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Related intuitions and the mental representation of causative verbs in adults and children*

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He left it dead ... .
Somehow it seems to fill my head with ideas –
only I don't exactly know what they are!
However, *somebody* killed *something*:
that's clear, at any rate.

Through the Looking-Glass, Lewis Carroll

Abstract

Several lines of investigation refute the empirical basis for previous claims that experiments on subjective word relatedness demonstrate the psychological unreality of decompositional semantic representations for lexical causatives. Using three different techniques, we show that perceived relatedness between words is not *a function of their structural distance at different levels of linguistic representation. Therefore, relatedness intuitions cannot be used as a critical test of the relative structural complexity of underlying syntactic or semantic representations. In contrast, subjective relatedness between nouns of structurally identical sentences are clearly affected by aspects of their* conceptual interpretation, *such as the 'definiteness' and 'concreteness' of the denoted entities, the intensity of their 'intentional interaction', or the 'directness of causation' expressed.*

The meaning of lexical causatives cannot be accounted for in terms of a prototype concept of direct causation. The prototype theory generates wrong predictions about the referential use of causative verbs in adults. It also fails

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to account for facts in the acquisition of lexical causatives. There is a stage of broad causative generalization when the use of both existing and novel causative verbs is extended to non-prototypical as well as prototypical causative events.

We propose a bi-level lexical representation of causative verbs, which consists of (i) a decompositional – but non-definitional – semantic representation articulating their causative status, and (ii) a contextually attached conceptual stereotype specifying their range of application as a function of their context of use. The decomposable semantic structure emerges as a developmental stage in the acquisition of lexical concepts as a result of the linguistic reorganization of the lexicon. The conceptual stereotype becomes embedded later as part of the representation available in the mental lexicon for access by adults.

Part 1: Relatedness intuitions and levels of linguistic representation

1.1. Introduction

1.1.1. Definitional decomposition versus meaning postulates

Any adequate theory of word meaning must capture three major aspects of lexical knowledge. Whatever structural properties and representational format are assumed by such a theory, it must minimally be able (i) to give an account of how the semantic information contained in the lexical entry of a word is combined with that of another to form the semantic representation (SR) of a complex expression when the word is inserted into a larger sentential context; (ii) to capture the systematic semantic relations that obtain between the word and other words in the mental lexicon; and (iii) to characterize the referential range of the possible uses of the word in different contexts.

In current linguistic theory the earliest and most influential attempt to outline the structure of such a theory was the work of Katz and Fodor (1963). The basic idea of their definitional decompositional (DD) approach was that many morphologically simple lexical items have internally complex semantic structure composed of a set of basic abstract semantic elements. For example, the meaning of the word "bachelor" could be represented as the combination of the more basic semantic predicates "NOT MARRIED MAN", "deaf" as "NOT ABLE TO HEAR", "kill" as "CAUSE TO DIE", etc. The elementary semantic units, which could not be further decomposed, were thought to correspond to the basic innate elements of the human conceptual system. The combinatorial mechanism that combines such semantic primitives to form complex lexical meaning representations is identical to that which forms phra-

sal SRs out of word meanings when words are inserted into sentences (i). The compositional structure of lexical items also provided an elegant mechanism to capture semantic relations (ii) such as entailment, synonymy, contradiction, class inclusion, etc. Thus, if the SR of the verb "kill" is "X CAUSE (Y DIE)", then the necessary entailment relation that holds between the sentences "John killed Bill" and "Bill died" is automatically captured at the level of SRs by containment: "John killed Bill" is mapped onto the structure "JOHN CAUSE (BILL DIE)" which contains the SR of "Bill died". Within the same framework it also seemed possible to account for (iii), the problem of characterizing the referential range of the possible uses of lexical items. It was believed that by systematically carrying out the componential program, semanticians would sooner or later arrive at the identification of the correct (and hopefully small) set of semantic primitives, the right combinations of which would provide intensional definitions for the meanings of the lexical items in terms of necessary and sufficient conditions.

The original Katz and Fodor (1963) proposals have stimulated a large body of research, and, though there are disagreements over numerous issues, the basic idea of decompositional SRs has been adopted by a variety of current semantic theories (e.g., Bierwisch, 1970, 1981; Jackendoff, 1975, 1978; Katz, 1972, 1981; Lakoff, 1970; McCawley, 1971; Miller & Johnson-Laird, 1976). Recently, however, decompositional semantic theories have been strongly criticized by the advocates of an alternative approach to lexical semantics, called the "meaning postulate" (MP) approach (Fodor, 1981; Fodor, Fodor & Garrett, 1975; Fodor, Garrett, Walker & Parkes, 1980; Kintsch, 1974).

Their central argument against a DD treatment of lexical meanings has been that the latter has not been able to come up with decompositional definitions which correctly identify the necessary and sufficient conditions for the referential use of lexical items. A case in point is the decompositional analysis of causative verbs. This has become a paradigm case in the theoretical and empirical investigations over the status of decompositional semantics, and will be the central topic of the present paper.

One of the early arguments in favour of decompositional semantics (e.g., Lakoff, 1970; McCawley, 1971) was its success in accounting for the apparent synonymy between simple transitive sentences involving causative verbs such as "kill" or "break" and corresponding syntactically complex periphrastic constructions such as "cause to die" or "cause to break". For example, if the decompositional SR of the causative verb "NP1 drop NP2" is "NP1 CAUSE (NP2 DROP)", then the relation of synonymy between (1) and (2) can be accounted for by the fact that both sentences map onto identical SRs.

(1) Floyd dropped the glass.
(2) Floyd caused the glass to drop.

However, it was soon realized that lexical causatives and their corresponding periphrastic constructions are not fully synonymous (e.g., Fodor, 1970; Jackendoff, 1972; Shibatani, 1976) as shown by the fact that (4) is not an acceptable paraphrase of (3):

(3) Floyd caused the glass to drop by tickling Mary who was holding it.
(4) *Floyd dropped the glass by tickling Mary who was holding it.

As the example shows, decomposing lexical causatives into a "CAUSE (CHANGE OF STATE)" predicate schema does not capture the correct referential range of such verbs. In general, their use is more restricted than that of the periphrastic expression, and usually implies the specification of some particular manner of causation. For example, the use of the transitive "drop" implies direct physical manipulation of the causee by the causer. All in all, attempts to provide decompositional definitions correctly capturing the particular manner specifications implied by the use of different lexical causatives have not been successful (see e.g., Green, 1974; McCawley, 1971).

This failure is interpreted by the adherents of the MP approach as being due to the fact that the meanings of simple lexical items, in fact, do *not* have decompositional definitions. They propose instead that all monomorphemic words are directly mapped onto corresponding unitary semantic predicates which are not further decomposable. In such a model the semantic relations between lexical items are captured by asymmetric rules of inference, called "meaning postulates" (Carnap, 1956), which are stated over the unitary semantic elements corresponding to words. Thus, the entailment relation between transitive and intransitive "drop" is not captured by their semantic structure; rather, the lexical entry for transitive "drop" contains a list of MPs specifying its necessary implications which has as one of its members the MP "if X drop Y → Y drop".

1.1.2. The present status of the psychological evidence in the DD versus MP controversy

Adherents of both approaches have claimed that there is empirical evidence supporting their theories and/or demonstrating the psychological unreality of the opposing view. Here we shall only briefly summarize the present status of these claims (for a detailed review, see Carey, 1982).

In the 1970s there were many studies on the development of word meanings which seemed to support the DD approach. These investigations centered on the acquisition of words belonging to lexical domains (such as spatial terms or verbs of possession) for which linguists developed plausible componential analyses (e.g., Bendix, 1966; Bierwisch, 1967; H. Clark, 1973;

Fillmore, 1969) from which developmental predictions could be derived. These studies generally showed either that relative complexity of definitions predicts order of acquisition (e.g., that negative spatial adjectives like "short" are learned later than their positive counterparts like "tall", see Bartlett, 1976; Brewer & Stone, 1975; Donaldson & Wales, 1970; Wales & Campbell, 1970), or that at the same point in development children use complex words synonymously with less complex ones whose definition is made up of a subset of the semantic elements included in the decompositional structure of the complex words (e.g., young children use "short", "thin", or "low" synonymously with "little", see E. Clark, 1972; Brewer & Stone, 1975).

Both kinds of evidence have been interpreted as showing the existence of incomplete lexical entries during development and as demonstrating that the process of acquisition involves the gradual addition of semantic elements under the lexical entry until the correct compositional definition is identified.

Most of these studies have been shown to have serious methodological flaws, however. In some cases the predictions were based on wrong componential analysis (see Carey, 1982), and in many cases the results were shown to be due to non-linguistic response biases rather than to incomplete lexical entries (e.g., Carey, 1977; Trehub & Abramovitch, 1978; Wilcox & Palermo, 1977). Also, as Carey (1982) points out, order of acquisition is in general "... better predicted by frequency of use than by semantic complexity, although it is roughly in accord with relative complexity". Therefore, the developmental evidence is, at best, inconclusive concerning the empirical status of compositional meaning representations. (There is, however, a further type of developmental evidence involving productive novel word formations (Bowerman, 1974, 1982a) which, as we shall argue, support a particular view of lexical representations with a compositional—though non-definitional—semantic component. We shall postpone the discussion of this until Section 2.3.)

Recently there have been several experimental attempts by proponents of the MP view to demonstrate the psychological unreality of decompositional SRs (Fodor et al., 1975; Fodor et al., 1980; Kintsch, 1974). These studies depend on the assumption that the different semantic theories correspond to distinct models of comprehension. The compositional theory is taken to "... entail that representations which specify definitions are internally displayed in the process of sentence comprehension" (Fodor et al., 1980). The MP approach, conversely, is assumed to involve only a direct mapping of the words onto the corresponding unitary semantic elements. A further implication of this interpretation is that the compositional theory predicts that lexical items involving more semantic primitives will be relatively hard to understand. Thus, a lexical causative such as "kill" must be harder to comprehend

than a non-causative, e.g., "kiss"; similarly, implicit negative words (e.g., "bachelor" = NOT MARRIED MAN) should be as complex as the corresponding explicit negatives (e.g., the phrase "not married man").

Such predictions have been tested in several comprehension experiments. Kintsch (1974) used a phoneme monitoring task to contrast the comprehension of lexical causative sentences with simple transitives, and failed to find a difference. He concluded that comprehension does not involve decomposition, and, therefore, that the compositional theory in general is unsupported by behavioral evidence. Fodor et al. (1975), using an inference verification task, came to a similar conclusion, based on their finding that implicit negative words are easier to comprehend than corresponding explicit negative expressions.

These conclusions have been questioned by Katz (1977) on the grounds that the contrasting semantic theories are not about comprehension models. Lexical comprehension might draw on overlearned, rapid processes that render irrelevant all semantic complexity differences. In the same vein, Miller (1978) suggests that the compositional SR of lexical items operates in language use as an overlearned Gestalt which is not ordinarily broken into its constituents.

In response to such criticisms, Fodor et al. (1980) studied relatedness judgements between words in sentences with lexical causatives; an experimental paradigm which, they suggest, is not subject to these methodological objections. They claim that "... some important predictions which follow naturally" from the decompositional theory of lexical meanings "... are strikingly disconfirmed".

In Section 1.2 we shall examine Fodor et al.'s results in detail. (All references to Fodor et al. therein refer to Fodor et al., 1980.) We shall report experimental data demonstrating that their basic assumptions concerning the nature of relatedness judgements as an investigative tool are false. Accordingly, their results are irrelevant to the issue of the psychological reality of semantic decomposition. The relatedness data will then be discussed from the point of view of the relation between semantic and conceptual structure. We shall argue for a principled distinction between these two closely related, but nevertheless qualitatively different, levels of mental representation. Using this framework, we shall show that the relatedness data reflect certain aspects of the conceptual interpretation of the test sentences rather than their semantic structure.

In Section 2 we shall discuss a third approach to the semantics of causative constructions: the theory of lexical prototypes as applied to the development and mental representation of causative verbs (Lakoff, 1977; Lakoff & Johnson, 1980). We shall argue that the prototype approach is inadequate on

both descriptive and empirical grounds as it (a) generates incorrect predictions about the referential range of causative verbs, and (b) cannot account for the available evidence on the acquisition of causative expressions.

Finally, we shall propose an alternative theory of the mental representation of causative verbs, which partition their lexical representations into two components: (i) a semantic "base-meaning" which is compositional (however, non-definitional), and (ii) a "lexical stereotype" which is a culturally salient conceptual interpretation of the base-meaning relative to a particular context. We shall discuss evidence from developmental studies which, as we shall argue, supports the dual theory while posing problems for the other approaches.

1.2. Relatedness intuitions and semantic decomposition

1.2.1. Fodor et al.'s use of relatedness intuitions as a measure of structural separation

The relatedness paradigm adopted by Fodor et al. (1980) is a version of the procedure developed by Levelt (1970). In Levelt's studies, subjects judged the relative degree of "relatedness" of pairs of words within sentences. Fodor et al. argue that the subject's activity in this task is comparable to the process of producing linguistic intuitions, which is the primary source of empirical data in linguistics. Therefore, they consider this technique to be ideally suited to test the psychological reality of competing linguistic analyses. In Levelt's studies the tree structures computed by a Hierarchical Clustering Analysis of such judgements were similar to surface structure representations of the test sentences, proposed by linguists. Subjects' judgements also seemed to reflect relatedness between words at a more abstract level of representation. Thus, for the sentence "John drove to the store and walked home" the word pairs "John–drove" and "John–walked" were judged as equally related though their surface structure representation is different. However, they are close at a more abstract level of analysis: "John" being the deep structure subject and also the agent of both "drove" and "walked". On the basis of this finding Fodor et al. argue "... that given a pair of sentences which have the same surface structures, but which differ in the abstract relations among their constituents, subjects' scalings might well reflect the distribution of underlying relations".

They note that according to the decompositional theory "... the pattern of grammatical relations among phrases shifts as between surface form and the semantic representation of a causative construction". In particular, while

"John" and "Mary" are grammatically related in the surface structure of (6) as the subject

(5) John kissed Mary.
(6) John killed Mary.

and the object of the causative verb (Figure 1), they are not so related in the underlying SR (Figure 2) where they appear in different clauses: "John" as the subject of "cause" in the matrix clause and "Mary" as the subject of "die" in the embedded clause. (No such shift occurs in the case of the non-causative (5).) Thus, if subjects' relatedness judgements were a function of the pattern of grammatical constituent relations at the level of SRs, then, assuming the decompositional analysis, one could expect the surface subject and object of a causative verb (as in (6)) to be judged as *less* related than the corresponding arguments of a non-causative verb (as in (5)).

Figure 1. *Surface structure for (5) and (6).*

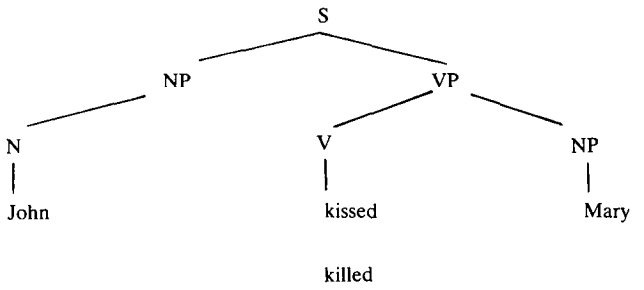
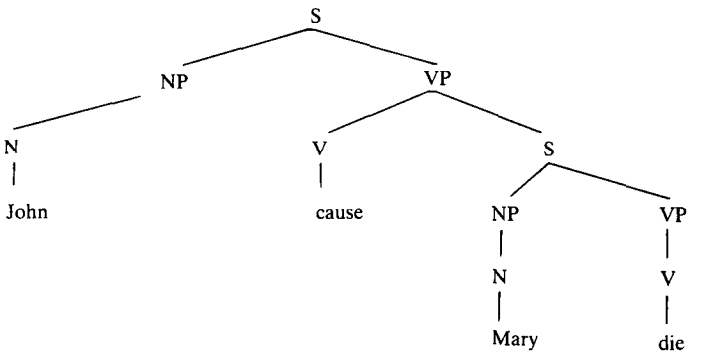


Figure 2. *Semantic analysis for (6).*



Fodor et al. first demonstrate that Levelt's technique can be used to detect such structural shifts in constructions where they are not the result of decomposition. They used four sentence contrasts that involve differences in the structural position of words in the underlying structure. For example, in (7a) "Mary" is in the same underlying clause as "John" (Figure 3), while in (7b) it is not (Figure 4) (see Fodor et al., 1980, p. 295 for this analysis).

(7a) John persuaded Mary to leave.
(7b) John expected Mary to leave.

Using such sentences Fodor et al. showed that subjects find the constituents that are grammatically related both in surface and in underlying clause structure to be more related than those which are so related only at the level of surface representation. This, they argue, demonstrates that relatedness judgements are sensitive to structural shifts in the pattern of grammatical relations in the underlying representations.

Fodor et al.'s argument hinges crucially on the assumption that intuitions about relatedness are sensitive to structural shifts in the pattern of grammatical relations at the abstract level of *SRs*. It might be argued, however, that the observed differences in (7a) and (7b) reflect syntactic distinctions only. Shifts exhibited only at the level of SRs (as in the case of lexical causatives) might not influence the same kind of intuitions.

Figure 3. *Underlying structure for (7a).*

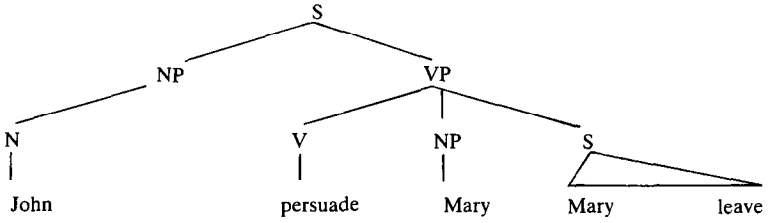
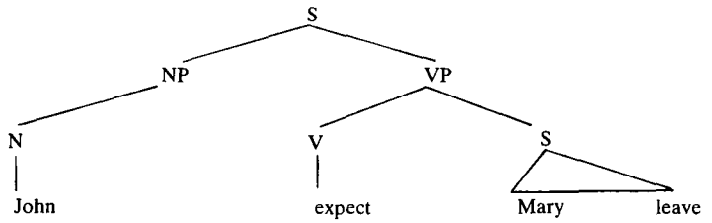


Figure 4. *Underlying structure for (7b).*



To meet this objection Fodor et al. introduced two further validating sentence types, designed to show that the test instrument is sensitive to differences in purely semantic relations. These cases involve negative quantifiers (such as in (8b)), and intensional verbs (such as in (9b)).

(8a) All of the men left.
(8b) None of the men left.
(9a) John used a cane to walk.
(9b) John needed a cane to walk.

(8a) and (8b) are syntactic minimal pairs which differ in their semantic relations as a result of the difference in the meanings of "all" and "none". In particular, the property "left" is attributed to "the men" in (8a), but not in (8b). Similarly, in (9a) there is a relation between "John" and a *particular* cane, while in (9b) this is not the case. Fodor et al. point out that "... in both of these cases ... there is a difference in semantic relations between superficially similar sentences, and that difference turns crucially upon the meaning of one of the constituent words: just as the difference in semantic structure between e.g., 'John killed Mary' and 'John bit Mary' is supposed to turn crucially upon the differences in the meanings of 'killed' and 'bit'. Here again, though the logical differences seem patent, and though they turn precisely upon the meanings of lexical items, they do not involve definitional decompositions". The relatedness judgements appeared to show the effect of such semantic differences (closer relatedness in (8a) and (9a) than in (8b) and (9b), respectively).

Fodor et al. conclude that there is indeed "... some indication ... that the procedures are sensitive to semantic relations as well as to syntactic relations like clausal membership". Their results with the same technique, however, showed no differences in relatedness between surface subjects and objects in lexical causative sentences when contrasted with corresponding non-causative sentences. Fodor et al. conclude that lexical causatives do not decompose into complex underlying SRs. They take this lack of empirical support for decomposition in the case of lexical causatives to indicate that simple lexical items in general do not have decompositional semantic structure.

Of course, experimental failures like Fodor et al.'s admit of alternative interpretations. In particular, we shall argue that the relatedness judgements in Fodor et al.'s tests can be interpreted as being due to behavioral factors that are *not* related to underlying linguistic structure.

1.2.2. The behavioral basis for relatedness intuitions

It is useful to articulate the empirical assumptions underlying Fodor et al.'s interpretation of relatedness intuitions. First, it is not only syntactic structure that affects relatedness judgements; subjective relatedness between words must also be sensitive to the level of *SRs*. Second, *structural distance* must affect relatedness, if the technique is to be used as a test of compositional complexity. Accordingly, Fodor et al. are at pains to verify both the semantic level and the structural distance assumption before applying the method to causatives themselves.

However, as we shall demonstrate, all the validating cases they used to vary the effect of underlying structural distance on relatedness involved systematic differences in conceptual interpretation as well, which coincided with the structural contrasts tested. Below we shall argue that it is these differences that caused the observed effects on relatedness rather than the structural separation of the tested words.

First, we compared relatedness intuitions in critical cases in which the meanings of the tested sentence pairs could be held relatively constant, varying only the structural distance between the critical nouns. We contrasted lexical causatives with their periphrastic paraphrases, since this comparison is most directly relevant to Fodor et al.'s investigation. We used seven of their lexical causative test sentences, comparing the relatedness intuitions between the critical nouns (underlined) like those in (10a) and (10b).

(10a) Sitting in his high chair the baby spilled the juice in his cup.
(10b) Sitting in his high chair the baby caused the juice in his cup to spill.

Note that on the basis of Fodor et al.'s assumptions the periphrastic construction (10b) is clearly predicted to result in less relatedness between the critical nouns than (10a). This is so, firstly, because their structural distance is greater at both surface and deep syntactic representations, and secondly, because, assuming that lexical causatives do not decompose, the structural distance in (10b) is greater even at the level of SRs.

Subjects judged the relatedness of various words in each sentence. The method closely followed that of Fodor et al. (See Appendix 1 for a complete presentation of the experiments and results, including all tables.) Relatedness for the critical comparison (e.g., between "baby" and "juice" in (10)) clearly failed to show the difference predicted on the basis of the structural distance assumption (Table 2). In fact, it is the periphrastic sentences rather than the lexical causatives which exhibit a slight tendency towards more relatedness between the critical nouns (Items: $p < .25$; Subjects: $p < .10$). (For further

discussion see p. 230 and p. 233 where we shall advance an alternative explanation for this finding.) Note that the same subjects do show the difference found by Fodor et al. on the "expect/persuade" cases (Table 3) indicating that their general performance is similar (Items: $p < .08$; Subjects: $p < .12$). (See Appendix 1 for a discussion of the relative strength of this result; see also Section 1.2.4. in which the effect is replicated using a different experimental paradigm.)

This finding disconfirms the basic assumption that structural separation determines relatedness, when the meaning of the test sentences is held constant. In fact, all of Fodor et al.'s "structural shift" effects in the sentences they used to validate their structural distance assumption can be explained as being due to systematic differences in the conceptual interpretation of the sentences, which coincided with the syntactic structural differences tested. We shall discuss them in turn:

(11a) According to single women, bachelors are eager to entertain at home.
(11b) According to single women, bachelors are easy to entertain at home.

Fodor et al. found that the noun and the adjective (underlined) are judged as more related in (11a) than in (11b). They attribute this to their structural closeness in the underlying structure of (11a). Note, however, that the sentences imply entailment differences that establish "eager" as an attribute of "John", but not "easy". Thus, the structural difference coincides with a difference in interpretation that itself could plausibly account for the relatedness differences.

(12a) Where is the island in the Caribbean which has a free port?
(12b) Is there an island in the Caribbean which has a free port?

Fodor et al. argue that in a sentence like (12b) "there" is transformationally introduced and is not related to "island" in the abstract underlying representation, while "where" in (12a) is so related. However, almost all the sentence pairs of this kind included a contrast between a definite and an indefinite article (or quantifier) preceding the critical nouns. (In their "Ratings" task this was true of 72% of the pairs, while in their "Forced Choice" task, 90%.) We tested the effect on relatedness of only varying the definiteness of the article, using sentences like those in (13).

(13a) Contrary to his father's orders, Steve took a plane to New York.
(13b) Contrary to his father's orders, Steve took the plane to New York.

The results (Table 4) show a clear increase in relatedness when the deter-

miner is definite (Items: $p < .03$; Subjects: $p < .01$). Hence, the findings with sentences like (12) could be due to the difference in definiteness of the critical words compared rather than to the structural difference in their underlying representations.

Moreover, most of the sentences in this set used by Fodor et al. that did not contrast definite and indefinite NPs contrasted an abstract with a concrete use of "there", as in (14).

(14a) If you want to meet someone interesting, over there is a professor who is trying to collect solar energy with mushrooms.
(14b) You may find it hard to believe, but there is a professor who is trying to collect solar energy with mushrooms.

In (14a) "there" is interpreted as a concrete location, physically coincident with the professor, while in (14b) it is an abstract pleonastic subject. We explored the effect of concreteness independently by using a set of sentence pairs like (15).

(15a) The young boy grasped the pitcher easily though it was very heavy.
(15b) The young boy grasped the idea easily though it was very abstract.

Relatedness between the critical nouns was stronger when they were both concrete as in (15a) (Items: $p < .06$; Subjects: $p < .0005$; Table 5). The effect of concreteness can also explain the relatedness differences reported by Fodor et al. in their so-called "sluicing" pairs:

(16a) I'm sure I used to know somebody who makes violins, but I can hardly recall him.
(16b) I'm sure I used to know somebody who makes violins, but I can hardly recall who.

In the sentences with definite pronouns ("him") the critical words are interpreted as identifying two concrete entities ("I" and "him"), while that is not the case with interrogative pronouns ("I" and "who").

There appears to be some similarity in the aspects of meaning that result in closer relatedness in these different kinds of cases. Anything that makes the relation more specific and concrete in the interpretation of these sentences seems to increase the closeness of the relatedness judgements.

This generalization is also consistent with the semantic effects that Fodor et al. studied specifically (see (8) and (9) above). Thus, the interpretation of (9a) necessarily implies that there is a particular cane, while that of (9b) does not. Similarly, while in (8a) there are men who left, in (8b) there are not.

Finally, let us consider Fodor et al.'s last example of the effect of structural

shift on relatedness: the case of "persuade" vs. "expect". Using sentence pairs like (17a) and (17b), Fodor et al. found the surface subject and object of "persuade"-type verbs, which take an NP object plus a complement as in (17a), to be more related than those of "expect"-type verbs, which take sentential objects as in (17b).

(17a) During the stormy Atlantic crossing, the captain persuaded the passengers to remain calm.
(17b) During the stormy Atlantic crossing, the captain expected the passengers to remain calm.

Note, first of all, that the syntactic contrast between these constructions at their underlying level of representation (see Figures 3 and 4 on p. 219) is structurally analogous to that which exists between lexical vs. periphrastic causatives in their syntactic deep structure. That is, the critical NPs in lexical causative sentences are grammatically related in the same deep structure clause just as the corresponding NPs of "persuade"-type sentences are, while the critical NPs of the periphrastic constructions appear in two separate clauses in their underlying structure just as the corresponding NPs of "expect"-type verbs do.

In spite of this structural analogy, however, the relatedness results do *not* demonstrate a comparably similar pattern: while "expect"-type verbs show less relatedness than "persuade"-type verbs in both Fodor et al.'s and our results (Table 3), periphrastic causatives showed no such difference when compared to lexical causatives (Table 2). This finding clearly contradicts the structural distance assumption made by Fodor et al.

We can observe, however, that while in the case of the lexical vs. periphrastic causatives the meaning of the two constructions was held constant, this was not true for the "expect" vs. "persuade" pairs. This suggests that, similar to the other cases, the relatedness effect in the "expect" vs. "persuade" sentences might also be due to some systematic difference in interpretation which correlates with the tested structural contrast, rather than to the structural contrast itself.

We list the verbs that were contrasted in Fodor et al.'s "Ratings" task below:

persuade	expect
tell	discover
remind	announce
advise	believe
convince	suppose
warn	report

The interpretation of the cases like "persuade" implies that the subject of the main verb interacts with the subject of the embedded complement with the aim of changing the intention of the latter so that the event expressed by the complement clause would actually occur. For example, in "Mary persuaded John to go" it is presupposed that John originally did not want to go, and that Mary interacted with him until John changed his mind. With verbs like "expect", however, the intentional state of the complement subject in the embedded proposition is independent of the activity of the matrix subject as in "Mary believed that John would leave".

This dimension of "intentional interaction" coincided with the structural differentiation of the complement verbs in *all* of Fodor et al.'s test sentences. Therefore, we can hypothesize that what results in the increase in relatedness between the surface subject and object in the case of "persuade"-type verbs is the presence of intentional interaction between them in the interpretation of the test sentences, rather than their structural closeness in the underlying representation.

To demonstrate that this is, indeed, the relevant factor we carried out an experiment using the method of rank ordering in which we used 12 verbs each of which was structurally analogous to the "persuade"-type verbs: their surface subject and object remained in the same structural positions (i.e., they did not "shift") even in their underlying representations (see e.g., Akmajian & Heny, 1975; or Postal, 1974 for some relevant syntactic tests). Structural distance was thus held constant, but the verbs chosen clearly differ as to the degree to which they imply changing the intentional state of the object as a result of his interaction with the subject. We divided the 12 verbs into two main groups accordingly. The 6 verbs in our "High" intentional interaction group below typically express such a change, while the 6 "Low" group verbs typically do not: in the latter group the intention of the object is either assumed to be constant (as before and after the interaction) as in the case of the "permissive" verbs ("allow", "let", and "permit"), or it is unspecified as in the case of "encourage", "advise", and "ask".

High	*Low*
make	encourage
get	advise
convince	ask
persuade	allow
coax	let
cajole	permit

We predicted that verbs in the "High" group would result in stronger subject–object relatedness than verbs in the "Low" group. No such difference would be predicted on the basis of the structural distance assumption, however, as the verbs in the two groups are structurally analogous.

All of the 12 verbs were embedded in each of 5 sentence frames, such as "Tom ... Jim to buy a newspaper". Subjects were asked to rank order for each frame the 12 token sentences according to the degree of felt relatedness between their subject and object. Our prediction was strongly corroborated: verbs in the "High" group showed stronger relatedness (mean ranking = 4.9) than verbs in the "Low" group (mean ranking = 8.15) ($p < .0005$; Table 7). In fact, there was no overlap between the verbs in the two groups: each one of the "High" verbs received greater relatedness ranking than either one of the "Low" verbs (Table 6). Additional support for our hypothesis is the emergence of a further subdivision between the three "permissive" verbs of the "Low" group ("allow", "let", "permit") (mean ranking = 9.43), and the other three "Low" verbs ("encourage", "advise", "ask") (mean ranking = 6.88), the "permissive" verbs showing lower relatedness ($p < .0002$; Table 7).

To sum up: out of the 12 structurally analogous "persuade"-type verbs three clearly distinct groups emerged:

(i) Least related were the subjects and objects of "permissive" verbs in which the intention of the object is assumed to be constant, and so the degree of intentional interaction is the lowest;
(ii) Intermediate were the three other "Low" group verbs which are relatively noncommittal as to the intentional state of the object before and after the interaction they express;
(iii) The strongest subject–object relatedness was found in the case of the "High" group verbs which imply that as the result of the expressed interaction the subject succeeds in changing the intentional state of the object.

1.2.3. Semantic representation versus conceptual interpretation

Some of the properties of the interpretation of sentences that we have shown to affect relatedness (e.g., differences in concreteness of reference, or in the intensity of "intentional interaction") obviously do not correspond to differences in the structural distance of semantic elements. Thus, even assuming that relatedness intuitions tap the level of SRs, as proposed by Fodor et al., it seems clear that they are not a function of structural separation of elements at that level of representation either. Therefore, the relatedness technique cannot serve as a measure of complexity differences in SRs.

In fact, our results raise the possibility that the level of representation which affects relatedness intuitions is not that of SRs *per se*. Rather, we shall argue that relatedness depends on aspects of the *conceptual interpretation* (CI) of the sentences that are constructed on the basis of their SRs, but whose structures are not identical to those of the latter.

Let us briefly spell out the implications of this proposal concerning the relationship between SR and CI. Many theorists, in particular the adherents of both the DD and the MP approach, identify the elements of SR with those of conceptual structure, the former being the lexically encoded subset of the latter. However, conceptual structure can also be viewed as a distinct level of mental representations with its own principles of organization which are not necessarily identical with (though, obviously, in many respects intimately related to) those of semantic structure. (See Bierwisch, 1981 for a detailed discussion of this distinction.)

In this view, semantic structure consists of systematizing linguistic generalizations projected over the structures of the conceptual system, capturing certain distinctions of the latter while leaving others unspecified.[1] Thus, SR determines, as Bierwisch (1981) put it, "... a family of related conceptual units the differentiation of which depends on the context within which the word is interpreted". "Indeterminateness" of word meanings is a standard example (see e.g., Bierwisch, 1981) that illustrates how distinct conceptual entities (which do not correspond to distinct semantic categories) are identified in CI as a function of context. See, for example, the four different uses of the word "university" below:

(18a) On Friday morning, Bill came out of the university and took a cab.
(18b) For two years, Bill has been teaching at the university of Appletown.
(18c) The university by now covers the whole area around the house you live at.
(18d) The university is a typically European institution that developed during the Middle Ages.

In the CI of these sentences "university" denotes conceptually distinct entities: a building in (18a), an institution in (18b), a campus in (18c), and a

[1]See Carey (1982) for a discussion of this "theory-laden" character of basic semantic units and on the developmental implications of this view. Bowerman (1982b) provides developmental evidence on how some basic abstract semantic categories are established over earlier conceptual categories of different scope as a result of experience with, and the systematization of, related linguistic forms. See also Section 2.3 of this paper for further discussion.

sort of abstract conceptual principle in (18d). These conceptual entities are systematically related in the organized body of knowledge we possess about universities; however, they do not correspond to four different senses of the word "university". Rather, they become identified in the CI of the sentences which is a joint function of the abstract SR of the word "university" and its context of use.

Given this framework, let us now turn back to the psychological interpretation of the nature of the relatedness technique. When comprehending a sentence in discourse the listener constructs a CI for it on the basis of its SR and the available contextual information. However, it is clear that such a CI can be either partially or more fully specified along the optional parameters of SR (as the semantic information is often vague or indeterminate in certain respects). Furthermore, the extent to which the computed CI is elaborated depends not only on the semantic and contextual information available, but also on the specific purpose to which such a representation is put (see e.g., Miller, 1979). Our point is that the task requirements that the subject faces in the relatedness task are such that, if anything, they greatly *enhance* the degree of elaboration of the CI of the test sentences that the subjects compute.

From this point of view, Fodor et al.'s assessment of the psychological nature of the relatedness task seems quite implausible to us. They suggest that the subject's activity in this task is akin to that of the linguist who is producing linguistic intuitions. However, when linguists try to identify the correct semantic structure of a sentence their aim is to produce valid generalizations over the range of *all* allowable CIs based on that sentence. While, clearly, the task of the linguist also involves computing particular CIs for sentences, the use to which such representations are put seems quite different in his case than in the case of the subject in the relatedness task.

Consider, for example, the semantician, doing componential analysis, who is interested in the systematic categorial parameters along which related words in the lexicon are individuated. This calls for a comparison of a large number of possible CIs of semantically related expressions, and involves abstracting away from the idiosyncratic properties of the particular CIs computed. On the other hand, the naive subject, when considering an isolated sentence in the relatedness task, is much more likely to construct only one particular, but fully elaborated CI which provides an instantiating mental model of the typical range of referential situations covered by the sentence. When doing so, in lack of specifying contextual cues, he is likely to use as "default values" salient conceptual stereotypes to fill in particular values of the CI, where these are left unspecified by the SR of the sentence. Relatedness judgements are, then, generated over such a highly elaborated instantiat-

ing CI, rather than over the structure of the SR of the sentence per se.

If this characterization of the psychological processes underlying the relatedness task is correct (and in the next section we shall report further evidence supporting this view), then it should not be surprising to find that relatedness judgements fail to conform to the ordering predicted on the basis of a complexity metric that is defined over the level of SRs. Fodor and Garrett (1966) recognized this kind of problem when they stated that "... in showing that a predicted complexity order fails to obtain, one has not shown that the grammar is disconfirmed ... Rather ... an acceptable theory of the relation between competence and performance models will have to represent that relation as abstract ...". Their use of relatedness intuitions as direct reflections of linguistic structure was based on the apparent success of the validating cases and the lack of an explicit theory that would give those cases a different interpretation. They assumed a view of the relation between semantic structure and performance, which theory our experiments refuted. Furthermore, our results provide basis for an alternative interpretation of the nature of relatedness intuitions according to which the level of representation that determines them is that of CI, and not the different levels of linguistic representations.

1.2.4. Relatedness intuitions as a function of conceptual interpretation

Let us consider how the above view on the relation between SR and CI applies in the case of causative sentences. The SR of a periphrastic "cause" construction (such as (19b)) identifies a family of causative events in which the caused event expressed by the embedded clause is brought about as a result of the event encoded by the matrix clause. The particular manner of causation, however, is left unspecified: it is a "free parameter of interpretation" that is fixed in the process of constructing a CI for the sentence on the basis of contextual information.

(19a) Floyd dropped the glass.
(19b) Floyd caused the glass to drop.
(19c) Floyd caused the glass to drop by tickling Mary who was holding it.
(19d) *Floyd dropped the glass by tickling Mary who was holding it.
(19e) Floyd caused the glass to drop by letting go of it.
(19f) Floyd dropped Mary.

Such contextual information can be explicitly linguistic as in (19c) or (19e) where the manner of causation is specified in a by-phrase. Furthermore, as suggested by McCawley (1978a), in everyday conversational contexts CI can be guided by Gricean conversational implicatures which specify a linguistic

division of labor between periphrastic forms and corresponding lexical causatives to the effect that the latter is reserved to refer to "... unmarked causative situations: those involving direct causation, by a standard means if there is one and for a standard purpose if there is one, and the periphrastic causative is reserved to causative situations that are marked in one of these respects" (McCawley, 1978a).

Thus, the interpretation of the lexical causative "drop" in (19a) or (19f) assumes a typical dropping event which involves direct physical manipulation of the causee by the causer, and a lack of volitional control on the part of the causee over the caused event (i.e., Mary has no choice in (19f)). Accordingly, (19a) assumes that Floyd was holding the glass, while in (19c) it is clear that he was not. The unacceptability of (19d) is due to the violation of the assumption that there is direct physical contact. Note, however, that given the relevant contextual information, the unmarked standard interpretation *is* available for the periphrastic "cause" construction as shown by the acceptability of (19e).

Above we argued that the relatedness task induces subjects to construct highly elaborate CIs for the test sentences in which conceptual exemplars are used as default values to fix the unspecified values of SR. Accordingly, we can hypothesize that for the periphrastic "cause" constructions, in the absence of specifying contextual information, the free values of causative manner specification will be fixed in terms of the standard, stereotypic conceptual exemplar which, in normal conversational contexts, would be expressed by the lexical causative. This, then, could account for our finding (Table 2) that the relatedness judgements for the periphrastic "cause" constructions did not differ significantly from those evoked by the corresponding lexical causative sentences.

Such an explanation is clearly based on the assumption that if the CI of a causative expression specifies an unmarked, direct causative event, then the relatedness between causer and causee will increase. Naturally, it would be supportive to be able to test this assumption directly by varying directness of causation in the CI of expressions which, at the same time, would be structurally identical. Unfortunately, English lexical causatives cannot be used for this purpose as they normally do not allow an indirect causative interpretation. This is not a linguistic universal, however. Hungarian, for example, has productive causative suffixes (such as "-at/-et" or "-tat/-tet") which, as illustrated below, turn non-causative predicates into lexical causatives, *regardless* of whether the expressed causation is direct or indirect (for more details, see Appendix 1):

lengeni = to flap
lengetni = to cause-to-flap

A zászló leng = The flag is flapping
A férfi lengeti a zászlót" = The man is flapping the flag

tornászni = to do exercises
tornásztatni = to cause-to-do-exercises
A fiú tornászik = The boy is doing exercises
A férfi tornásztatja a fiút = The man makes the boy do exercises

The specification of the manner of causation can be a function of context as the examples below demonstrate:

(20a) Az édesanyja egész órán át tornásztatta a csipőficamos kisbabát. (His mother made the baby with a sprained back do exercises for the whole hour.)
(20b) A szadista tornatanár egész órán át tornásztatta a tanulókat. (The sadistic physical education teacher made the students do exercises for the whole hour.)

Though the causative verb is identical in both cases, (20a) implies direct causation with the mother physically manipulating the baby who has no control over the resulting event, while in (20b) the manner of causation is indirect: it does not involve physical contact, and the caused activity is under the voluntary control of the causee.

We had native Hungarian speakers judge word relatedness in causative sentences that had either a direct or an indirect interpretation, but where both types of sentences were formed with morphologically identical lexical causatives. As in Fodor et al.'s critical test, each causative sentence was contrasted with a sentence that was identical except that it had a non-causative control verb in the place of the causative verb.

The results clearly support our hypothesis: lexical causatives with a *direct* causative interpretation lead to stronger subject–object relatedness than do corresponding control sentences with non-causative transitive verbs (Items: $p < .02$, Subjects: $p < .05$; Table 9). In contrast, lexical causatives in sentences with an *indirect* causative interpretation show less relatedness than the corresponding non-causative controls (Items: $p < .04$, Subjects: $p < .07$; Table 10). Again, it is clear that this effect cannot be predicted on the basis of the structural distance assumption as the causative sentences of both the "direct" and the "indirect" conditions were structurally identical.

1.2.5. Forced-choice relatedness judgements

Fodor et al. back up many of their findings with isolated sentences, by presenting other subjects with pairs of contrasting sentences in a "forced-choice"

task requiring them to make a relative judgement as to which sentence provides a closer relation between the critical nouns. We decided to use the same task, partly to replicate our crucial findings, and partly to test more critically for non-structural factors that govern relatedness intuitions between nouns.

Our isolated sentence study yielded only weak results from the "expect/persuade" contrast. Therefore, our first goal was to replicate that finding with the forced-choice paradigm. The results strongly confirmed the effect (Items: $p < .001$; Subjects: $p < .001$; Table 13), showing that our subjects were responding to the task in a general manner similar to that of Fodor et al.

We then turned to materials that would further clarify the nature of the relatedness task. We used four kinds of transitive verbs to test for the role of CI in determining relatedness, when syntax is held constant. We studied three types of contrasts, exemplified in (21)–(23).

(21a) The policeman observed the demonstrator who was standing in front of the administration building.
(21b) The policeman kicked the demonstrator who was standing in front of the administration building.

(22a) The maid cleaned the room before the guests used it.
(22b) The maid inspected the room before the guests used it.

(23a) The electrician shortened the wire when he was trying to fix the light.
(23b) The electrician saw the wire when he was trying to fix the light.

Perception verbs, like "observe" in (21a), do not involve physical interaction between subject and object while physical-contact transitives, like "kick" in (21b), do—hence, we would predict closer subject–object relatedness for sentences with physical-contact verbs. Similarly, causatives expressing direct physical causation, like "clean" in (22a), should also show more relatedness than perception verbs; and this should also be true even when the causative status of the verb is morphologically marked, as in "shorten" in (23b). In contrast, since the sentence pairs are syntactically identical, on the basis of the structural distance assumption no differences would be predicted in either of these cases.[2]

The results (Tables 14–16) support our hypothesis that subjects access the CI of the sentences to make relatedness judgements: in every pair, the perception verb resulted in *less* relatedness between the subject and object nouns

[2]Except perhaps for (23), where, if the *marked* causative verb "shorten" is considered to map onto a two-clause semantic structure "NP1 CAUSE (NP2 BECOME SHORT)", then the prediction would be the *opposite* of ours, expecting less relatedness in (23a).

(for (21): Items: $p < .05$; Subjects: $p < .02$; Table 14; for (22): Items: $p < .05$; Subjects: $p < .001$; Table 15; for (23): Items: $p < .001$; Subjects: $p < .001$; Table 16).[3]

When we look at the relative strength of the effects above we can observe that the largest difference resulted from the causatives carrying an explicit causative marker ("short*en*") followed by unmarked causatives ("clean") which, in turn, showed a somewhat stronger effect than non-causative physical-contact transitives ("kick"). This observation suggests two things: (a) that the causative relation *itself* increases relatedness, and (b) that the *explicit surface marking* of the causative relation increases relatedness even more.

The latter point gains further support when we note that in their isolated sentence task Fodor et al. also found a nearly significant difference in the same direction: marked lexical causatives resulting in *more* subject–object relatedness than non-causative controls (see Fodor et al., Set 5B: Items: $p < .088$; Subjects: $p < .229$). This result is, of course, not very strong (Fodor et al. do not even comment on it), however, this might be due to the fact that their transitive controls contained both physical-contact verbs and arguably causative verbs (see footnote 3). Therefore, we repeated this condition comparing eight pairs of marked lexical causatives and no-contact transitive controls for relative subject–object relatedness in an isolated-sentence ratings task. The result confirmed our hypothesis: marked lexical causatives showed greater relatedness than their controls (Items: $p < .02$; Subjects: $p < .05$; Table 20).

The fact that explicit surface marking of the causative relation seems to increase relatedness in its own right is also interesting for us because it can explain our previous finding (Table 1) that in the isolated-sentence task the periphrastic "cause" sentences showed a slight tendency towards *more* relatedness than the (unmarked) lexical causatives (see p. 221 above). In the periphrastic constructions the critical nouns were arguments of the explicitly causative verb "cause", while the lexical causatives contained no explicit surface marker of causation, which could have resulted in the slightly stronger relatedness in the periphrastic case.

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[3]It is interesting that, contrary to our results, Fodor et al. did *not* find a difference between lexical causatives and simple transitives in their forced-choice task (see their Table 15). This might be due to the following two factors: (i) our control verbs were all no-contact transitives while theirs included many physical-contact verbs, and, as our results show, physical contact is an effective factor in increasing relatedness; (ii) quite a few of their "simple" transitive control verbs are, in fact, arguably causative verbs. (At least the following verbs from Fodor et al.'s control verb list have been explicitly argued to have causative analysis: "sell" (Katz, 1972; Miller & Johnson-Laird, 1976), "tie" (Fillmore, 1971), "find" (Bendix, 1971; Miller & Johnson-Laird, 1976), "get", "pull", "eat", "drink", "repeat", "assemble" (Miller & Johnson-Laird, 1976), while others, such as "add" or "bolt" could clearly be given similar decompositional analyses.)

We also applied the forced-choice task to further test the effect of direct vs. indirect causative interpretation on relatedness, this time using English periphrastic constructions, as in (24):

(24a) Floyd caused the glass to drop by suddenly letting go of it.
(24b) Floyd caused the glass to drop by tickling Mary who was holding it.

Clearly, (24a) specifies a direct physical relation between "Floyd" and "the glass", while (24b) does not. Similar to our result using Hungarian lexical causatives in isolated sentences, we found a sharp difference in favor of closer relatedness for sentences with direct causative interpretation (Items: $p < .001$; Subjects: $p < .001$; Table 18).

Finally, we tested the crucial comparison, lexical causatives vs. their corresponding periphrastics, like (25):

(25a) Sitting in his high chair the baby spilled the juice in his cup.
(25b) Sitting in his high chair the baby caused the juice in his cup to spill.

The forced-choice results showed stronger relatedness for the lexical causatives than for the periphrastic constructions (Items: $p < .001$; Subjects: $p < .001$; Table 17). This result would seem at first to give support to the central methodological assumption of Fodor et al., that relatedness judgements indicate closeness in the structural description of a sentence. However, the other forced-choice pairs, which do *not* have structural differences, also showed comparable differences in relatedness. Accordingly, if we can show how the difference might arise from our methodological assumptions, other interpretations will become gratuitous.

Note that there are several specific properties of the lexical causative/periphrastic pairs that might contribute to the forced-choice result. Firstly, we can observe that while there are the same number of words intervening between the critical nouns in the lexical vs. the periphrastic versions, the relative length of the sentence material surrounding them is different. In the literature there are results (e.g., Martin, 1970, see our discussion of previous studies in Appendix 1) which suggest that relative length plays a role in determining subjective relatedness.

To test for this we used nonsense sequences that varied the length outside of the critical word pair, in just the same way as the length differences between lexical causative and periphrastic constructions (26), and in a different way (27).

(26a) Baby merget juice. (The baby spilled the juice.)
(26b) Baby dutket juice ref snig. (The baby caused the juice to spill.)

(27a) Baby merget juice.
(27b) Ref snig baby dutket juice.

We asked subjects who were already experienced with the relatedness task in English, to make similar predictions about the judgements of native speakers for a language they did not know. In both kinds of cases subjects reported greater relatedness between the critical nouns in the shorter sequences (for (26): $p < .001$; for (27): $p < .02$; Table 19).

Of course, results from a nonsense-sequence experiment are hard to use as the basis for interpreting results obtained with comprehensible sentences. All other things equal, however, there is a general reason to expect that the number of words surrounding the critical nouns will affect their perceived relatedness. This follows from the simple fact that there is a greater likelihood that one of the nouns will be involved in a construction with the adjacent material, potentially reducing its relative relatedness to the other noun when a forced-choice task contrasts the sentence with an other construction that does not have as much adjacent material. In fact, just that is true of the periphrastic constructions that we used. (See p. 271 of Appendix 1 for further discussion of this.)

Apart from relative length, there is also another property that differentiates the members of the lexical causative/periphrastic pairs in the context of the forced-choice paradigm. Unlike the isolated-sentence study, the task requirements of the forced-choice test provide strong contextual cues that induce subjects to construct highly differentiating CIs for the lexical vs. the periphrastic sentences. Since the subject's task here is to *contrast these sentence types directly*, it is most likely that his attention will become focused on the characteristic differences in the typical application of the two constructions. This suggests an explanation directly related to our demonstrated hypothesis that subjects make relatedness judgements about sentences by accessing their CIs.

Consider the two members of (25), trying to decide in which sentence "baby" is more closely related to "juice". It is clear when we contrast them directly, that the periphrastic version allows more easily CIs which correspond to non-stereotypic causative situations where the physical act causing the event is remote. For example, if the subject imagines that the juice spilled as a result of the baby's accidental sneezing (in contrast to, say, his intentional knocking over the cup), it would be clearly more appropriate to describe this event by saying that "the baby caused the juice to spill" by sneezing than to say that "the baby spilled the juice". Hence, the periphrastic construction is judged in the forced-choice task as predicating less relatedness between the subject and the object, because it allows for CIs in which the causative event is less direct.

But, Fodor et al. might reply, we have merely re-stated their methodological hypothesis, couched in terms of an alleged "conceptual interpretation". It is true that our hypothesis converges on the same prediction as theirs, in *this* case. However, the reason is different: in our case it is based on the assumption that subjects access the CIs of the sentences, and use their contrast at *that* level of representation to answer the relatedness question. Unlike Fodor et al., we can also predict the other phenomena we have reviewed with the same methodological interpretation of the basis for relatedness judgements.

To sum up: we have shown that relatedness judgements are not sensitive to those structural factors of linguistic representations which would be relevant if the method were to reveal underlying structural complexity. Therefore, we concluded that the use of the relatedness technique to assess the psychological reality of decompositional SRs of lexical items is unwarranted.

We have argued that the level of representation affecting relatedness judgements is that of the CI of sentences. CIs are particular instantiating model representations of expressions which are constructed on the basis of their SRs as a function of their context of use. It has been demonstrated that such non-structural aspects of CI as e.g., directness of causation, definiteness and concreteness of the denoted entities, or the relative intensity of their intentional interaction, have systematic effects on relatedness.

Apart from the particular conclusion concerning the inadequacy of the relatedness technique to measure lexical decomposition, there is also a broader methodological implication of our results. The fact that all the cases of relatedness judgement examined seem to reflect properties of CI calls into doubt the main empirical assumption made both by Levelt and Fodor et al., that relatedness intuitions are directly sensitive to syntactic constituent structure. In fact, it might be the case that syntactic structure is revealed by relatedness intuitions only insofar as it reflects aspects of CI, which, in their turn, affect relatedness. (For a discussion of this hypothesis see Appendix 1, where we show how this interpretation is consistent with the findings of previous studies using the relatedness technique and other closely related proximity measures.)

At any rate, our results certainly show that relatedness intuitions cannot be uncritically relied on as structural evidence: their use to empirically evaluate the psychological reality of competing linguistic analyses is highly suspect.

Part 2: The mental representation of lexical causatives

Let us now turn back to the question of how the meaning of causative verbs is represented mentally. Up to this point our discussion focused on the controversy over this issue between the DD and the MP approaches to lexical semantics. In Section 2.1 we shall critically examine a third approach recently proposed by G. Lakoff (Lakoff, 1977; Lakoff & Johnson, 1980). His proposal is an extension of Rosch's prototype theory of natural kind terms (e.g., Rosch, 1978) to the concept of causation. We shall argue, however, that the attempt to capture the semantic facts about, and the acquisition of, causative constructions in terms of a prototype concept of causation is inadequate on both descriptive and empirical grounds.

In Section 2.2 we shall advance an alternative proposal which characterizes the lexical representation of causative verbs as having two components: (i) a componential semantic "base-meaning"; and (ii) a contextually attached conceptual "stereotype".

Finally, in Section 2.3 we shall discuss some evidence from language acquisition and argue that it supports the two-component model while posing difficulties for the alternative approaches.

2.1. Causation as a prototype concept

Recently, Lakoff (Lakoff, 1977; Lakoff & Johnson, 1980) has proposed to capture the semantics of causative constructions within the framework of a prototype theory of categories as developed by Rosch (e.g., Rosch & Mervis, 1975; Rosch, 1978). Briefly, prototype theory holds that many concepts (in particular, those underlying terms of natural kind taxonomies such as "animal", "bird", "robin", or human artifact taxonomies like "furniture", "table") are not represented mentally in terms of necessary and sufficient conditions. Rather, such concepts have a prototype structure which consists of a set of features typically (but not necessarily) co-occurring in the members of the category (such as "flies", "sings", "has wings", "has a beak", "lays eggs", etc., for the category "bird").

Prototype concepts are mentally represented in terms of a "best exemplar" which has all the prototypical features of the category. Particular members of the class differ as to the amount of features they share with the exemplar, bearing higher or lower degree of "family resemblance" (Wittgenstein, 1953) to it. Thus, class membership is a matter of degree, and prototype categories have fuzzy boundaries. By now there is a large body of experimental evidence suggesting that the conceptual representation of kind terms indeed

has a prototype structure (for a review, see Smith, 1978; Rosch, 1978).

Lakoff and Johnson (1980) proposed that the concept of causation is not an undecomposable conceptual primitive as is often supposed, but, similarly to kind terms, it also has a prototype structure composed of "... a cluster of other components". They believe, following Piaget, that infants learn about causation through their early experiences with direct sensorimotor object manipulation, such as dropping toys, throwing cups, etc. "Though each of these actions is different, the overwhelming proportion of them share features of a 'prototypical' ... case of direct causation". Such features include direct physical manipulation, a volitional causer, a non-volitional causee, spatio-temporal overlap between the causer's action and the caused event, a perceptible change of state, etc.

This notion of causation as a prototype concept is then applied to explain the differences in meaning between lexical vs. periphrastic causatives. The idea is that prototypical causative events (i.e., those sharing many of the features of the causative prototype) will be referred to by lexical causatives, while peripheral causative events, lacking a few or more of the prototypical features, will be encoded by periphrastic constructions. Thus, Lakoff (1977) claims that "... the fact that single lexical items tend to prototypical uses while peri-phrastic causatives signal a deviation from the prototype will predict the differences in the way they can be used".

Note that this theory proposes a solution to the same difficulty in the semantic characterization of lexical causatives that has motivated Fodor and his co-workers most strongly to reject the DD approach: i.e., it proposes to give a correct extensional characterization of the restricted range of causative events that are encoded by lexical causatives.[4]

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[4]Recently, there have been numerous arguments raised in the literature which pose serious problems to any prototype theory of lexical semantics. We shall not discuss these arguments in any detail here; however, it should be clear that they also generalize to the extension of prototype theory to the semantics of verbal concepts involving causation. Briefly, the main problem for the prototype approach seems to be the lack of a viable combinatorial mechanism which could show how prototype concepts combine to form complex meaning representations (see e.g., Armstrong et al., 1983; Fodor, 1981; Osherson & Smith, 1981). Fuzzy logic (e.g., Lakoff, 1972; Zadeh, 1965) which was originally proposed for this purpose was shown to generate predictions about conceptual combination which violate basic intuitions (Osherson & Smith, 1981). A further problem is that clearly definitional terms such as "odd number" or "grandmother" have also been shown to have prototypical representations just as the kind terms investigated by Rosch (see Armstrong et al., 1983; Fodor, 1981; Wanner, 1979).

These arguments led to proposals to the effect that nominal terms in general might have dual, two-component representations: (a) a semantic core-meaning (e.g., "parent's mother" for "grandmother"), and (b) a prototype structure (e.g., with features like "has white hair", "is small", "wears glasses", "takes care of children", etc. for "grandmother") which serves as a perceptual "identification procedure" for the practical identification of instances in the extension of the term (see e.g., Armstrong et al., 1983; Osherson & Smith, 1981).

Consider, however, the following examples, due to Fodor (1981), about the semantic extension of the causative verb "paint": "... when Michelangelo dipped his brush into Cerulian Blue, he thereby covered the surface of his brush with paint and did so with the primary intention that the surface of his brush should be covered with paint in consequence of his having dipped it. But *Michelangelo was not, for all that, painting his brush*". Similarly, Fodor points out that when Michelangelo covered the Sistine Chapel with paint, he was not "painting the ceiling".

Fodor uses these examples to demonstrate that the decompositional definition of the verb "paint" as "CAUSE TO COVER SURFACE WITH PAINT" represents more than its correct extension. For the present argument note that both of the causative events described are highly prototypical: they involve an intentional causer, direct physical manipulation, spatio-temporal overlap, a non-volitional causee, a perceptible change of state, etc. A prototype theory of causatives would therefore falsely predict that the referential use of the verb "paint" should include the above cases.

Note that in the case of "paint" the manner of causation normally implied by the verb *is* prototypical. However, as the examples show, there are other ways of bringing about the change of state in question, which due to the amount of shared features with the hypothesized prototype of direct causation, should also count as highly prototypical, and so, by hypothesis, should also be included in the referential range of the verb. This situation is, in fact, highly characteristic of the class of denominal causative verbs in general: for example, as McCawley (1971) observed, one does not "hammer a nail in" when one places the hammer on the nail and then sits on it, though, obviously, this non-stereotypic manner of driving the nail in also shares the basic features of the prototype of direct causation.

Even more damaging for the prototype view is the existence of cases where the manner of causation implied by the normal use of lexical causatives is *low* in prototypicality as in (27a) and (28a):

(27a) Mary persuaded John to leave by writing him a letter.
(28a) Judy reminded Bill of his mother's birthday by leaving a note on his desk before she left.

Of course, "causing-to-intend" and "causing-to-remember" can be achieved by much more direct means, too, in which case the situation would clearly be much closer to the causative prototype in terms of the amount of shared features. Nevertheless, such highly "prototypical" causative events, while readily expressible in terms of periphrastic causatives, are not normally encoded by lexical means:

(27b) *Mary persuaded John to leave by kicking him.
(27c) Mary caused John to intend to leave by kicking him.
(28b) *The psychiatrist reminded the aphasic of his mother's birthday by giving him an electric shock.
(28c) The psychiatrist caused the aphasic to remember his mother's birthday by giving him an electric shock.

Such observations strongly suggest that there is no single set of "prototypical" features that are adequate to describe the lexical representations of causative verbs *as a class*. The referential range of the particular lexical causatives is constrained by their idiosyncratic manner and function specifications rather than by the degree of resemblance of the reference situations to a prototype of direct causation.[5]

2.2. A two-component lexical representation for causative verbs

In Section 1.2.3 we outlined a framework for lexical semantics which draws a principled distinction between the levels of semantic and conceptual representations (see Bierwisch, 1981). The lexical representation of causative verbs can be viewed within this framework as having two components: one, that we shall call the compositional "*base-meaning*", belongs to the level of SRs, while the other, that we shall refer to as the "*lexical stereotype*", is part of conceptual structure, and is identified as a function of the context within which the base-meaning is interpreted.

We argued that the meaning that is conveyed by an expression is its CI that is computed partly on the basis of its SR and partly on the basis of the contextual information available. In the case of lexical causatives the basis of the CI is the compositional semantic base-meaning (taking the form of a "CAUSE (CHANGE OF STATE)" predicate schema) which identifies a broad class of causative events (i.e., those bringing about the particular change of state involved). The contextual information which fixes the particular CI of the base-meaning involves two factors: (a) First, the fact that the speaker uses the *lexical* causative surface mapping of the base-meaning rather than the alternative periphrastic expression provides the hearer with the information that the intended interpretation is stereotypic. However, the *par-*

[5]This is, of course, not to deny that the lexical representations of the *particular within-lexical item* manner and function specifications (that we shall call "lexical stereotypes") might themselves have prototypical representations: thus, hammering with a shoe might be a less prototypical hammering-event than hammering with a hammer, in just the same way as a penguin is a less prototypical bird than is a robin.

ticular stereotype intended is identified on the basis of the information provided by (b), the specific context of use within which the base-meaning is interpreted.

For example, when hearing the sentence "Marvin ran the horse yesterday" the identification of the intended CI involves two steps: (a) The fact that the lexical causative "run" is used restricts the referential range of the expression by excluding such non-stereotypic ways of making your horse run as waving a torch in front of its eyes, or feeding it amphetamine. These interpretations would require the use of a periphrastic form like "Marvin made the horse run by ...". However, to identify the particular stereotypic interpretation intended one also has to know (b), the context of use within which the base-meaning is interpreted: Marvin can be a jockey who is running the horse by riding it, or he can be the owner of the horse entering it for a race.

Thus, lexical stereotypes are conceptual structures that specify the culturally salient standard manner and function of a causative event *relative to a particular context*. The attachment of such conceptual stereotypes to lexical items as the assumed CI of their base-meaning is a function of a division of linguistic labor between alternative forms with identical SRs available in the language. This is the gist of McCawley's proposal who suggests that "... principles of cooperation constrain the speaker's choice among alternative expressions of a given semantic structure ...", and so "... a lexical item and a syntactically complex 'equivalent' of it may make different contributions to the interpretation of a sentence without making different contributions to its semantic structure" (McCawley, 1978b).

The fact that lexical alternates to phrases involve stereotypic interpretations can be given a straightforward functional interpretation in terms of coding efficiency. It is reasonable that memorized vocabulary items should not be totally redundant in usage with phrases that correspond to them semantically. This might follow from a functional principle of language use which normally requires formally distinct linguistic expressions to be used non-synonymously.

2.3. Evidence for a two-component lexical representation of causative verbs

In Section 1.1.2 we reviewed studies of lexical development that have been claimed to support the DD approach. We argued that this evidence is, at best, inconclusive. Note, however, that the studies in question all assume a view of lexical acquisition which is clearly based on the classical DD approach: the lexical representation of a word is thought to be established over time by the piecemeal process of adding new basic semantic elements to the

lexical definition of the word until the correct DD is achieved.

However, we can also find in the developmental literature evidence of a different kind (namely, young children's productive novel word formations, e.g., Bowerman, 1974, 1982a; E. Clark, 1982), which is immune to the methodological problems that flawed the studies reviewed. This evidence is best understood in terms of an alternative theory of lexical acquisition (see Bowerman, 1982b) which emphasizes the role of linguistic experience with related forms, and of the resulting lexical reorganizational processes, as the basis for the establishment of compositional SRs for lexical items.

Bowerman's proposal does not require the compositional semantic elements of lexical representations to be developmentally primitive (i.e., to be a subset of innate conceptual primitives). Rather, they are seen as emerging from lexical reorganizational processes as *linguistic generalizations* projected over (or constructed from) the early conceptual representations of individual lexical items. The establishment of such a distinct, higher-order level of systematizing linguistic representations of word meanings is seen to be triggered by the child's linguistic experience with the growing set of morphologically and distributionally related linguistic forms that he has acquired. It is significant to us that Bowerman's theory of lexical reorganizational processes can be naturally interpreted in terms of the theoretical framework outlined in Section 1.2.3, which makes a principled distinction between the levels of semantic and conceptual structure.

In what follows, we shall briefly summarize Bowerman's account and data on the development of causative expressions, and argue that her evidence, together with some additional observations, supports our two-component model of lexical causatives, while posing problems for the alternative approaches. On the basis of detailed observational evidence Bowerman (1974, 1982a) describes the following stages in the acquisition of causative expressions:

Stage 1 (18–24 months)

(a) A set of simple causative transitive verbs are used by the child with apparently appropriate extension (e.g., "break", "open", "drop").
(b) The corresponding morphologically identical non-causative intransitive forms of these verbs are also appropriately used referentially at this stage.

Stage 2 (starting at about 24 months)

(a) The child's first periphrastic causative constructions appear (formed with "make" and "get").
(b) The child starts to produce novel lexical causatives productively by tak-

ing any non-causative intransitive predicate and using it transitively to express a causative meaning: e.g., "Daddy go me around" (= make me go around); "You just cried me" (= made me cry); "Come it closer" (= make it come closer/bring it closer). (For a collection of such novel forms see Bowerman, 1974, Tables 1 and 2; or Bowerman, 1982a, Table 1.)

Stage 3

Gradually the errors of Stage 2 become rarer, largely (but not totally) disappearing by age 6.

According to Bowerman the sudden appearance of the novel causative forms is due to the establishment of a productive word-formation rule (WFR) which allows the child to take any intransitive predicate and use it transitively to express a causative event in which the state or event encoded by the intransitive predicate is brought about. What is the underlying basis for the establishment of such a WFR? While there have been several alternative hypotheses proposed (e.g., Bowerman, 1974; E. Clark, 1982), the one that seems most plausible relates the origin of the WFR to the child's early linguistic experience during Stage 1 with a set of *morphologically related* transitive–intransitive verb pairs in his lexicon (Bowerman, 1982a; Gergely, 1980).

At Stage 1 the child has already acquired a set of transitive and intransitive predicates that he uses apparently correctly. It is likely that these early predicate terms have been acquired separately, and that the conceptual representations underlying their referential use are unrelated at first. It is hypothesized, however, that the child's experience with systematic morphological and distributional regularities between the separate lexical entries in his lexicon triggers a process of lexical reorganization: the hitherto unrelated conceptual representations of the individual lexical items are searched for similarities that might correspond to the formal regularities present. Thus, the child is seen as using such formal regularities in his lexicon as a *guide-line* to identify or construct valid categorial generalizations over the separate conceptual representations of his lexical entries. These generalizations are then established as *a new level of linguistic representations of lexical meanings* (i.e., the SRs) which systematically relate the hitherto separate lexical entries at the level of SRs.

In particular, at Stage 1 a subset of the child's transitive verb entries becomes individuated due to the fact that these transitives (such as "break", "open", or "drop"), unlike the others in his lexicon (e.g., "hit", "bite", or "kick"), have morphologically identical intransitive counterparts. Searching for some corresponding regularity in the conceptual representations of these

items, the child establishes that in all cases the change of state encoded by the intransitive verb is represented as an inherent part of the conceptual representation of the corresponding transitive verb which, in all cases, expresses an event resulting in the particular change of state in question.

Therefore, at this point, the child can establish a "CAUSE (CHANGE OF STATE)" predicate schema which is a valid categorial generalization over the conceptual representations of the set of transitive verbs having morphologically identical intransitive counterparts. He can now set up a new level of *linguistic* meaning representations (the SRs) for his lexical entries in terms of the above generalization which will thus be *compositional*. The lexical generalization then becomes overgeneralized, and is used as an active WFR: whenever a change of state encoded by an intransitive predicate is brought about, the causative event can be expressed by the intransitive predicate used as a transitive verb with the compositional meaning "X CAUSE (Y CHANGE OF STATE)".

From this account we can generate a set of predictions concerning the nature of the child's causative expressions in Stage 2:

(A) If the semantic generalization underlying the WFR is, in fact, the compositional "CAUSE (CHANGE OF STATE)" schema, we can expect that the referential use of the novel causative verbs would *not* be restricted to cover only stereotypic, direct (or, under Lakoff's account "prototypical") causative events. Rather, since the causative schema identifies a *broad* class of causative events (i.e., *any* event which brings about the change of state specified by the intransitive predicate), the child can be expected (i) to use novel causatives to refer to both direct and indirect causative events, and (ii) to use them synonymously with the (simultaneously emerging) periphrastic constructions. Bowerman (1982a) provides a detailed analysis of the error data (see her Table 2 on p. 47) showing that *both* of the above predictions are, in fact, correct.

(B) Given the establishment of the WFR, it can be expected that the child will form novel causatives out of intransitives even in cases where there is an already existing, but morphologically unrelated causative verb in his lexicon which could pre-empt the usage of the novel form. The case is analogous to other, well-documented cases of productive overextension of newly acquired rules, such as the formation of past tense by attaching "-ed" to the verb stem (Berko, 1958) (for a discussion, see Bowerman, 1982b). In such cases it has been observed that previously acquired irregular forms such as "broke" (i) do not pre-empt the active formation of overextended forms like "breaked", and (ii) do not themselves disappear either. Rather, the two forms are *both* produced during the period of active overextension of the rule.

Again, Bowerman's (1982a) analysis of her data shows that the prediction is correct: the child freely produces novel causatives like "Come it closer" or "Be it on" in spite of the simultaneous availability (and active use) of corresponding (potentially pre-emptive) correct lexical forms such as "bring" or "put", respectively.[6]

(C) We know that adults use lexical causatives restrictively, i.e., to cover only stereotypic causative events, and we have seen that the child's early use of his first causatives during Stage 1 also appears to be restrictive. However, if during Stage 2 these verbs indeed receive new compositional SRs in terms of the general "CAUSE (CHANGE OF STATE)" predicate schema, which identifies a *broad* class of causative events, then we can predict that at Stage 2 their use will become *non-restrictive*, covering also the periphrastic, non-stereotypic interpretations.

Our examination of Bowerman's data (1974, 1982a, pers. commun.) shows that this is, in fact, the case: during Stage 2, lexical causatives that were correctly used at Stage 1 are overextended to non-stereotypic causative situations. For example, the sentence "Christy drop a boy out my bucket" was used to refer to a situation in which Christy accidentally kicked over a bucket of toys that, as a result, dropped out: a clearly non-stereotypic causative event that adults would have to express by a periphrastic construction (cf. (19d) on p. 229). (In Appendix 2 we give a list of examples of such non-stereotypic uses during Stage 2.)

In our view the above facts constitute positive developmental evidence for the psychological reality of compositional SRs for lexical causatives. Using our terminology, the compositional lexical representations established in the lexical reorganization process correspond to what we called the semantic "base-meaning" of lexical causatives. The restrictive conventions of language

[6]E. Clark (1982) proposes an alternative hypothesis concerning the origins of the novel word formations. Clark suggests that children coin new verbs under communicative pressure in order " ... to fill gaps in their current lexicon". In this vein, she seeks to explain the fact that children sometimes create a novel causative instead of using the corresponding periphrastic expression that is available to them by reference to the meaning differences between lexical and periphrastic causatives. However, such an alternative seems to be definitely ruled out by the facts described under (A) and (B) above. Firstly, the synonymous (and, in many cases, alternating, see Bowerman, 1982a, Table 2) use of periphrastic and novel lexical forms (A) strongly suggests that the child at this stage is not aware of the meaning contrast between these alternative forms. Secondly, the synonymous (and, in many cases, alternating, see Bowerman, 1982a, Table 1) use of both the novel causative forms (e.g., "Come it closer") and the corresponding suppletive causatives (e.g., "Bring it closer") (B) shows that, though the meaning of the latter forms (which are readily available to the child) pre-empts that of the former, the novel word formations still occur freely. Neither of these facts would be expected to systematically occur if the novel causative verbs would, indeed, arise as a result of communicative pressure, as suggested by Clark.

use that govern the linguistic division of labor between the adult use of lexical vs. periphrastic alternatives are clearly not yet present at Stage 2, as shown by the non-restrictive use of both the novel (A) *and* the previously restrictively used existing (C) causatives. During Stage 3, as these conventions of language use become operative, the child gradually acquires and attaches to his lexical representations those culturally salient stereotypic manner and function specifications which form the content of the particular lexical causative stereotypes in his language.

Note that while the developmental evidence lends itself naturally for an interpretation within the framework of our two-component model, it seems to pose problems for the alternative approaches. Consider first Lakoff's prototype approach. Briefly, if what governs the correct use of the set of causative verbs during Stage 1 is the child's emerging prototype concept of direct causation, then the lexical generalization underlying the causative WFR would *also* have to have this prototype concept as its semantic basis. Therefore, the prototype approach predicts (a) that the referential use of the novel causatives would be restricted to prototypical, direct causative events, and (b) that the causative verbs, which were correctly used during Stage 1, would be continued to be restrictively used at Stage 2 as well, covering only prototypical, direct causative events. However, as we have shown above (see (A) and (C)), neither of these predictions is borne out by the data. Therefore, we can conclude that apart from its inadequacy to capture the semantic facts about the use of lexical causatives in adults, the prototype theory also fails as an account of the acquisition of causatives.

Turning now to the MP approach, it is not clear how it would account for the establishment of the causative WFR in the first place.[7] According to this view, since during Stage 1 the child appears to use a set of transitive and intransitive verbs referentially correctly, it can be assumed that the corresponding innate unitary conceptual elements have been triggered and established as the SRs for their respective lexical entries. In addition, the child may have acquired that some transitive predicates are inferentially related to some intransitive ones, i.e., he may have separately established MPs in his lexicon connecting pairs of lexical entries such as "X break Y → Y break", or "X kill Y → Y dead".

However, since, as the theory is presently stated, the MPs are simply statements of implicational relations between lexical entries, there is nothing to differentiate MPs carrying causative implications from ones capturing non-causative relations such as "X marry Y → Y human" or "X grab Y" → "Y

[7]See also Bowerman (1982a) for a discussion of the MP approach in relation to the child's causative errors.

solid". Thus, if the lexical generalization underlying the WFR were projected over MPs relating two-place to one-place predicate terms, the resulting novel transitive verbs would include not only ones expressing causative events but also unlikely non-causative verbs such as "X human Y" or "X solid Y". Such novel forms could then be used to express *any* transitive event (causative or otherwise) for whose object the intransitive predicate is necessarily true. Such forms, however, do not appear in the child's novel verb formations.

Even if the above difficulty were overcome by an elaboration of the MP view,[8] there are additional problems for the MP approach. For example, assuming that the innate unitary concepts corresponding to the child's early causatives had been triggered and established as the SRs of these verbs underlying their correct referential use during Stage 1, it is just not clear why, at Stage 2, the child would suddenly start to erroneously overextend these verbs to cover a much broader range of causative situations than that specified by their innate SRs. However, this is exactly what happens during Stage 2 (see (C) above).

Assuming, then, that there is evidence for compositional SRs in the child's lexicon, it could still be maintained that the adult lexical representations are, nevertheless, unitary, emerging from, but not composed of, the early compositional structures. Fodor (1981) elaborates this idea by suggesting a nativist ethological interpretation for the "mental chemistry" metaphor (e.g., Savin, 1973), as the innate mechanism through which early compositional concepts might give rise to (or, indeed, trigger) other, later appearing, unitary innate concepts. Fodor's point is that the innate laws of "mental chemistry" *cannot* be those of logical combination, since the meanings of the late-arising unitary concepts are not definitionally related to their compositional source-concepts.

Thus, the difference in meaning between the innate unitary concept underlying an adult's lexical causative and its earlier compositional source-concept, which mentally triggers it, would be explicable in terms of the innate laws of "mental chemistry". According to Fodor, these innate laws, which form "... the structure of the triggering hierarchy" of conceptual development, should turn out to be "... quite natural from the point of view of an ethologist".

While this proposal could obviously accommodate any evidence for early decompositional SRs, there is something quite unnatural about it, precisely from the point of view of the evolutionary theorist. The point is that in many

[8]The necessary elaboration would require the MP approach to accept (a) that causative MPs are representationally distinguished from non-causative ones in the mind, and (b) that the domain of the child's lexical generalizations (underlying his novel WFRs) includes not only formal properties of the lexicon (such as the morphological shape of words or their associated argument frames) but also such individuating semantic properties of MPs as CAUSATIVE.

cases the *kind* of difference between the meaning of lexical causatives and of the semantic predicate expression in their compositional base involves *culture-dependent* (and consequently often language specific) manner and function specifications which are a function of cultural development, changing social habits, technical innovations, etc.[9]

Given the often culture-dependent nature of the restrictive use of adult lexical causatives, the "mental chemistry" account implies that the ethological laws of the mind determining the semantic character of such late-emerging lexical causative concepts specify highly culture-dependent information *innately*. That is, from an evolutionary point of view, the proposal that verbal meanings, involving culture-dependent manner and function specifications, are unitary and innate has the same prima facie implausibility about it as the proposal that there are innate unitary nominal concepts for technical innovations such as "umbrella" or "trumpet" (see Fodor, 1981).

3. Conclusions

We have considered several alternative approaches to the mental representation of the meaning of lexical causative verbs. We have shown:

(1) The empirical basis of the attempt by the MP approach to disprove through the use of relatedness intuitions the psychological reality of decompositional semantic representations is false. Using several proximity measures, we have demonstrated that the degree of structural separation between words is, in general, not a reliable determinant of their judged relatedness. Therefore, the relatedness technique is inadequate to measure the underlying structural complexity of linguistic representations.

(2) The subjective relatedness between two nouns of a sentence has been shown to be sensitive to such non-structural aspects of their CI as the

[9]Thus, the use of the causative verb "run" in our earlier example to refer to the stereotype of an owner's entering a horse for a race implies knowledge about a set of cultural institutions such as "sport", "racing", "ownership", "betting", "winning", etc. Or consider the causative verb "to marry" as in "The priest married the couple" with the compositional base-meaning "CAUSE TO BE MARRIED". Here the attached lexical stereotype is clearly culture-specific containing manner specifications which are a function of legal and religious conventions that are subject to historical change. Furthermore, note that different languages often attach different cultural stereotypes to the same base-meaning: e.g., in English, the causative transitive verb "bleed" (with the base-meaning "CAUSE TO BLEED") is restricted to the medical stereotype of drawing blood surgically from a patient, while in present-day Hungarian the corresponding lexical causative "kivéreztet" (= cause-to-bleed) is typically restricted to the (quite different) stereotype of allowing the blood to flow from one's wound, for example, by applying slight manual pressure to the area surrounding it.

definiteness and concreteness of the referent representations, the relative intensity of their intentional interaction, or the directness of causation implied.

(3) A broader methodological implication of (1) and (2) is that they call into question the central empirical assumption underlying earlier applications of relatedness intuitions according to which relatedness judgements are directly sensitive to syntactic constituent structure. Intuitions about lexical relatedness have been one stable basis for the assignment of phrase structure constituency in linguistics. However, our results raise the possibility that relatedness intuitions reveal syntactic structure only insofar as the latter reflects aspects of CI, which, in turn, affect subjective word relatedness. It is not pertinent to our present concerns to explore the implications of our findings for linguistic research, but it may be the case that certain apparently structural linguistic intuitions are determined by the psychological properties of relatedness judgements.

(4) Our results, therefore, render the use of the relatedness technique to evaluate empirically the psychological reality of competing linguistic analyses questionable. At the same time, they call attention to the potential usefulness of relatedness intuitions as a tool to investigate the empirical nature of the instantiating model representations that are constructed as the CI of sentences. It seems that future research might successfully apply the relatedness method to explore the spatial, temporal, causal, or intentional parameters of such representational structures.

(5) The attempt to describe lexical causatives in terms of a prototype concept of direct causation based on early experience with object manipulation fails to account for the semantics of causatives, as it leads to incorrect predictions about the referential range of such verbs.

(6) The developmental sequence of the child's acquisition of lexical causatives further invalidates the prototype approach, as it exhibits a stage of broad causative generalization where both existing and novel causative verbs are used to refer to non-prototypical as well as prototypical causative events.

(7) The stages of the development of causative expressions provide positive evidence for semantic decomposition of lexical causatives, at least developmentally. First, there is an initial stage in which a small set of early causative verbs are apparently used referentially correctly. In a subsequent stage, due to the child's linguistic experience with a growing set of morphologically and distributionally related forms in his lexicon, the lexical concept of causation is individuated as a linguistic generalization.

This generalization is projected over the unrelated, conceptual representations of early causative verbs. The lexically individuated concept of causation is then broadly overgeneralized resulting in the appearance of novel causative verbs and the incorrect referential use of existing ones. This demonstrates that the child is in a phase of treating lexical causatives decompositionally.

(8) A two-level theory of the mental representation for causatives can account for these phenomena. On this theory, the lexical representation of causative verbs includes information about both a componential—but non-definitional—semantic analysis which articulates their causative status, and a conceptual stereotype specifying its range of application as a function of their context of use. The decompositional semantic structure emerges during development as a result of the linguistic reorganization of the child's lexicon, while the conceptual stereotype becomes attached to the lexical representation during the later phases of development. In adults, access of a lexical item can involve both kinds of representations, which can obscure the separate effect of either in behavior.

Appendix 1: Experiments on the subjective relatedness of words in sentences

(by G. Gergely, L.A. Gerken, S.M. Jandreau and T.G. Bever)

Introduction

In this section we report five experiments examining the relative degree of subjective relatedness of words in sentences. The experiments were carried out in two languages, English and Hungarian. The technique of eliciting relatedness judgements between words of a sentence originates from Levelt (1970; 1974). He found that by the method of Hierarchical Clustering Analysis it is possible to derive from such data tree structure representations of the stimulus sentences which are similar to the structural descriptions assigned to those sentences by linguists on purely linguistic grounds. He argued that this method reveals the syntactic structural organization of sentences at both surface and underlying levels of representation.

Recently, Fodor et al. (1980) argued that the same experimental technique demonstrates the psychological "unreality" of compositional semantic representations for lexical causatives. They made two basic empirical assumptions concerning the nature of relatedness intuitions: (a) that words which are grammatically related at the level of surface structure, but are not so related in the underlying representation of the sentence, show a smaller de-

gree of relatedness than do words exhibiting no such "shifts" in grammatical relations between levels; and (b) that this kind of structural separation affects relatedness not only at the underlying syntactic level but also at the level of semantic representations.

The present study questions the validity of both of these assumptions. Indeed, our results raise the possibility that, while subjective relatedness judgements are sensitive to certain aspects of the conceptual interpretation of sentences, they, however, do *not* reflect in a systematic manner the structural separation of words at the different linguistic levels of representation. (The specific hypotheses and arguments to substantiate this point are developed in the main body of the paper.)

Since in our experiments we question the empirical assumptions concerning the nature of a behavioral measure, it was important that our use of the experimental technique should be comparable to that of Fodor et al. Therefore in the design of our experiments and in the data analysis we closely followed the paradigms of Fodor et al.'s "Ratings" and "Forced-choice" tasks.

Fodor et al.'s critical comparisons were of two types: (a) the experimental (Subject–Probe) comparison which involves words of the sentence that are grammatically related in the same surface clause but appear in separate clauses in the underlying representation; and (b) the control comparison (Subject–Control) which measures the relatedness of two words taken from separate surface clauses of the sentence. Fodor et al.'s rationale for contrasting these comparisons was that the hypothesized effect of the within-clause structural separation should only decrease the subjective relatedness of the words in the experimental (Subject–Probe) comparison, while the across-clause (Subject–Control) comparison, whose words do not change their structural relation to each other, should stay relatively unaffected. Note that since we argue against the validity of the assumption concerning the effect of structural separation on word relatedness the above rationale does not generalize to our experiments. Nevertheless, in order to make the two studies more fully comparable, we report both experimental and control comparisons for our data.

Experiment 1 (ratings task)

Method

Subjects

24 male Columbia undergraduates served as subjects. They participated in the experiment as partial fulfilment of their course requirement.

Materials

The stimuli were composed of sentences of four different experimental types each consisting of 7 pairs of sentence tokens. These together with an additional 21 filler sentences made up the list of 49 sentences presented to a given subject. The 21 filler sentences were all two-clause constructions of approximately the same length as the experimental sentences, however, they did not involve any of the relevant syntactic or meaning dimensions tested. They were randomly intermixed with the experimental sentences throughout the stimulus list in order to prevent subjects from developing specific expectancies about the structure of the experimental sentence types. The experimental types contrast 7 A/B minimal sentence pairs which differ only in the relevant syntactic or meaning dimension tested (see the main text for a description of the contrasts involved). Here (Table 1) we shall only give an example of a minimal pair for each experimental type. The critical words

Table 1. *Stimulus sentences*

Type 1: Periphrastic 'cause' constructions (A) vs. corresponding unmarked lexical causatives (B). (The (B) sentences containing the lexical causatives were taken from Fodor et al.'s stimulus material (Set 5).)
C S V P
(A) Sitting in his high chair the baby caused the juice in his cup to spill.
C S V P
(B) Sitting in his high chair the baby spilled the juice in his cup.
Type 2: 'Expect' (A) vs. 'persuade' (B) sentences. (The sentences used here were taken from Fodor et al's 'expect'/'persuade' sentences (Set 1).)
C S V P
(A) During the stormy Atlantic crossing the captain expected the passengers to be frightened.
C S V P
(B) During the stormy Atlantic crossing the captain persuaded the passengers to remain calm.
Type 3: Indefinite (A) vs. definite (B) direct object.
C S V P
(A) Contrary to his father's orders Steve took a plane to New York.
C S V P
(B) Contrary to his father's orders Steve took the plane to New York.
Type 4: Abstract (A) vs. concrete (B) direct object.
S V P C
(A) The young boy grasped the idea easily though it was very abstract.
S V P C
(B) The young boy grasped the pitcher easily though it was very heavy.

judged by the subjects for relatedness are marked as "S" (Subject), "P" (Probe), "V" (Verb), and "C" (Control).

Procedure

Each sentence was computer printed on a separate page followed by six pairs of words corresponding to the possible combinations of the four test words "S", "P", "V", and "C". The six word pairs followed each other in a column under the sentence on the left side of the page. On the right, corresponding to each word pair there was a five-point scale. The order of the six word pairs after each sentence was randomized, and so was the left/right positioning of a given test word in its pairs. This guaranteed equal overall left/right pairing frequences for each word tested. Furthermore, any given word pair appeared equally often in all six serial positions following its target sentence.

Subjects were instructed to read each sentence carefully and then to consider each of the six word pairs separately, independently from the others, and only in relation to the target sentence. They were asked to mark on the five-point scale (ranging from "very strongly related" to "hardly related") "how related the two words in the word pair seem within the sentence". They were told to base their judgements on their first spontaneous intuitions. The completion of the test took about 35 minutes.

For any given sentence each subject saw either its A or its B version but never both. From the seven token sentences of a given experimental type half of the subjects were presented with three A and four B versions while the other half saw four A and three B versions. The order of the sentences was randomized for each subject separately. To avoid order effects the seven sentences of each type were equally distributed over the list for each subject.

Results

The data analysis was similar to that adopted by Fodor et al. Subjects' ratings were adjusted for idiosyncratic subject and item variability. To remove the differences in the subjects' use of the rating scale from the comparison of A and B versions of given sentences, item scores were converted into difference scores from each subject's mean rating score across all his S–P and S–C rating judgements. These difference scores provided the raw data for the item-based analysis. For the subject-based analysis subjects' scores were expressed as deviations from each (paired) item's mean rating across all subjects' S–P and S–C judgements. The rating scores were then tested for A–B differences in two types of word pairs: the experimental S–P comparison and the control S–C comparison.

Table 2. *Type 1: Periphrastic (A) vs. corresponding unmarked lexical (B) causatives*

	Analysis type	
	Items ($n = 7$)	Subjects ($n = 24$)
Mean B–A differences for critical word pairs (Subject–Probe)	−.261 $t = -1.403$ (df = 6) $p < .25$	−.040 $t = -1.791$ (df = 23) $p < .10$
Mean B–A differences for control word pairs (Subject–Control)	.108 $t = .962$ (df = 6) $p < .40$	.013 $t = .682$ (df = 23) $p < .60$

As shown in Table 2, contrary to the hypothesis of structural separation, the Subject–Probe comparison does not show less relatedness in the periphrastic "cause" constructions. In fact, the periphrastic construction results in slightly *more* relatedness than the corresponding unmarked lexical causatives.

Table 3. *Type 2: 'Expect' (A) vs. 'persuade' (B) sentences*

	Analysis type	
	Items ($n = 7$)	Subjects ($n = 24$)
Mean B–A differences for critical word pairs (Subject–Probe)	.251 $t = 1.646$ (df = 6) $p < .08$ (1-tailed)	.038 $t = 1.216$ (df = 23) $p < .12$ (1-tailed)
Mean B–A differences for control word pairs (Subject–Control)	.108 $t = .873$ (df = 6) $p < .50$	.016 $t = .665$ (df = 23) $p < .50$

As we can see in Table 3, "persuade" sentences show a tendency for more relatedness in the critical comparison than do "expect" sentences. This basically replicates Fodor et al.'s similar result, though the differences fail to reach significance. This might be due to the smaller number of subjects we used. (Fodor et al. had 60 subjects in this condition.) To ascertain that the two experiments indeed show the same effect we reanalysed the data by dropping from the analysis those rating judgements that deviated more than 2 standard deviations from the subjects' mean rating score on that sentence

type. These extreme scores constituted less than 3% of the ratings. This restriction of the data resulted in a significant difference in both the item-based ($t = 2.54$; $p < .025$; 1-tailed) and the subject-based ($t = 2.32$; $p < .015$; 1-tailed) analysis. To further validate this finding we have also investigated the "expect"/"persuade" contrast using a different relatedness paradigm (forced-choice) which showed a highly significant effect of the distinction (see our Experiment 4a; Table 13).

Table 4. *Type 3: Indefinite (A) vs. definite (B) direct object*

	Analysis type	
	Items ($n = 7$)	Subjects ($n = 24$)
Mean B–A differences for critical word pairs (Subject–Probe)	.308 $t = 2.434$ (df = 6) $p < .03$ (l-tailed)	.120 $t = 2.423$ (df = 23) $p < .01$ (l-tailed)
Mean B–A differences for control word pairs (Subject–Control)	−.025 $t = -.132$ (df = 6) $p < .90$	.008 $t = .164$ (df = 23) $p < .90$

As shown in Table 4, sentences with definite direct objects result in significantly more subject–object relatedness than do sentences with indefinite direct objects.

Table 5. *Type 4: Abstract (A) vs. concrete (B) direct object*

	Analysis type	
	Items ($n = 7$)	Subjects ($n = 24$)
Mean B–A differences for critical word pairs (Subject–Probe)	.430 $t = 1.810$ (df = 6) $p < .06$ (l-tailed)	.458 $t = 4.068$ (df = 23) $p < .0005$ (l-tailed)
Mean B–A differences for control word pairs (Subject–Control)	.037 $t = .160$ (df = 6) $p < .90$	.031 $t = .262$ (df = 23) $p < .80$

Table 5 indicates that sentences with concrete direct objects result in closer subject–object relatedness than those with abstract objects.

Experiment 2 (rank ordering task)

Method

Subjects

The subjects were 11 Columbia undergraduates (8 males and 3 females) who participated in the experiment as partial fulfilment of their course requirement.

Materials

The 12 structurally analogous ("non-shifter") "persuade"-type verbs used can be divided into two main experimental groups according to the relative intensity of "intentional interaction" they express between their subject and object (see p. 225 of the paper). The six "High" intentional interaction verbs were: "make", "get", "convince", "persuade", "coax", and "cajole", and the six "Low" intentional interaction verbs were: "encourage", "advise", "ask", "allow", "let", and "permit". (Within the "Low" group a further subdivision can be made between the three "permissive" verbs ("allow", "let", and "permit") where the intentional state of the object is assumed to be constant (= lowest intentional interaction), and the remaining three "Low" verbs ("encourage", "advise" and "ask") which are non-committal as to the intentional state of the object (= medium intentional interaction).)

All the 12 verbs were embedded in each of five sentence frames which differed as to whether the activity expressed by their embedded clause is typically desirable (two "positive" frames), undesirable (two "negative" frames) or neutral (one "neutral" frame). An example of the "positive" frames is: "John ... Mary to accept the prize-money that she won". An example of the "negative" frames is: "Steve ... Neil to clean the toilet". The "neutral" frame was: "Tom ... Jim to buy a newspaper". We used these different types of sentence frames in order to neutralize the relative contribution of the particular sentence contexts to the CIs of the tested sentences, thereby achieving a relatively unbiased measure of the contribution to CI of the experimental verbs themselves.

Thus we generated 5 sets of 12 sentences each of which was typed on a 3×5 index card. The subject and the object of the tested verbs to be judged for relatedness were underlined.

Procedure

The subjects were asked to rank order the 12 verbs five times (for the five different sentence frames) as to the felt degree of relatedness between the subject and object of the sentences, thereby assigning each of them a value

from 1 (= most related) to 12 (= least related). The order of presentation of the five sentence frame sets was randomized for each subject separately, and so was the order of the 12 sentences in each sentence frame set. The subjects were asked to use their spontaneous intuition when making their judgements.

Results

Each of the 12 verbs were judged five times for relative degree of subject–object relatedness by the 11 subjects. The 11 means of these five judgements were averaged for each of the 12 verbs. These mean rank ordering values for

Table 6. *Individual and group means of the rank ordering for relative degree of subject–object relatedness of 'High' vs. 'Low' intentional interaction verbs*[a]

'High' verbs (n = 6)			'Low' verbs (n = 6)			
Individual means		Group mean (n = 6)	Individual means		Subgroup means (n = 3)	Group mean (n = 6)
Make	: 3.93		Encourage	: 6.53		
Get	: 4.58		Advise	: 7.04	'Other' verbs	
Convince	: 4.70	4.90	Ask	: 7.07	6.88	8.15
Persuade	: 4.91		Allow	: 9.32		
Coax	: 5.53		Let	: 9.44	'Permissive' verbs:	
Cajole	: 5.73		Permit	: 9.52	9.43	

[a](1 = most related; 12 = least related).

Table 7. *Differences between the verb groups in the relative degree of subject–object relatedness*

(i)	'High' (n = 6) vs. 'Low' (n = 6) verbs: −3.25 $t = -5.13$ (df = 10) $p < .0005$	(ii)	'High' (n = 6) vs. 'permissive' 'Low' (n = 3) verbs: −4.53 $t = -11.45$ $p < .0001$
(iii)	'High' (n = 6) vs. Other 'Low' (n = 3) verbs: −1.98 $t = -4.84$ (df = 7) $p < .002$	(iv)	Other 'Low' (n = 3) vs. 'permissive' 'Low' (n = 3) verbs: −2.55 $t = -13.80$ (df = 4) $p < .0002$

the individual verbs are displayed in Table 6. Table 6 also shows the group means for the different verb groups. Table 7 displays the results of the tests comparing the different verb groups for relative degree of subject–object relatedness.

The results clearly support our hypothesis (see p. 225) that the relative intensity of "intentional interaction" between the subject and the object is reflected in the degree of relatedness. Thus, "High" verbs show significantly more subject–object relatedness than do "Low" verbs (Table 7(i)). Furthermore, within the "Low" group, "permissive" verbs, as predicted, result in less relatedness than the other "Low" verbs (Table 7 (iv)). However, the difference between the "High" vs. "Low" groups is not reducible to the low relatedness scores of the "permissive" verbs alone in the "Low" group: "High" verbs are significantly more related than either of the two subgroups of the "Low" verbs (Table 7 (ii) and (iii)). Note that none of these differences can be predicted on the basis of the structural distance assumption, as all the 12 verbs are structurally analogous ("non-shifter") "persuade"-type verbs.

Experiment 3 (ratings task)

Method

Subjects

Experiment 3 was carried out in Hungary using 24 male college students as subjects whose native language was Hungarian.

Materials

We shall provide here a brief description of those aspects of the Hungarian causative formation which are relevant for the present experiment. (For a more detailed discussion of Hungarian causativization see Hetzron, 1976.)

The most important productive causative suffixes in Hungarian are "-it", "-t", "-at/-et", and "-tat/-tet". (There are some other causative suffixes, too, but all with very restricted lexical range. Some suppletive forms also exist.) Historically these forms might have derived from a periphrastic expression containing the verb "make", hence their similarity to the verb root "te-" (= "make", "do") (Baboss, 1938; Hetzron, 1976).

In the experiment all the lexical causatives used were formed with either "-at/-et" or "-tat/-tet", which are the most productive causative formatives in Hungarian. (In both experimental conditions (Type 1 and Type 2 below) half of the lexical causatives tested were formed with "-at/-et", while the other

half were formed with "-tat/-tet".) Both suffixes can apply to transitive as well as to intransitive verbs. In general, "-at/-et" is the productive causative suffix that applies to verbs ending in "consonant + t" and to monosyllabic verbs other than those ending with "vowel + t". It is also regular with bisyllabic durative expressive verbs. "-tat/-tet" is the most frequent causative formative in Hungarian. It applies in most of the cases not covered by "-it", "-t", or "-at/-et".

Subjects were presented with a total of 40 sentences. There were two experimental types each with 10 sentence tokens. Both experimental types contained syntactically identical constructions formed with lexical causatives. However, the directness of the causative event expressed by the verbs was varied as a function of their sentence context: in Type 1 (A) sentences the context invited a direct causative interpretation, while in Type 2 (A) sentences the context specified an indirect interpretation (cf. p. 231). The experimental sentences were contrasted for relative subject–object relatedness with

Table 8.

Type 1: Hungarian 'direct' lexical causatives (suffix: '-at/-et' or '-tat/-tet') (A) vs. non-causative transitive verbs (B)

S V P C
(A) A részeg teljes erővel döngette az ajtót, de a házból senki se jött ki.
S V P
The drunken man was banging the door with all his force, but nobody came out of the
C
house.

S V P C
(B) A részeg teljes erővel rugdosta az ajtót, de a házból senki se jött ki.
S V P
The drunken man was kicking the door with all his force, but nobody came out of the
C
house.

Type 2: Hungarian 'indirect' lexical causatives (suffix: '-at/-et' or '-tat/-tet') (A) vs. non-causative transitive verbs (B)

C S V P
(A) Hiába volt ez az utolsó tanítási nap, a dühös magyar tanár egész órán át íratta a diákokat.
C S P V
Though it was the last day of classes, the angry Hungarian teacher made the students write for the whole hour.

C S V P
(B) Hiába volt ez az utolsó tanítási nap, a dühös magyar tanár egész órán át verte a diákokat.
C S V P
Though it was the last day of classes, the angry Hungarian teacher was beating the students for the whole hour.

control sentences (B) that were identical except for including non-causative physical-contact verbs in place of the tested causatives.

The remaining 20 sentences were two-clause filler constructions whose length was similar to that of the experimental sentences. They, however, did not involve the experimentally contrasted meaning dimension (i.e., direct vs. indirect causation). They were randomly intermixed with the experimental sentences throughout the stimulus list to prevent subjects from building up specific expectations about the character of the experimental sentence types.

Procedure

The experimental procedure was identical to that of Experiment 1. For each experimental sentence a given subject saw either an A or a B version, never both. Each subject received equal number of A and B versions of the experimental sentences. Sentences from both experimental types were equally distributed throughout the list to avoid order effects.The order of presentation of the sentences was randomized individually for each subject.

Results

The method of data analysis was identical to that for Experiment 1.

Table 9. *Type 1: Hungarian 'direct' lexical causatives (A) vs. non-causative transitive verbs (B)*

	Analysis type	
	Items ($n = 10$)	Subjects ($n = 24$)
Mean B–A differences for critical word pairs (Subject–Probe)	$-.19$ $t = -2.54$ (df = 9) $p < .02$ (1-tailed)	$-.06$ $t = -1.73$ (df = 23) $p < .05$ (1-tailed)
Mean B–A differences for control word pairs (Subject–Control)	$-.04$ $t = -.23$ (df = 9) $p < .90$	$-.04$ $t = -.63$ (df = 23) $p < .60$

Table 9 shows that Hungarian lexical causatives expressing *direct* causation (A) result in significantly more relatedness in the critical (subject-object) comparison than do non-causative transitive control verbs (B).

Table 10. *Type 2: Hungarian 'indirect' lexical causatives (A) vs. non-causative transitive verbs (B)*

	Analysis type	
	Items (n = 10)	Subjects (n = 24)
Mean B–A differences for critical word pairs (Subject–Probe)	.21 t = 2.00 (df = 9) p < .04 (1-tailed)	.17 t = 1.57 (df = 23) p < .07 (1-tailed)
Mean B–A differences for control word pairs (Subject–Control)	.12 t = .67 (df = 9) p < .60	.12 t = .96 (df = 23) p < .40

The results in Table 10 show that Hungarian lexical causatives expressing *indirect* causation result in a smaller degree of relatedness in the critical (subject–object) comparison than their non-causative transitive control verbs.

Experiment 4a (forced-choice task)

Apart from their isolated-sentence ratings task, Fodor et al. also presented contrasting structures simultaneously and asked subjects for forced-choice judgements on *relative* relatedness. Several of their results were statistically stronger with this technique. Accordingly, we undertook several forced-choice studies, both to further examine the effects on relatedness judgements, and better to understand the nature of the forced-choice relatedness-judgement paradigm.

Method

Subjects

The subjects were 32 Columbia and Barnard undergraduates (13 females and 19 males) drawn from the same pool as Experiments 1–3.

Materials

The materials were selected from Experiments 1–3 as well as introducing some new contrasts. There were eight sentence pairs of each kind. Table 11 shows some of the tested contrasts.

Table 11.

Type 1: 'Persuade' (B) vs. 'expect' (A) sentences.
C S P
(A) During the stormy Atlantic crossing the captain expected the passengers to be frightened.
C S P
(B) During the stormy Atlantic crossing the captain persuaded the passengers to remain calm.
Type 2: Physical-contact transitives (B) vs. no-contact perception verbs (A)
S P
(A) The policeman observed the demonstrator who was standing in front of the administration C building.
S P
(B) The policeman kicked the demonstrator who was standing in front of the administration C building.
Type 3: Unmarked lexical causatives (B) vs. no-contact perception verbs (A).
S P C
(A) The maid inspected the room before the guests used it.
S P C
(B) The maid cleaned the room before the guests used it.
Type 4: Marked lexical causatives (B) vs. no-contact perception verbs (A).
S P C
(A) The electrician saw the wire when he was trying to fix the light.
S P C
(B) The electrician shortened the wire when he was trying to fix the light.
Type 5: Periphrastic 'cause' sentences (A) vs. corresponding lexical causatives (B).
C S P
(A) Sitting in his high chair the baby caused the juice in his cup to spill.
C S P
(B) Sitting in his high chair the baby spilled the juice in his cup.

Sixteen of the 32 subjects were also presented with eight additional sentence pairs belonging to a further experimental sentence type in which periphrastic 'cause' constructions expressing direct causation (B) were contrasted with similar sentences expressing indirect causation (A), as exemplified in Table 12.

Table 12.

Type 6: Periphrastic 'cause' sentences expressing direct (B) vs. indirect (A) causation.

S P

(A) Floyd caused the glass to drop by tickling Mary who was holding it.

S P

(B) Floyd caused the glass to drop by suddenly letting go of it.

Procedure

This experiment was a slightly modified version of Fodor et al.'s "Forced-choice" task. Unlike in the isolated-sentence ratings task, subjects were presented with both versions of a given minimal pair at the same time. The two sentences were printed on the same page marked 'A' or 'B', respectively. Subjects had to choose which of the two sentences indicated a closer relation between the two underlined test words in them. (These were always the same in both of the sentences in a given pair.) A particular sentence pair was presented to a given subject only once, and in one of two forms: either (a) with the critical word pair (S–P), or (b) with the control word pair (S–C) underlined. Thus, for any given sentence type a subject judged four experimental and four control token pairs. In this way, each sentence pair was judged by 16 subjects for experimental and by another 16 subjects for control word pair relatedness.

The order of the sentence pairs was randomized for each subject separately. The eight token pairs of each experimental type were equally distributed over the lists to avoid order effects. In any given sentence pair both sentences were presented equally often as first or as second to avoid biasing effects of idiosyncratic preferences of presentation order.

Results

The data analysis was similar to that of Fodor et al.'s "Forced-choice" task. The scores used for the item analysis were differences in the frequency with which the A and B versions of a given sentence pair were chosen. For the subject analysis, the scores used were the differences in the frequency with which A and B versions were chosen, summing across the different sentences for which a given structural choice was presented to a subject.

Table 13 shows that "persuade"-type sentences are chosen significantly more often as showing more subject–object-relatedness than are "expect"-type sentences.

Table 14 shows that physical-contact verbs were chosen significantly more often as exhibiting more subject–object relatedness than no-contact transitives.

Table 13. *Type 1: 'Expect' (A) vs. 'persuade' (B) sentences*

	Analysis type	
	Items ($n = 8$)	Subjects ($n = 32$)
Forced choice mean B–A differences for critical word pairs (Subject–Probe)	8.25 $t = 5.74$ (df = 7) $p < .001$	2.06 $t = 7.88$ (df = 31) $p < .001$
Forced choice mean B–A differences for control word pairs (Subject–Control)	4.00 $t = 1.58$ (df = 7) $p < .20$	1.00 $t = 4.21$ (df = 31) $p < .001$

Table 14. *Type 2: No-contact transitive verbs (A) vs. physical-contact transitives (B)*

	Analysis type	
	Items ($n = 8$)	Subjects ($n = 32$)
Forced choice mean B–A differences for critical word pairs (Subject–Probe)	5.25 $t = 2.58$ (df = 7) $p < .05$	1.25 $t = 3.40$ (df = 31) $p < .02$
Forced choice mean B–A differences for control word pairs (Subject–Control)	3.25 $t = 2.49$ (df = 7) $p < .05$	1.13 $t = 2.56$ (df = 31) $p < .02$

Table 15. *Type 3: Unmarked lexical causatives (B) vs. no-contact transitives (A)*

	Analysis type	
	Items ($n = 8$)	Subjects ($n = 32$)
Forced choice mean B–A differences for critical word pairs (Subject–Probe)	6.75 $t = 2.83$ (df = 7) $p < .05$	1.69 $t = 5.00$ (df = 31) $p < .001$
Forced choice mean B–A differences for control word pairs (Subject–Control)	4.00 $t = 1.84$ (df = 7) $p < .20$	1.00 $t = 2.55$ (df = 31) $p < .02$

As Table 15 shows, unmarked lexical causatives are chosen, as showing more subject–object relatedness, significantly more often than no-contact perception verbs.

Table 16. *Type 4: Marked lexical causatives (B) vs. no-contact transitive verbs (A)*

	Analysis type	
	Items (n = 8)	Subjects (n = 32)
Forced choice mean B–A differences for critical word pairs (Subject–Probe)	8.50 t = 10.32 (df = 7) $p < .001$	2.25 t = 6.12 (df = 31) $p < .001$
Forced choice mean B–A differences for control word pairs (Subject–Control)	11.00 t = 6.35 (df = 7) $p < .001$	2.75 t = 9.81 (df = 31) $p < .001$

Table 16 shows that marked lexical causatives result in significantly more subject–object relatedness in a forced-choice task than do no-contact transitives. (Note that in their isolated-sentence ratings task Fodor et al. also found a nearly significant difference in the same direction: marked lexical causatives resulting in more subject—object relatedness than non-causative controls. For a replication of that finding see Experiment 5, and for a discussion of its implications see pp. 233.)

Table 17. *Type 5: Periphrastic 'cause' constructions (A) vs. corresponding lexical causatives (B)*

	Analysis type	
	Items (n = 8)	Subjects (n = 32)
Forced choice mean B–A differences for critical word pairs (Subject–Probe)	11.00 t = 5.50 (df = 7) $p < .001$	2.75 t = 8.93 (df = 31) $p < .001$
Forced choice mean B–A differences for control word pairs (Subject–Control)	10.50 t = 5.96 (df = 7) $p < .001$	2.63 t = 9.52 (df = 31) $p < .001$

Table 17 demonstrates that lexical causatives are chosen more often as showing more causer–causee relatedness in a forced-choice task than are the corresponding periphrastic sentences.

Table 18. *Type 6: Periphrastic 'cause' sentences expressing direct (B) vs. indirect (A) causation*

	Analysis type	
	Items ($n = 8$)	Subjects ($n = 16$)
Forced choice mean B–A differences for critical word pairs (Subject–Probe)	13.00 $t = 10.37$ (df = 7) $p < .001$	6.50 $t = 9.04$ (df = 15) $p < .001$

As shown in Table 18 periphrastic "cause" sentences expressing direct causation are chosen as showing greater causer-causee relatedness significantly more frequently than are the corresponding periphrastic constructions expressing indirect causation. (Control word pairs were not tested in this condition.)

In sum, the results of Experiment 4a show that any verb which involves a physical interaction between the subject and object produces closer reported relatedness between them than a no-contact perception verb. In addition, this study replicates the "persuade"/"expect" difference with greater statistical reliability than the isolated-sentence study. It also shows that when in periphrastic sentences the causative relation is described as physically direct, the reported relatedness judgements are also stronger, than when the relation is described as indirect. Finally, unlike Experiment 1, this study brings out a relatedness difference that prima facie favors Fodor et al.: lexical causatives yield closer subject–object relatedness than do the corresponding periphrastic causatives.

Experiment 4b (the effect of sequence length)

All the materials contrasted in these studies involve paired sentences of identical length, except the lexical causative/periphrastic distinction. Therefore, it is important to know what the effects of length alone are on relatedness judgements. To isolate this, we asked subjects to rate the relatedness of nouns, embedded in word strings they could not recognize.

Method

Subjects

The subjects were the same as in Experiment 4a.

Materials

The materials placed English nouns in a variety of nonsensical contexts designed to mimic the serial position features of lexical causatives and periphrastics in one case (i) but not in the other (ii) (lower case letters stand for non-English words, 'N' for proper names).

(i) N a N vs. N b N c d
(ii) N a N vs. c d N b N

Procedure

Subjects were asked to perform a similar task to that they had just performed in 4a, except this time they would not fully understand the sentences. They were asked to do the best they could at judging the relatedness of the underlined words as though they were speakers of the language.

Results

The results are shown in Table 19. Basically, they demonstrate that longer sequences occasion lower relatedness judgements by the subjects, even when the distance between the critical nouns does not itself differ.

Table 19. *Long (A) vs. short (B) nonsense strings*

(i)	(A) N b N c d	Proportion of subjects choosing (B) as more related:	.875
	(B) N a N		
		Sign test:	$z = 4.24$
			$p < .001$
(ii)	(A) c d N b N	Proportion of subjects choosing (B) as more related:	.72
	(B) N a N	Sign test:	$z = 2.48$
			$p < .02$

Experiment 5 (ratings task)

This experiment is a repetition of Fodor et al.'s marked lexical causatives vs. non-causative transitives condition (Fodor et al., 1980; Set 5B) using only no-contact perception verbs as our transitive controls (see p. 233).

Method

Subjects

Twenty Columbia undergraduates (8 females and 12 males) served as subjects, all of whom participated in the experiment as part of their course requirement.

Materials

Subjects were presented with a total of 32 sentences. The tested experimental sentence type contributed 8 (4A and 4B) sentences to a given subject's list. The remaining 24 sentences were filler sentences. They were similar in length to the experimental sentences, however, they belonged to different structural types and did not involve the same meaning contrasts. The test sentences were randomly intermixed with the fillers throughout the stimulus list. The experimental contrast involved marked lexical causatives (B) vs. no-contact perception verbs (A) as exemplified below:

S V P C
(A) The electrician saw the wire when he was trying to fix the light.

S V P C
(B) The electrician shortened the wire when he was trying to fix the light.

Procedure

The experimental procedure was identical to that of Experiment 1. From the eight token sentences of the tested contrast each subject saw 4A and 4B versions. In this way, each (A or B) version of a given minimal pair was seen by 10 subjects. The experimental sentences were equally distributed over the stimulus list, and their order of presentation was randomized separately for each subject.

Results

The method of data analysis was identical to that of Experiment 1.

As Table 20 shows, marked lexical causatives result in significantly more subject–object relatedness than do no-contact transitives.

Discussion

Though due to the relatively small number of subjects and items used some of our results only approach conventional levels of significance, nevertheless, the following conclusions seem to be clearly supported by the data.

Table 20. *Marked lexical causatives (B) vs. no-contact transitives (A)*

	Analysis type	
	Items ($n = 8$)	Subjects ($n = 20$)
Mean B–A differences for critical word pairs (Subject–Probe)	.30 $t = 2.93$ (df = 7) $p < .02$ (1-tailed)	.31 $t = 1.88$ (df = 19) $p < .05$ (1-tailed)
Mean B–A differences for control word pairs (Subject–Control)	.16 $t = .89$ (df = 7) $p < .90$	.11 $t = .67$ (df = 19) $p < .60$

First of all, the result of our "periphrastic/lexical" condition (Table 2) clearly contradicts the structural distance assumption made by both Levelt (1970; 1974) and Fodor et al. (1980). Here, while meaning was held constant, the two constructions clearly differed as to the structural distance of the critical NPs in *both* their surface and deep structure syntactic representations. Still, there was no corresponding difference in relatedness. In fact, the periphrastic sentences showed a slight tendency for more relatedness in the direction opposite to that predicted on the basis of the structural distance assumption.

The finding is, however, consistent with our alternative hypothesis according to which the level of representation over which relatedness judgements are generated is that of the *conceptual interpretation* (CI) of sentences rather than their surface or underlying linguistic structure. We have argued that at this level of representation lexical and periphrastic causatives receive similar canonical CIs in the isolated-sentence relatedness task (see p. 230). The slight tendency for stronger relatedness in the case of the periphrastic "cause" constructions can be attributed to the effect of explicit surface marking of the causative relation, which was shown to increase relatedness in other tasks, too (see p. 233).

The other experimental results provide positive evidence for our alternative hypothesis. In all of these cases the constructions compared for relatedness were syntactically analogous. Therefore, the demonstrated effects on relatedness cannot be predicted on the basis of differences in the structural separation of words at the different levels of syntactic representation. Furthermore, the aspects of CI which were shown to affect relatedness (i.e., "definiteness" (Table 4) and "concreteness" (Table 5) of the denoted entities, the intensity of their "intentional interaction" (Table 7) and "directness" vs. "indirectness" of causation (Table 9, Table 10, and Table 18)) cannot be

plausibly interpreted as corresponding to differences in the structural separation of elements at the level of semantic structure either.

Finally, a word is in order about the results of the forced-choice study. The first point is that it brings out a difference among transitive verbs, that have identical syntactic structure on anybody's theory: physical-contact transitives ("hit") vs. no-contact perception verbs ("see") (Table 14). This difference is entirely consistent with the hypothesis that the subjects access the CI of the sentences for relatedness judgements. The corresponding results for lexical causatives (morphologically marked or unmarked, see Tables 15 and 16) further support the CI hypothesis: in these cases, Fodor et al. would again predict no difference (or, at most, a difference in the *opposite* direction for morphologically marked causatives, if these are considered compositional). Finally, the effect of context-differentiated direct vs. indirect causation in syntactically identical periphrastic constructions also supports the CI hypothesis (Table 18).

The forced-choice paradigm also brings out an effect of the lexical causative/periphrastic distinction, suggesting less relatedness between nouns in the periphrastic construction (Table 17). This would (at last) seem to lend support to Fodor et al.: indeed, it does, so far as just these data are concerned.

However, this finding must be considered in the context of all the other evidence showing the true nature of the relatedness task. For example, the other, structurally identical, forced-choice pairs, such as the physical-contact vs. perception verbs, or the periphrastic constructions expressing direct vs. indirect causation, also showed similar relatedness differences. This fact forces us to consider other sources for the forced-choice lexical causative/periphrastic effect than the difference in structural distance. In particular, it can be argued that the forced-choice task, in which the sentences are contrasted *directly* for relative relatedness, induces subjects to construct highly differentiating CIs for the lexical vs. the periphrastic versions. This makes it likely that the periphrastic version will receive a marked, indirect causative interpretation, and, as a result, will be judged less related (see p. 235).

A further factor that might have contributed to the difference has to do with the contrast between the two alternative causative constructions in terms of their relative length. Previous studies have already demonstrated that nonstructural surface variables, such as sequence length, influence subjective relatedness (see e.g., Martin, 1970). This is further supported by our nonsense-sequence study (Table 19) in which we isolated the effect of relative length: we found that nouns, whose serial distance is constant, are judged less related when the material surrounding them is longer (see p. 235).

The fact that our comparisons seem to show the effects of CI on relatedness calls into doubt the main assumption made both by Levelt and by Fodor et

al., that relatedness intuitions reflect syntactic constituent structure. In fact, on the basis of our results it seems possible that relatedness intuitions reveal syntactic structure only insofar as the latter reflects CI. In what follows we shall argue that this interpretation is also consistent with the results of the original studies on subjective word relatedness.

One clear difference between the CI hypothesis and the syntactic structure hypothesis concerns their predictions about the subjective phrase structure of an SVO sequence based on relatedness judgements. Syntactic phrase structure unequivocally prescribes an S(VO) grouping. From the point of view of CI, however, a transitive verb can be seen equally as expressing the activity of its subject or as expressing the action affecting its object. This leaves indeterminate whether relatedness judgements over an SVO sequence would show an SV(O) or an S(VO) subjective constituency. As it turns out, the subjective phrase structures in Levelt's data show both the SV(O) and the S(VO) groupings thereby supporting the CI hypothesis over the syntactic structure hypothesis.

Other studies using closely related methods to elicite subjective phrase structures emphasize the same point. Martin (1970) (replicated by Bond & Gray, 1973) using a word sorting technique found that subjects intuitively grouped SVO sequences into SV(O) or S(VO) constituents as a function of the relative length of the subject phrase and the object phrase. Similar results were obtained when subjects grouped the words of sentences into phonological phrases (Martin, Kolodziej, & Genay, 1971). These results demonstrate that, apart from aspects of CI, surface variables such as relative length and phonological contour also have an effect on subjective relatedness.

These findings suggest a mechanism whereby words adjacent to a noun... noun contrast might reduce the perceived relatedness between the nouns. If words are grouped together in part as a function of length (as the preceding results suggest), then a noun with adjacent words will tend to some extent to be perceived as grouped with those words, and therefore will have a correspondingly weaker attachment to the other noun. One might expect this effect to be relatively weak—in fact, only to appear when the shorter or longer environments are explicitly contrasted in constructions that otherwise have similar meaning (or nonsensical, as in our experiment on the effect of sequence length). Of course, this is just the kind of contrast presented in the forced-choice study of lexical causatives vs. corresponding periphrastic constructions.

A further fact that speaks against the syntactic structure hypothesis is the finding that subjective phrase structures often fail to exhibit within-clause hierarchical organization. Martin (1970) found " ... considerable variability in the internal organization of the relative clause (Prn V Adv), including

where Prn, V and Adv enter into three-way tie, thereby yielding a trinary structure".

Levelt (1970) also claimed that relatedness intuitions are sensitive to syntactic deep structure. However, the cited evidence can again be plausibly explained in terms of the CI hypothesis. He found that sentences with lexical "gaps" generate relatedness judgements similar to those of the corresponding sentences without the gaps. For example, the hierarchical best fit for the two sentences below

(a) John eats apples and Peter pears.
(b) John eats apples and Peter eats pears.

is the same if one assumes a covert "eats" between "Peter" and "pears" in (a). Levelt argued that this demonstrated the psychological reality of the underlying syntactic structure of sentences. One could, however, argue as easily that it demonstrates the relevance of the underlying conceptual relations in the CI of the sentence even when they are not directly reflected in surface structure constituency.

We leave open the question whether syntactic structure alone can ever affect relatedness intuitions. We have tested this specifically in our isolated-sentence task by contrasting corresponding periphrastic and lexical causative cases, in which the meaning is held constant while clearly changing the structural closeness of the critical nouns. The fact that we found no corresponding difference in relatedness is complemented by the fact that when we hold syntax constant but vary aspects of CI, there are relatedness differences. Furthermore, for all the effects of structural separation on relatedness reported by Fodor et al. it was possible to provide an alternative explanation in terms of systematic differences in CI which correlated with the structural factors tested (see pp. 222–226 of the paper). Whether there exist purely syntactic effects on relatedness intuitions at all is, however, a question that should be answered by further investigations. As Levelt put it, " ... more has to be known about the 'face validity' of this scaling instrument".

At any rate, our results certainly show that relatedness intuitions cannot be uncritically relied on as structural evidence. The use of the technique to "discover" psychologically real phrase structures (or its application in aphasia studies to measure grammatical ability) seems, therefore, as unwarranted as its use to disconfirm compositional semantic theories.

Appendix 2: The overextension of correct lexical causative verbs to encode periphrastic meanings in Stage 2. (Bowerman, 1982a, Table 2; p.c.)

Christy:

(1) (3;1) How come it works better to *slip me down* if I have on long pants?
(After going down slide in long pants. Earlier, she'd tried in shorts and her skin stuck; M had said she needed long pants.)

(2) (3;4) M: Your point's gone away.
C: The water doesn't *stand it up*. (While M is rinsing C's hair. Just before, M had made an erect point of C's soapy hair, now the water has washed the point out. Implicit seems to be the notion that the soap *does* "stand it up".)

(3) (3;10) She's growing. She's *growing* her feet. Her feet are growing.
(C, re: E's feet, after discussion of how some of C's old shoes are still too big for E.)

(4) (3;8) You *put* me forward. You *put* me forward a little bit.
(C in carseat; car jerked a little as M was starting it. = made me go forward.)

(5) (3;9) Yeah, but it'll only *take* her that much high. (= make her go that high. *send, *put, etc. C arguing for getting on spring horse with E, who is bouncing. She wants to bounce higher.)

(6) (4;0) The machine might *put* him away. (= make him go away. C watching "Captain Kangaroo". Story about a magic machine that caused Captain Kangaroo to disappear for a while; she's now suggesting same thing may happen to Mr. Greenjeans.)

(7) (5;2) I can stand on that so I won't slip. It *slips* me. (C trying to balance on wooden edge of her bed, keeps slipping off.)

(8) (5;4) But while they were doing it, they *dropped* it. They were too heavy.
(Re: bird feeder that has fallen. "doing it" = eating. = made it drop (fall).)

(9) (5;8) It's not worse. But the airplane's *keeping* it.
(Re: stomach ache C had before boarding plane. Now, as we fly, the plane (ride) is making stomach ache continue.)

Eva:

(10) (2;1) Christy *drop* a boy out my bucket.
(After C accidentally kicks over E's pumpkin bucket and one of her "boys" (peg dolls) spills out.)

(11) (3;4) What *takes it out?*
(E after pulling at key in door, can't get it out. = make it come out.)

(12) (4;2) I got it in another hole and *took it out.*
(Playing with little ball-in-hole game. "took" = made it come out/got it out; as no direct contact with hands is involved.)

(13) (4;6) Keep doing it the way that *takes it down.*
(To M, after other instructions to effect that later in day she wants M to twist spiral on a book so that it goes back down to proper location (after it has been twisted up so it sticks out on top). = keep twisting it until it goes down (makes it go down).)

Jamie:

(14) (5;0) It *brings* your wishes true.
(= makes your wishes come true. After M has asked him what his magic pebble does.)

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Résumé

Plusieurs lignes d'investigation réfutent les fondements empiriques de la position selon laquelle les expériences sur la perception subjective des relations entre des mots (*relatedness judgments*) démontrent la non-réalité psychologique des représentations sémantiques décompositionnelles des verbes causatifs. Avec trois techniques différentes, nous démontrons que les relations subjectivement perçues entre des mots ne dépendent pas de leur distance structurale à différents niveaux de représentation linguistique. Donc, ces intuitions ne permettent pas de tester la complexité structurale relative des représentations syntaxiques ou sémantiques sous-jacentes. Par contre, les jugements de relation entre des noms dans des phrases structuralement identiques sont visiblement sensibles à des aspects de leur *interprétation conceptuelle*, comme par exemple le caractère "défini" ou "concret" des entités dénotées, l'intensité de leur "interaction intentionnelle", ou le caractère "direct" de la séquence causale exprimée.

Le sens des verbes causatifs ne peut pas être expliqué en termes d'un concept prototypique de cause directe. La théorie prototypique fait des prédictions fausses sur l'emploi référentiel des verbes causatifs par les adultes. Elle ne permet pas d'expliquer non plus les données sur l'acquisition des verbes causatifs, qui montrent l'existence d'une étape de généralisation causative globale au cours de laquelle l'utilisation de causatifs existants aussi bien que nouveaux est généralisée à des évènements causatifs aussi bien prototypiques que non-prototypiques.

Nous proposons que les verbes causatifs possèdent une représentation lexicale à deux niveaux qui consiste en (i) une représentation sémantique décompositionnelle (mais non-définitionnelle) qui rend explicite leur statut causatif, et (ii) un stéréotype conceptuel dépendant du contexte qui spécifie leur domaine d'application comme une fonction de leur contexte d'usage. La structure sémantique décomposable apparaît comme une étape de développement au cours de l'acquisition des concepts lexicaux en tant que conséquence de la réorganisation linguistique du lexique. Le stéréotype conceptuel est un ajout plus tardif, qui fait partie de la représentation disponible dans le lexique mental des adultes.