VALIDATION OF A RELATED-COMPONENT MODEL OF VERB MEANING

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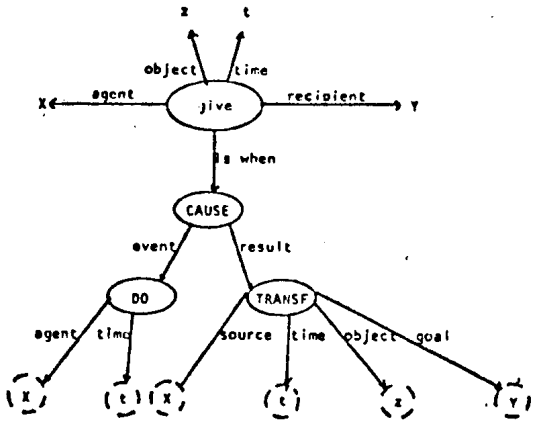
Introduction

This paper presents a developmental test of the kind of semantic representation proposed by Norman, Rumelhart and the LNR Research Group (1975). A set of possession verbs--give, take, pay, trade, buy, sell and spend--were semantically analyzed according to the LNR format. The resulting representations generated prodictions concerning the patterns of acquisition of the meanings of this set of verbs, which were tested in a comprehension study.

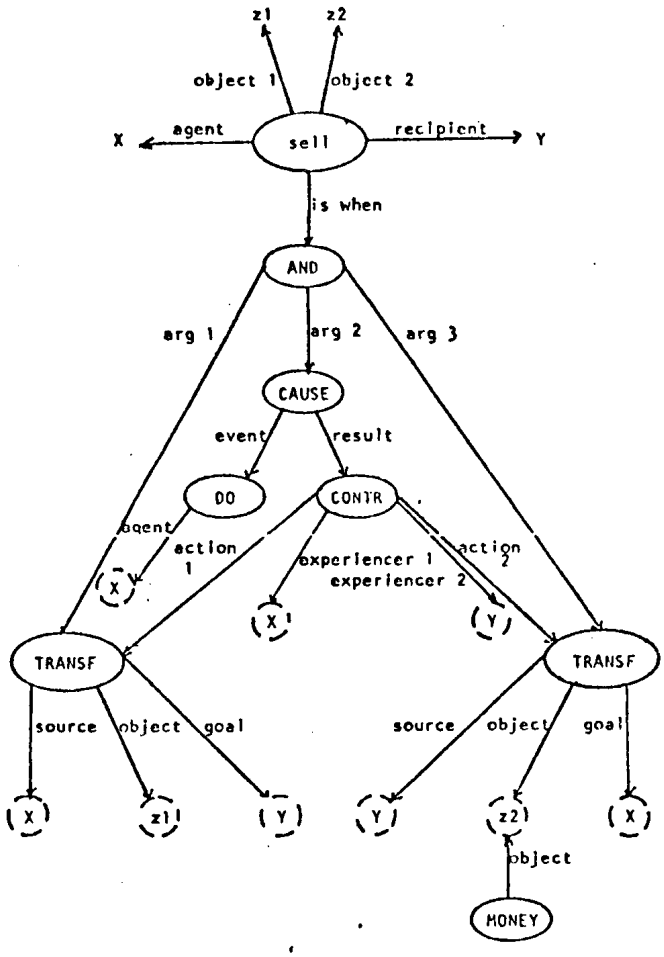
The LNR framework seems a promising one to apply to the study of acquisition of meaning. In this format for verb semantics, not only the features or components that make up the meaning of the verb but also the relations between them are written explicitly. This allows more complete expression of the meanings than is possible in a feature-list format or a binary tree structure. Notions such as agentive action, change-of-state and a causal relation between them are clearly expressed in this format.

The representation of a set of verbs of possession

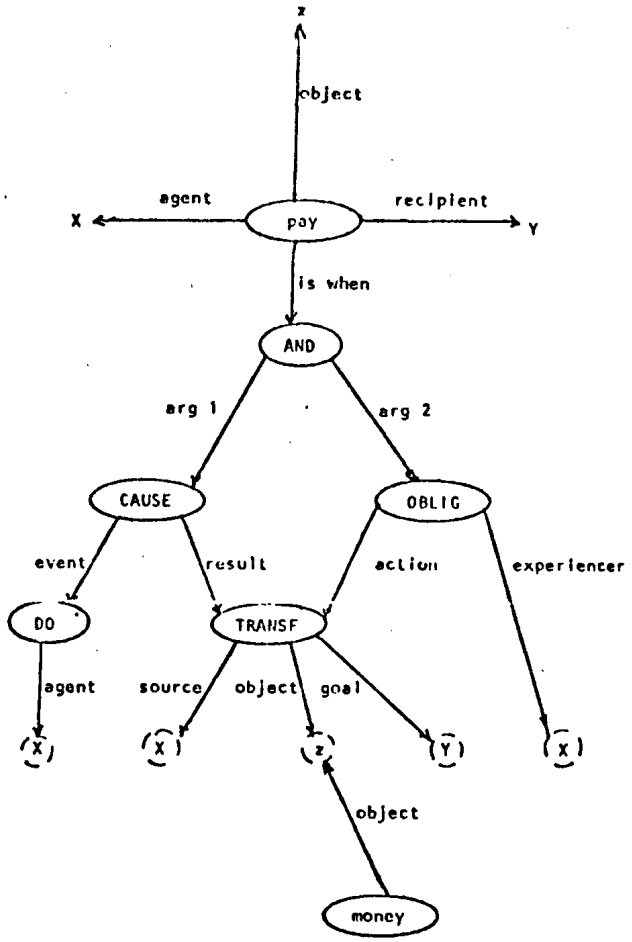
Three of the semantic representations proposed here are shown in Figure 1, and the underlying components used in these representations are defined in Table 1. The basic component shared by all these verbs is TRANSF. A TRANSF of an object z from a source person X to a goal person Y denotes a change from an initial state in which X possesses z to a final state in which Y possesses z. (Note that both the initial state and the final state are considered as part of the meaning, and not merely the final state.) To the notion of TRANSF we can add other components to make up the meanings of these verbs of possession. For example, if X does something (DO [X, ACT]) to cause a TRANSF from an initial state of possession of z by X to a final state of possession of z by Y, then we can say that X gives z to Y. (See Figure 1.) If we add a further component stating that X was socially obligated (OBLIG [X, ACT]) to perform this TRANSF, then the verb pay is an appropriate lexicalization of the semantic representation. (See Gentner, 1975, for a more complete presentation of these representations.)



X gives Y a z at time t.



X sells z1 to Y for z2 (money).



X pays z to Y.

Figure 1. Representations for give, pay and sell.

TABLE 1

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.
TRANSF	A change of possession (transfer) of an object from one person to another
OBLIG	A state of societal obligation to perform some act.
CONTR	A state of mutual societal obligation in which each of two persons is obligated to perform some agreed-upon act.
AND	A general conjunction, all of whose arguments must be fulfilled.

Predicted order of acquisition

The work of Eve Clark and others has indicated that much of the development of word meanings proceeds by gradual addition of semantic components to existing representations (E. Clark, 1971, 1973; Maratsos, 1974). Applying this "Semantic Features Hypothesis" (E. Clark, 1973) to a set of semantically related terms allows us to predict the order in which the meaning of the terms should be acquired. There should be a nested representations effect: if the structure for one verb is entirely contained within the structure for another, the simpler verb should be acquired first (cf. H. Clark, 1973). Note that this is a strong prediction: any reversal in this ordering would invalidate either the representations or the theory of acquisition.

Within the set of verbs considered here there are three such levels of nested representations:

I. The simplest group, give and take, can be understood as soon as the components DO, CAUSE and TRANSF are acquired. (See Table 1 for definitions of the components.)

II. Pay and trade both require the more abstract component OBLIG as well as the components DO, CAUSE and TRANSF. In addition, pay requires the argument-constraint that one of the objects transferred be money, while trade requires not merely one-way social obligation (OBLIG) but the more complex notion of mutual obligation (CONTR).

III. In the most complex group are buy, sell and spend. These verbs contain all the components required for both of the verbs in Group II (and therefore in Group I also). Thus the predicted order of acquisition is Group I, then Group II, then Group III.

These predictions stem purely from the structural relations between the representations of the verbs. There is also evidence from the developmental literature for the early acquisition of the concepts of DO, CAUSE and TRANSF. (See Gentner, 1975).

Error predictions

Applying the notion of gradual acquisition of semantic components to a set of representations allows us to predict not only the order of acquisition among the terms but also the errors that should occur in the child's early interpretations of the more complex terms. In the stages before all of its components are present, the meaning of a complex term can only be made up of the components that are present at that moment. Thus when only DO, CAUSE and TRANSF are understood, the verbs in Group II--pay and trade--and in Group III--buy, sell and spend--should be built from the same components (and have the same meanings) as the verbs in Group I--give and take.

Experimental procedure

Children between the ages of 3;6 and 8;6 were asked to manipulate two dolls to act out sentences containing possession verbs, e.g. "Make Ernie sell a car to Bert."

Subjects. The subjects were 70 children, approximately evenly divided between males and females. There were fourteen children at each of five age levels: 3;6-4;5, 4;6-5;5, 5;6-6;5,6;6-7;5, and 7;6-8;5.

Apparatus. The child was presented with two dolls, "Ernie" and "Bert". Each doll had near it its own table covered with its toys.

Sentences used. In general the wording of the sentences was fixed, or varied between two alternative forms. However, for some subjects the sentences for give, take, buy and sell were presented in different wordings in order to check the effects of the surface forms of the sentences used. These variations are presented in Table 2 along with the standard versions of the sentences.

Method. The child was asked to make the dolls act out sentences containing the verbs, e.g., "Make Ernie buy a car for Bert." or, "Make Bert spend some money." A child acted out 8 sentences each for give, take, buy, sell, and spend, and 2 sentences each for pay and trade, presented in semi-random order. To avoid giving clues, the experimenter made sure that an instance of the toy and/or money to be transferred appeared on each doll's table at the outset of every sentence.

TABLE 2

Sentences Used

Verb	Sentence Used
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.
buy	Make X buy a z from Y. Make X buy from Y a z. Make X buy a z.

Notes.

1. Nonindented sentences are the ones normally used. Indented sentences were used mainly when checking for effects of surface forms.

2. X and Y denote agent and recipient, respectively; z denotes object.

Scoring of responses. For each response the following information was recorded: object (which object was moved), source (from which place the object was moved), goal (to which place the object was moved), and when possible, agent (who moved the object). (On 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.)

If there was more than one transfer in a response the information was recorded for each of the transfers. To be counted as correct, a response had to have the correct object, source and goal for each of the required transfers.

Results and Discussion

Order of acquisition. The proportion of correct responses at each age level is shown in Figure 2. From this it can be seen that the order of acquisition of the verbs agrees quite well with the expected order. Group I--give and take--is acquired first; then Group II--pay and trade--and finally Group III--buy, sell, and spend.

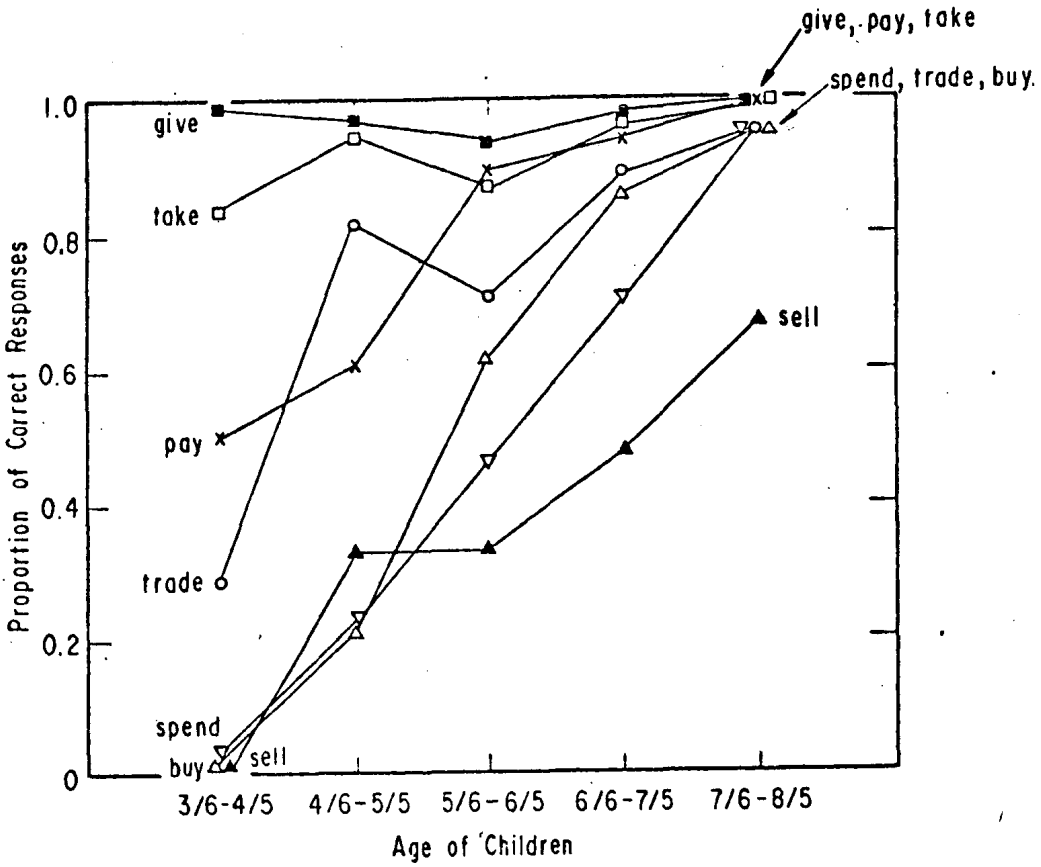


Figure 2. Proportion correct, by age of subjects.

Planned comparisons between each pair of verbs support this order of acquisition. All differences between verbs in different groups are significant ($p \leq .05$); and differences within groups are not significant, with one exception: sell is acquired significantly later than buy and spend.*

This result holds up within individual subjects. There were only two cases out of a possible 102 in which as a child achieved a high score (defined as 6/8 correct; or, for pay and trade, 2/2 correct) on a verb without having achieved a high score on at least one verb in every simpler group. More stringently, there were only 12 our of 102 cases in which a child achieved a high score on a verb without having achieved high scores on every verb in every simpler group.

Errors. Figure 3 shows the time course both of correct responses and of the most common incorrect responses for the five verbs in Groups II and III. For each of these verbs, the commonest mistake was, as predicted, the most appropriate one-way transfer. In each case the direction of this one-way transfer is correct.

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, and to sell as if it were give. The components 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 sentences involving pay the most frequent error was a transfer of the object to be paid from the agent to the recipient (a return). In the responses to trade we also find that one-way transfers outnumber the correct two-way transfer at the outset. (For trade there are several possible one-way transfers.)

A check for the use of surface cues. I have argued for a semantic interpretation of the finding that young children perform the correct one-way object transfer before they understand the rest of the meaning of a complex verb. It is possible, however, that surface-structure cues could have determined the child's responses, as was argued by Chomsky (1969) in her study of acquisition of verbs of communication. The verbs buy and sell, in particular, occurred in sentence forms which could conceivably have been matched with the corresponding take and give sentences on the basis of surface cues only. An experiment was done to rule out this possibility.

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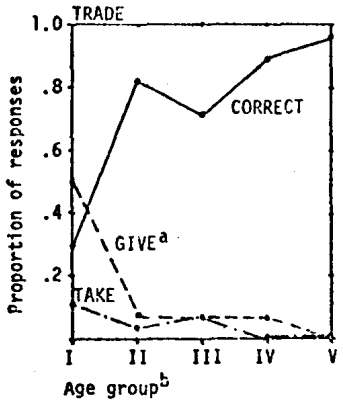
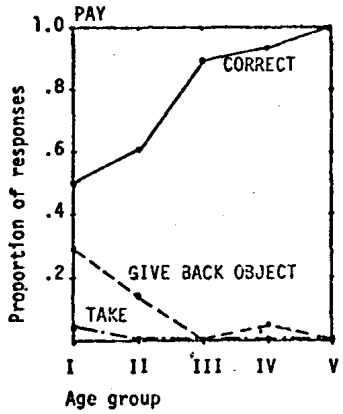
* It may be that sell should be analyzed as a more complex verb (possibly meaning "cause-to-buy"). Or, sell may be acquired later than the other verbs in Group III simply because children have less experience with selling than with buying or spending. In either case, the modifications to the theory would not alter its basic framework.



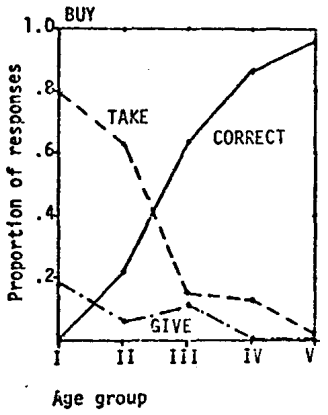


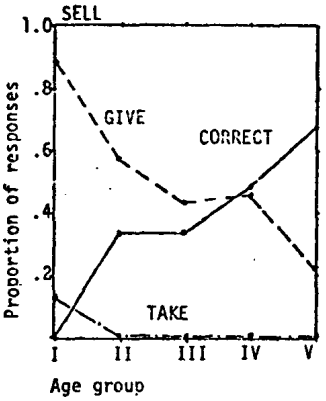
Notes:

a. "give" denotes a one way transfer from the subject of the verb; "take" denotes a one-way transfer to the subject of the verb. The actual agent of the transfer is sometimes the doll-subject and sometimes the child.

b. The age groups are as follows:

I: 3/6 - 4/5
II: 4/6 - 5/5
III: 5/6 - 6/5
IV: 6/6 - 7/5
V: 7/6 - 8/5





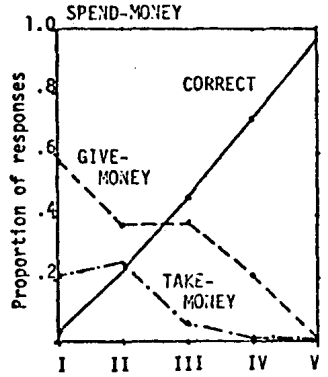


Figure 3. Proportions of response types, by age of subjects.

There are two plausible surface strategies. First, the child could simply have used the prepositions "from" and "to" in the sentences containing buy and sell, respectively, to determine the direction of object transfer. Thus, he would interpret the verb in

Make X verb a z from Y

as take and the verb in

Make X verb a z to Y

as give. A second non-semantic clue to the correct direction of object transfer is the order of the object and recipient in the sentence. The sentence normally used for buy,

Make X buy a z from Y

has the same object-recipient order that is used in the normal take sentence,

Make X take a z from Y.

The reverse order is normally used in sentences containing sell or give:

Make X sell Y a z.

Make X give Y a z.

To check for the use of one or both of these strategies, 38 of the subjects were tested on a few examples of the verbs buy and sell presented in alternative sentence forms (shown in Table 2). In some of these forms, the word "from" or "to" and its following noun were omitted; in others the order of recipient and object was reversed from the normal order. Although changes in the surface form appeared to affect the number of perfectly correct responses to buy and sell, none of the surface variations diminished the number of object transfers in the correct direction. Thus, the one-way transfers are not caused by surface strategies, and must be explained semantically.

The child performs the object transfer in the correct direction because he understands the TRANSF component of the verb's meaning. He omits the return transfer partly because he does not understand the function of money and partly because he has not yet acquired the abstract components of CONTR and OBLIG with which to organize the multiple transfers into a coherent whole.

Discussion

The results are in very close accord with the predictions generated by assuming gradual acquisition of the components of the proposed

semantic representations. The order of acquisition among the verbs is as predicted (with the exception of the late arrival of sell). The pattern of errors is also as predicted. Specifically, the predominance of one-way-transfers in the correct direction among the errors made on the complex verbs is in accord with the dual contentions 1) that TRANSF (along with DO and CAUSE) should be acquired before the more abstract, socially defined components; and 2) that TRANSF is a relational component and is so understood, even by very young children.

The need to take into account the child's interest in relational and dynamic concepts has been stressed lately (cf. Nelson, 1973). I submit that the sorts of representations proposed here will go a long way towards making such concepts explicitly representable.

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