSF, Negation, and Presupposition

The meaning of **TRANSF** includes both the initial state and the final state of possession, as well as the change front one to the other. The sentence

(5) I took some candy from the children (at time T).

communicates a number of different aspects of the event: the initial state, the final state, the change to the final state, and the cause of the change. Thus, the following ideas are all contained within (5):

(6A) The children had some candy (before time *T). [The initial state]*

(6B) *I* had some candy (for some time after *T). [The final state]*

(6C) *I* got some candy (at time *T). [The change to the final state]*

(6ll) *I caused myself to get some candy (at time 'T'). [The causal element]*

All of these submeanings are normally communicated by "take."

A problem arises with negative sentences. As Fillmore points out, the negation of sentence 5

(5) I took some candy from the children.

affects only the change to the final state part of the transfer, not the initial state; that is,

(7) I didn't take any candy from the children.

normally conveys that the speaker did not get any candy but *not* that the children did not have candy. Fillmore builds this difference into his representation of "take." In his system, only sentence 6ll, which contains the causal element and the change to the final state, makes up the asserted meaning of the verb. The initial state that the children had some candy is not directly communicated, but is a presupposition. In other words, it is part of the necessary background information (along with the fact that the children exist, and so on) that must be true in order for the sentence to make sense. (A more complete discussion of presupposition is given in Chapter 4.)

Although Fillmore's representation captures the behavior of "take" under negation, the omission of the initial state from the "'asserted meaning" seems clearly wrong for positive sentences. The **TRANSF**

chunk has the advantage that it represents the full positive meaning, including both the initial and final states. To this **TRANSF** representation we can add a conversational postulate that states that negating a change-of-state verb such as "take" does not normally affect the initial state, but affects only the change to the final state.

There is an independent motivation for this postulate. There are indefinitely many negative sentences that could truthfully be uttered. One could edify one's companions with remarks like

(8A) I didn't take any diamonds from the children.

(8B) Robespierre didn't take any animal crackers from Sophie Tucker.

and so on. People normally talk about what did not happen only when it might well have happened. It is only plausible to utter a negative sentence when some, but not all, of the chunks that would have been conveyed by the positive sentence are iii fact valid. Sometimes the speaker uses special stress to indicate which part of the meaning should be negated, as in

(9A) I didn't take any candy from the children.

(9B) I didn't take any candy from the children.

In the absence of special information, one normally assumes only that the change of state did not occur. With this postulate we can capture the effect of negation on change-of-state verbs while still representing the full positive meaning of the verb.

Obligation: **OBLIG**

The verbs "give" and "take" can be represented simply as actions on the part of a person that result in transfer of possession, but many possession verbs are more complex. Some notion of obligation is included in the meanings of many of these verbs. Sometimes only one person is obligated, as in the verb "owe." More often there is mutual obligation, as in verbs of exchange such as "buy" and "trade." A common pattern is that two actions must be completed to fulfill the meaning of the verb. For example, consider this story:

(10) Ida and Sam decided to trade speakers since hers were too big for her apartment. She delivered hers to him on Wednesday but by Saturday he still hadn't brought his over.

Here we can see several features of these verbs. First, there is an initial agreement, either explicit or, as iii a store where the rules are well known, implicit. Each party agrees to be obligated to perform some action in return for the other party's performing his action. I call the stative component of the verb that denotes this obligation **OBLIG.**

Sometimes a final time by which both actions must be completed is specified. But even if such a time is not made explicit, there is some implicit feeling about the duration, such that the tardy person becomes increasingly in the wrong after some vaguely defined interval following the completion of the other half of the bargain. In informal situations, the completion of one person's action tends to ratify the agreement, and thus confirms the other person's state of **OBLIG.** Words such as "buy" and "sell" normally imply that the transfers of both the object being purchased and the money being paid take place at the same time.-' Words such as "borrow" and "loan" imply that there is a reasonably long interval between the initial transfer of the object being loaned and the final transfer of the object back to the loaner.

Notice that the notion of **OBLIG** is concerned with the acceptance of a social or moral requirement. One would not use **OBLIG** in the case of a man who was being robbed. The actions that are agreed upon are most often transfer of possession, as in "trade," "buy," or "return." But other sorts of actions are also possible, as in the verbs "hire," "work for," and "contract." Thus **OBLIG** is a stative denoting the social or moral necessity for performing a certain action. The structural format for **OBLIG** is shown in Figure 9.4.

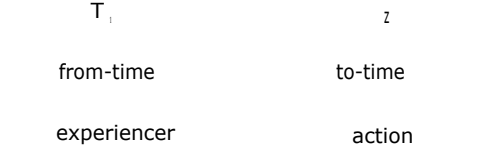


FIGURE 9.4
The argument structure of **OBLIG:** X has been in a state of obligation since tine T1 to perform) the action W by time T2.

'In this and later analysis, I use the term "money" to include all formal acts that have become equivalent to the actual physical use of noucy, such its presentation of a check or a credit card to the seller.

Mutual Obligation or Contract: **CONTR**

Some verbs are concerned with a state of obligation that applies to one person only. For example, "owe" and "pay" communicate a state of **OBLIG** on the part of the owner or payer, but do not convey that the other person is in a state of **OBLIG.** However, there are many verbs that involve two co-agents who both agree to be obligated to perform actions. I use the term **CONTR** to refer to the state of mutual obligation to perform stated actions. The structure of **CONTR** is shown in Figure 9.5.

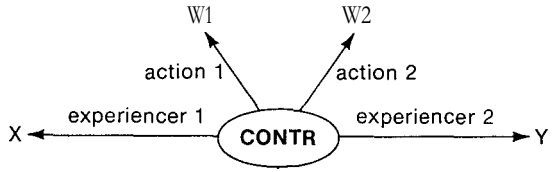
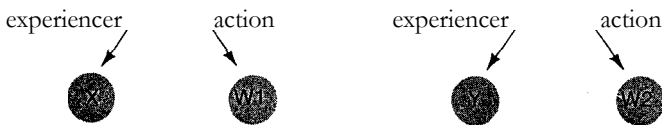


FIGURE 9.5
The structure of **CONTR:** X and Y have contracted (mutually agreed) to perform actions W1 and W2, respectively.

iswhen

arg 1 arg 2



BOX 9.1
A set of possession verbs.

The components discussed in this chapter are sufficient to define a broad set of the verbs of possession. In this box are shown the representations of the verbs "give," "take," "pay," "trade," "buy," "sell," and "spend money." These verbs are studied in experiments reported later in this chapter. To simplify the diagrams the representation of time has been omitted.

(Continued)

I3OX 9.1 (continued)

I. COMPONENTS USED IN THESE DIAGRAMS.

CAUSE	The causal connection between an event and its result.
DO	An unspecified action performed by some agent: the abstract actional component of the verb.
CHANGE	A change from one state to another state.
POSS	The state of ownership by the experiencer of the specified object.
TRANSF	The change of possession (transfer) of an object from one person to another.
OBLIG	The state of societal obligation to perform some act or series of acts.
CONTR	The state of mutual societal obligation in which each of two persons is obliged to perform an (in general, different) agreed-upon act.
AND	A general conjunction, all of whose arguments must be fulfilled.

II. RELATION NAMES USED IN THESE DIAGRAMS.

Name of the relation	Symbol normally used for the argument of the relation	Description of the relation
Agent	X	human performer of an action
Experiencer	–	human who undergoes an indicated state
Recipient	Y	human who is the nonagentive participant in an action (the indirect object)
Object	z	physical object
Source	–	initial possessor of an object
Goal	–	final possessor of an object
Argument (arg)		onc of the argununlt rolations of the coujunetion **AND**
Action	W	action to be performed

((('oil I (II Ned)

III. STRUCTURAL REPRESENTATIONS OF A SET OF POSSESSION VERBS.

FIGURE B9.1
X gives Z to Y.

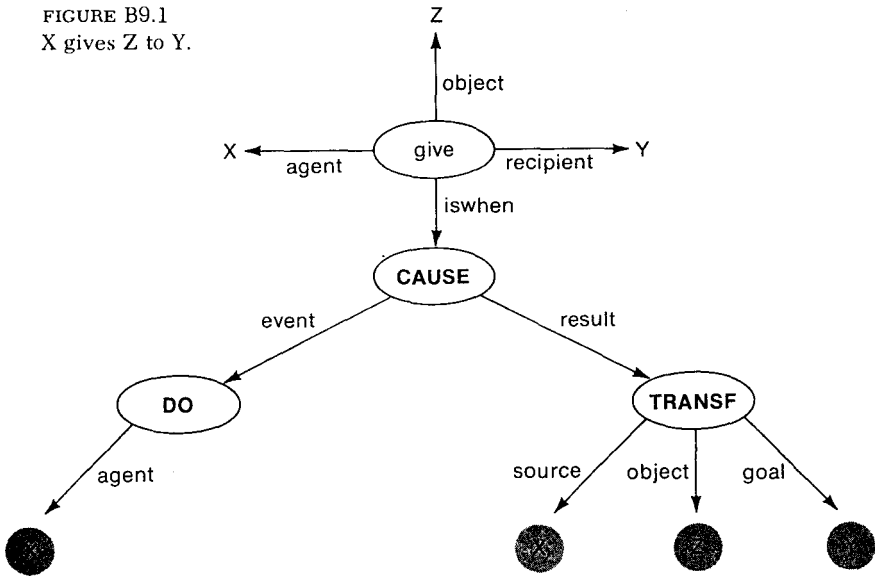
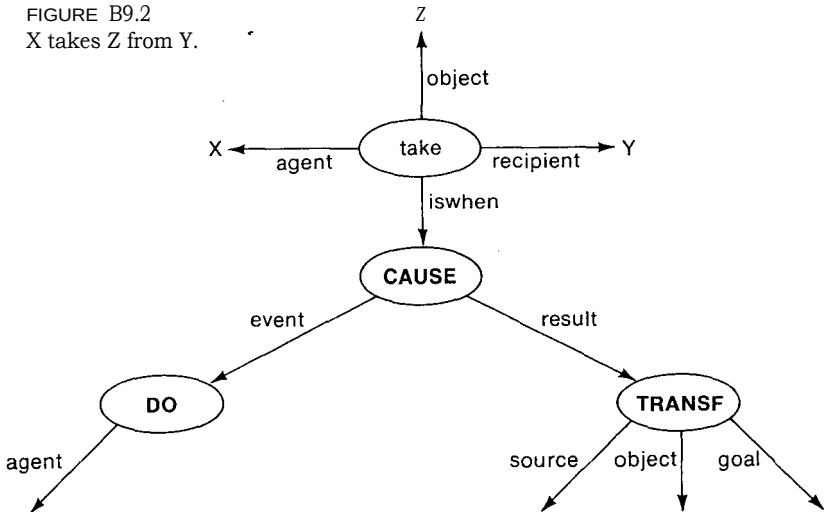


FIGURE B9.2
X takes Z from Y.



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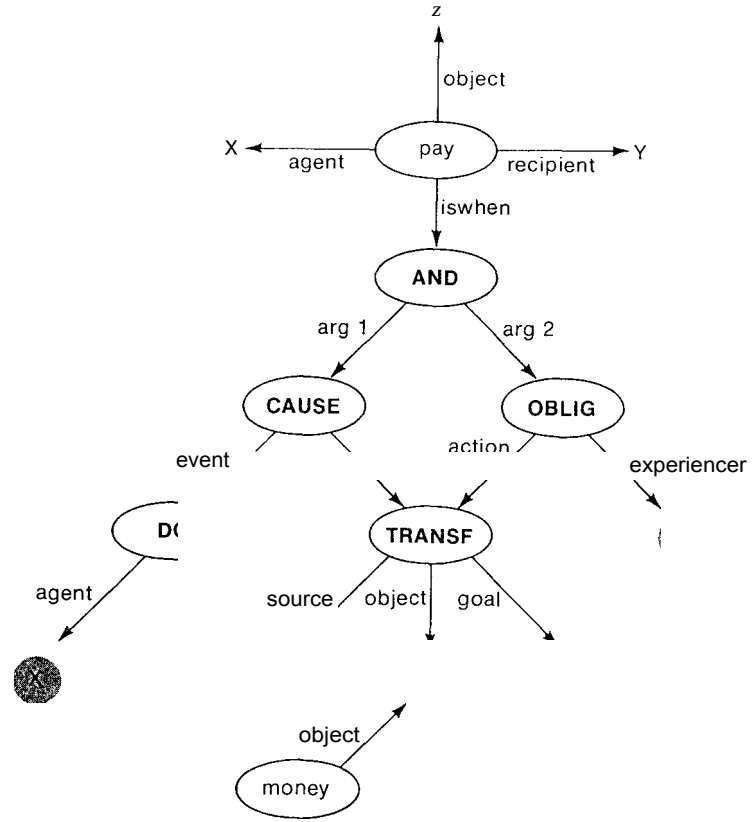

'rGUI(r; R I.3
pays Z to 1'.

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BOX 9.1 *(continued)*

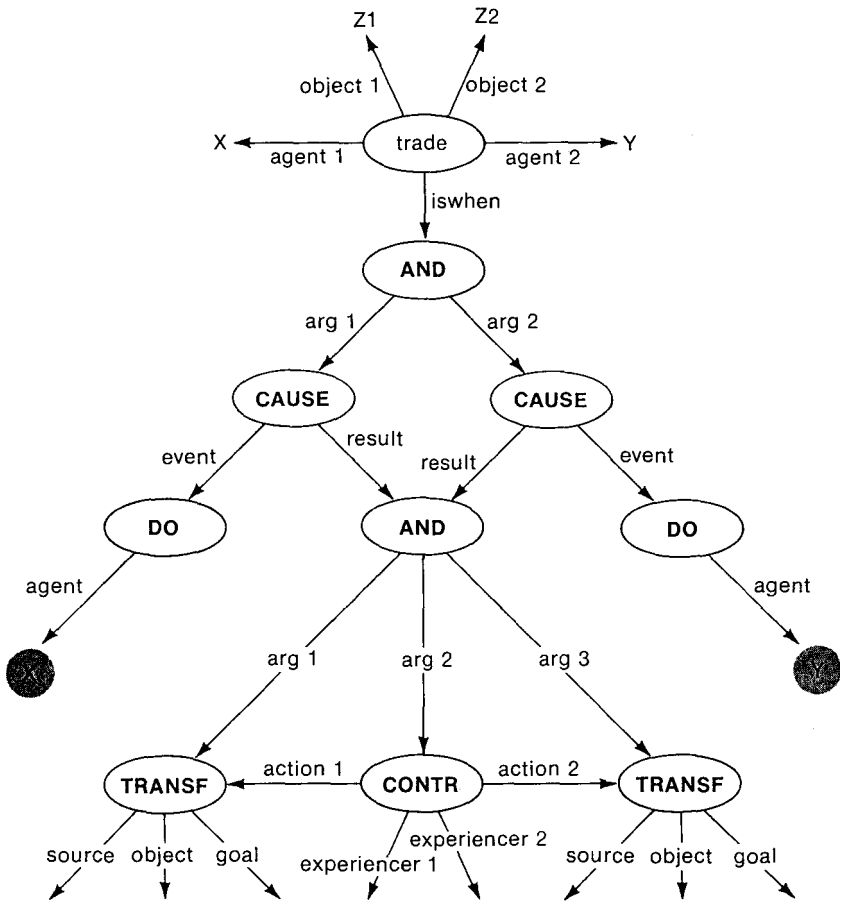

FIGURE 139.4
X trades Y a Z1 for a Z2.

(continued)

BOX 9.1 *(continued)*

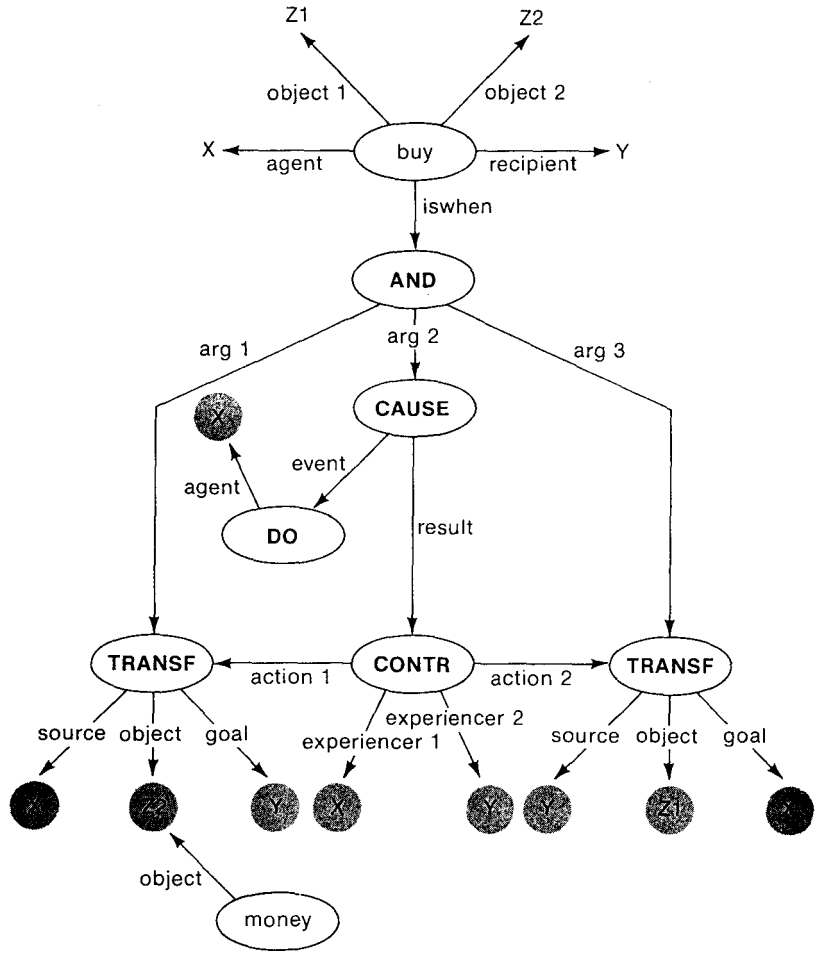

FIGURE 139.5
X buys Zl from Y with Z2 (money).

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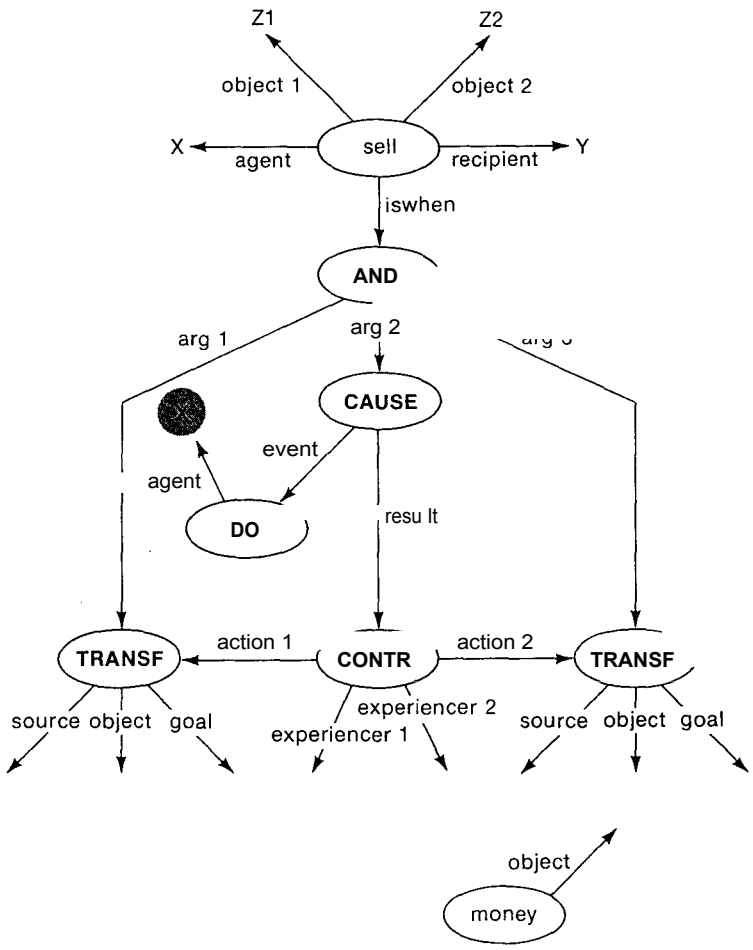
BOX *9.1 (continued)*



FIGURI. 139.6
X sells Z1 to Y for Z2 (money).

(continued)

BOX *9.1 (continued)*

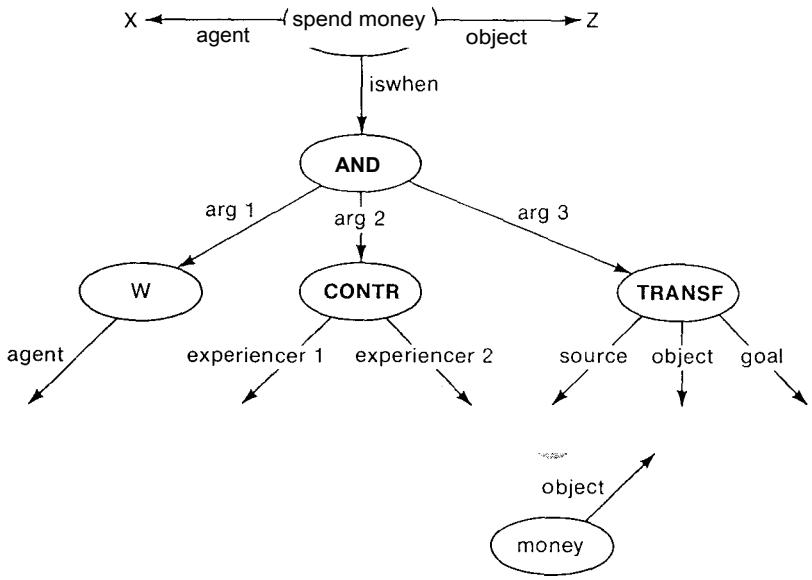


FIGURE *B9.7*
X spends Z (money). [X gives some person (Y) some money (Z), and in return Y performs some action (W).1

MEMORY FOR CHUNKS

To understand the meaning of a sentence, it is necessary to expand the lexical items to their semantic components and to link these components in the way specified by the sentence. 'To read out a sentence from memory requires the production of a set of words that correspond to the interrelated chunks. This process of going from the semantic components to the surface words is akin to the linguistic notions of predicate-raising (MeCawley, 196$a) and "conflation,, (Talmy, *1972).* There are usually several ways to combine the chunks into words. A set of chunks may be read out as "went by foot" or as "walked," for example. Usually it is not possible to predict exactly what lexicalization should result from a given structure. However, we can make some general predictions.

Confusions among Semantically Similar Verbs

If verbs are stored as interrelated sets of chunks, then recall for verbs should depend on the recall for chunks. An immediate implication is that verbs whose underlying structures overlap should be more confusable than verbs whose structures are very different.

In an experiment designed to test for such confusions, I showed subjects triads of sentences. The verbs in two of the sentences (types S1 and S2) had chunks in common; the verb in the third sentence (type D) had little or no semantic overlap with the other two verbs. All three sentences had the same agent, as in the following triad:

(11A) Ida received the backpack. (type S1: *similar)*

(11B) Ida borrowed the tablecloth. (type *S2: similar)*

(11C) Ida ruined the drafting set. (type *D: different)*

Figure 9.6 shows the structural networks for sentences 11A, B, and C. The sections of the networks for "receive" and "borrow" that overlap (the **CHANGE** of **POSS** sections) are shaded.

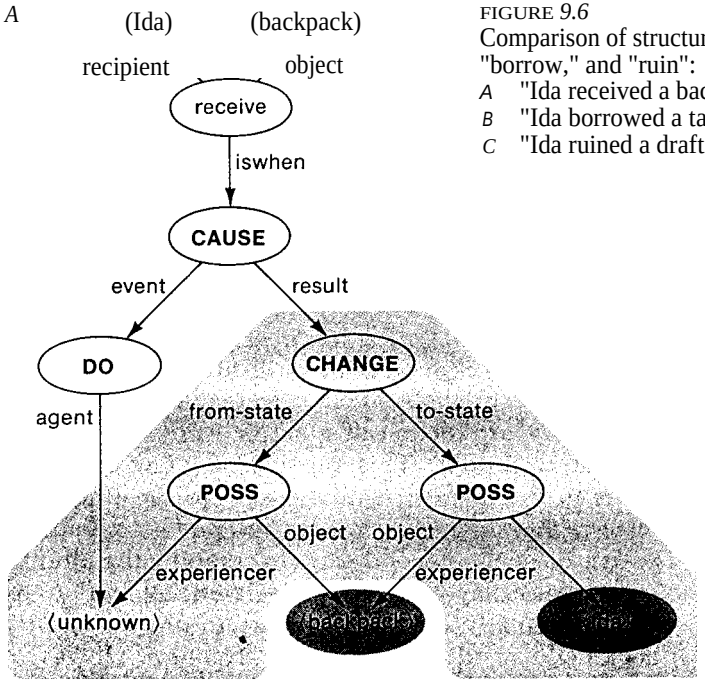
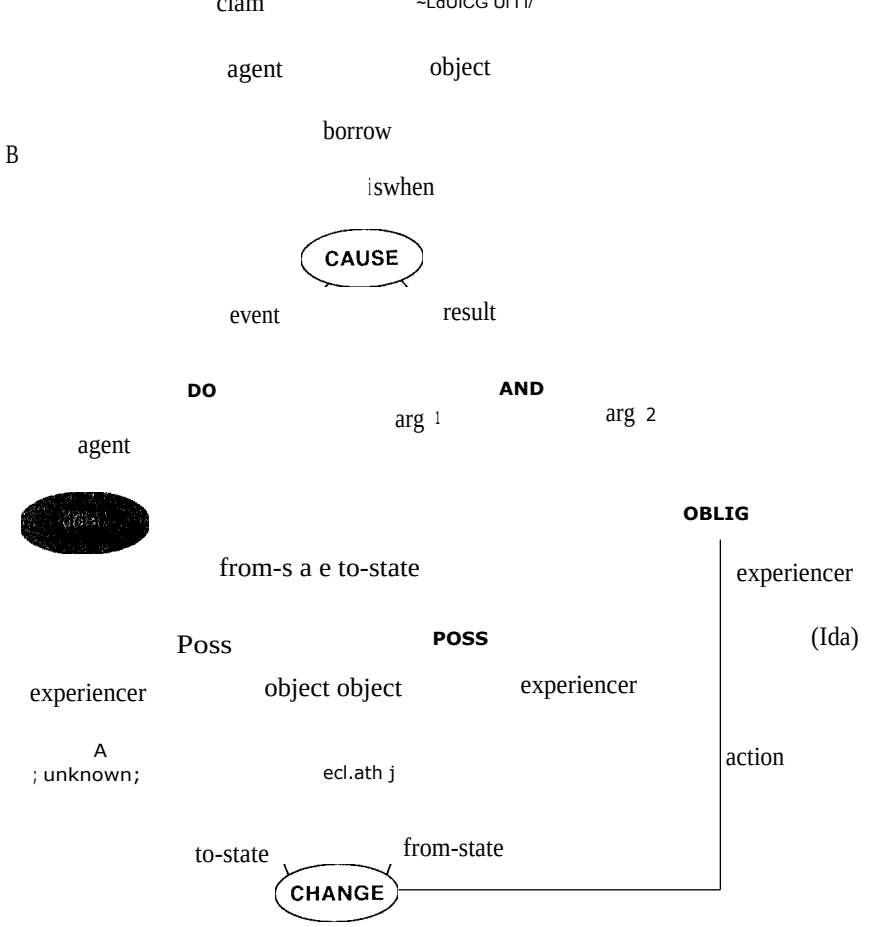
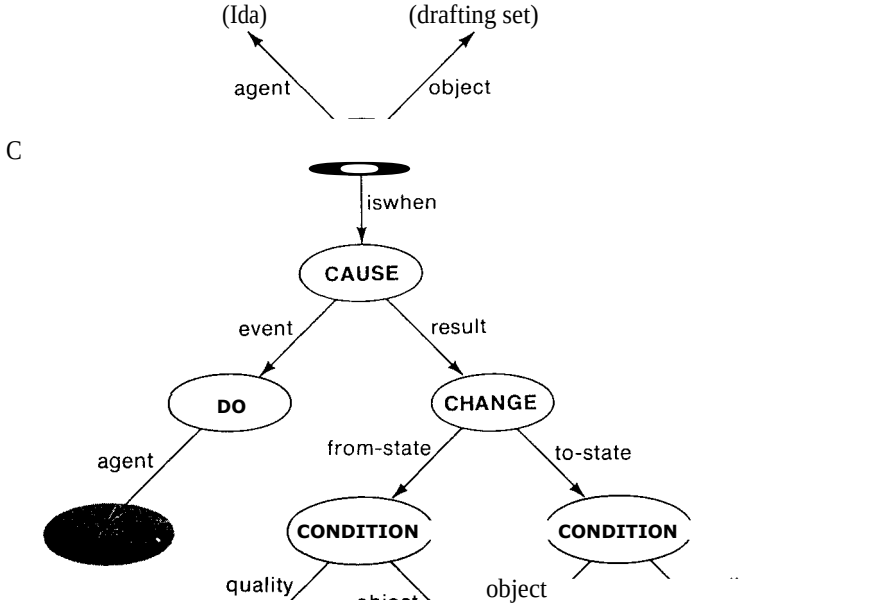


FIGURE *9.6*
Comparison of structures for "receive," "borrow," and "ruin":
A "Ida received a backpack."
B "Ida borrowed a tablecloth."
C "Ida ruined a drafting set."





Consider a subject who has seen three sentences of the form shown in (I IA, B, and C) and who has forgotten some of the underlying components. In particular, consider the subject who has retained some of the information shown in the shaded portions of Figures 9.6A and 9.6B, but who has lost the links with the rest of the network for the verbs. Suppose we now test him by presenting one of the following probes:

(12A) Ida borrowed

or

(12B) Ida received

Both probes contain substructures (the shaded areas in Figures 9.6A and 9.6B) that are consistent with either of his partial networks: the structure concerning possession of the backpack and the structure concerning possession of the tablecloth. The subject who has lost the connecting links for these substructures should be unable to tell which fragment belongs with which probe. Since sentences of type D have little or no overlap with the other sentences, a probe derived from a sentence of type D

(13) Ida ruined

should seldom lead to confusion. The theoretical prediction is that because of the overlap in the structures, there should be more object confusions between sentences of types S1 and S2 than between sentences of types S1 and D or S2 and D.

Since the predictions for the experiment concern only errors, subjects were deliberately overloaded in an effort to increase the number of errors. Each subject heard 40 sentences. The stimuli were 8 S1-S2-D triads (making 24 sentences) randomly interspersed with filler sentences. The subjects were instructed to remember the sentences for a recall task. In addition, they were told that they would have to write a brief impression of each of the 4 people who were the agents of the 40 sentences: Ida, Frederick, Sam, and Violet. (For each agent there were 2 triads and 4 filler sentences.) The subjects were asked to write the impressions in order to encourage them to comprehend the sentences, not simply to memorize them. Within each triad the pairing of verbs and objects was counterbalanced over 3 groups of subjects.

Under these conditions subjects made a large number of errors. Only 31 percent of the responses were correct; another 55 percent were omitted entirely. The errors of interest were the confusion errors, in which an object that was presented with one verb was mistakenly

recalled with another verb. These constituted 8 percent of the responses. As predicted, confusions between objects of overlapping verbs greatly outnumbered confusions between objects of nonoverlapping verbs. Eighty-one percent of the confusion errors occurred between Sl and S2 sentences, although by chance alone these errors should have constituted only one-third of the total number of responses. Table 9.1 presents the proportions of confusion errors of each type. The overlap between verbs S1 and S2 existed wholly at the level of semantic representation. The high proportion of confusions between them is strong support for a componential treatment of meaning.

TABLE *9.1*
Confusions in which the object presented with one uerb is mistokentil recalled with another verb.

Confusion type	Sentence used for agent-verb cue	Sentence in which recalled object was actually presented	Proportion"
similar-similar	S1 S2	S2 S1	0.81
similar-different	S1 S2	D D	0.13
different-similar	D D	S1 S2	0.06

'$F(2,60) = 6.66$; $_{1)} < 0.01$.

Shifts between General and Specific Verbs

When parts of the structure for a verb are forgotten, the verb may be recalled as a more general verb, one that lacks some o1 the chunks of the verb actually heard. For example, the sentence

(14) Ida bought a lawn mower.

might be recalled as

(15) Ida got a lawn mower.

if the structural information necessary for the more specific verb "bought" has been lost. Palmer (personal communication) obtained this specific-to-general shift in noun recognition. In his experiment

subjects were less likely to notice the substitution of a general noun (such as "flowers" in sentence 1613) for a specific noun (such as "tulips" in sentence 16A) than the substitution of a specific noun for a general noun.

(16A) The boy noticed the tulips in the park.

(16B) The boy noticed the flowers in the park.

It is also possible to produce general-to-specific errors. If chunks are added by context to the network for a general verb, the resulting structure may look identical to the one for a more specific verb. In this case the extra chunk will sometimes be recalled as part of the verb, producing a shift from a general verb to a specific verb.

For example, consider the pair of words "give" and "pay." The meaning of "pay" is almost the same as that of "give" with the addition of the specification of the object as money and of the element of owing (a state of **OBLIG** to **TRANSF** something). Suppose someone hears a statement that combines "give" with a prior condition of owing and with the notion that the object involved is money. He should construct a structural representation that looks like the structure for "pay." One would then expect him to use the word "pay" when he recalls the passage.

In a simple demonstration of this phenomenon, I presented subjects with one of two stories, each ending with the same final sentence:

(17) Max finally gave Sam the ten dollars.

In one story, Max was described as owing money to Sam. In the other story, Sam simply asked Max for some money. The two groups of subjects were then asked to recall the story as accurately as possible. The results of their recall of the critical sentence, sentence 17, are presented in Table 9.2. When sentence 17 was presented in the story that involved owing, subjects used the phrases "paid" and "paid back" considerably more often than they used the correct word "gave" (47 percent compared with 30 percent). Subjects who had heard the story that involved asking for money recalled sentence 17 quite differently. No subjects used the words "paid" or "paid back." One-third of the subjects used the word "loaned": the same fraction that used the correct word "give."

Since no subjects heard the word "pay" in the experiment, the high incidence of false recalls of "pay" and "paid back" in the "owing" version is not the result of simple memory for lexical items. Further, the fact that no subjects made the "pay" substitution in the "asking" version rules out the possibility that "pay" simply fitted better in the sentence. I conclude that subjects constructed a componential representation that included not merely the lexical verb ("give") but also its context. When they were asked to recall the story, they had to partition their semantic structures into words, which often yielded words that were different from those that they had originally heard, These results, like the results of the semantic confusions experiment, support a model of memory in which verbal material is stored as sets of interrelated components.

TABLE 9.2
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Verbs recalled in sentence 17	When sentence appeared:	
	In a story containing "owing" (percent)	In a story containing "asking" (percent)
gave (the correct response)	30	33
paid	31	0
paid back	17	0
loaned	0	34
other	22	33

SEMANTIC STRUCTURE AND THE ACQUISITION OF MEANING: AN EXPERIMENTAL ANALYSIS

If word meanings are embedded within structural networks composed of interrelated semantic components, then acquisition of word meaning should be largely explainable in terms of the acquisition of components and the relations among them. There is considerable evidence that the development of word meanings proceeds by gradual addition of chunks to existing representations. The work of E. Clark and of Donaldson, Balfour, and Wales provides several examples of the gradual accretion Of the "semantic features"[1] associated with a given word (E. Clark, 1970, 1971, 1973; Donaldson and Balfour, 1968; Donaldson and Wales, 1970). In the stages before all the necessary features are added to the representation of "a word, the child's use of the word indicates that its meaning for him lacks some features of the adult meaning.

[1] For present purposes, E. Clark's "semantic features" can be considered to be roughly equivalent to what I have called chunks.

A verb whose representation includes chunks that are acquired late should be learned later than one whose chunks are acquired early. Further, verbs with few chunks should be used correctly before verbs with many chunks. More specifically, there should be a nested-chunks effect. If the structure for one verb is entirely contained within the structure for another, the former verb should be acquired first. Because a child's representation of a verb depends upon just how many of the underlying components have been acquired, a child's mistakes in interpreting complex verbs should in general reflect omission of the chunks not yet acquired.' His interpretation of a complex verb may be identical to his (correct) interpretation of a simple verb, at least until he acquires the necessary additional verb components. The order of acquisition of the underlying components of possession verbs should determine both the relative ages at which children can acquire the meanings of these verbs and the types of errors children will make if they attempt to use a possession verb before they have acquired all of its meaning components.

A weak order of acquisition among the chunks can be derived directly from the nested relations among the chunks. **CONTR** contains **OBLIG** as part of its meaning, and the composites **CONTR-TO-TRANS** and **OBLIG-TO-TRANSF** cannot be understood until their components (**DO, CAUSE,** and **TRANSF)** are present.

Additional ordering predictions can be inferred from the developmental psychology literature. The work of Piaget suggests that young children tend to rely very heavily on the notion of animism-the tendency to attribute animate causes to events (Piaget, 1955, 1965). This attribution of cause requires (implicit) knowledge of **CAUSE** and **DO. TRANSF** should also be learned relatively early, because the notion of change of possession is both more concrete than the notions of **OBLIG** and **CONTR** and more common in the experience of children.

The expectation, then, is that **DO, CAUSE,** and **TRANSF** should be acquired early by children. The other components enter into the child's representational system later.

To use **OBLIG** correctly as part of a verb, the child must understand something about the notion of social obligation. **CONTR,** which involves mutual social obligation, requires prior understanding of **OBLIG.** Accordingly, it should be the last chunk to be acquired.

Thus, the predicted ordering of acquisition is roughly **DO, CAUSE, TRANSF, OBLIG,** and finally **CONTR.** In addition to these conceptual

'This naturally applies only to verbs that the child has heard and that he attempts to use prior to acquisition of all the necessary chunks. If a complex verb is only first encountered after all the necessary chunks have been acquired, the course of acquisition may be quite different.

chunks, the function of money as an argument constraint must also be learned in order for the child to use verbs such as "pay" or "buy."

In order to predict the order of acquisition of the verbs themselves, it is necessary to consider not only the individual chunks, but also the nested relations among the sets that comprise the verbs. There are two nesting orders among the sets of subconcepts that make up the verbs under consideration. Figure 9.7 shows these nesting orders and the derived predictions for the order of acquisition of the verbs.

First come "give" and "take." Both these verbs should be acquired early in the development of the child since they require only **DO, CAUSE,** and **TRANSF.** The next two words to be acquired should be "trade" and "pay." Both these words add **OBLIG** (as well as other components) to the previous **DO, CAUSE, TRANSF** structures. Which of these two words comes first depends upou whether the child first learns about social contracts (**CONTR)** or about the use of money. There is no *a priori* reason to suspect the primacy of one of these concepts over the other. One would suspect that the relative order of acquisition of **CONTR** and of the notion of money varies from child to child.

Finally, after both **CONTR** and money have been acquired, then the child is ready to use properly terms such as "buy," "sell," and "spend money." Of the words that are examined in this chapter, these three should be the last to be acquired.

Confusions among the Verbs

At the stage when only **DO, CAUSE,** and **TRANSF** are understood, only the verbs "give" and "take" can be represented correctly by the child. More complex verbs such as "buy" and "sell" should be represented incompletely as some combination of **DO, CAUSE,** and **TRANSF.** The child who has not yet acquired **OBLIG, CONTR,** or the notion of money sees in an act of "buying" only a series of transfer, of which only the object transfer makes sense. He has no way of organizing the transaction as a whole. The most we can expect this child to store as his representation of a complex verb is some sort of object transfer.

Experimental Procedure

The details of the experimental study are reported in Gentner (1974). Here an outline of the study is presented, along with reasonably complete results. Children between the ages of' :3 an<I 8 were asked to

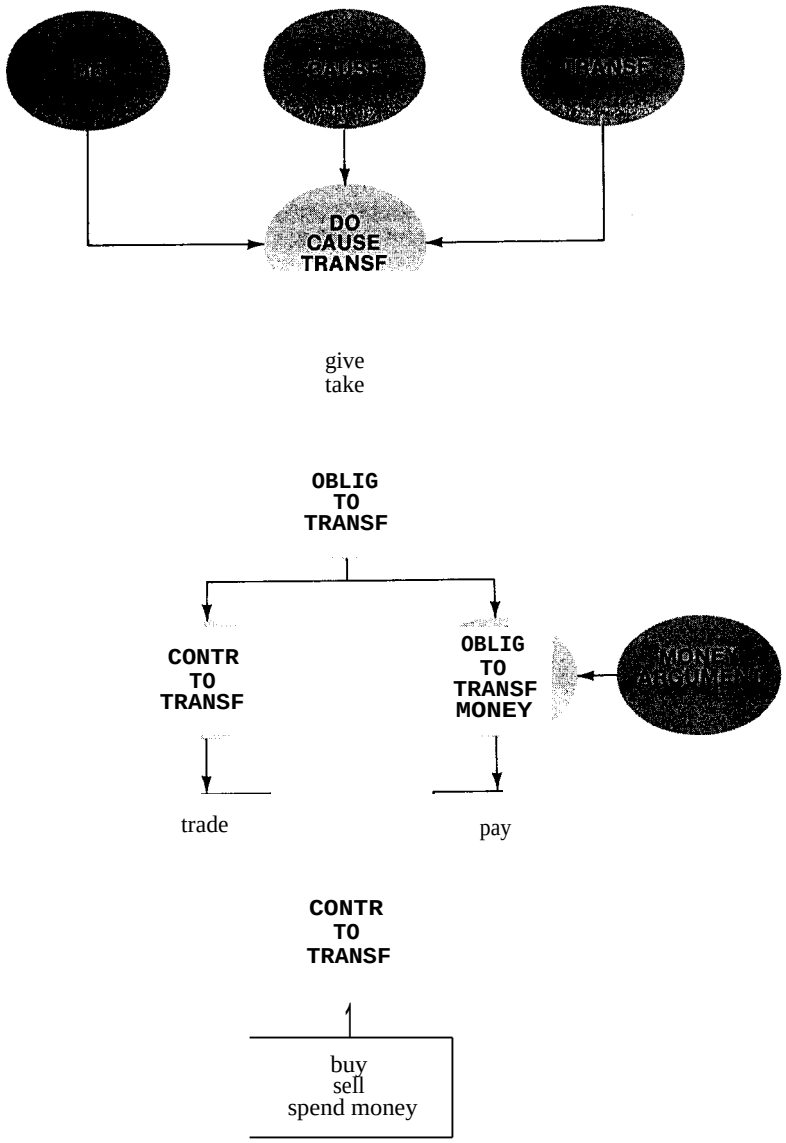


FIGURE 9.7
The nested relationships among the concepts underlying the verbs "give," "take," "trade," "pay," "buy," "sell," and "spend money." Semantic components (chunks) are represented by darkly shaded ovals. The states that permit full understanding of the verbs are represented by lightly shaded ovals. Age of acquisition of the verbs proceeds vertically, youngest age at the top.

manipulate two dolls to act out sentences containing possession verbs. The experimenter observed and recorded the manipulation, taking particular note of the types of errors made. Special care was taken to ensure that the children fully understood the nature of the task, that the dolls (and their names) were well learned by the children, and that simple artifacts could not account for the results. In particular, care was taken that the number, type, and arrangement of the objects that were to be transferred could offer no clues as to the operations that should be performed, and a control experiment was performed to ensure that the children were in fact using their semantic understanding of the verbs that had been presented to them, and not simply responding to the surface ordering of the names of the dolls and objects used in the sentences.

The subjects were 70 children ranging in age from 3/6 to 8/6 years .[5] There were 14 children at each of 5 age levels, approximately evenly divided between males and females (see Table 9.3). Each child received one dollar and some candies for his participation.

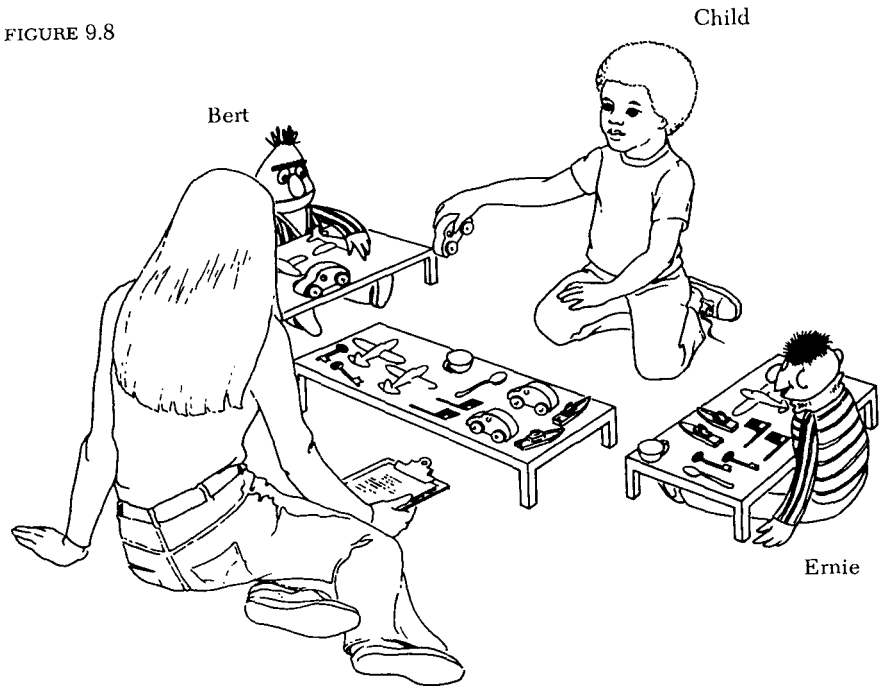
TABLE 9.3
Distribution of subjects used in the experiment.

Age range (years/months)	Females	Males	Total per age
3/6-4/5	7	7	14
4/6-5/5	8	6	14
5/6-6/5	4	10	14
6/6-7/5	8	6	14
7/6-8/5	8	6	14
Totals	35	35	70

The experimental arrangement is shown in Figure 9.8. The experiment was performed with each child individually in the child's home. The child was seated on the floor and presented with two stuffed beanbag dolls. The dolls were known as "Ernie" and "Bert" and were the conmrercially available models of' the dolls with those names used in the television show "Sesame Street." Usually the child was already familiar with the dolls and their names. If not, the experimenter talked to him about the dolls until he was able to name them easily.

'The age notation is that of years/months. Thus, age 3/6 means 3 years 6 months.

FIGURE 9.8



The experimenter spent considerable time with each child to ensure that he understood the names of the dolls, understood the seating arrangements, knew which table and which objects belonged to each doll, and was able to manipulate each doll to make it "pick up a toy," "move it over here," and "drop it down." The experiment began once the child had mastered all of these concepts and manipulations. Initially, each doll had the same set of toys: two each of cars, boats, flags, and keys; one each of a spoon and a cup. In addition, the experimenter placed some toys on the third "dining room table," saying, "Here are some things that Mother left on the dining room table." At least one of each type of toy was placed on the third table. This was done to allow confusions about the source and goal and the objects to be visible to the experimenter. However, children almost never used the objects on this third table.

The list of test sentences is shown in Table 9.4. At least two instances of "take" and two of "give" were administered. Then the experimenter said, "Now Mother comes in and says, `You've been very good today, both of you, so you can both have some money.'" The child helped distribute play money to the dolls: two dimes and two

TABLE 9.4

Sentences used. Nonindented sentences are the ones normally used. Indented sentences are those used -when checking for the effects of surface form. X and Y denote agent *cool* recipient, *respectively. Z denotes* object.

Verb	Sentences	Verb	Sentences
give	Make X give Y a Z. Make X give a Z to Y.	take	Make X take a Z from Y. Make X take from Y a Z.
sell	make X sell Y a Z.. Make X sell a Z to Y. Make X sell a Z.	hay	Make X buy a Z from Y. Make X buy from Y a Z. Make X buy a Z.

pennies to each doll. The experimenter continued with something like "Now they can do lots of things. Can you make Ernie, buy a car from Bert?"

After this, the experimenter progressed semirandomly through a total of eight instances of each of the verbs "give," "take," "buy," "sell," and "spend money," and two each of "trade" and "pay." The objects and the dolls used as agents (or subjects of the sentences) were varied from sentence to sentence.

The experimenter avoided saying "good" and making other evaluative remarks. Instead, to encourage the child, the experimenter would often either comment on the action after the child had completed it (for example, "Now Ernie has lots of planes, huh?") or else speak for one of the dolls ("Gee, thanks Bert. The car was just what I wanted"). Remarks of this sort were made often, particularly whenever the child seemed to be flagging, and were independent of the correctness of his response.

Scoring of Responses

The responses were recorded by the experimenter. For each response the following information was recorded: *object* (which object was moved), *source* (from what place the object was moved), *goal* (to what place the object was moved), and *agent* (who moved the object). If there was more than one transfer, the information was recorded for each of them, along with the time order of the transfers. If, in any transfer, the' experimenter failed to see the source, goal, or object used, that transaction was not recorded and another sentence of the same type was asked later. However, if only the agent was not seen, the transfer was recorded with the agent information missing. On

some of the later transfers, children frequently failed to use an agent; that is, they moved the objects themselves instead of causing the dolls to move them.

Results and Discussion

Order of Acquisition. The proportion of correct responses at each age level is shown in Figure 9.9. From this it can be seen that the order of acquisition of the verbs (where "acquisition" is arbitrarily defined as the point at which the child scores 75 percent correct) agrees quite well with the expected order. The verb group consisting of "give" and "take" is acquired first; then the group consisting of "pay" and "trade"; and finally the group consisting of "buy," "sell," and "spend."" The overall performance on a verb in any group is significantly different from the performance on verbs in the other two groups. Within the groupings the differences in performance are not significant, with one exception: "Sell" differs significantly from both "buy" and "spend." It is not clear whether the poorer performance on "sell" reflects some added conceptual complexity over "buy" and "spend" or whether "sell" is acquired later simply because the act of selling and the term "to sell" are relatively infrequent in a child's experience.

Another way to view the order of acquisition is shown in Table 9.5, which gives for each verb the conditional probability of achieving a high score on that verb, given a high score on each of the other verbs.' If a subject understands a verb belonging to one group, the probability that he will also understand the verbs from a simpler group is quite high, ranging from .91 to 1.0. The probability that he will understand a given verb from a more complex group is much lower, ranging from .33 to .76. For verbs in the same group, intermediate and approximately symmetric conditional probabilities appear." The probability of understanding "trade" given "pay," for example, is about the same as that of understanding "pay" given "trade" (.77 and .83, respectively).

"For "Make X trade Y a Z1 for a Z2," either of two responses was counted as correct: either the transfer of Z1 front X to Y and of Z2 from Y to X, or the reverse transfer of Z2 front X to Y and Z I front Y to X. Both these interpretations exist among adult speakers; 3 out of 14 adults tested on this sentence performed the reverse transfer.

'A "high score" on a verb or "understanding" a verb means that the subject scored 6 or more correct responses out of 8, or, in the case of "trade" and "pay," 2 correct responses out of 2.

"There are two exceptions to the several patterns observed in Table 9.5: "Give" and "take" have very high mutual probabilities, apparently because these verbs were well learned even by the younger children; in addition, "sell" does not appear to behave the same as "buy" and "spend." As noted before, "sell" appears to be acquired later than the other verbs in its group.

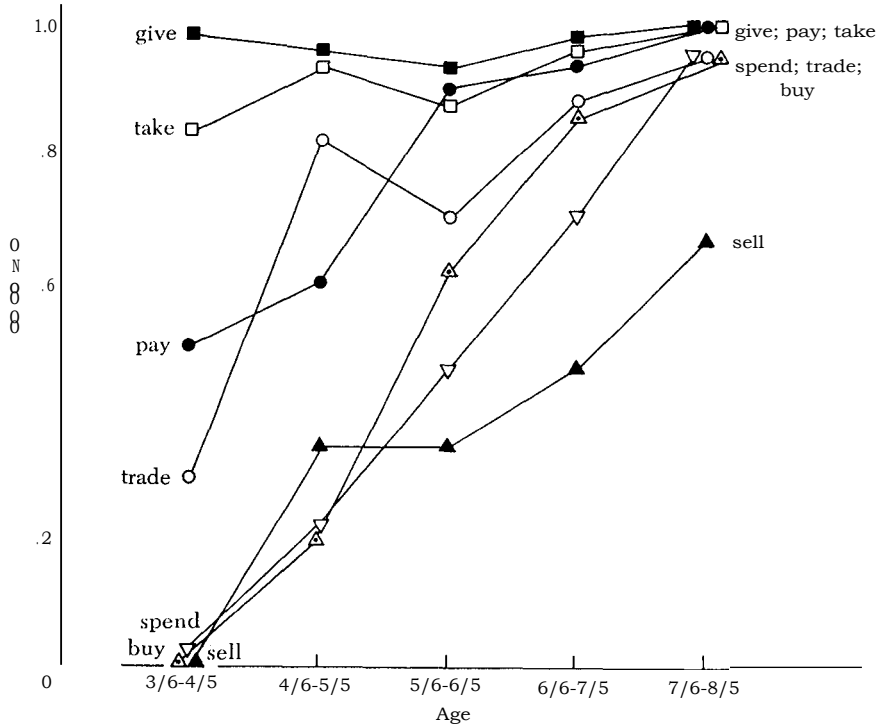


FIGURE 9.9

TABLE 9.5

Probability of a high score on the column verb, given a high score on the row verb.

	give	take	pay	trade	buy	spend	sell
give	–	.96	.76	.70	.50	.48	.33
take	.99	–	.74	.69	.52	.48	.33
pay	.98	.92	–	.77	.67	.60	.39
trade	.98	.94	.83	–	.67	.63	.46
buy	.97	.97	1.0	.91		.77	.57
spend	1.0	.97	.97	.94	.81		.59
sell	1.0	1.0	.91	1.0	.91	.86	

NOTES:

1. A "high score" is defined to he 6 correct responses out of 8 for 'give,' "take," "buy, spend," and sell" and 2 correct responses out oft for trade" and pay...
2. The different shadings indicate the :3 different sets of probabilities: those below the diagonal (p)-e(licted to be high); those above the diagonal (predicted to be low); and those near the diagonal (predicted to be intermediate). All 3 differences were significant.

Children understand verbs that are conceptually simple before they understand verbs that are complex. It is rare for a subject to perform well on the verbs in a group unless he also performs well on the verbs in groups that are less complex. There are only 2 instances out of a possible 102 cases in which a subject achieves a high score on a verb in one group without also achieving a high score on at least one verb in every simpler group. More stringently, there are only 12 instances out of a possible 102 in which a subject scores high on a verb without also achieving a high score on *every* verb in every simpler group.

Errors. Figure 9.10 shows the time course of acquisition both of correct responses and of the most common incorrect responses for the five complex verbs. For all of these verbs, the commonest incorrect response was some form of one-way transfer. This is in accord with the notion that **TRANSF** enters the semantic representations before the more abstract obligational notions (**OBLIG)** are acquired.

It is noteworthy that for all five complex verbs the erroneous one-way transfers are in the correct direction. Although the child's representations of the meanings of these verbs are incomplete, he nevertheless understands some components. For example, the young child acting out "buy" and "sell" completely disregards the money transfer that should be part of their meanings, yet performs the object transfer in the correct direction. He reacts to "buy" as if it were "take." He treats "sell" as if it were "give." The chunks that are present in the representations-notably TRANSF-can be used correctly, even though the complete representation is not present.

This pattern of correct one-way transfers shows up in the other complex verbs as well. For "spend money," the commonest error was simply to transfer money from the spender to the goal. As with "buy" and "sell," the object, source, and goal of the one-way transfer are all correct; only the other transfer is lacking. Notice that when money is explicitly mentioned in the sentence ("Make X spend some money"), even the young child performs a money transfer, though without performing the object transfer necessary to complete the **CONTR.** He can physically identify the objects called money, but he does not understand the abstract function of money. He interprets "spend money" as "give away money."

Another example of the young child's difficulty with the notion of money can be seen in the responses to the verb "pay." Here, the correct response is a simple one-way transfer of money. The commonest incorrect response is a transfer of the object to be paid for (a return) from the payer to the other doll. The child performs the one-

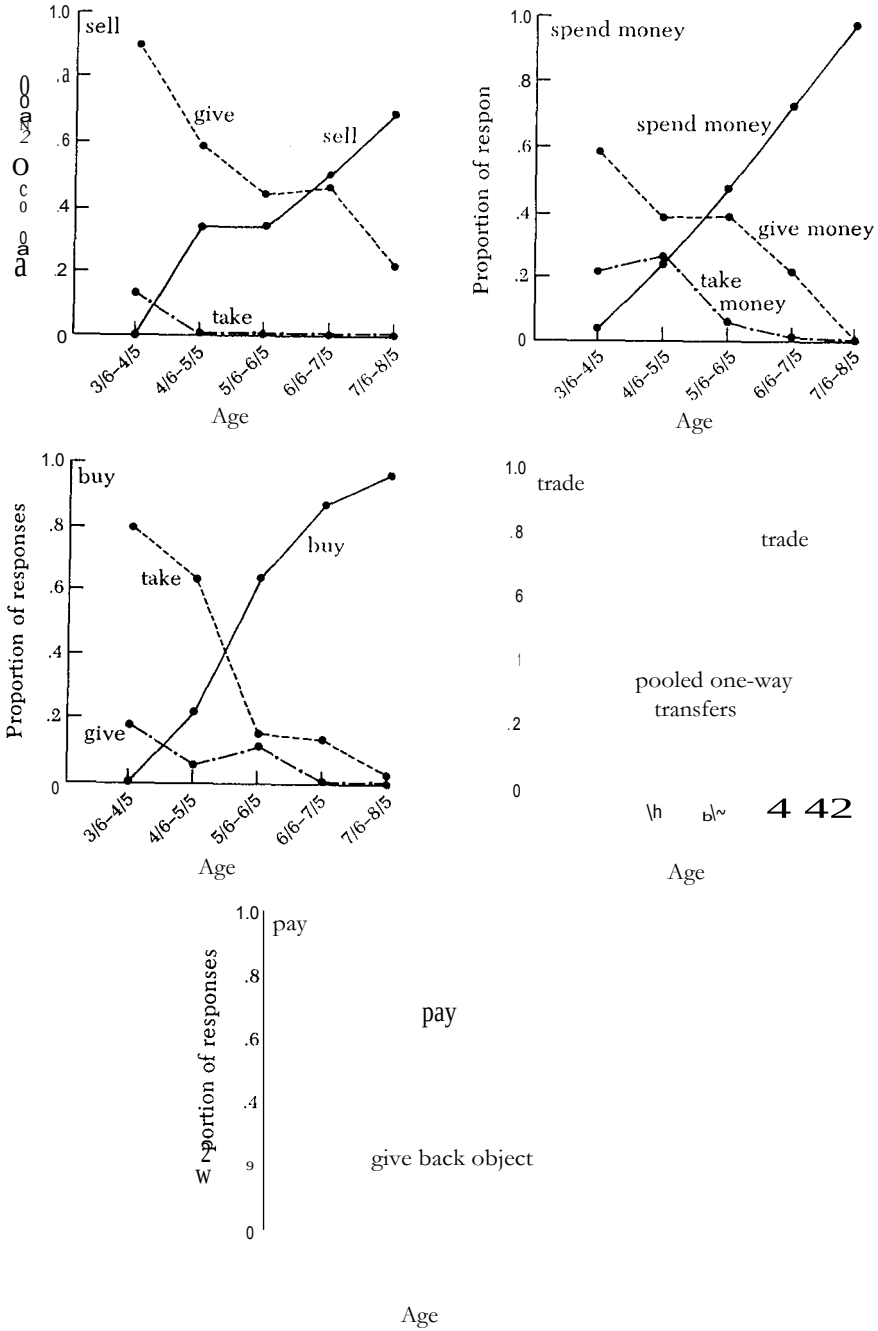


FIGURE 9.10

The proportion of correct responses and the proportion of the most frequent incorrect responses to the complex verbs. The correct responses are shown by solid lines; the incorrect responses are shown by dotted lines. (The verbs acted out for the incorrect responses are written on the graphs.) Responses that were denoted as "give" and "take" are transfers *to* or *from* the subject of the sentence, respectively.

way object transfer that is most appropriate and in the correct direction, again consistent with his lack of understanding of the money argument involved in "pay."

The responses to "trade" show the lack of the **CONTR** chunk in the younger children. One-way transfers outnumber the correct two-way transfer at the outset. Notice that there are several likely one-way transfers for the sentence form used in the experiment:

(19) Make X trade Y the Z1 for the Z2.

Either Z1 or Z2 or both may be transferred, either in the direction from X to Y or in the opposite direction.

A Check for the Use of Surface Cues. I have argued for a semantic interpretation of the fact that young children perform the correct one-way object transfer before they understand the rest of the meaning of a complex verb. To justify this interpretation it is necessary to rule out the possibility that the surface syntactic cues present in the sentences determined the children's responses. The verbs "buy" and "sell," in particular, occurred in sentence forms that could have been matched, using surface cues, with the corresponding "take" and "give" sentences. This would lead to the correct object transfer, but for nonsemantic reasons. For the verbs "buy" and "sell," the sentences normally used were of these forms:

(20) Make X buy a Z from Y.

(21) Make X sell Y a Z.

Notice the similarity of these sentences to the forms most commonly used for "take" and "give," namely:

(22) Make X take a *Z* from Y.

(23) Make X give *Y* a Z.

There are two possible surface strategies:

1. The preposition ("from" or "to") could be used to deduce the direction of transfer of the object with respect to the agent.
2. The order of the *object* and *recipient (goal)* in "buy" and "sell" sentences could he matched with the order in "take" and "give" sentences, respectively.

To check for the use of one of these strategies, 38 of the subjects were tested in a few examples of the verbs "buy" and "sell" presented in alternative sentence forms (shown in Table 9.4). In some of these forms, the words "from" or "to" and the nouns that followed them were omitted; in others the order of goal and object was reversed from the normal order in "take" and "give" sentences. Table 9.6 presents the results of these manipulations, averaged across all ages.

None of the surface variations produced any lessening of the tendency to perform the object transfer in the correct direction. This

TABLE 9.6
Effect Of surface forms of sentences used.

	Buy		
	Order of object and recipient same as for normal "take"	Order of object and recipient reversed from normal "take"	Recipient omitted
	"Make *X buy* a *Z from Y*."	"Make X buy from Y a Z."	"Make X buy a Z."
Proportion correct	.57	.48	.76
Proportion *of* "take" responses	.25	3J	.11
Proportion of object transfers in correct direction (sum *of* rows *1* and *2)*	.82	.87	.87
Number *of* responses	143	61	63

	Sell		
	Order of object and recipient Same as for normal "give"	Order of object and recipient reversed from normal "give"	Recipient omitted
	"Make X sell (to) Y a Z."	"Make X sell a Z to Y."	"Make X sell a Z."
Proportion correct	.43	.38	.56
Proportion *of* "give" responses	.53	.59	.44
Proportion *of* object transfers in correct direction *(sum of* rows *1* and *2)*	.95	.97	1.0
Number *of* responses	14:3	81	43

conclusion appears to hold when the data are analyzed by age. Unfortunately, since only four children from the youngest group-3/6 to 4/6-were tested with the altered sentence forms, there remains a possibility that very young children use nonsemantic strategies in their interpretation of "buy" and "sell" sentences. If this were true, the semantic interpretation proposed would still be valid overall: Children learn the complex possession verbs starting with the simple notions of **DO, CAUSE,** and **TRANSF,** and add more abstract chunks later.

SUMMARY

In this chapter I have presented an analysis of a set of possession verbs. Verbs of possession were hypothesized to contain an underlying set of more basic semantic components or "chunks." When these verbs are used in language, their differing underlying structures convey different meanings. A person who hears a particular verb may later make errors in recall of the verb, either because he had not recovered all of the verb components that were originally there or because, through confusions among the structures in his memory, he has added other components to the structure for that verb. Further, through loss of some of the chunks of a verb, a person may confuse the proposition centered around that verb with another proposition centered around a verb whose underlying structure shares some components with the original verb.

The proposed semantic structures allow predictions about the order in which children should acquire the meanings of the verbs. Accordingly, children ranging in age from 3 years to 8 years were asked to demonstrate their understanding of this set of possession verbs. They were found to understand verbs that contain relatively few and simple chunks first, and verbs with larger numbers of chunks later. The order of acquisition and the pattern of the errors were explainable in terms of sequential acquisition of the semantic chunks hypothesized in this chapter.

CHAPTE

Experimental Analy the Semantics of Move

ADELE A. ABRAHA.

Throughout this book we have argued that a model of cognitiv linguistic processing must go deeper than the surface level o guage, that the mind has its own special "language." Both ling and nonlinguistic inputs are encoded into this common inforrr format. The other chapters have argued that information at the u lying conceptual level involves units smaller than words. One may communicate several conceptual units or *semantic den* Furthermore, a small number of semantic elements underlie a number of words; they include basic concepts that recur in th coding of our experiences. There is reason to believe that semantic elements are universal, that all languages communicai same elements in their various ways.

Examples readily come to mind: The concepts of change, of c tion, of location, and of movement seem basic to much of h communication. These concepts have already been discussed ii

[1] I thank Carlton James for his suggestions. Completion of the analyses a writing of this chapter were aided by grant 07-2128 from the Rutgers Univers search Council.