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SOME PSYCHOLOGICAL IMPLICATIONS OF THE VERBS OF MOTION*

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The present study centers on the verbs of motion, which are a particularly appropriate subset of lexicalized concepts to begin the exploration of how the human mind operates. The semantic field of verbs of motion is briefly analyzed, and results of sorting tasks are reported to specify the organizing concepts of the field. Direction and causality are shown to be two of the most important, and are used to illustrate what is involved in semantic decomposition. In the second half, the paper focuses on the relation between perception and language by examining the perceptual bases of these semantic distinctions. Results of various RT experiments are reviewed, from which it is concluded that there is no experimental support for the idea that the more complicated the semantic decomposition of a verb is, the longer it will take to use it or understand it. This should lead psycholinguists to pay further attention to the problem of how to combine a structural description of the lexicon with a functional description of language comprehension.

Psychological interest in language is based on the assumption that we can learn from it something important about the mind. Human beings are most unusual among the higher mammals in having evolved this elaborate symbolic system for externalizing and communicating the contents of mental life. Thus, language offers a remarkable opportunity to study most directly many cognitive processes that are covert and must be inferred from the nonlinguistic behavior of other intelligent animals. If we are to take advantage of this opportunity, we must study human speech and language in as much detail as possible. However, our psychological interest is not so much in language *per se* as in the conceptual and intellectual capacities that language reveals.

Because this is an enormously large and difficult field of study, it is useful to divide it up at the outset and to choose some more limited aspect to pursue in detail. One way to do this is to distinguish between the conceptual relations that language can express and the purposes that can be served by expressing them. Both aspects are psychologically important, of course, but we cannot study everything at the same time. Therefore, I have chosen to concentrate here on the conceptual relations that language can express, and to set aside tem-

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porarily those fascinating psychological questions of why we bother to express them.

Even this limitation does not narrow my topic far enough. I have no wish to underestimate the bewildering variety of concepts that the human mind can generate, and no hope of finding a system of classification adequate to deal with all of them. Another assumption will limit my topic still further: I will assume that lexicalized concepts – those concepts sufficiently important to achieve the degree of social endorsement represented by incorporation into the lexicon of everyday speech – represent a subset of all the possible concepts, a subset that is particularly appropriate for psychological study. The degree of general acceptance that is required for lexical incorporation is unlikely for concepts that do not reflect basic aspects of the human mind; the analysis of lexicalized concepts should be pursued systematically as a central part of our attempts to understand the human mind.

But my topic is still too broad. Anyone who has seriously contemplated the amount of information that is represented by a dictionary will surely agree that there is an enormous variety of lexical concepts in every language. Therefore, I must make still another assumption in order to limit my topic: I will assume that verbs are more important than nouns. That is to say, I assume that what makes language a special mode of communication, and more than just a system for assigning labels to things, is the capacity it gives us for predication. It is the verb that completes the formation of the sentence, which is the grammatical purpose of language; it is the verb that enables us to express concepts that are not mere automatic reflexes, but are propositions that can be judged true or false. To say “boy” when one sees a boy could be merely a conditioned reflex, but to say “That is a boy” when one sees a boy is to use predication in order to express a judgment that others can evaluate for themselves.

Even the variety of verbal concepts is too great, however. My final assumption, therefore, is that the verbs of motion are not only the most prototypical verbs of all, but that they are probably the easiest for psychologists to study because they express concepts having a strongly perceptual basis. It is no accident that verbs of motion are among the first words that children learn to use. I assume, therefore, that we should start our psychological studies of verbal concepts in the same place children start theirs.

Perhaps I should apologize for taking so long to get to the subject I want to discuss. The time required will not have been wasted, however, if it has suggested the larger context in which I view my subject. My underlying interest is to discover from the study of language how the human mind operates, and, for reasons now given, I view the verbs of motion as a particularly appropriate place to begin such an exploration.

The first question should be: What are the verbs of motion? They are all those verbs that describe how a person or thing at one location at one time changes to another location at a later time. In English

I have been able to identify about 200 such verbs that seem to be closely enough related to form what might be called a semantic field (Miller, 1972). This term, "semantic field", has been used by various authors with a regrettable lack of precision, but I assume that it is a meaningful idea, and adequate for the purpose of initiating lexical explorations. I will follow the lead of Trier, who proposes that a semantic field consists of two parts: a conceptual field of related concepts, and a lexical field onto which those concepts are mapped like a mosaic. In the case of the verbs of motion, the lexical field of English includes such verbs as *move, come, go, travel, walk, run, raise, lower, open, close, leave, bring, turn*. The first goal is to characterize the conceptual field that these words can express, and the concept of change-of-location-through-time provides a first step toward that goal.

Although this definition implies that change-of-location-through-time should be a primitive concept, at least for the purposes of analyzing verbs of motion, the semantic field of verbs of motion can be considered to be a subfield of what we might call the verbs of location. English has the verbs *contain, hold, remain, stay, sit*, and so on, which predicate immobility, the absence of motion. If I wished to describe this larger semantic field, I would consider location as a primitive concept, in which case the concept of change-of-location-through-time would have to be broken up into change, location, and time, which would be regarded as separate primitives. Then I could distinguish verbs of four kinds: no motion, beginning of motion, ending of motion, and continuation of motion. I will consider only the last three of these four types, rather than all four; in French, of course, the so-called verbs-of-no-motion are expressed by *être* plus a prepositional phrase, so this conceptual field does not seem to have a corresponding lexical field. But the point I would make is a more general one. When we undertake to analyze lexical concepts, we face puzzling questions about the nature of the conceptual atoms into which we are trying to decompose them. How far should the decomposition be carried? How do we determine that a concept cannot (or should not) be further analyzed? I will not try to impose my own answers on you, but this question should always be kept in mind.

If you will grant that the concept change-of-location-through-time – or the concept of motion, as I will call it hereafter – is expressed by many different verbs, then presumably you will grant that this is an example of the kind of concepts that are revealed by lexical analysis. Obviously, motion must be an important concept for organisms that have evolved as mankind has evolved; motility is an important aspect of our life and experience. Moreover, its importance is reflected linguistically in the number of different verbs that express it in one way or another.

By way of contrast, we might consider another concept that can be discovered in the verbs of motion: the concept of propelling oneself forward without losing contact with the ground. I take this to be the concept that distinguishes between walking and running. English has

a variety of walking verbs (*walk, stroll, promenade, march, stagger, tramp*, and so on) as well as a variety of running verbs (*run, sprint, jog, trot, scamper*, and so on). It is commonly assumed that walking verbs all imply that contact is maintained with the ground, and running verbs all imply that both feet come off the ground at some point during the stride. Since a variety of verbs express this concept, it must also be important to organisms like ourselves. But I would argue that it is less important than the more general concept of motion, which can be expressed by a far wider variety of verbs.

By such arguments, therefore, we can hope to construct some rough hierarchy of the importance or generality of the concepts that are incorporated in the lexicon. Given the psychological purposes of our inquiry, I feel it is appropriate for us to concentrate on the most important concepts, and to leave the more refined distinctions for later consideration. That is to say, we should be less interested in drawing the precise distinction between two near-synonyms than in capturing the conceptual similarities that have the widest lexical scope – especially when the precise distinction between near-synonyms is some concept (like *feet-always-touching-ground*) that is distinctive nowhere else in the lexicon. This is a methodological proposal that, elsewhere, I have called the method of incomplete definitions. Since we are psychologists, not lexicologists, we can be content to note the the broadest generalities that give structure to the lexicon, and to leave a considerable residuum of the meanings of individual words unanalyzed.

One important concept incorporated in many motion verbs is direction. For example, English has verbs like *rise* and *ascend* that denote upward motion, and other verbs like *drop, fall, sink*, and *descend* that denote downward motion. Similarly, *leave, flee*, and *depart* denote motion away, *exit* and *emerge* denote motion outward, *progress* and *advance* denote motion forward, and so on. I assume, therefore, that direction is a concept that is incorporated in the lexicon. Unlike the concept that distinguishes *walk* and *run*, however, the concept of direction has relatively broad lexical scope; it is expressed not only by the verbs of motion but also by the directional adverbs *up, down, away, out, forward*, and so on, and elsewhere in the lexicon. We can, therefore, partition the motion verbs into two classes: those that incorporate some specific directional meaning and those that do not.

I have used a sorting task to show that native speakers of English are sensitive to this directional component of motion verbs (Miller, 1972). I gave subjects a set of 18 cards; on each card was printed a particular motion verb: *approach, assemble, collect, descend, drop, eject, exit, fall, gather, leave, lower, pivot, rotate, sink, spin, turn, visit*, or *withdraw*. The subjects were asked to sort the cards into piles on the basis of similarity of meaning. I did not specify how many piles or how many cards per pile they should use, but I assumed that whenever they put two verbs in the same pile it reflected a judgment

that they were similar in meaning in some way. I then tabulated, for every pair of verbs, how many people put that pair in the same pile. If you are willing to assume that the number of people who will put two words together is a measure of the semantic similarity of those words for native speakers of English, then you can look for groupings of words that go together frequently and try to find the subjects' intuitive basis for that grouping.

It is possible to apply various kinds of multidimensional scaling procedures to such a data matrix. The five strongest clusterings occurred among verbs that can be paraphrased as *travel to*, *travel together*, *travel around*, *travel down*, and *travel out*, indicating that direction is one of the major concepts we use to differentiate among motion verbs. Direction, however, is but one of several components that we use to characterize the path of motion; others involve such things as the origin and destination of the motion, intermediate locations, and the medium traveled through. This lexical elaboration seems to fit well with the fact that the path is one of the most obvious perceptual features of a moving object.

Before considering other concepts incorporated in verbs of motion, we should pause to note a difference between the concepts of motion and direction as they are expressed lexically. Motion can serve as a core concept around which we can arrange a whole semantic field of motion words; the concept of direction cannot serve that purpose. In order to support this claim, let me consider simply the two most basic directional concepts: *from* an origin and *to* a destination. *From* and *to* serve to distinguish motion verbs like *leave* and *depart* from verbs like *reach* and *arrive*, but they also serve to distinguish verbs of possession like *lose* and *give* from *get* and *receive*, and to distinguish verbs of communication like *speak* and *write* from *listen* and *read*. That is to say, the notion that something is *from* an origin or *to* a destination is expressed in a variety of semantic fields other than the prepositions and adverbs of direction. If we were to try to form a semantic field of directional words, we would have to include the words *from*, *leave*, *give*, and *speak* in one subset and the words *to*, *arrive*, *receive*, and *listen* in a complementary subset. However, these sets of words do not constitute coherent semantic domains. Subjects would not put them together in sorting tasks of the kind I have just described.

It seems necessary, therefore, to distinguish two kinds of lexical concepts: 1. those that provide the conceptual core of a semantic field, and 2. those that serve to differentiate a core concept into a variety of specific expressions of it. Perhaps the most striking example of this difference can be found in nominal semantic fields, where the concept of class inclusion provides a strong hierarchical organization, but where we would be at a loss to organize a semantic field of "class inclusion words". Nominal semantic fields can be organized around such concepts as animal, plant, kinship, or color, but in every case the concept of class inclusion is used to relate words *within* the semantic

field; class inclusion is an organizing concept, not a concept expressed by a field of related words.

This distinction between concepts that form the core of semantic fields and concepts that differentiate lexical items within a field derives ultimately from psychological intuition. That is to say, there is no formal reason why we cannot take any lexical concept as a conceptual core and assemble lexical fields of words that express it. It is simply an empirical fact that when we carry out such a formal exercise, the resulting groups of words do not seem to form a semantically coherent group to someone who speaks the language. They might have, but in fact they do not. I assume, therefore, that this difference in the role of core versus organizing concepts reflects something fundamental about the way lexical information is stored in our long-term memories.

Before returning to the verbs of motion, let me say one more thing about this distinction. It obviously complicates the simple notion of "importance" with which I began. Now we have two criteria for importance. The original criterion was that the importance of a core concept in any given language can be estimated by the number of words in the language that express it. The new criterion would be that the importance of an organizing concept can be estimated by the number of different semantic fields that it helps to organize. One might be tempted to argue that the organizing concepts are the more important, that they are, in fact, too important to be confined to any single lexical field. To say that what organizes is more important than what is organized, however, is like saying that a runner's right leg is more important than his left. Both are equally necessary for the kind of conceptual organization that underlies lexical memory.

Another organizing concept that can be documented from semantic distinctions among the motion verbs is the concept of causality. English, for example, has the closely related verbs, *rise* and *raise*. *Rise* means that something travels upward. *Raise* also means that something travels upward, but it carries the additional meaning that something caused the upward travel. The difference is reflected in the syntactic complexity of the two verbs: *rise* is intransitive, the only argument of the verb being reserved for the word that denotes the object that travels upward; *raise* is transitive, one argument denoting the object that travels upward and the other argument denoting the actor or agent that caused the object to rise.

I do not have good evidence that subjects sort on the basis of causality. There is some suggestion in the sorting studies I have done that people will sort motion verbs first on the basis of direction and then some people will go on to sort further within those groups on the basis of causality. I suspect that it would be possible to construct a list of motion verbs in which the natural groupings would allow the causative-noncausative distinction, but I have not done so.

The reason I believe it would be possible is that the sorting task is very sensitive to context effects, to the context provided by the

particular set of words used in the task. Two words that are judged similar in one context may be judged different in another context. Context effects can be very strong; they direct people's attention to the particular semantic components that serve best to differentiate the particular set of words they have been asked to sort. In interpreting the results, therefore, we must be careful to take the context into consideration. I think the correct interpretation is to assume that a semantic distinction is intuitively real if any context can be found in which people will respect it, but the more salient distinctions will be respected in a wider variety of contexts. On those grounds, I would judge that causality is a real semantic component, but that direction of motion is far more salient intuitively.

The difference in meaning between *rise* and *raise* can be expressed formally (following Miller and Johnson-Laird, 1976) by the incomplete definitions :

RISE(y) : (UP(TRAVEL)) (y)
 RAISE(x,y) : DO(x,s) & CAUSE(s, RISE(y))

In paraphrase, *y rises* if *y* travels up, and *x raises y* if *x* does something *s* and *s* causes *y* to rise. In this fashion the concept of cause is incorporated in the notation for the meaning of *raise*.

The question whether this lexically incorporated concept of cause bears any clear relation to the concept of cause that has emerged from the scientific sophistication of modern Western thought is a deep one that Miller and Johnson-Laird discuss at length; I will not explore it here. I will also ignore complications that arise in English because there are double-purpose verbs like *turn* that can be used either causatively (*John turned the wheel*) or noncausatively (*The wheel turned*). Nor will I try to review all of the different lexical concepts that one might hope to identify in the verbs of motion; direction and causality are two of the most important, and they serve to illustrate what is involved in such decompositions. Instead, I would like to direct my remarks primarily to the perceptual bases for these semantic distinctions, and to the perceptual basis for the causative component in particular.

One reason the verbs of motion seem particularly worthy of psychological study is that motion provides an obvious perceptual referent. We can manipulate the perceptual input in various ways and note which verbs people will use to describe it, for example. We might hope eventually to establish correspondences between verbs of motion and perceived motions that would be comparable, say, to the correspondences that have been established between names of colors and perceived colors. We understand a great deal about color terminology, in part because we understand a great deal about color perception. Perhaps motion terminology could be similarly clarified if we understood as much about motion perception as we do about color perception.

The perception of motion has been studied by many psychologists, of course, but the work of greatest relevance for psycholinguistics

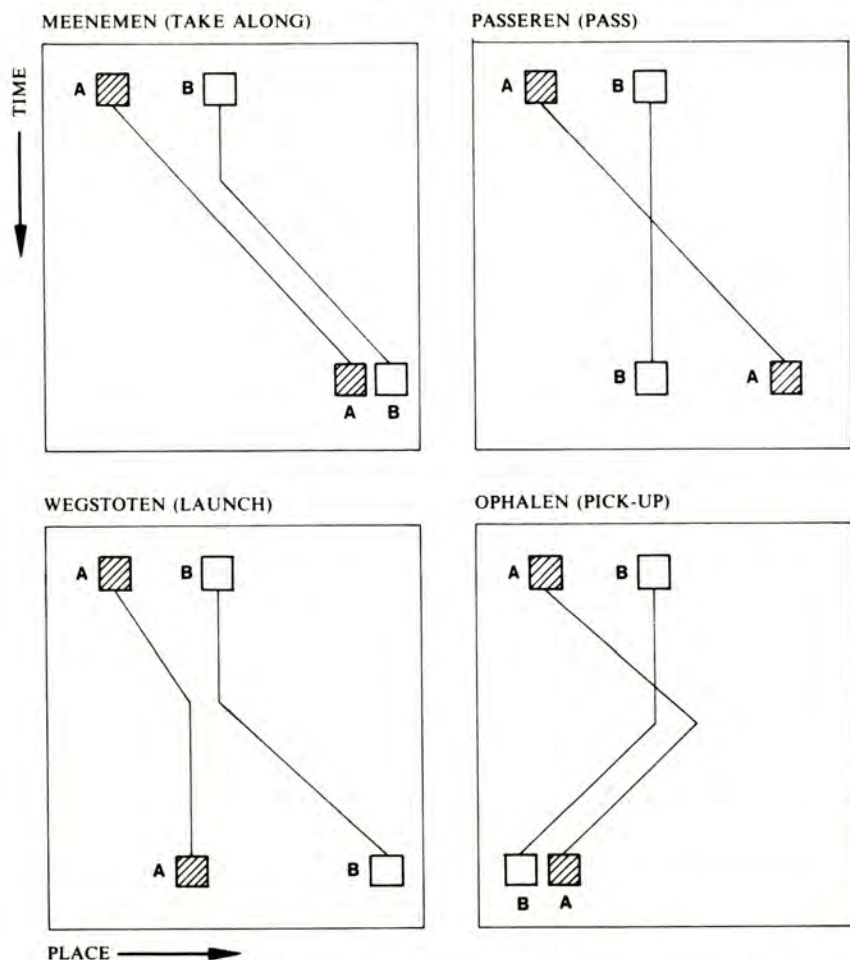


FIG. 1. MOTION PATTERNS OF TWO SPOTS USED BY VAN JAARSVELD (1973), ALONG WITH THEIR PREFERRED VERBAL DESCRIPTIONS. Publication kindly permitted by the author.

is that of Michotte (1946). Michotte believed that many of the basic concepts we use to organize our experience are derived directly from the innate structures of perception. He undertook to study those concepts by systematically varying visual patterns of motion and analysing how people described what they saw. In this way he explored the bases of such perceptual categories as perceived motion, velocity, direction, and, most interesting of all, perceived causality. The similarity of these perceptual categories to the conceptual categories

expressed by the major classes of motion verbs is obvious, but Michotte did not undertake a linguistic analysis of his subject's verbal responses.

Could there be a closer relation between the perceptual and the lexical categories than Michotte suspected? One approach to this question has been explored by van Jaarsveld (1973) who used mental chronometry in order to test the hypothesis that each of the semantic components of the motion verbs corresponds to a perceptual decision that a person makes when he decides that a verb denotes some perceived motion. In one of van Jaarsveld's experiments he created patterns of motion of two spots illustrated in Fig. 1 – patterns that Dutch-speaking observers called *meenemen* (take along), *passeren* (pass), *wegstoten* (launch), and *ophalen* (pick up). Subjects looked at these visual patterns and as soon as they recognized which pattern was occurring, they pushed the one of four alternative keys that corresponded to that pattern.

Reliable differences in reaction times to the four patterns were obtained, but, unfortunately for any simple theory of the relation between perception and language, the order of reaction times did not correspond to any plausible semantic analysis of the corresponding motion verbs into directional and causal components of meaning. It might be possible to invent some *ad hoc* analysis of the verb meanings in order to account for the experimental results, but I do not believe that such an exercise of the theoretical imagination would be profitable. It is possible that we are dealing here with another instance of a context effect, that when only these four verbs were at issue the subjects adopted some special way to distinguish among them on the basis of perceptual features that were most distinctive in that context, but might not have been the features they would use in a more general context.

Levelt, Schreuder, and Hoenkamp (1976) noticed a somewhat different pattern in van Jaarsveld's results. For example, the longest reaction times were obtained for the motion pattern that observers would call *meenemen* (take along), which is a very general and frequently used verb in Dutch; the other verbs, with more specific meanings, gave shorter reaction times. In a subsequent experiment, therefore, motions corresponding to pairs of general and specific verbs were compared. For example, they tested such pairs as *rise* and *move*. Since *rise* entails *move*, but *move* does not entail *rise*, it is clear that *rise* is more specific in meaning than is *move*. One might expect that *rise* would take longer to understand, because it would seem necessary to perform all the perceptual tests required to verify *move* plus whatever additional tests are required to determine the direction of motion. Levelt, Schreuder, and Hoenkamp found, however, that *rise* could be verified faster than *move*. The tests were conducted with 19 such pairs of verbs, using a "true" or "false" response. When the response was "true", the specific verbs showed shorter reaction times than the general verbs; when the response was "false", there was no significant difference in reaction times.

Similar results have been obtained by Smith, Balzano, and Cotton (1977) with "true" and "false" responses to pictures of objects. Subjects were told in advance that they should look at the picture and decide whether or not it was an instance of a word they had been given in advance. It took them longer to respond correctly when the word they were given was a generic term like *vegetable* than when it was a specific term like *carrot*. In the case of generic nominal concepts, one supposes that many of them are disjunctive; in order to decide whether something is a vegetable, for example, the subject must run down his list of specific names of vegetables: Is it a cabbage or a potato or a bean or a carrot or a... whatever, until he comes to the right instance. Whether or not this is an adequate explanation of the nominal case, however, it seems implausible for verbal concepts; one does not suppose that the meaning of *move* is a disjunction of rise, fall, advance, retreat, emerge, enter, and so on. Thus, although the results for nominal and verbal concepts are similar, the reasons for those results may be different in the two cases.

Levelt, Schreuder, and Hoenkamp (1976) have proposed an ingenious explanation for the verbal results in terms of the saliency of the perceptual features. Direction of motion, for example, is more salient perceptually than motion itself; therefore, when the direction is upward the salient feature fits the verbal definition immediately and a "true" response can be given very quickly. They comment, however, that these results must be interpreted cautiously, because different pairs of verbs behaved rather differently.

In any case, whether general verbs take longer to use than specific verbs or whether there is no difference, it seems clear that these results provide no support for the idea that the more complicated the semantic decomposition of a verb is, the longer it will take to use it or understand it. If other evidence continues to show this general pattern, we may be forced to conclude that semantic decomposition is not a process that people ordinarily perform when they understand the meanings of words. That is to say, whether the verb is general, like *move*, or specific, like *rise*, its meaning seems to be appreciated directly as a more or less coherent gestalt. Given this gestalt, of course, it is possible for a speaker of the language to appreciate the various logical entailments that follow from it (for example, that *rise* entails *move*), but it does not seem necessary for him to appreciate its logical entailments before he can grasp its meaning. Unlike grammatical complexity, the semantic complexity of highly familiar verbs may have no measurable effect on the speed or amount of information processing that a person must perform in order to comprehend.

I have suspected for some time that this might be the case. I found (Miller, 1972), for example, that the English verb *jump* – as used in the sentence "The horse jumped over the fence" – could be decomposed into a very complex set of meaning components. Nearly all of the components I needed to analyze English verbs of motion are incorporated into this verb, yet I assume that young children can understand

what *jump* means long before they would be able to appreciate all of its logical entailments. If so, then they must understand it in terms of some perceptual-motor pattern that it denotes, and not in terms of its relations to all the other verbs of motion. Presumably, understanding the relations that we can find by decomposition must come later in a child's development, as well as later in the process of comprehension.

Still a third kind of argument one can make against the claim that semantic decomposition is a process that must occur in the course of understanding a word can be based on the complexity of the information processing that would be necessary. That is to say, if we must decompose a verb like *jump* into the ultimate semantic atoms proposed by Miller and Johnson-Laird (1976), the result is a very long and complex structure bearing little superficial resemblance to the concept of jumping. Usually, about half of the expanded definition will be concerned with the temporal order of events and the other half will describe the events themselves (Miller, 1978). It is possible, of course, that Miller and Johnson-Laird have not chosen the correct semantic primitives, but whatever atomic concepts you assume, the result of a complete decomposition will be a long and elaborate formula. I personally find it highly implausible that the process of comprehension consists of taking words apart in this way.

At the present time, therefore, I am forced to assume that semantic decomposition is not a process that people perform when they understand language. Why, then, should a psychologist study semantic decomposition? If our sole interest is to describe the cognitive processes that people must perform in order to understand spoken language, then there is little to be learned by taking words apart in this way. But psychologists should be interested in more than just the sequence of processes people perform. We should also be interested in the structure of the information systems that they use. On that score, the decomposition of words into the concepts that they share can be one of our most powerful ways to study the conceptual structures underlying language.

It leaves us, however, with another version of a problem that has now become all too familiar: how to combine structural and processing theories. In psycholinguistics, we encountered this problem first in trying to combine the structural description of syntax developed by linguists with the functional descriptions of language use developed by psychologists and sociologists. I believe that we now face another version of the same problem in trying to combine a structural description of the lexicon with a functional description of language comprehension. I have no simple solution to this problem, but I believe that how we resolve it will influence the kind of research we do in psycholinguistics for many years to come.

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