The organization of verbs of knowing: Evidence for cultural commonality and variation in theory of mind

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Cross-cultural commonality and variation in folk theories of knowing were studied by examining the organization of verbs of knowing in German and Japanese adults. German and Japanese adults performed one of two tasks: a similarity judgment task and an attribute rating task. Organizational structure was assessed for the similarity judgment task using multidimensional scaling and additive similarity tree analyses. The attribute rating task was used to describe the characteristics that organized the dimensions and clusters emerging from the scaling solutions. The folk theory of mind displayed was an information processing model with constructive components, although the constructive aspects were more salient for the Germans than for the Japanese.

Folk theories of mind are important because of the fundamental role that they might play in our understanding of the everyday behavior of others, as well as in guiding our own strategic behavior (A. Clark, 1987; Perner, 1991). Most research on theories of mind has concentrated on very young children's understanding of the mind (see Wellman, 1990, for a review), although some research has focused on theories of mind held by adults (A. Clark, 1987; D'Andrade, 1987; Keesing, 1987; Rips & Conrad, 1989; Schwanenflugel, Fabricius, Noyes, Bigler, & Alexander, 1994). The term *folk theory* is used to refer to the naive views that are shared by a social group regarding the workings of a domain (D'Andrade, 1987; Keesing, 1987). Among other things, they determine the attributes that distinguish and relate concepts to each other (Murphy & Medin, 1985; Smith, Carey, & Wiser, 1985) and highlight what is viewed as important to the domain.

A typical approach to assessing the theory of mind held by a particular cultural group is to study the language that the group possesses for mental activities. From his interviews of several informants from the United States, D'Andrade (1987) concluded that English verbs for men-

tal activities can be divided into six types: perceptions, beliefs/knowledge, feelings/emotions, desires/wishes, intentions, and resolutions. D'Andrade's informants indicated words for each of these types that suggested a state aspect in which the mind is treated like a container that is in various states and a process aspect in which the mind is carrying out specific operations.

Rips and Conrad (1989) examined a sampling of mental concepts more formally, asking American participants to make "part of" (partonomic) and "kind of" (taxonomic) judgments for pairs of mental verbs. They found that people made a basic distinction between analytic verbs (corresponding roughly to the "verbs of knowing" used in the study to be reported here) and nonanalytic verbs. Furthermore, *thinking* was viewed as central: *thinking* was seen as a part of most mental verbs, and most mental verbs were seen as a kind of thinking. A kind-part reciprocal relation for mental verbs was detected in which one mental activity was deemed part of another if the second was viewed as a kind of the first. However, Fellbaum and Miller (1990) have questioned the appropriateness and generality of these relations for verbs. Furthermore, the reciprocal kind-part relation appears not to be specific to mental verbs (van Mechelen & De Boeck, 1993).

Hall and colleagues (Hall & Nagy, 1986; Hall, Scholnick, & Hughes, 1987) have argued that cognitive verbs are organized along a hierarchy of levels according to abstractness and conceptual difficulty ranging from the lower levels of perception, recognition, recall, and understanding to the higher levels of metacognition and evaluation.

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Evidence for this theoretical view was found in the production frequencies in adults' speech for these various categories of cognitive verbs reflecting a predominance of lower level uses (Hall et al., 1987). Furthermore, developmental increases occur in children's spontaneous use of higher order cognitive meanings (Booth & Hall, 1994, 1995; Frank & Hall, 1991; Hall et al., 1987). Although this proposed hierarchy may reflect essential elements in American adults' organization of cognitive verbs, it may instead simply reflect that situations requiring the higher levels of uses are less common and, therefore, developmentally less available to children. Moreover, some verbs or cognitive situations may simultaneously mix lower and higher levels of the hierarchy (such as for *search*, which has both a high perceptual element and a high evaluative element).

Schwanenflugel, Fabricius, and their colleagues have assessed people's theories of mind by examining the organization of mental verbs emerging from people's intensional and extensional judgments regarding verb similarity. In several studies, Schwanenflugel and her colleagues (M. D. Clark, Schwanenflugel, Everhart, & Bartini, 1996; Schwanenflugel, Fabricius, & Noyes, 1996; Schwanenflugel et al., 1994) have asked children and adults from the United States to rate pairs of mental verbs on how similar they are in terms of the way they use their mind in each one. Independent ratings regarding potential distinguishing attributes of major clusters and dimensions were obtained to describe the organizational features that emerged.

Evidence has been found for two major distinctions: First, people organize mental verbs along an information processing continuum ranging from input functions (e.g., *notice*) through processing (e.g., *think*) and memory functions (e.g., *learn*) to output functions (e.g., *explain*). Verbs at the input end of this continuum are rated as being perceptual; verbs at the center and output end of the continuum are rated as being conceptual. Cluster analysis suggested an organization according to information processing terms indicating major clusters for input, processing, and memory components. Across several studies, there has been little disagreement regarding the nature of this basic information processing continuum regardless of groups examined (cf. M. D. Clark et al., 1996; Schwanenflugel et al., 1996) or tasks used (cf. Schwanenflugel, Henderson, & Fabricius, 1998) to assess it.

A second distinction that has emerged consistently is one surrounding the *certainty* aspects of cognitive verbs. Both adults and children seem to make a distinction between certain and uncertain verbs (e.g., *know* vs. *guess*). In these studies, input and memory verbs seem to be viewed as rather certain surefire processes, whereas processing verbs tend to range from those relying on certain information (e.g., *explain*) to those relying on more uncertain information (e.g., *guess*). However, adults, older elementary school children, and comprehension moni-

tors (i.e., children able to identify explicit contradictions in stories) seem to place more emphasis on the certainty aspects of cognitive verbs than younger children and comprehension nonmonitors (Schwanenflugel et al., 1996; Schwanenflugel et al., 1998). We have argued that understanding that cognitive processes can be uncertain represents one aspect of the understanding constructive nature of mental activities.

In sum, then, a recurrent theme that emerges in much of the research on the organization of cognitive terms in American English is an organization along information processing characteristics (D'Andrade, 1987; Hall & Nagy, 1986; Schwanenflugel et al., 1994). Cognitive certainty and uncertainty may also be part of this organization.

The purpose of the present study was to examine the extent to which the features reported above with regards to the organization of cognitive verbs (which we will define as "ways of knowing or coming to know something") can be replicated for cultures other than the United States. Specifically, we examined whether the organization of verbs of knowing assessed by similarity ratings would be similar for Japanese and German adults. We started by assuming that we could test for the presence of the organization earlier noted for Americans, particularly the information processing and certainty emphases noted in that organization. There was some reason to anticipate that there might be some cultural variation in the organization of cognitive verbs for the Germans and Japanese. In previous research on the *emotion* domain, both cross-cultural commonality (Russell, 1983; Russell, Lewicka, & Niit, 1989) and variation (Gehm & Scherer, 1988; Yoshida, Kinase, Kurokawa, & Yashiro, 1970) for these two cultural groups have been found when contrasted against the organization displayed by American adults from the United States. In the present study, we looked for evidence of an information processing distinction characterized by an organization of cognitive verbs in terms of their input-output and perceptual/conceptual relations and a certainty distinction characterized by an organization of verbs in terms of the degree to which they represent knowing something for certain.

METHOD

Participants

The participants in the similarity judgment task were 30 Germans from the University of Mainz community and 29 Japanese from the University of Tsukuba community. All had at least 1 year of college education or were currently students. The participants in the attribute rating task were 15 Germans from the University of Mainz community and 13 Japanese from either the University of Tsukuba community or the University of Georgia community (having less than 2 years residency in the United States, $n = 3$). All participants volunteered for the experiment. In the follow-up attribute rating task were 10 Germans from the University of Mainz community and 10 Japanese participants from the Shinshu University community.

Table 1
Cross-Cultural Correlation Between Ratings

Group	Americans	Germans	Japanese
Similarity Judgments			
Americans	1.00		
Germans	.70	1.00	
Japanese	.56	.59	1.00
Perceptual/Conceptual Ratings			
Americans	1.00		
Germans	.89	1.00	
Japanese	.85	.81	1.00
Information Processing Ratings			
Americans	1.00		
Germans	.67	1.00	
Japanese	.71	.86	1.00
Certainty Ratings			
Americans	1.00		
Germans	.73	1.00	
Japanese	.67	.65	1.00

Note—All $ps < .05$.

Stimuli

Stimuli were German and Japanese translations of the 30 verbs of knowing employed by Schwanenflugel et al. (1994). These verbs had been selected by at least 8 out of 10 experts in cognitively oriented programs at the University of Georgia as being representative ways of knowing or coming to know something. All verbs had a frequency of 10 or greater per million according to the third grade English language corpus of Carroll, Davies, and Richman (1971). Thus, these were representative of basic, early-acquired cognitive verbs in English.

Translations from English to German and Japanese were first performed by two highly proficient German-English and Japanese-English bilinguals. Each had been speaking English for at least 15 years and had used it professionally or in their personal life for at least 5 years. Translations went to the multiple-word level when necessary. When there were two possible translations of the English word (there were six in German and four in Japanese), both were given to another highly proficient back translator who translated the items back into English, listing the targeted English verb as the best translation. (Even the rejected translations yielded a very close synonym for the desired term; e.g., *select* instead of *choose*; *scout out* instead of *explore*.) The translations used can be found in the Appendix A. In German, three of these translations went to the multi-word level (*reason*, *pay attention*, and *remember*) and, in Japanese, four did (*figure out*, *notice*, *pay attention*, and *reason*).

To ensure an equally representative subset of the cognitive verbs possessed by the various cultural groups, 18 Germans, 18 Americans, and 19 Japanese adults were asked to write down whatever cognitive verbs they could think of (defined as they were for the experts as "ways of knowing or coming to know something") in 5 min. The percentage of participants listing each verb was tabulated for each cognitive verb used in the study. An analysis of variance comparing the average percentage of participants listing each cognitive verb in the study indicated no difference in the representativeness of the set of verbs used in the study for the Americans ($M = 16$, $SD = 27$), Germans ($M = 21$, $SD = 24$), and Japanese ($M = 18$, $SD = 27$) [$F(2,58) = 1.02$, $p > .20$]. Moreover, correlations between the percentage of participants listing each verb in each cultural group indicated substantial correspondence between cultural groups in the relative frequency with which the various verbs tended to be listed by the cultural groups (Germans-Americans, $r = .68$; Japanese-Americans, $r = .78$; Germans-Japanese, $r = .73$). Therefore, the

verbs seemed to be a similarly representative sample of the cognitive verbs for each cultural group.

Procedure

For the similarity judgment task, the participants received a booklet containing a random ordering of all 435 pairs of the 30 verbs. The instructions for the similarity judgment task were translated versions of those used by Schwanenflugel et al. (1994). Each participant was asked to rate each pair of 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 way of using the mind and 7 representing a completely different way of using the mind. The participants were urged to use the full range of the scale. Each participant completed the task independently.

For the attribute rating task, the German and Japanese participants were asked to rate the 30 verbs on three attribute rating scales descriptive of the primary organizational features of the mental verbs for American adults. They were asked to rate the verbs on these attributes using the full range of the scale: (1) *certainty*, for which verbs were rated according to the degree to which they involve knowing something for certain (1 = *certain*, 7 = *uncertain*); (2) *information processing*, for which verbs were rated along an information processing continuum from input to output (1 = *input*, 7 = *output*); (3) *perceptual/conceptual*, for which verbs were rated according to their perceptual versus conceptual nature (1 = *perceptual*, 7 = *conceptual*). These scales were translated into German and Japanese for these participants.

RESULTS AND DISCUSSION

To create a similarity matrix for the verb similarity judgment task, ratings for each of the 435 verb pairs were averaged across participants. However, prior to averaging, it was important to determine that there was reasonable agreement across participants from each cultural group in their determinations of similarity. A Cronbach's alpha was performed on both the Japanese and the German data to assess interrater reliability for each group. The high interrater reliabilities obtained (Japanese, .95; German, .87) indicated a great degree of commonality among participants in each group, making it reasonable to average ratings across participants.

One way of assessing a common conception regarding the organization of cognitive verbs is to correlate each group's ratings with those of the other groups. We contrasted the German and Japanese ratings with the data obtained from the similarity judgment task in Schwanenflugel et al. (1994). These cross-cultural correlations (shown in Table 1) between the similarity matrices of each group show moderate cross-cultural correspondence in their similarity judgments (see Table 1).

Another way of determining a similar conception of cognitive verbs is to examine the degree to which the cultures view the verbs' attributes similarly. To assess this for each scale, we averaged across participant ratings for each cultural group. Then, we correlated the ratings obtained from the attribute rating task across all 30 verbs for all cultures. Table 1 shows moderate to high cross-cultural correspondence between each attribute rating scale.

Table 2
Correlations Between Each Culture's Verb
Attribute Ratings With Position of Verbs for the
First Two Dimensions of Each Group MDS

Dimension	Attribute Ratings		
	Certainty	Information Processing	Perceptual/Conceptual
Germans			
1	.71*	-.19	-.03
2	-.31	.80*	.85*
Japanese			
1	.47*	.11	-.02
2	-.25	.86*	.76*

* $p < .05$.

Multidimensional Scaling

Multidimensional scaling (MDS) is useful for uncovering global relational information organizing a semantic domain (Kruskal & Wish, 1978; Shoben & Ross, 1987). One version of MDS called INDSCAL allows us to combine the data from all cultural groups to assess the weight that each group places on various information in their ratings. To gain a sense of how each cultural group organized the global features of the domain, simple MDSs were performed on each cultural group's data separately using the Alscal program of SAS (*SAS Supplemental Library User's Guide*, 1980). When using MDS, the choice of number of dimensions is based on several criteria, among them goodness-of-fit, number of items, stability of solution, and theoretical or interpretive criteria. We present the three-dimensional solution in each case because (1) the number of verbs would permit it, (2) it provided a reasonable fit for each group's data (German, $R^2 = .808$, stress = .169; Japanese, $R^2 = .750$, stress = .174), and (3) the interpretability was maximized for this solution in each group. Previous research investigating the organization of mental verbs in American adults and children (Schwanenflugel et al., 1996; Schwanenflugel et al., 1994) has suggested that the identity of the third dimension is not stable, changing from subgroup to subgroup and verb set to verb set. The interpretations of the information processing and certainty dimensions have remained stable across studies, however. The fit between the American solution's information processing and certainty dimension was much closer when using the first two dimensions of the three dimensional solution for the German and Japanese groups. Because we feared underestimating the actual correspondence between these groups along these two dimensions (and potentially misrepresenting the organization as a result), we elected to use the organization obtained from the first two dimensions of the three-dimensional solution, which were the focus of our hypotheses from the start.

A descriptive account of MDS space involves orienting and interpreting the dimensions. The attribute ratings from each cultural group were used to assess whether each cultural group's organization along the various dimensions might be interpreted according to information processing

and certainty distinctions. To assess whether these distinctions were strong candidates for the organization of the space, we correlated the relevant attribute ratings obtained from the attribute rating task with the position of verbs along four 45° potential orientations of the dimension, looking for the best correlation with the dimension while maintaining the orthogonality of the space. Table 2 presents the correlations between the information processing, perceptual/conceptual, and certainty ratings obtained from each cultural group with their MDS. The MDS solution for the certainty and information processing dimensions are presented for the Germans in Figure 1 and the Japanese in Figure 2.

What is quickly noticeable about these MDSs is that each group makes a clear distinction between cognitive verbs in terms of the information processing characteristics (information processing, perceptual/conceptual) of the verbs. Each cultural group's attribute ratings of the verbs along the information processing continuum and their perceptual versus conceptual characteristics correlated highly with the position of verbs along the second dimension for both the German and the Japanese solution. In Schwanenflugel et al. (1994), the verbs that anchored the input end of the information processing continuum were *see*, *notice*, *observe*, *discover*, *recognize*, *attend*, and *explore*, and verbs anchoring the output end were *plan*, *reason*, *decide*, *explain*, *estimate*, *describe*, and *think*. Comparing these with items appearing at the poles of this dimension for the Germans and the Japanese, the Germans share 4 out of 7 of the polar input verbs and 5 out of 7 of the polar output verbs found in the American solution. Similarly, the Japanese share 5 out of 7 of the polar input verbs and 5 out of 7 of the polar output verbs found in the American solution.

The situation is somewhat different for the ordering of verbs along the certainty dimension. Whereas the certainty attribute ratings obtained from each cultural group correlated significantly with the organization of cognitive verbs along each group's first dimension, the Germans appeared to more closely organize their cognitive verbs according to certainty than the Japanese did, although this difference between correlations was not significant ($Z = 1.38$). The American MDS obtained by Schwanenflugel et al. (1994) yielded *memorize*, *remember*, *know*, *understand*, *learn*, *hear*, and *describe* at the certain end of the continuum and *question*, *check*, *search*, *choose*, *guess*, *examine*, and *explore* at the uncertain end. The Germans largely agree with the Americans in terms of the items that appear at the poles of the dimensions. Six out of 7 of the polar uncertain and 6 out of 7 of the polar certain verbs were shared by the Germans and the Americans. In contrast, the Japanese and the Americans share 6 out of 7 of the certain verbs, but only 3 out of 7 of the uncertain verbs. Thus, the differences between the Japanese and the other groups are relegated to the uncertain end of this dimension.

Another way to assess cross-cultural variation in MDS terms is to examine the relative weight that cultures place

Figure 1. Multidimensional scaling organization of verbs of knowing for German adults.

on dimensions. To assess this, an INDSCAL analysis was performed, entering the similarity matrices for the German, Japanese, and the previously published American similarity judgment tasks from Schwanenflugel et al. (1994) as one "individual." INDSCAL assumes that there is reasonable commonality of structure underlying the organization of each group taken individually. Evidence for this was presented for the interpretative criteria presented in Table 2 and in the similarity matrix correlations presented in Table 1. The two-dimensional solution was selected for further analysis because we had identified commonality of structure for the first two dimensions of the MDS for each of the individual groups' separate MDSs. Furthermore, the two-dimensional solution was a somewhat more balanced one across groups than the three-dimensional version was, fitting all groups very similarly (Japanese, $R^2 = .498$, stress = .299; German, $R^2 = .463$, stress = .308; American, $R^2 = .501$, stress = .296).

The first dimension to emerge from this analysis was related to the certainty of mental activities. A multiple correlation analyses regressing the certainty attribute ratings from all three cultural groups with the position of items along the first dimension yielded $R = .737$, $F(3,26) = 10.31$, $p = .0001$. Overall, this dimension accounted for 26.31% of the variance in the participants' similarity ratings. Importantly, however, the weights placed on the

certainty dimension was very similar across groups (German, .462; Japanese, .558; and American, .514).

The second dimension was related to information processing characteristics of the verbs. A multiple correlation analysis regressing the information processing and perceptual/conceptual attribute ratings from all three cultural groups with the position of items along the second dimension yielded $R = .870$, $F(6,23) = 11.98$, $p < .0001$. Overall, this dimension accounted for 22.42% of the variance in the participants' similarity ratings. This dimension was also weighted very similarly in each cultural groups' ratings (German, .501; Japanese, .432; and American, .486). Thus, the INDSCAL suggests a similar cross-cultural organization of cognitive verbs along the information processing dimension.

Additive Similarity Trees (ADDTREE)

ADDTREE (Sattath & Tversky, 1977) is a hierarchical network analysis for determining potential hierarchical clusters and subclusters in a conceptual domain. Similarity between concepts is represented when two items are represented in the same cluster and subcluster. To assess this kind of information regarding verbs of knowing, the similarity matrices from the similarity judgment task for the Japanese and German groups were submitted to ADDTREE. Figures 3 and 4 show the ADDTREE solu-

Figure 2. Multidimensional scaling organization of verbs of knowing for Japanese adults.

tion for the Germans and the Japanese, respectively. Clusters with the clearest interpretations are labeled.

Because some of our interpretations clearly went beyond the attribute ratings obtained in the attribute rating task, a follow-up attribute rating task was conducted ad hoc using 10 additional German students from the University of Mainz and 10 Japanese students from Shinshu University. This rating task included rating the verbs on the following scales: (1) *memory involvement* (1 = *involves little memory*, 7 = *involves lots of memory*); (2) *problem solving* (1 = *little problem solving*, 7 = *a lot to do with problem solving*); (3) *logic involvement* (1 = *little logic*, 7 = *a lot of logic*); (4) *creativity process* (1 = *little to do with creative process*, 7 = *lots to do with creative process*); (5) *decision making* (1 = *little part of decision making process*, 7 = *big part of decision making process*); (6) *visual/spatial-auditory/verbal* (1 = *visual/spatial*, 7 = *auditory/verbal*). We present the mean ratings from the attribute rating and follow-up attribute rating tasks for each word in Appendix B.

German ADDTREE. The German ADDTREE solution accounted for 71.9% of the variance, with a stress of .083. This ADDTREE gives us three major clusters (memory, processing, and input), suggesting a folk model of knowing that is remarkably similar to the information processing structure displayed by Americans.

First, on the bottom of Figure 3, we find a major cluster of verbs that seem to be involved in the input of information from the perceptual world, which we have labeled the *input component cluster*. In the attribute rating task, the German participants rated these verbs as belonging to the input end of the information processing scale ($M = 2.4$) and the perceptual end of the perceptual/conceptual scale ($M = 2.4$). This input component cluster includes all the verbs found in the analogous cluster of the previously published American data (Schwanenflugel et al., 1994; *hear, see, observe, pay attention, and notice*), as well as some other verbs (*discover, learn, memorize, and read*). This major cluster is further divided according to the perceptual modality relied on by the verbs, a distinction not found in the rather sparse input component cluster of the American solution. The Germans made a distinction between verbs relating to visual/spatial processes (*discover, notice, observe, and see*) and those relating to auditory/verbal processes (*hear, pay attention, learn, memorize, and read*). The subcluster labeled *visual/spatial* were rated $M = 2.3$, and those labeled *auditory/verbal* were rated $M = 4.4$ on the visual/spatial-auditory/verbal scale.

The top of Figure 3 shows a cluster of verbs that relate to memory aspects of information processing, and, thus, we have labeled it the *memory component*. The attribute

Figure 3. Additive similarity tree organization of verbs of knowing for German adults.

rating task suggested that these belong to the output end of the information processing scale ($M = 5.1$) and the conceptual end of the perceptual/conceptual scale ($M = 5.0$). The main distinction between the German memory component and the American one obtained by Schwanenflugel et al. (1994) is the addition of memory output verbs *describe* and *explain* to the other memory processes

know, *recognize*, and *remember*, and the movement of *learn* and *memorize* by the Germans to the input component cluster. The memory component verbs were rated $M = 5.0$ on the memory involvement scale, and the memory input verbs were rated $M = 5.2$.

Finally, in the center of Figure 3, we see a large set of mental verbs that deal with various ways of processing

information. The analogous cluster in the American solution obtained by Schwanenflugel et al. (1994) included a large cluster of verbs relevant to the various kinds of information manipulation, including output processes (*describe, explain*), creative processes (*discover, explore, figure out, invent, plan*), decision processes (*choose, decide, estimate, guess*), generic processes (*think, reason*), and mental comparison processes (*check, examine, search, compare, question*). This cluster from the German solution contained 83% of the verbs found in the American processing component cluster. The verbs within this cluster were rated as referring to conceptual processes ($M = 5.0$) rather than perceptual ones and were viewed as being located in the center of the information processing scale ($M = 4.5$) between inputs and outputs.

Within this large processing component cluster, the Germans make a further subdistinction between verbs involved in logical decision making (*choose, decide, compare, estimate, plan, reason, and think*; rated $M = 5.0$ on logic involvement, and $M = 5.7$ on relevance to decision making) and verbs involved in uncertain problem solving (*examine, explore, check, search, and question*; rated $M = 5.3$ in problem solving involvement scale). Presumably, decision processes relying on logic should be seen as relatively certain, which can be seen in ratings of these *logical decision* verbs as certain ($M = 2.9$) in contrast to ratings of certainty for the verbs labeled *uncertain problem solving* ($M = 4.5$). Thus, the Germans seem to make a distinction between processes engaged in reducing uncertainty through logic and processes involved in the uncertain exploration and expansion of information for problem solving.

Japanese ADDTREE. The Japanese ADDTREE accounted for 74.6% of the variance in the ratings (stress = .079). This ADDTREE indicates four major clusters, rather than the three found in the German solution. However, taken as a whole, the ADDTREE suggests an information processing characterization reasonably similar to the one suggested by the German solution.

At the bottom of Figure 4, we find two major clusters of verbs that relate to the input of information from the perceptual world to the conceptual one. Because they seem to be organized according to their perceptual modality/format characteristics (as the Germans did), we have labeled the cluster containing the verbs *discover, invent, notice, explore, search, check, examine, pay attention, observe, and see* the *visual/spatial input component*, and the cluster containing the verbs *hear, learn, question, and read* the *auditory/verbal input component*. The participants in the attribute rating task found these verbs to be relatively perceptual ($M_s = 2.63$ and 3.08 for the visual/spatial and auditory/verbal input components, respectively) and located at the input end of the information processing continuum ($M_s = 2.7$ and 2.04 for the visual/spatial and auditory/verbal input components, respectively). Verbs in the auditory/verbal cluster were rated

as being located toward the auditory/verbal end of the visual/spatial-auditory/verbal continuum ($M = 5.5$). Verbs in the visual/spatial input component cluster were rated as being located toward the visual/spatial end of the visual/spatial-auditory/verbal scale ($M = 2.3$). Within the visual/spatial input component is a set of verbs that refer to the input of visual/spatial information used during creative activities (*discover, invent, notice, explore, and search*; rated $M = 5.8$ on the involvement in the creative process scale). Within this visual/spatial input component is another set of verbs that refer to the rather generic functions of visual/spatial input (*check, examine, pay attention, observe, and see*), relying on relatively certain stable input ($M = 2.6$). The visual/spatial input and auditory/verbal input components taken together capture 89% of the verbs indicated in the German input component cluster and 100% of the verbs indicated in the analogous cluster from Schwanenflugel et al. (1994), suggesting a close alignment of these two clusters with the input component clusters of the other two cultural groups.

On the top of Figure 4, we find a cluster of verbs relevant to memory aspects of information processing, and so we have labeled this cluster (*describe, explain, memorize, know, remember, recognize, and understand*) the *memory component*. These verbs were rated by the participants in the attribute rating task as relatively conceptual ($M = 4.9$) and located somewhat toward the output end of the information processing continuum ($M = 4.7$). It includes all the verbs present in the analogous German cluster, including the distinction regarding output functions of memory (*describe* and *explain*) and all but one found in the analogous American cluster (*learn*).

In the middle of the Japanese solution is a large cluster of verbs (including *choose, decide, compare, guess, estimate, plan, figure out, reason, and think*), which we have labeled the *processing component cluster*. These verbs were rated by the participants in the attribute rating task as being relatively conceptual ($M = 5.2$) and toward the center of the information processing scale ($M = 4.4$). This component contained a cluster of verbs labeled *decision*, which were rated as highly involved in decision making ($M = 6.6$). It also contained another cluster of verbs, which we have labeled *logical problem solving*, whose verbs were rated as highly involved in logic ($M = 6.5$) and as part of the problem solving process ($M = 6.6$). Overall, however, this processing component cluster was greatly circumscribed relative to the contrasting German processing component clusters and the analogous cluster previously observed for Americans (Schwanenflugel et al., 1994). It consisted only of 56% of the verbs present in the German processing component and only 50% from the American clusters.

Specifically, what is missing from this Japanese processing component cluster was the set of verbs labeled *uncertain problem solving* in the German solution, which consisted of *examine, explore, check, search, and question*. The Japanese appeared to place greater emphasis on the

Figure 4. Additive similarity tree organization of verbs of knowing for Japanese adults.

input/output aspects of these verbs, in contrast to the emphasis on cognitive uncertainty that characterized German and American concept. Thus, it seems as though the Japanese view these processes as being more data-driven, in contrast to the conceptually driven characterization accorded these verbs by Germans and Americans.

GENERAL DISCUSSION

The present study identified both similarities and differences in the basic characterization of the folk theory of mind assessed from the conceptual organization of the cognitive verbs in Germans and Japanese. A robust and

particularly clear commonality was that both cultural groups appeared to distinguish among verbs according to their information processing memory functions. Previous research (Schwanenflugel et al., 1996; Schwanenflugel et al., 1998) has shown that even American elementary school children make distinctions among cognitive verbs according to these characteristics. Thus, the organization among cognitive verbs along information processing lines may represent a fundamental and potentially universal aspect of the folk theory of mind.

Evidence regarding a second commonality among mental verbs was more mixed. Specifically, each culture indicated some distinction made among cognitive verbs according to their certainty aspects, the importance of which did not appear to differ in the combined group INDSCAL. This certainty distinction was very clear for the Germans, whose conceptual organization of these verbs along one dimension of the MDS was closely related to that culture's ratings of certainty. Furthermore, the Germans demonstrated a processing component subcluster consisting of relatively uncertain, nonlogical problem-solving-related verbs. The Japanese data, in contrast, yielded only a weak organization along certainty in their MDS, with an organization matching the American and German MDSs only at the certain end of the spectrum. Furthermore, the cluster of uncertain, nonlogical problem solving functions identified in the German ADDTREE was absent from the Japanese solution.

What implications might cultural differences in emphasis on cognitive uncertainty have for the theory of mind possessed by the groups? Schwanenflugel et al. (1996; Schwanenflugel et al., 1994) have argued that cognitive certainty and uncertainty are part of a constructivist theory of mind. Importantly, certainty and uncertainty represent *cognitive feelings*, which are used to guide action and decision making (Clore & Parrott, 1994). Uncertainty may enable people to evaluate their knowledge, understanding, or expectations to motivate and modify further action. For instance, Clore and Parrott demonstrated that adults use feelings of uncertainty to assess that they did not understand something. If the distinction between cognitive certainty and uncertainty is an important element in this constructive theory of mind, and if cognitive uncertainty is not used by the Japanese to organize their mental verbs, it is possible that the Japanese do not view the mind to be quite as constructive as the Germans and the Americans do. Alternatively, to the degree that they view some uncertain cognitive processes as constructive, these constructive aspects appear to be relegated to input functions rather than to the conceptual processing that occurs once the information has entered the cognitive system. In contrast, Americans and Germans may view constructive processing to be more of a function of the cognitive processing system than the input system.

The theory of mind uncovered in this work bears some resemblance to the findings of previous research on the-

ory of mind in adults using other methods. Similar to D'Andrade (1987) and Hall and Nagy (1986), the German and the Japanese participants made a distinction between perceptual and knowledge processes, although the present findings also indicated a distinction between perceptual format for input verbs. Similar to Rips and Conrad (1989), the centrality verb *think* in the German and Japanese solutions suggests a high generality of *think* to most of the other verbs in the cognitive domain.

The present work may expand our current knowledge about commonality and variation in folk psychologies in general. To date, most of the literature on folk psychologies has dealt with the issue of the universality of human emotions and human emotion concepts, rather than cognition. For example, research on the organization and structure of the emotion lexicon has generally indicated substantial cross-cultural commonalities and only more subtle variations in the organization of that domain (see Russell, 1991, for an excellent review). Close cross-cultural correspondence is often obtained for at least one of the major dimensions (*pleasure-displeasure* being the strongest organizational feature found among emotion words) but not the others in multidimensional scaling of the words (Herrmann & Raybeck, 1981; Lutz, 1982; Russell, 1983; Russell et al., 1989). Thus, it appears that when the folk psychologies regarding both cognition and affect are taken into account, both cross-cultural commonalities and variations can be found in the ways that human beings construe the mind, although the particular insights vary from domain to domain.

There are several limitations of the present research that support the need for further treatment of this topic. First, only highly educated groups from industrial societies were used. It may be that these aspects of culture alone produced the commonalities that we detected in this study. Persons from agrarian societies with less emphasis on or availability of formal schooling may show an organization different from the ones manifested here. For example, limited schooling may be associated with a tendency to use modeling and more contextualized problem solving rather than inquiry or "mental talk" in the transmission and learning of new information (Laosa, 1983; Rogoff, Mistry, Göncü, & Mosier, 1993). In fact, Laosa (1983) has linked the inquiry approach of the formally schooled directly with an information processing characterization of learning. Investigation of less schooled, agrarian societies is necessary for drawing firm conclusions regarding cross-cultural correspondence in organization of cognitive verbs.

Another limitation of the present study is that the theory of mind uncovered from the organization of cognitive verbs may be limited to the particular sample of mental verbs we selected. The verbs used in this study were translations of early-acquired verbs learned by children in the United States. Early-acquired words tend to be prototypical, familiar, and basic (Anglin, 1977; Bjorklund,

Thompson, & Ornstein, 1983; Lin, Schwanenflugel, & Wisenbaker, 1990; Rosch, 1978). The cross-cultural correspondence of such words may actually be much greater than for words referring to either the boundaries of the categories or the subgeneric/subordinate level (Berlin, 1992). Therefore, it is conceivable that greater cross-cultural variation would be found if later-acquired verbs were used.

Finally, a full understanding of cross-cultural variation in the categorization and organization of any domain involves two complementary approaches (Blount & Schwanenflugel, 1993). One approach typically used in cognitive anthropology is to examine the availability of nomenclature from each culture regarding the domain and then explore the implications of lexical gaps within domains. Another approach typically used in cognitive psychology is to explore speakers' intuitions regarding reasonably translatable items and drawing inferences regarding cross-cultural differences from these intuitions. The present study relied on the latter, but a full account will rely on both approaches.

Related to this latter point, a third limitation that pervades all research of this type is the issue of translation correspondence. Wierzbicka (1986) has pointed out the difficulty of obtaining exact translation equivalents in a domain where there are no clear Munsell chip-like equivalences to match them against. She argues that it may be best to attempt to define words according to universal semantic primitives instead, although how this might be done in the absence of a theoretical approach to the domain is not at all clear (see Russell, 1991, p. 442). However, the attribute ratings we obtained from each culture help us establish the degree of correspondence between translations of the verbs for at least these attributes and support our interpretation of the organizational features that emerged. Thus, we feel this limitation is less applicable to our results because it was each culture's understanding and not our own that guided the conclusions we have drawn.

In any case, the limitations we outlined above would seem to operate to emphasize the cross-cultural commonality of verbs in this domain. Yet, we found evidence of both conceptual commonalities and variations. Cross-cultural commonalities were mainly found for the information processing aspects of the domain, and some variation was noted for the certainty aspects of cognitive verbs of knowing.

REFERENCES

- ANGLIN, J. M. (1977). *Word, object, and conceptual development*. New York: Norton.
- BERLIN, B. (1992). *Ethnobiological classification: Principles of categorization of plants and animals in traditional societies*. Princeton, NJ: Princeton University Press.
- BJORKLUND, D. F., THOMPSON, B. E., & ORNSTEIN, P. A. (1983). Developmental trends in children's typicality judgments. *Behavior Research Methods & Instrumentation*, **15**, 350-356.
- BLOUNT, B. G., & SCHWANENFLUGEL, P. J. (1993). Cultural bases of folk classificational systems. In J. Altarriba (Ed.), *Cognition and culture: A cross-cultural approach to psychology* (pp. 3-22). Amsterdam: Elsevier.
- BOOTH, J. R., & HALL, W. S. (1994). Role of the cognitive internal state lexicon in reading comprehension. *Journal of Educational Psychology*, **86**, 413-422.
- BOOTH, J. R., & HALL, W. S. (1995). Development of the understanding of the polysemous meanings of the mental-state verb know. *Cognitive Development*, **10**, 529-549.
- CARROLL, J. B., DAVIES, P., & RICHMAN, B. (1971). *The American Heritage word frequency book*. New York: Houghton Mifflin.
- CLARK, A. (1987). From folk psychology to naive psychology. *Cognitive Science*, **11**, 139-154.
- CLARK, M. D., SCHWANENFLUGEL, P. J., EVERHART, V. S., & BARTINI, M. (1996). Theory of mind in deaf adults and the organization of verbs of knowing. *Journal of Deaf Studies & Deaf Education*, **1**, 179-189.
- CLORE, G. L., & PARROTT, W. G. (1994). Cognitive feelings and meta-cognitive judgments. *European Journal of Social Psychology*, **24**, 101-115.
- 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: Cambridge University Press.
- FELLBAUM, C., & MILLER, G. A. (1990). Folk psychology or semantic entailment? Comment on Rips and Conrad (1989). *Psychological Review*, **97**, 565-570.
- FRANK, R. E., & HALL, W. S. (1991). Polysemy and the acquisition of the cognitive internal state lexicon. *Journal of Psycholinguistic Research*, **20**, 283-304.
- GEHM, T. L., & SCHERER, K. R. (1988). Factors determining the dimensions of subjunctive space. In K. R. Scherer (Ed.), *Facets of emotion: Recent research* (pp. 99-113). Hillsdale, NJ: Erlbaum.
- HALL, W. S., & NAGY, W. E. (1986). Theoretical issues in the investigation of words of internal report. In *Studies in cognitive science from the McGill workshops* (pp. 25-65). Norwood, NJ: Ablex.
- HALL, W. S., SCHOLNICK, E. K., & HUGHES, A. T. (1987). Contextual constraints on usage of cognitive words. *Journal of Psycholinguistic Research*, **16**, 289-310.
- HERRMANN, D. J., & RAYBECK, D. (1981). Similarities and differences in meaning in six cultures. *Journal of Cross-Cultural Psychology*, **12**, 194-206.
- 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: Cambridge University Press.
- KRUSKAL, J. B., & WISH, M. (1978). *Multidimensional scaling* (Sage University Paper Series on Quantitative Applications in the Social Sciences; Series No. 07-011). Beverly Hills, CA: Sage.
- LAOSA, L. M. (1983). School, occupation, culture, and family: The impact of schooling on the parent-child relationship. In I. E. Sigel & L. M. Laosa (Eds.), *Changing families* (pp. 79-135). NY: Plenum.
- 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. (1982). The domain of emotion words in Ifaluk. *American Ethnologist*, **9**, 113-128.
- MURPHY, G. L., & MEDIN, D. L. (1985). The role of theories in conceptual coherence. *Psychological Review*, **92**, 289-316.
- PERNER, J. (1991). *Understanding the representational mind*. Cambridge, MA: MIT Press.
- RIPS, L. J., & CONRAD, F. G. (1989). Folk psychology of mental activities. *Psychological Review*, **96**, 187-207.
- ROGOFF, B., MISTRY, J., GÖNCÜ, A., & MOSIER, C. (1993). Guided participation in cultural activity by toddlers and caregivers. *Monographs of the Society for Research in Child Development*, **58**(8), v-179.

- ROSCH, E. (1978). Principles of categorization. In E. Rosch & B. Lloyd (Eds.), *Cognition and categorization* (pp. 27-48). Hillsdale, NJ: Erlbaum.
- RUSSELL, J. A. (1983). Pancultural aspects of human conceptual organization of emotions. *Journal of Personality & Social Psychology*, 45, 1281-1288.
- RUSSELL, J. A. (1991). Culture and the categorization of emotions. *Psychological Bulletin*, 110, 426-450.
- RUSSELL, J. A., LEWICKA, M., & NIIT, T. (1989). A cross-cultural study of a circumplex model of affect. *Journal of Personality & Social Psychology*, 57, 848-856.
- SAS SUPPLEMENTAL LIBRARY USER'S GUIDE (1980). Carey, NC: SAS Institute.
- SATTATH, S., & TVERSKY, A. (1977). Additive similarity trees. *Psychometrika*, 42, 319-345.
- SCHWANENFLUGEL, P. J., FABRICIUS, W. V., & NOYES, C. R. (1996). Developing organization of mental verbs: Evidence for the development of a constructivist theory of mind in middle childhood. *Cognitive Development*, 11, 265-294.
- SCHWANENFLUGEL, P. J., FABRICIUS, W. V., NOYES, C. R., BIGLER, K. D., & ALEXANDER, J. M. (1994). The organization of mental verbs and folk theories of knowing. *Journal of Memory & Language*, 33, 376-395.
- SCHWANENFLUGEL, P. J., HENDERSON, R., & FABRICIUS, W. V. (1998). Developing organization of mental verbs and theory of mind: Evidence from extensions. *Developmental Psychology*, 34, 512-524.
- 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. Conoley, & J. C. Witt (Eds.), *The influence of cognitive psychology on testing* (pp. 229-266). Hillsdale, NJ: Erlbaum.
- SMITH, C., CAREY, S., & WISER, M. (1985). On differentiation: A case study of the development of the concepts of size, weight, and density. *Cognition*, 21, 177-237.
- VAN MECHELEN, I., & DE BOECK, P. (1993). Part-instance association in the categorization of acts. *Memory & Cognition*, 21, 41-47.
- WELLMAN, H. M. (1990). *The child's theory of mind*. Cambridge, MA: MIT Press.
- WIERZBICKA, A. (1986). Human emotions: Universal or culture-specific? *American Anthropologist*, 88, 584-594.
- YOSHIDA, M., KINASE, R., KUROKAWA, J., & YASHIRO, S. (1970). Multidimensional scaling of emotion. *Japanese Psychological Research*, 12, 45-61.

APPENDIX A Verb Translations Used in the Study

English	German	Japanese
check	überprüfen	チェックする
choose	auswählen	選ぶ
compare	vergleichen	くらべる
decide	entscheiden	決める
describe	beschreiben	描写する
discover	entdecken	発見する
estimate	einschätzen	見積もる
examine	untersuchen	検査する
explain	erklären	説明する
explore	erforschen	探検する
figure out	herausbekommen	(問題などを) 解く
guess	raten	推測する
hear	hören	聞(聴)く
invent	erfinden	発明する
know	wissen	知っている
learn	lernen	習う
memorize	einprägen	暗記する
notice	bemerken	気づく(目にとまる)
observe	beobachten	観察する
pay attention	aufmerksam sein	注意を向ける
plan	planen	計画する
question	befragen	質問する
read	lesen	読む
reason	logisch denken	(論理的に) 思考する
recognize	wiedererkennen	認識する
remember	sich erinnern	覚えている
search	durchsuchen	探す
see	sehen	見る
think	denken	考える
understand	verstehen	わかる

APPENDIX B Mean Attribute Ratings for the Verbs

Verb	Attribute Ratings								
	MEM	P/C	CERT	INFO	DEC	CREA	V/A	LOG	PS
Germans									
check	4.8	4.7	3.8	4.5	5.3	2.8	2.8	5.2	5.3
choose	4.5	5.2	2.3	4.7	5.6	3.6	3.0	3.7	4.2
compare	4.1	4.3	3.2	4.6	5.3	3.1	3.1	4.4	5.2
decide	4.4	6.2	2.2	5.3	7.0	4.3	3.2	5.4	6.3
describe	3.9	5.0	2.7	5.8	3.1	3.8	4.3	4.4	4.0
discover	3.2	2.4	4.5	2.1	4.3	4.9	2.5	4.0	4.9
estimate	4.2	4.9	3.3	5.2	4.7	2.6	3.3	4.1	4.0
examine	4.4	4.4	4.3	3.9	4.9	3.2	2.7	5.2	5.3
explain	5.0	6.1	2.2	5.9	4.1	2.7	5.3	5.7	5.2
explore	3.8	3.7	4.6	3.7	5.1	3.9	3.1	5.3	5.7
figure out	4.8	5.6	4.4	4.6	5.2	4.2	4.1	5.4	5.5
guess	3.6	4.2	6.2	4.5	2.7	2.9	4.7	1.7	2.2
hear	2.5	1.2	3.6	1.7	3.2	2.9	7.0	2.0	3.7
invent	4.3	5.3	3.5	5.5	2.9	6.7	2.5	4.8	4.0
know	5.0	5.5	1.6	4.7	5.8	3.6	3.9	5.1	6.1
learn	4.8	3.9	4.2	3.2	4.2	4.2	4.4	5.1	5.0

Appendix B (Continued)

Verb	Attribute Ratings								
	MEM	P/C	CERT	INFO	DEC	CREA	V/A	LOG	PS
memorize	5.6	4.3	2.8	4.0	3.4	3.5	3.8	4.1	4.4
notice	3.3	2.8	3.3	3.4	4.2	3.5	3.5	4.1	4.6
observe	3.5	1.7	4.4	1.7	4.4	3.5	2.3	3.2	5.4
pay attention	3.2	2.2	4.5	2.1	4.0	3.7	4.4	3.0	5.6
plan	4.8	6.3	2.6	5.4	5.2	4.6	3.4	4.8	4.0
question	3.7	4.6	4.6	3.0	4.6	3.6	5.2	3.4	4.5
read	3.4	2.3	3.5	2.3	4.1	2.5	2.2	3.0	4.1
reason	5.0	5.8	2.8	4.2	5.9	3.4	3.1	6.9	6.3
recognize	5.1	3.6	2.2	4.5	3.7	1.9	2.7	3.2	4.2
remember	6.0	4.6	2.8	4.7	4.5	3.0	3.2	3.3	3.8
search	4.2	2.8	5.3	3.5	3.4	3.9	2.2	3.2	5.6
see	2.6	1.2	3.2	1.5	3.4	4.2	1.0	2.5	4.2
think	4.9	5.8	3.9	4.2	5.9	5.1	3.9	5.8	6.3
understand	4.9	5.4	2.1	4.5	5.6	3.8	5.1	6.0	6.2
Japanese									
check	4.1	2.5	1.6	2.9	5.0	3.1	2.4	4.5	3.8
choose	4.3	3.5	3.1	3.6	6.6	3.7	3.2	4.7	5.6
compare	4.3	4.0	3.1	3.7	6.2	3.1	2.8	5.8	6.2
decide	4.0	5.2	2.5	5.5	7.0	3.9	4.4	4.7	6.4
describe	4.7	2.9	2.5	4.7	3.1	5.4	1.9	3.9	2.8
discover	3.0	2.8	2.6	2.9	3.6	6.4	2.2	2.8	5.6
estimate	3.6	4.3	3.5	4.3	5.0	4.2	3.4	5.0	5.2
examine	3.1	3.0	3.0	3.3	3.6	3.2	3.1	4.9	4.6
explain	4.8	5.4	2.2	6.4	4.5	3.3	6.3	6.5	4.1
explore	2.5	2.7	5.5	2.0	3.1	5.9	2.2	2.3	3.4
figure out	5.3	5.5	3.0	5.1	4.8	5.3	4.8	6.7	6.8
guess	4.6	5.8	5.3	4.3	5.3	5.7	4.7	5.8	6.2
hear	2.9	1.2	2.3	1.0	2.7	3.0	7.0	2.6	3.4
invent	3.4	4.6	3.2	5.9	3.8	7.0	3.3	2.9	3.7
know	6.9	5.5	1.6	4.9	4.1	2.7	5.0	4.0	5.3
learn	4.5	3.5	3.6	2.1	3.3	3.6	4.6	3.8	4.0
memorize	6.9	4.5	2.7	3.2	2.5	2.2	4.8	3.4	3.7
notice	3.0	2.0	2.9	1.9	4.4	4.8	1.4	2.9	5.3
observe	3.7	2.2	3.1	2.2	4.9	4.4	1.4	4.1	5.6
pay attention	3.5	2.6	2.7	2.4	4.8	4.2	3.1	3.8	4.8
plan	3.8	5.5	3.8	4.6	5.6	5.1	4.4	6.2	4.8
question	4.1	4.7	4.7	3.5	3.8	3.9	6.0	5.1	4.7
read	3.9	2.9	2.9	1.6	2.6	2.4	4.5	3.6	4.2
reason	5.0	6.7	3.6	4.4	5.7	4.9	5.5	6.9	6.8
recognize	5.4	5.2	2.7	4.1	4.8	4.4	4.4	5.8	5.3
remember	7.0	5.4	2.6	4.8	3.3	2.1	4.1	4.4	4.3
search	5.2	2.6	4.5	2.2	4.3	5.1	2.3	3.6	5.0
see	3.5	1.3	2.4	1.1	4.1	3.4	1.2	2.8	4.0
think	4.9	5.9	3.3	3.8	6.2	5.2	4.9	6.0	6.2
understand	5.5	5.5	1.9	5.1	5.4	4.6	4.8	5.7	5.7

Note—MEM, memory; P/C, perceptual/conceptual; CERT, certainty; INFO, information processing continuum (input/output); DEC, decision making process; CREA, creativity process; V/A, visual-spatial/auditory-verbal; LOG, Logic; PS, problem solving.