The Organization of Mental Verbs and Folk Theories of Knowing

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Folk theories of knowing in North American adults were studied by examining the organization of mental verbs in two tasks: (a) a Similarity Judgment Task in which subjects rated the similarity of verb pairs in terms of the way the mind is used, and (b) a Verb Extension Task in which subjects identified the mental verbs applicable to a variety of scenarios requiring specific mental activities. Organizational structure was assessed using multidimensional scaling and additive similarity tree analyses. An Attribute Rating Task was used to describe the characteristics which organized the various dimensions and clusters obtained in the scaling solutions. The folk theory of mind displayed was a naive information processing model with interactive and constructive components. © 1994 Academic Press, Inc.

Folk theories of mind are likely to be important in guiding daily activities and in the production of strategic behavior (Clark, 1987). Keesing (1987, p. 380) defines the term "folk model" as "culturally constructed common sense" regarding a domain. D'Andrade (1987, p. 112) defines it as "a cognitive schema that is intersubjectively shared by a social group." The purpose of this article is to describe these implicit naive or folk concepts regarding ways of knowing or coming to know something common to adults in this culture.

We make the assumption that we can assess theories of knowing by studying the organization of verb concepts in the domain. Murphy and Medin (1985) have argued convincingly that the important and coherent concepts in any domain are embedded in deeper, underlying theories that people have about the domain. People's naive theories in a domain are said to constrain concept formation both on an intra- and interconcept level. To this end, our study examines the organizational features of a representative sample of mental verbs

of knowing, specifically, their intensional and extensional relations. We hope that the domain of our current study (ways of knowing) is broad enough to enable us to characterize large and important aspects of adults' fold theory of mind in general, but curtailed enough to enable us to depict with some resolution some subcharacteristics of the domain.

This approach of studying the language of mental activities has been employed by several researchers. D'Andrade (1987), using the interview methods common in cognitive anthropology, interviewed several naive informants regarding their conceptions of mental verbs. On the basis of these interviews, he noted that English verbs can be categorized into six types: perceptions, belief/knowledge, feeling/emotions, desires/wishes, intentions, and resolutions. Each of these types is said to have a state aspect in which the mind is treated as a container that is in various states, and a process aspect in which the mind is carrying on certain operations. Unfortunately, these claims were based on a set of anecdotes collected from a small number of informants.

Rips and Conrad (1989) examined naive theories of mind by examining the form of people's judgments regarding partonomic and taxonomic distinctions between mental verbs. Subjects were asked to judge whether, for example, thinking is a part of all kinds of remembering and whether all kinds of remembering are kinds of thinking. For our purposes here, the most important findings are the following: (a) There was a basic distinction that people made between what Rips and Conrad called *analytic* verbs (corresponding roughly to our *verbs of knowing*) and *nonanalytic* verbs. (b) For many verb pairs, subjects judged one activity to be part of the other while at the same time judging the second activity to be a kind of the first. Thus, thinking was judged to be part of conceptualizing, while conceptualizing was judged to be a kind of thinking. Rips and Conrad pointed out that these

sorts of relationships are not common with artifact and natural kind terms. Thus, mental verbs possess an unusual relationship not typically found in real world objects. (c) Thinking was said to be the most central verb in common with most mental verbs.

While the reciprocal relationship between part-of and kind-of relations may be an important feature of mental verbs, the method they used appears to have two important limitations. First, it is not clear that part-of and kind-of judgments are either typical verb relations or a complete accounting of the relations existing between verbs (Fellbaum & Miller, 1990). For example, according to Fellbaum and Miller (1990; Chaffin, Fellbaum, & Jenei, 1993; Fellbaum, 1990), the part-of relation common for nouns only somewhat resembles the proper inclusion relation for verbs (to which it is most analogous). Moreover, there are a number of other verb relations not considered by Rips and Conrad which may be equally or more important in characterizing the organization of mental concepts. Second, the method Rips and Conrad used does not work well with a large number of items because of componential limitations forcing the exclusion of unclear cases. These unclear cases may be telling us something about the nature of people's theories of mind. Consider the relationship between planning and reasoning. Most of us would probably have difficulty deciding whether planning is a kind of reasoning in all cases. Would we want to say that planning how to avoid a coffee table on our way to the other side of the room is an example of reasoning? Perhaps, but the objects of reasoning seem to be typically more mental and complex than that. The difficulty is that, while many examples of planning are good examples of reasoning, many are not. It is not likely to be an all-or-none thing any more than it has been for noun taxonomic relationships (Rosch, 1978).

Finally, the approach of Hoskens and

DeBoeck (1991) with Belgian participants is similar to the one we have taken. They asked 10 laypersons, 10 psychology majors, and 10 experts to sort 49 verbs of intelligence into groups with nearly identical meanings (forcing exclusive groupings). Multidimensional scaling of the resulting similarity matrices suggested a *depth of processing* dimension, a *judgment* dimension, and a *creativity* dimension.

The generalizability of these results to other naive groups is unclear. First, the presence of expert and near-expert groups is likely to have influenced the solution that was obtained—laypersons placed little emphasis on the depth of processing dimension and much more emphasis on the creativity dimension. Moreover, the interpretation of the solution was performed by expert groups. Second, we cannot assume that Danish subjects possess the same theory of mind that North Americans do. Some prior research has shown that Germans may have a more active and effortful view of mental activity than Americans (Carr, Kurtz, Schneider, Turner, & Borkowski, 1989). Thus, even in related western cultures, there may be subtle, but important differences in theory of mind. Finally, translations of the verbs indicated the inclusion of a large number of verbs with fairly synonymous meanings (e.g., five forms of the verb *think*). The presence of these synonyms might have had undue influence on the form of the solution obtained.

In some earlier developmental research on this topic, we (Fabricius & Schwanenflugel, in press; Fabricius, Schwanenflugel, Kyllonen, Barclay, & Denton, 1989; Schwanenflugel, Fabricius, & Alexander, in press) asked children and adults to make similarity judgments between prototypical scenarios of various kinds of mental activities. We detected that adult conceptions of mental activities centered around several themes: (a) the influence of *memory* in various activities, (b) the role of *attentional processes* in regulating input from the ex-

ternal world, and (c) the role of *cognitive mediation* in connecting the contents of memory and input from the external world. However, this approach has had limitations also in that we have only been able to assess a limited portion of the domain of knowing at any given time.

The purpose of the present study was to study people's conception of ways of knowing or coming to know something by studying their organization of mental verbs. Studying mental verbs of knowing separately from other more emotional or nonanalytic verbs might seem contrived from some non-western cultural perspectives (such as the Ifaluk; Lutz, 1985). However, evidence from the above studies suggests that it may be reasonable to describe at least part of the domain of knowing by examining this particular subset of mental verbs. For example, Rips and Conrad uncovered a major distinction between analytic and nonanalytic verbs. D'Andrade noted a distinct grouping of perceptions and belief/knowledge verbs from other types of mental verbs. Our distinction of verbs of knowing correspond roughly to these major classifications above.

In this study, we examined a diverse set of mental verbs of knowing, concentrating on relatively early acquired mental verbs. Semantic development research suggests that children tend to acquire prototypical and familiar items in a domain prior to atypical, unfamiliar ones (Anglin, 1977; Bjorklund, Thompson, & Ornstein, 1983; Lin, Schwanenflugel, & Wisenbaker, 1990; Mervis & Rosch, 1981; Salz, Soller, & Sigel, 1976; White, 1982). Thus, the verbs used were likely to be fairly prototypical and familiar to our participants.

We examined the organization of verbs of knowing in two ways: (a) judgments regarding the similarity of the meaning of the mental verbs or *intensional relations* and (b) judgments regarding the applicability of the mental verbs to different real world contexts or *extensional relations*. For the Similarity Judgment Task, people were

asked simply to decide how similar the verbs were in terms of the ways they use their mind for each one. For the Extension Task, people were provided with scenarios and asked to select verbs that applied to it. The assumption of this second task is that everyday cognitive contexts are complex and involve a number of cognitive processes operating simultaneously or in tandem. By examining the similarity between mental verbs in the way that people extend or do not extend the verbs across contexts, we can gain information regarding the conceptual similarity of mental verbs in terms of their use in the real world. Further, by assembling organizational features from both these kinds of judgments, we hoped to gain access to the robust features of folk theories of knowing that apply both to intensional and extensional judgments of mental verbs.

In order to uncover organizational information present in these theories of knowing, multidimensional scaling (MDS) and additive similarity tree analyses (ADDTREE) were conducted. MDS was used to assess the global, perhaps continuous aspects underlying the domain. In MDS, similarity among items is indicated by spatial proximity in multidimensional space (Kruscal & Wish, 1978; Shoben & Ross, 1987). ADDTREE (Sattath & Tversky, 1977) is a hierarchical network analysis for determining potential hierarchical clusters and subclusters in a conceptual domain. Similarity is represented when two items are represented in the same cluster or subcluster. To provide a descriptive account of the organization of mental verbs assessed by these methods, naive raters rated each verb on attributes thought to be potentially important descriptors of the various clusters and dimensions obtained from the MDS and ADDTREE solutions. We used the strengths of these different kinds of analyses along with these ratings from the Attribute Rating Task to assemble a description of naive theories of knowing and to highlight different aspects of this domain.

METHODS

Subjects

Two groups of 10 experts participated in the Stimulus Selection Task. One group participated in selecting the set of words to be used in the Similarity Judgment Task. The other group participated in selecting the set of sentences to be used in the Verb Extension Task. These experts were faculty and doctoral students in the cognitively oriented programs at the University of Georgia. Thirty introductory psychology students served as participants in the Similarity Judgment Task in order to meet a course requirement. Another 38 introductory educational psychology students served as volunteer participants in the Verb Extension Task.[1] Fifteen additional educational psychology students participated in the reliability task for the Verb Extension Task. Two groups of 10 naive subjects participated in the Attribute Rating Task.

Stimulus Selection

The selection of stimuli for the study proceeded in two phases: the selection of mental verbs and the selection of scenarios corresponding to those mental verbs. To select the mental verbs, 136 potential mental verbs having a frequency of 10 or greater per million were culled from the third grade corpus of the Carroll, Davies, and Richman (1971) *Word Frequency Book*. Then, with this list of potential mental verbs, we asked a group of experts to decide whether each verb represents a way that one cognitively knows or comes to know something. We identified 30 verbs that at least 8 out of 10 experts agreed were representative ways of knowing or coming to know something.

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[1] According to the course instructor, students in the Similarity Judgment Task had received no more than 30 min of formal instruction on theories of cognition. The Verb Extension Task was conducted early in the term prior to the discussion of cognition in the course. Thus, we can consider the students to be fairly naive regarding expert knowledge of theories of cognition.

TABLE 1
MENTAL VERBS USED IN EXPERIMENT 1

Mental verbs				
Check	Estimate	Hear	Observe	Recognize
Choose	Examine	Invent	Pay attention	Remember
Compare	Explain	Know	Plan	Search
Decide	Explore	Learn	Question	See
Describe	Figure out	Memorize	Read	Think
Discover	Guess	Notice	Reason	Understand

This set appeared to reflect a wide range of cognitive activities. The final list of verbs used in these studies can be found in Table 1.

For the Verb Extension Task, it was important to sample a wide variety of mental activities in order to be able to examine how verbs were similar (or different) in the ways that people extended the meaning of the verb to various cognitive contexts. To determine the scenarios to be used in the Verb Extension Task, the following procedure was used: Several candidate scenarios depicting the cognitive activity used in each of the 30 mental verbs from Experiment 1 of the study were created by three different experimenters. The actual targeted mental verb itself was avoided in the description of the scenario. For example, for the verb *hear,* the scenario "Being awakened by the telephone when it rings" never directly mentions the activity of hearing and has to be inferred from the scenario itself.[2] Only scenarios unanimously agreed upon by the three experimenters as being good examples of the mental activity were included in the list of scenarios given to the experts. Under each scenario was a list of six potential verb to which each scenario might apply. One of these verbs represented the targeted activity. One distractor was also in-

cluded which the Similarity Judgment Task had indicated was highly related to the target verb (e.g., *observe* for *see*). Four other distractors were randomly chosen from the original list of 30 verbs. The experts were asked to select the mental verb which best signified the dominant mental activity that the scenario involved. For experts to distinguish the close distractor from the targeted mental verb, the scenario would need to be highly and specifically representative of the targeted mental verb. In this way, we could be sure that the mental activities used in the final Verb Extension Task sampled different aspects of the domain of knowing.

For each mental verb, two scenarios were selected which had at least a 70% agreement among experts as being the predominant mental activity involved in the scenario with the following exceptions: (a) For the verb *see,* one scenario had only a 60% agreement; (b) two additional scenarios were selected for the verbs *remember* and *figure out.* The verb *remember* is used to refer to two types of memory important in our previous studies, prospective and list memory. The verb *figure out* is used to refer to both complex problem solving and simple inferencing. Thus, scenarios were included that referred to these dual uses of the verbs. The scenarios are presented in Appendix A.

In sum, 30 mental verbs were selected for the Similarity Judgment Task and 64 scenarios were selected for use in the Verb Extension Task. The mean expert agreement across mental verbs was 94% and across scenarios was 91%. Thus, the verbs

[2] Because we wished to use these stimuli in a further developmental study on this topic, these scenarios were designed to be relatively familiar ones to elementary school children as well, accounting for the childlike character of some of the items. None of the adults participating in the Verb Extension Task expressed difficulty with this.

selected were very good examples of ways of knowing overall and their corresponding scenarios were good extensions of those verbs according to expert judgments.

Similarity Judgment Task

Subjects were asked to rate a randomly ordered list of all pairs of the 30 mental verbs in terms of the similarity of "the way you use your mind when you are in the process of doing the described mental activity." Each pair was rated on a 7-point scale with 1 representing a highly similar and 7 representing a completely different way of using the mind. Subjects completed a total of 435 ratings. They were run in small groups or singly. Subjects took approximately 40 minutes to complete the similarity judgments.

Verb Extension Task

Participants received a booklet containing a random ordering of the 64 scenarios. Beneath each scenario was an alphabetically ordered list of the 30 verbs. Participants were instructed to read each scenario and decide which of the 30 verbs applied to the activity. They were asked to circle only those verbs which were primarily involved

in the sentence, but there was no limit placed on the actual number of verbs they might select. In fact, in order for us to be able to discern information regarding extensional overlap between verbs, it was important that our subjects select more than a single mental verb, but subjects were not told this.

Attribute Rating Task

The participants in the Attribute Rating Task were asked to rate the 30 verbs on 12 or 13 of the attribute rating scales. The list of the rating scales and their endpoints can be found in Table 2. The attributes were either ones that were important in our previous studies (Fabricius et al., 1989; Schwanenflugel et al., in press) or that seemed to be potential candidates as descriptors for the various clusters and dimensions emerging in the scaling solutions. The scales were of two types: (a) Some were magnitude scales where one end represented a small degree and the other a large degree of the attribute (e.g., the degree to which the verb involved memory as a component), and (b) others were polar opposite scales where one end represented one type of attribute and the other repre-

TABLE 2
SCALES USED IN THE ATTRIBUTE RATING TASK

Attribute rating scale[a]	
Low–high memory involvement	Passive–active
Primarily perceptual–Primarily conceptual information	Involved in integrating–discriminating information
External–internal information	Low–high amount of inferencing
Low–high amount of verbal information	Input–output (information processing)
Low–high degree of attention required	Information gathering–information using
Abstract–concrete	Low–high amount of comprehension
Indefinite–definite knowledge	Low–high amount of logic required
Low–high involvement in problem solving	Subjective–objective
	Information involved not available–information available
Visual/spatial–auditory/verbal	Retrieval–acquisition of information
Low–high degree of certainty	Involved–not involved in creative process
Know–come to know something	Precursor–outcome of mental activity
Involved–not involved in scientific reasoning	
Theoretical–observable	

[a] Polar ends are represented. Attribute on left represents a rating of 1; attribute on right represents a rating of 7.

sented another type (e.g., the degree to which the processes involved were primarily conceptual in nature or primarily perceptual in nature). Subjects were urged to use the full range of the scale. This task required approximately 45 min to complete.[3]

RESULTS AND DISCUSSION

Reliability

To create a similarity matrix for the Verb Similarity task, ratings for each of the 435 comparisons from the Similarity Judgment Task were averaged across subjects. However, prior to averaging, it was important to determine that there was some agreement across subjects in their judgments. A .90 Cronbach's α indicated high inter-rater agreement, suggesting a great degree of commonality among subjects in their judgments regarding the verb pairs. Thus, it seemed reasonable to use a single averaged similarity matrix for the group in further analyses of the Verb Similarity Task.

For the Verb Extension Task, we were interested in determining the similarity in the use of the mental verbs in terms of their extensions to real world phenomena. First, for each *verb,* we calculated the number of subjects selecting the verb for each of the 64 scenarios. Then, we correlated the frequencies for each *verb pair* across scenarios. Thus, verbs with a similar pattern of extensions across scenarios would have a high correlation and those with distinct extensions would have a low correlation. The resulting correlation matrix provided the group similarity matrix that was used in further analysis of the data.

It should be noted that the focus of this method was not on whether subjects selected the appropriate verb for their targeted scenarios (although they did so at a reasonably high rate, 68.6%), but on how similarly subjects applied verbs across scenarios. In fact, for this method to provide

[3] The mean ratings from the Attribute Rating Task are available upon request from the first author.

us with an index of similarity, subjects would need to apply the verb to a range of scenarios. In fact, subjects applied each verb to an average of 9.9 or 15.5% of the scenarios used in the study. Thus, we were able to examine whether any given pair of verbs was extended to similar or different scenarios.

To obtain an indicator of the method's reliability, we asked an additional group of 15 students to perform a similar, but not identical sorting task. For each of the 64 scenarios, subjects sorted 30 index cards each bearing a mental verb into a "yes" or "no" pile based on whether they believed the mental verb applied to the scenario. The index cards were presented in random order by shuffling the deck for each scenario. With this sorting data, a similarity matrix was calculated as described above. The resulting matrix correlated .913 with the above similarity matrix from the Verb Extension Task. Therefore, the method used in the Verb Extension Task was considered a reliable indicator of subjects' verb extension.

There was a moderate correspondence between the Similarity Judgment and Verb Extension Task in the assessment of similarity between the verb pairs. The correlation between the similarity matrices of the Verb Extension Task and the Similarity Judgment Task was .48, $p < .001$. As will be seen in our discussion of the ADDTREE solutions later, this moderate correlation was attributable primarily to differences between the two tasks in ratings for verbs dealing with uncertain, inferential activities.

Multidimensional Scaling. Multidimensional scaling is useful for uncovering global relational information organizing a semantic domain. One version of MDS called INDSCAL allows us to combine the data from both tasks to examine the relative weighting that people in each task placed on various information in their ratings. The INDSCAL solution was obtained using the Alscal program from SAS (SAS Supple-

mental Users Guide, 1980). The group similarity matrices from the Similarity Judgment Task and the Verb Extension Task served as input to the INDSCAL analysis. The data were transformed to a common scale.

The choice of dimensionality for the space is based on several criteria such as goodness-of-fit, the stability of the solution, and interpretive criteria. Generally, one looks for a solution which is low in stress and accounts for a large percentage of the variance in the ratings. In terms of interpretive criteria, one looks for well-fitting descriptions which are unique to the dimension (that is, uncorrelated with descriptions of the other dimensions) and which remain stable with increasing dimensionality. Typically, to provide an interpretation of the organization provided by the MDS, a number of potential interpretations are generated and rated by naive subjects, as was done in the Attribute Rating Task (see method). These ratings are then correlated with the position of items along each dimension and the best fit is selected as the

interpretation of the attribute organizing the items along the dimension.

We selected the three-dimensional solution because this seemed to be the optimal dimensionality of the space in terms of most of the criteria. First, at this dimensionality, sensible, unique, and well-fitting interpretations of the dimensions could be found. Second, the interpretation of the dimensions remained stable when going from two to three dimensions. Third, while not an excellent fit of the data as a whole (r^2 = .63, stress = .21), the solution fit the Similarity Judgment data and the Extension data similarly (similarity: r^2 = .63, stress = .21; extension: .64, stress = .21), something which was lost when further dimensionality of the space was considered. The results of this solution are presented in Fig. 1.

The first dimension centered around an information processing conception of mind. This dimension distinguished verbs dealing with perceptual inputs (such as *see, recognize, pay attention,* and *observe*) from those dealing with conceptual and logical
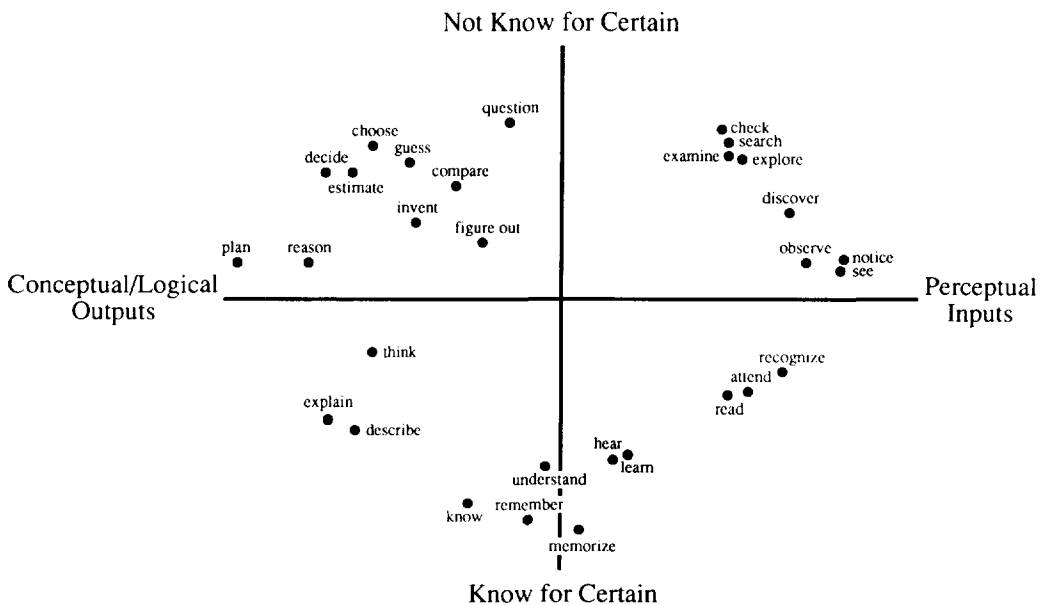

FIG. 1. The Dimension 1 (horizontal) and Dimension 2 (vertical) from the 3 dimensional INDSCAL representation of the Similarity Judgment and Verb Extension Task. The third dimension (not depicted) represents the degree to which the verbs are seen as part of the creative process.

outputs (such as *plan, reason, decide, explain,* and *estimate*). The best descriptors for Dimension 1 were the information processing (input/output), perceptual/conceptual, and logic requirement scales. Mean ratings on these dimensions correlated .77, .75, and .76, respectively with the coordinates of the verbs on this dimension. Moreover, these descriptors were all intercorrelated (all *rs* > .70). This dimension was weighted similarly in the Similarity Judgment and Extension Task (.44 and .60, respectively), and accounted for 27.9% of the variance accounted for by the INDSCAL solution.

The second dimension reflected a concern for the certainty of various mental processes. This dimension distinguished verbs which involved knowing something for certain (such as *memorize, remember, understand,* and *know*) from verbs that involved uncertainty (such as *question, check, search, choose,* and *guess*). Specifically, the Certainty dimension correlated .70 with the coordinates of the verbs on this dimension. Moreover, this descriptor did not correlate with the characterizations of Dimension 1 (all *ps* > .20), suggesting that it was a unique descriptor of Dimension 2. This dimension was weighted very similarly by the subjects in the Similarity Judgment (.49) and Extension (.48) task and accounted for 23.4% of the variance accounted for by the INDSCAL solution.

The third dimension distinguished verbs involved in the creative process (*invent, discover, explore,* and *figure out*) from verbs that are not (*hear, compare,* and *guess*). The Creativity dimension correlated .57 with the coordinates of the verbs on this dimension. This descriptor was also orthogonal to the descriptors of the other two dimensions (all *ps* > .20). However, this dimension seemed to be weighted more by the participants in the Similarity Judgment Task than by those in the Verb Extension Task (.43 and .21, respectively). Overall, it accounted for only 11.6% of the

variance accounted for by the INDSCAL solution.

In sum, the INDSCAL distinguished three important relations in the folk theory of mind. First, it distinguished verbs of knowing along an information processing continuum from perceptual input to conceptual output. Second, it distinguished verbs according to the certainty and reliability of their outcomes. Third, but less importantly, it distinguished between verbs involved in the creative process from verbs not involved in the process.

Additive Similarity Tree Analyses

The similarity matrices from the Similarity Judgment Task and the Verb Extension Task were submitted to Additive Similarity Tree analyses (Sattath & Tversky, 1978). Figure 2 shows the ADDTREE solution for the Similarity Judgment Task and Fig. 3 shows the solution for the Verb Extension Task. The clusters with the clearest interpretations are labeled. Figure 4 displays the characteristics of each major labeled cluster based on the important distinguishing attributes from the Attribute Rating Task. The mean attribute rating for each major cluster (three in the Similarity Judgment Task and four in the Verb Extension Task) on each of seven attributes is presented.

Similarity judgment task. The ADDTREE conducted for this task accounted for 74.6% of the variance with a stress of .083. This ADDTREE gives us three major clusters and a single verb cluster, *read*. Specifically, the major clusters in this folk model of knowing appear remarkably similar to the structures now familiar to information processing box models.

First, on the bottom of Fig. 2, we find a major cluster of verbs that seem to be involved in the regulation of information from the external world to the mental world, *hear, see, observe, notice,* and *pay attention.* We have labeled this cluster of verbs the "Input Component". As seen by the mean ratings from the Attribute Rating Task presented in Fig. 4, these verbs are

```
--------------------- learn
 -|
  |-------|       --------------------- know
  |       --------------- understand                    MEMORY
 ----|                                                  COMPONENT
     |          ------------------------------- memorize
     |------|        --------------- recognize
     |      --------|
     |               --------------------- remember
     |
     |        output        ------------------- describe
     |     -------------------|
     |     |                  ------------------ explain
     |     |             --------------------- discover
     |     |      --------|
     | creative |        ------------------ explore
     |  ----|   |        --------------------- figure out
     |      |   |               ----------------------------------- invent
     |      |   --------|
     |      |            |        ----------------------------------- plan
     |      |                          ----------------- choose
     |      | decision              --------|
     |      |  ------|               ------------- decide           PROCESSING
---  |      |        |                  ----------------- estimate  COMPONENT
     | ----||        |     ---------------------|
     |     ||        |          ----------------------- guess
     |     || generic   --------------------- reason
     |     ||  ---------|
     |     ||           ------------- think
     |     ||              ----------------------------- check
     |     ||        -----|
 -| |     || ---|     ------------------ examine
     | mental|  ---------------------------- search
     | ---|
     | comparison
     |    |------------------------------- compare
     |   -|
     |    ----------------------------------- question
     |
     |           ---------------- notice
     |        ----|
     |  -------|   ------------------ pay attention
     | -----|  |
     | |     |       ------------- observe                INPUT
     | |     |                                            COMPONENT
     | |     ----------------------- see
     | |
     | -------------------------------------------- hear
     |
     --------------------------------------- read
```
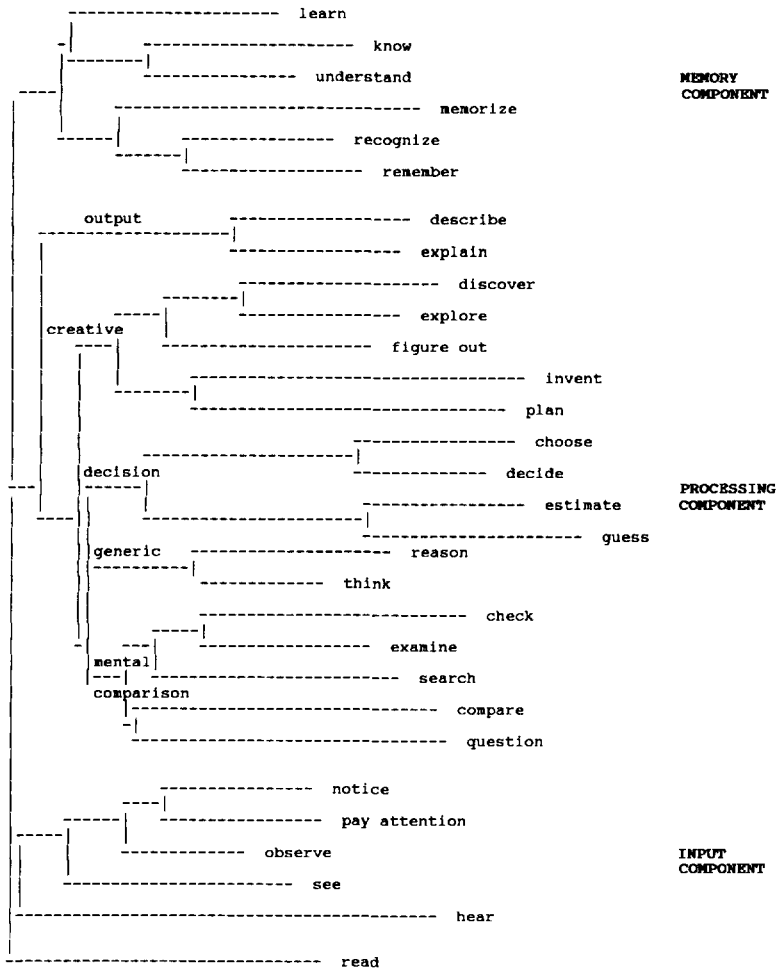
FIG. 2. The ADDTREE representation of the Similarity Judgment Task.

related to perceptual processes located at the input end of the information processing continuum and deal with external information. The information used by the verbs is viewed as readily available, enabling the processes they describe to be seen as relatively certain and non-inferential. These verbs do not rely much on information from memory as a component of the processing.

The top of Fig. 2 shows a cluster of mental verbs that seem to relate to memory aspects of information processing, *learn, know, understand, memorize, recognize,* and *remember*. We have labeled this cluster the "Memory Component". From the Attribute Rating Task displayed in Fig. 4, we can see that these verbs are rated high in the use of information from memory as a component of the processing. These memory processes are seen as certain and relatively non-inferential, using readily available information. The processes involved are viewed as conceptual, internal, and localized between input and output on the information processing scale. The naive conception of this cluster seems to be one of a set of sure-fire mental processes relating to Memory that are based on a stable and available information base.

Finally, in the center of Fig. 2, we see a large differentiated set of mental verbs that seem to deal with various ways of process-
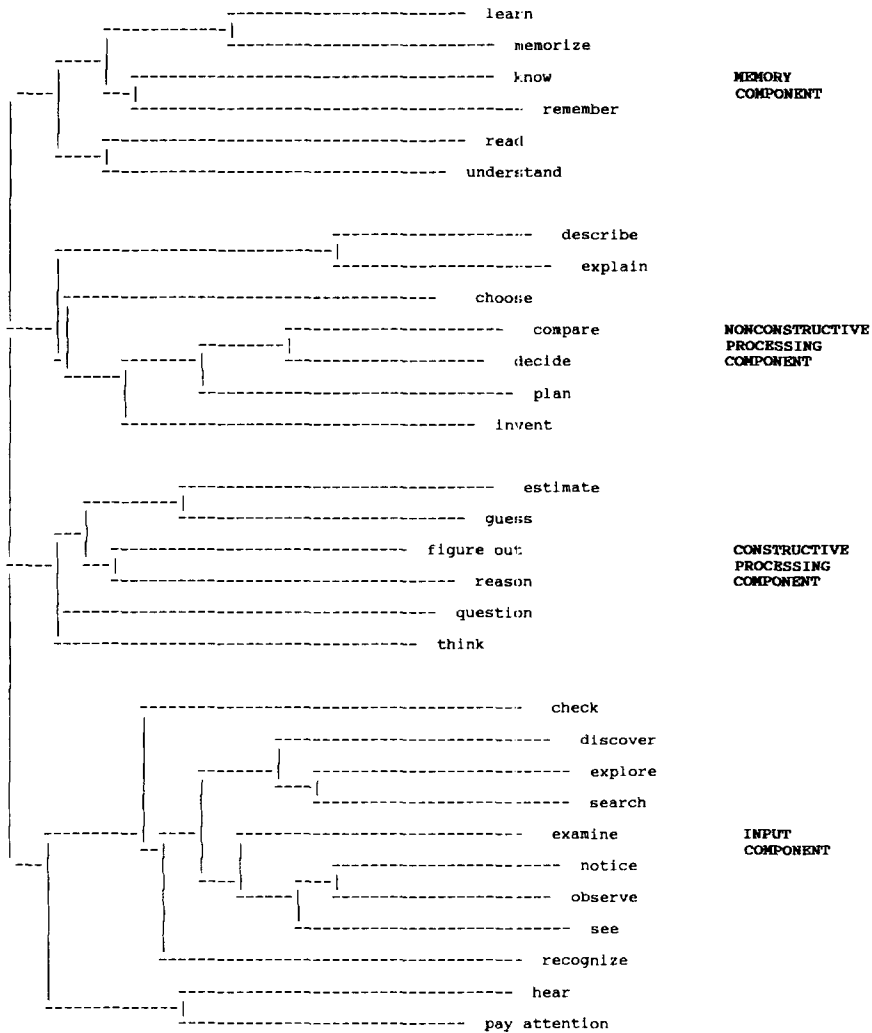
Fig. 3. The ADDTREE representation of the Verb Extension Task.

ing information. Thus, we have labeled this cluster the "Processing Component". As seen in Fig. 4, these verbs are conceptualized as relatively conceptual and internal and localized between input and output processes on the information processing continuum. They do not involve information from memory as a component of the processing as much as the memory verbs, but more than the input verbs do. However, what distinguishes this cluster from the others is its relation to an unstable information base. Specifically, these verbs seem to be relatively uncertain and inferen-

tial, dealing with information that is relatively less available than it is for the other clusters. Moreover, these verbs all fell toward the Uncertain end of the continuum in the second dimension of the INDSCAL solution.

In this large cluster of verbs, we can detect a further differentiation of verbs according to various functions. Specifically, we see a cluster of verbs, *describe* and *explain*, relating to verbal outputs. We find another cluster of verbs including *discover, explore, figure out, invent,* and *plan* which are involved in producing a creative prod-
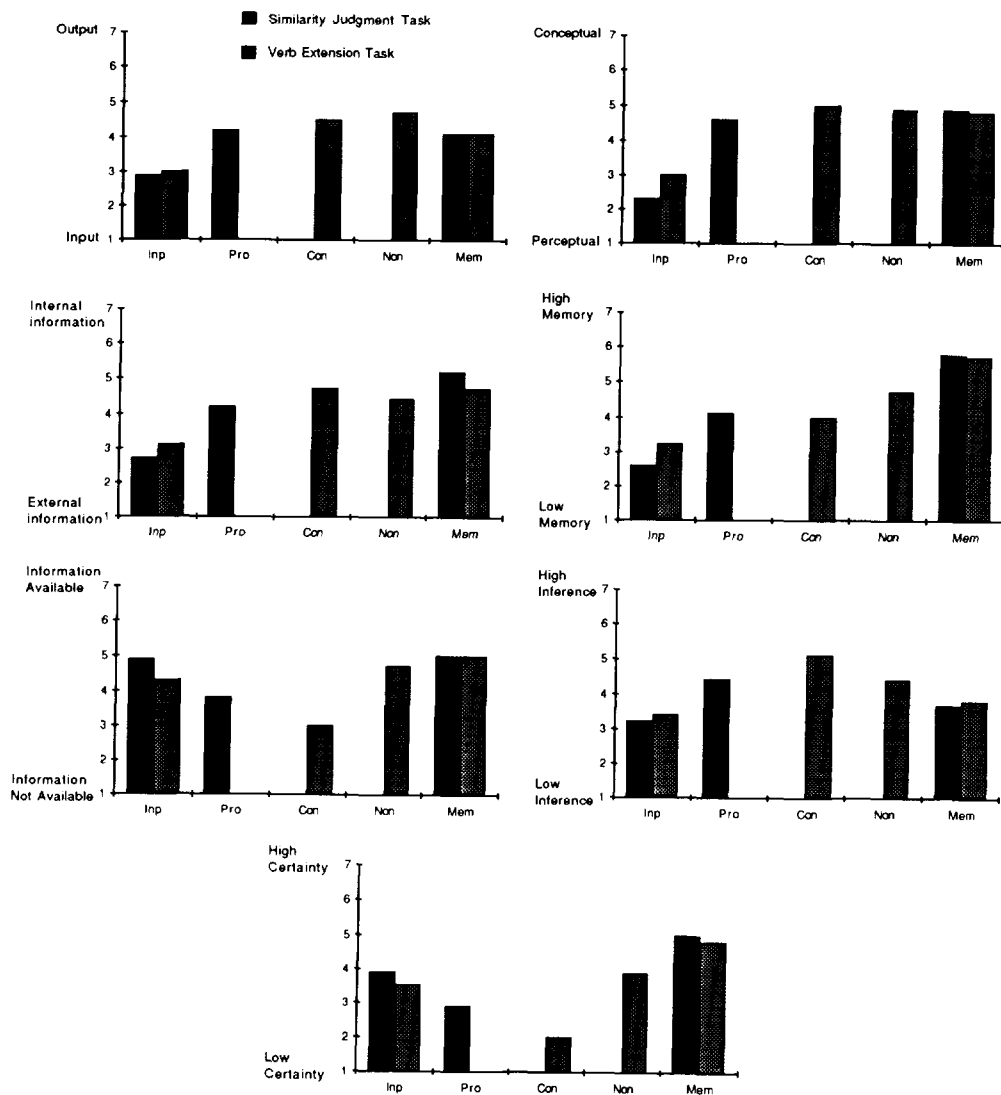
FIG. 4. Mean ratings from the Attribute Rating Task for important clusters on the ADDTREE (Inp, Input Component cluster; Pro, Processing Component cluster; Con, Constructive Processing Component cluster; Non, Nonconstructive Processing Component cluster; Mem, Memory Component cluster).

uct. We detect another cluster of verbs that result in the making of a decision, *choose, decide, estimate,* and *guess,* and another set of mental verbs involved in mental comparisons, *check, examine, search, compare,* and *question.* Finally, we have set of verbs reflecting the generic functions of this component, *reason* and *think.* In sum, this unit seems designed to carry out highly inferential, uncertain mental operations.

Verb extension task. The ADDTREE conducted for this task accounted for 75.6% of the variance in the ratings with a stress of .064. This ADDTREE gives us four major clusters, two of which relate closely to the ones obtained in the Similarity Judgment data.

The "Input Component" cluster again appears to represent a set of verbs all which have a role in relating information from the

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external world to the mental world, but it is broader in scope than was noted in the Similarity Judgment Task. This cluster includes all of the input verbs noted earlier (*notice, pay attention, observe, see,* and *hear*) plus some others (*check, discover, explore, search, examine,* and *recognize*). In fact, there was close correspondence between the ratings of all pairs of these eleven verbs obtained from the Similarity Judgment Task and the data from the Verb Extension Task, $r = .81, p < .001$. As seen in Fig. 4, these verbs as a group were rated very similarly on all attributes of the Input verbs identified in the Similarity Judgment Task, despite the fact that the Input Component cluster was more than twice as large in the Verb Extension Task. According to these attribute ratings, these verbs refer to perceptual input processes that relate to readily available, external information. They can be characterized as certain and non-inferential. They are not seen as involving memory. Further, to ascertain that this verb cluster possessed a kind of conceptual coherence, we compared the average number of times subjects extended these eleven verbs to scenarios targeted for other verbs both within the Input cluster and outside the cluster. This analysis showed that subjects more often extended the verbs to scenarios targeted for other verbs within the cluster ($M = 9.6$) than to scenarios outside it ($M = 5.1$). Thus, despite its relative breadth, the verbs in this Input Component cluster are seen as similar to the input component verbs identified in the Similarity Judgment Task.

The "Memory Component" cluster in Fig. 3 includes *learn, memorize, know, remember, read,* and *understand.* This cluster closely resembles the Memory Component cluster in the Similarity Judgment Task, with the exception that *recognize* is missing and *read* has been substituted in its place. There was reasonably close correspondence in verb similarity obtained in the two tasks for these six verbs, $r = .66, p < .01$. Attribute rating data presented in Fig. 4

are nearly identical for the two tasks, as would be expected because the clusters differ only by two verbs. Again, this cluster is characterized by verbs whose processes use readily available information from memory and are certain and non-inferential. The processes are seen as relatively internal and conceptual, falling in the center of the information processing scale. More extensions occurred to scenarios targeted for other verbs within ($M = 6.6$) than outside the cluster ($M = 3.2$) for every verb in the cluster.

The verbs of the middle two clusters all appeared in the Processing Component cluster of the Similarity Judgment Task. The verbs of these two clusters appear to refer to two different, but complementary types of functions of that component. We have labeled them "Nonconstructive Processing" and "Constructive Processing" Components. Specifically, the data from the Attribute Rating Task presented in Fig. 4 suggest that these clusters, although both seen as internal and conceptual, are differentiated by the amount of memory and inferencing they are seen to involve.

Nonconstructive Processing verbs involve more memory, less inferencing, and are seen as more certain. In contrast, Constructive Processing verbs involve less memory, more inferencing, and are less certain. Both the Nonconstructive and Constructive Processing Component verbs displayed conceptual coherence in that more extensions fell to scenarios targeted to other verbs within their clusters ($M = 7.8$ and 10.0, respectively) than outside of them ($M = 2.4$ and 6.3) for every verb in the clusters. However, perhaps because of the emphasis on certainty, inferencing, and memory, the correspondence in verb similarity obtained in the two tasks was rather low, although significant, for these 13 Constructive and Nonconstructive Processing verbs, $r = .33, p < .01$.

Summary. In sum, a similar picture of folk theories of knowing emerged from subjects' similarity judgments between mental

verbs and extensions to real world situations. The two tasks might have resulted in quite different depictions of conceptual structure. For example, the Verb Extension Task might have produced an organization following salient concrete characteristics of the scenarios. Instead, both tasks indicated a perceptual input cluster, although it was broader in scope for extensions than similarity judgments. Both tasks indicated a memory cluster of verbs. Finally, both tasks grouped verbs dealing with ways of processing information together, although the extension data indicated two such clusters whereas the similarity data produced only one large cluster.

GENERAL DISCUSSION

The basic characterization of the folk theory of mind obtained from the conceptual structure of mental verbs found in our sample of North American adults is that of a naive information processing model with interactive components. We found consistent evidence for this model in both the Similarity Judgment and Extension Tasks and in both the ADDTREE and INDSCAL solutions.

This information processing folk theory has a number of important characteristics. From the ADDTREEs we can infer that the model consists of three general components: Memory, Processing, and Input Components. From the first dimension of the INDSCAL, we know that this information processing flow conception is the major organizing characteristic of this domain. That is, ratings asking subjects to localize verbs along an information processing continuum from input to output correlated very well with the ordering of items on the first dimension. Verbs at the perceptual input end (e.g., *see, notice, observe, pay attention*) referred to processes regulating input from the external world. Verbs at the output end (e.g., *plan, explain, describe,* and *decide*) referred generally to Processing verbs producing discrete outputs. Informa-

tion processing ratings generally suggest that Memory and Processing Component verbs are both localized in the conceptual center between inputs and outputs.

The folk theory of knowing inferred from the structure of mental verbs suggests that persons are also highly sensitive to the degree of certainty involved in different mental processes. This feature organized the second dimension of the INDSCAL. The verbs at the uncertain end of this dimension were the Processing Component verbs from the ADDTREEs. This was also reflected in the Verb Extension Task because subjects made a distinction between constructive and nonconstructive processes largely on the basis of certainty.

The conception of this Processing Component is that of a transient, uncertain memory state designed to carry out many different kinds of operations. The similar localization of the Memory and Processing components along the information processing continuum suggests that the Processing Component is conceived of as being more than a simple short-term memory intermediary between Input and Memory. This component seems designed to serve the complex needs of the cognitive system, relying on information from memory and the external world as well as constructed information to produce various cognitive outcomes.

Although they yielded similar results, there were a number of differences between the Similarity Judgment Task and the Verb Extension Task. These differences can generally be traced to the contextual richness and specificity of the information provided by the scenarios in the Extension Task. In the presence of contextual information, people often focused on the information used by the verb because of its availability in the description of the scenarios. These differences were most apparent for the Processing Component verbs, suggesting that the activities of this component are designed to capitalize on the supportive fea-

tures of context. In the absence of such contextual information in the Similarity Judgment Task, subjects often focused on types of cognitive outcomes and logical relations among the verbs. We elaborate below.

In the Verb Extension Task, the sensory informational requirements of the verbs appeared to be more heavily weighted than they were for similarity judgements. This seems to have resulted in the movement of a number of sensorially related verbs from the Processing (*check, discover, explore, search,* and *examine*) and Memory (*recognize*) Component of the Similarity Judgment Task to the Input Component of the Verb Extension Task. In the real world, mental activities are supported by information provided by the sensory world and, thus, this aspect of their meaning becomes more heavily weighted in the Verb Extension Task. In fact, the verbs that migrated to the Input Component in the Verb Extension Task were those that were located at the Input end of the first dimension of the INDSCAL. In the Similarity Judgment Task, the characteristics of the perceptual input are less available and have to be inferred. Thus, this aspect of these verbs are less salient.

The relative salience of the information used by the verb in the Verb Extension Task can also be seen in another important difference between the Extension ADDTREE and the Similarity Judgment ADDTREE. In the Extension ADDTREE, there was a differentiation made among processing verbs between Nonconstructive and Constructive Processing verbs. These two clusters were differentiated by the relative availability of information from memory (in addition to the relative certainty of the process, as noted earlier). The activities of Nonconstructive Processing verbs appear to be those that are supported by information supplied relatively directly from memory. Thus, weighting of the information used by the verb, be it from memory or

from the sensory world, played a major distinguishing role between the Verb Extension Task and the Similarity Judgment Task.

In contrast, our subjects tended to focus on cognitive outcomes of the verbs and logical relations among the verbs for Similarity Judgments. An examination of the subclusters of the Processing Component in the Similarity Judgment ADDTREE solution suggests that these might be characterized by the various outcomes of the mental activities: producing a verbal output (*describe, explain*), creating something (*discover, explore, figure out, invent, plan*), producing a decision (*choose, decide, estimate, guess*), producing thought (*reason, think*), and performing a mental comparison (*check, examine, search, compare, question*). All of the lower level organization displayed in the Similarity Judgment Task might be characterized by the logical intensional relations entailed by the verb pair (Chaffin, Fellbaum, & Jenei, 1993; Fellbaum, 1990; Fellbaum & Miller, 1990), such as troponomy (e.g., *reason–think*), proper inclusion (e.g., *examine–check; search–check*), backward presupposition (e.g., *invent–plan*), and cause (e.g., *explore–discover*). While some of the organization found in the Verb Extension Task might also be described this way, there are contextual features which are better explanations of the differences between the two tasks. This tendency to weight cognitive outcomes in the Similarity Judgment Task can also be seen by the heavier weight placed on the Creativity dimension, the third dimension to appear in the INDSCAL.

Another potential explanation for the differences found between the two tasks is that, in the Verb Extension Task, we might have been unable to draw on the multiple facets of meaning that exist for verbs of knowing. Cognition verbs may be highly polysemous (i.e., have related meanings that often appear in different syntactic

frames depending on the specific sense intended) and, by examining only two potential scenarios for each verb, the meanings of the verbs in the Verb Extension Task were somehow more constrained than they were for the Similarity Judgment Task.

Linguistic views on verb ambiguity differ widely (c.f. Tanenhaus & Carlson, 1989), but sometimes make explicit distinctions between lexical core meaning ambiguity and argument–structure or thematic role ambiguity. Persons might, by this view, perform the Verb Extension Task by substituting the word into the context and seeing if it maintains a suitable syntactic and thematic frame as well as some core meaning. We feel that it is unlikely that this explanation forms the primary basis for the differences we detected between the Verb Extension Task and Similarity Judgment Task. On average, the verbs in the study were used quite broadly in 9.9 out of 64 possible scenarios. If subjects relied on the verbs' syntactic frame to make these judgments, then these frames seem to be quite general and apply to a large number of verbs of knowing. Also, there were instances in which the targeted verb would not substitute for the verb in the scenario directly (without the addition or deletion of prepositions and the like), but subject agreement on the appropriateness for the scenario was high (e.g., 79% for "Telling your Mom about the toy on TV while she is out of the room" for *describe* and 79% for "Trying to play a game you've never played before" for *figure out*). Clearly, subjects were using their naive understanding to interpret these verbs and not merely substituting the verb in the sentence.

Relatedly, another potential cause for the differences between the Verb Extension and Similarity Judgment task might be attributed to the fact that these scenarios were screened on the basis of expert, not naive judgments. Again, we think this is unlikely because of subjects' broad extension of the verbs in general. Examine the following scenarios not targeted for the verb *recognize* to which, on average, over ⅓ of the subjects extended its meaning:

Knowing that your Mom baked cookies for your school party by seeing the dirty dishes.

Picking out a word that is misspelled in a paragraph.

Listening to two different songs in music class and deciding if they were sung by the same person.

Figuring out where the rabbit is when it is the same color as the background in a picture in science class.

Deciding if two crayons are the same color out of your art box at school.

Clearly, these extensions reflected a naive understanding of *recognize* not displayed in expert judgments of those scenarios. Because subjects applied the verbs broadly, their folk knowledge of these processes were able to surface and influence the organization displayed in the Verb Extension Task. Nevertheless, we recognize that subjects' knowledge for the verbs we sampled is likely to be quite broader than the scenarios we created for the Verb Extension Task. Thus, we can assume that differences between the two tasks might be partially attributable to the particular scenarios we sampled. However, despite the potential for multiple sources of disagreements between the two tasks, the results were highly consistent across tasks.

The theory of mind uncovered in this study bears some resemblance to the work of Hoskens and DeBoeck (1991), D'Andrade (1987), and Rips and Conrad (1989). Both the naive Belgian subjects of Hoskens and DeBoeck (1991) and our North American subjects seemed to place an emphasis in their similarity ratings on the specialization of mental verbs for achieving common cognitive outcomes. In their study, subjects distinguished verbs involved in producing judgments and creative outcomes. Our subjects distinguished various kinds of cognitive outcomes as well including creativity,

decisional, and mental comparison outcomes. Further, the depth of processing dimension which distinguished verbs such as *think through, see through,* and *fathom* from *assume* and *memorize* was not a salient dimension for their naive subjects and it was not for ours either. Similar to D'Andrade (1987), our subjects made a major distinction between perceptual and knowledge processes, but they also made a number of further distinctions not noted by D'Andrade within knowledge verbs, particularly between processing and memory verbs. Also, the observation of Rips and Conrad (1989) that *think* is a very general cognitive verb (i.e., that it is deemed part of many cognitive processes) was supported. On average, the verb *think* was applied to nearly a third of the scenarios employed in the Extension Task (31.9%) and was the most general of all the verbs sampled.

The findings of this study support and extend that of our previous work (Fabricius et al., 1989; Schwanenflugel et al., in press). In this work, we have observed that adult theory of mind centers around three realizations. First, adults understand that memory plays a role in much cognitive processing. We find similar evidence in the present study. We found that adults distinguish constructive and nonconstructive processes on the basis of whether information from memory was directly available to support the process. Also, *understand* is not normally thought of as a direct memory process, but subjects in this and our previous studies saw understanding to be highly related to, but distinct from memory processes. Thus, memory is seen to play an important role in the cognitive mediation of understanding and nonconstructive cognitive operations, in particular.

Second, in our earlier research, we noted that adults recognized that inferential processes play a role in other cognitive processes. In this case, we found that adults viewed inference processes to play a role in distinguishing Processing Component verbs from other verbs in both ADDTREEs and, in particular, distinguishing Constructive from Nonconstructive processes in the Verb Extension Task ADDTREE.

Finally, in our earlier research, adults placed importance on the realization that the input mechanism was more than a conduit for sensory information. That is, adults appeared to understand that the input mechanism was an attentional mechanism mediating input from the sensory world to the conceptual world. This mediating mechanism was seen to have selective, limited capacity, and sampling abilities. The present research also supports this view by the finding of many different mediating cognitive operations both within the Input Component clusters of the ADDTREEs and at the input end of the information processing dimension of the MDS.

These aspects of adults' theory of mind suggested to us that adults are sensitive to the constructive nature of mental activity. The causal explanatory principles in a constructivist theory of mind include a conception of interactive mental processes that necessarily mediate between inputs and cognitive outcomes such as memories, plans, and decisions. Such a conception explains how it is possible for people to arrive at different cognitive outcomes from the same information. By placing great weight on the degree to which mental activities involved memory and inference, our subjects showed that they understood that one mental process interacts with and is often a part of anther mental process (see also Rips & Conrad, 1989). Similarly, their sophisticated conception of the attentional input mechanism reflected their understanding that mental processes such as attention, recognition, and comprehension occur even during the acquisition of information (Schwanenflugel et al., in press). Our present findings give us more direct evidence of adults' sensitivity to the constructive nature of mental processes. In this study, our subjects organized all mental

verbs according to the degree of certainty involved in the process, and they distinguished subgroups of verbs within the processing component that could be characterized as more or less constructive. The constructive processes were rated as being more uncertain and more inferential, using information that was less available and less likely to be retrieved from memory than nonconstructive processes.

Finally, the tasks and analyses used in this experiment were designed to uncover robust and salient features of this folk theory of mind. Subjects, no doubt, have additional knowledge of this domain and, perhaps, additional understandings that also organize this folk theory. Moreover, adults have many more than 30 verbs in their lexicon relating to ways of knowing or coming to know something not examined in the present study. However, our finding of converging results using different methods in this and our earlier work show that we are uncovering important and salient knowledge which people use to organize this domain.

In sum, our findings support the view that North American adults have an understanding of both the information processing characteristics and constructive characteristics of mental activities. They appear to view the components of the information processing system as highly interactive and flexible to support the use of information from both memory and perceptual systems and to produce distinct cognitive outcomes.

APPENDIX

Verb Extension Task Scenarios

Check	Going over your homework to see if you have made a mistake.
	Making sure you have your lunch money in your book bag.
Choose	Looking through your crayon box to get the perfect color for your new spaceman.
	Finding a partner for gym.
Compare	Listening to two different songs in music class and deciding if they were sung by the same person.
	Deciding if two crayons are the same color out of your art box at school.
Decide	Thinking about all the kids you know and realizing who you are going to give a Valentine's Day card to.
	Making up your mind about what to watch on TV.
Describe	Talking to your friend about what the new teacher is like.
	Telling your Mom about the toy on TV while she is out of the room.
Discover	Finding a shoe you thought you'd lost at the bottom of the toy box.
	Digging up a silver dollar in your backyard.
Estimate	Telling your Mom about how much longer it'll take to finish your homework.
	Drawing a line that is close to a foot long.
Examine	Running your hands over a piece of material to see how rough it feels.
	Looking at your fingerprint under a microscope.
Explain	Telling your Mom why you got a C in math.
	Helping your friend with a homework problem she doesn't understand.
Explore	Looking through the vacant lot behind your school to see what treasures you can find.
	Checking out an old barn to see what's left inside.
Figure out	(inference) Knowing that your Mom baked cookies for your school party by seeing the dirty dishes.
	(inference) Feeling that your teacher is going to give you a test when she says "put your books away."
	(complex problem solving) Coming in the middle of a film and putting together what's going on.
	(complex problem solving) Trying to play a game you've never played before.
Guess	Trying to figure out what your teacher is going to ask you next.
	Filling in a question when you don't know the answer.
Hear	Listening to some music.
	Being awakened by the phone when it rings.
Invent	Putting together a space-age car with legos.
	Making up a new game.

Know	Raising your hand to give the answer to a question your teacher asks.
	Having a secret from your friend.
Learn	Picking up a new song on the piano.
	Going over a new math concept in class.
Memorize	Practicing the order of the U.S. presidents.
	Going over your multiplication tables in your head.
Notice	Picking out a word that is misspelled in a paragraph.
	Seeing that your friend isn't in class today.
Observe	Watching your friends play outside from your bedroom window.
	Looking at the monkeys in their cages at the zoo.
Pay attention	Finding where the rabbit is, when it is the same color as the background in a picture in science class.
	Listening to the announcements in a noisy cafeteria at school.
Plan	Choosing what you need to make your costume for the school Christmas play.
	Deciding with your Mom where she is going to pick you up after school.
Question	Wondering when your homework is due.
	Asking how to make your experiment work.
Read	Finishing the last five pages of your library book.
	Looking at the funnies from the Sunday paper.
Reason	Trying to rule out some possibilities for why your friend is mad at you.
	Pointing out why joining the club is better than not joining it.
Recognize	Identifying a song by the first few notes your teacher plays on the piano.
	Seeing a mitten in the lost-and-found and knowing that it is the one you lost last week.
Remember	(prospective) Making sure to go to your classroom after playing to pick up your sweater before you go home.
	(prospective) Being sure to turn on the TV to watch your teacher on the evening news.
	(list) Writing down the names of the states you learned about in social studies last year.
	(list) Telling your friend everything you had to eat today in the school cafeteria.
Search	Looking all around your house to find your other shoe.
	Moving your hands through the sand to find the buried shovel.
See	Looking out the classroom window.
	Watching a movie.
Think	Wondering why there are so many stars up in the sky at night.
	Laying in the afternoon sun and going over the morning in your head.
Understand	Investigating a lego building during recess to see how it is built.
	Feeling like you know how to do an assignment after the teacher explains it.

REFERENCES

ANGLIN, J. M. (1977). *Word, object, and conceptual development.* New York: Norton.

BJORKLUND, D. F., THOMPSON, B. E., & ORNSTEIN, P. A. (1983). Developmental trends in children's typicality judgments. *Behavior Research Methods & Instrumentation*, 15, 350–356.

CARROLL, J. B., DAVIES, P., & RICHMAN, B. (1971). *The American heritage word frequency book.* NY: Houghton Mifflin Co.

CHAFFIN, R., FELLBAUM, C., & JENEI, J. (1993). *The paradigmatic organization of verbs in the mental lexicon.* Unpublished manuscript, Trenton State College, Trenton, NJ.

CLARK, A. (1987). From folk psychology to naive psychology. *Cognitive Science*, 11, 139–154.

D'ANDRADE, R. (1987). A folk model of the mind. In D. Holland & N. Quinn (Eds.), *Cultural models in language and thought* (pp. 112–148). Cambridge, England: Cambridge University Press.

FABRICIUS, W. V., & SCHWANENFLUGEL, P. J. (in press). The older child's theory of mind. In A. Demetriou & A. Efklides (Eds.), *The structure and development of mind: Models, methods, and application.* Amsterdam: North Holland.

FABRICIUS, W. V., SCHWANENFLUGEL, P. J., KYLLONEN, P. C., BARCLAY, C., & DENTON, S. M. (1989). Developing theories of mind: Children's and adults' concepts of mental activities. *Child Development*, 60, 1278–1290.

FELLBAUM, C. (1990). English verbs as a semantic net. *International Journal of Lexicography*, 3, 278–301.

FELLBAUM, C., & MILLER, G. A. (1990). Folk psychology or semantic entailment? Comment on Rips and Conrad (1989). *Psychological Review*, 97, 565–570.

HOSKENS, M., & DEBOECK, P. (1991). An implicit theory of intelligence-related mental activities. *Journal of Personality*, 59, 793–815.

KEESING, R. M. (1987). Models, "folk" and "cultural": Paradigms regained? In D. Holland & N. Quinn (Eds.), *Cultural models in language and thought* (pp. 369–393). Cambridge, England: Cambridge University Press.

KRUSCAL, J. B., & WISH, M. (1978). *Multidimensional scaling.* Sage University Paper Series on Quantitative Applications in the Social Sciences (Series No. 07-011). Beverley Hills, CA: Sage Publications.

LIN, P.-J., SCHWANENFLUGEL, P. J., & WISENBAKER, J. M. (1990). Category typicality, cultural familiarity, and the development of category knowledge. *Developmental Psychology,* 26, 805–813.

LUTZ, C. (1985). Ethnopsychology compared to what? Explaining behavior and consciousness among the Ifaluk. In G. White & J. Kirkpatrick (Eds.), *Person, self, and experience: Exploring Pacific ethnopsychologies* (pp. 35–79). Berkeley: University of California Press.

MURPHY, G. L., & MEDIN, D. L. (1985). The role of theories in conceptual coherence. *Psychological Review,* 92, 289–316.

RIPS, L. J., & CONRAD, F. G. (1989). Folk psychology of mental activities. *Psychological Review,* 96, 187–207.

ROSCH, E. (1975). Cognitive representations of semantic categories. *Journal of Experimental Psychology: General,* 104, 192–233.

ROSCH, E. (1978). Principles of categorization. In E. Rosch & B. Lloyd (Eds.), *Cognition and categorization* (pp. 27–48). Hillsdale, NJ: Erlbaum.

SATTATH, S., & TVERSKY, A. (1977). Additive similarity trees. *Psychometrika,* 42, 319–345.

SALTZ, E., SOLLER, E., & SIGEL, I. E. (1976). The development of natural language concepts. *Child Development,* 43, 1191–1202.

SAS SUPPLEMENTAL LIBRARY USER'S GUIDE (1980). Carey, NC: SAS Institute Inc.

SCHWANENFLUGEL, P. J., FABRICIUS, W. V., & ALEXANDER, J. M. (in press). Developing theories of the mind: Understanding categories and relations between mental activities. *Child Development.*

SHOBEN, E. J., & ROSS, B. H. (1987). Structure and process in cognitive psychology using multidimensional scaling and related techniques. In R. Ronning, J. Glover, J. C. Condey, & J. C. Witt (Eds.), *The influence of cognitive psychology on testing.* Hillsdale, NJ: Erlbaum.

TANENHAUS, M. K., & CARLSON, G. N. (1989). Lexical structure and language comprehension. In W. Marslen-Wilson (Ed.), *Lexical representation and process.* Cambridge, MA: MIT Press.

WHITE, T. G. (1982). Naming practices, typicality, and underextension in child language. *Journal of Experimental Child Psychology,* 33, 324–346.