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Does Function Provide a Core for Artifact Concepts?

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Mental representations of everyday categories include many features that are neither necessary nor sufficient for membership in the category. Recent proposals have suggested, however, that there may be “core” features in the representation that are critical to category membership. Several researchers have suggested that for artifact categories (*chair, pencil, toy*, etc.), function serves as the concept core. We conducted two experiments testing whether the function typically associated with an artifact category provides clear boundaries for category membership. We found that some objects that do possess the function typically associated with a category are excluded from category membership, and we also found that some objects that do not possess the standard function are still considered to belong to the category. These results suggest that function may not provide a core for artifact concepts.

INTRODUCTION

The traditional view of concepts assumed that concepts could be described in terms of necessary and sufficient features, while the more recent family resemblance view holds that they consist of a set of features associated with a category with some probability (see Smith & Medin, 1981). Each view has had trouble accounting for all the observed facts about classification, however, and these problems have led a number of researchers to propose a hybrid view of concepts (e.g., Armstrong, Gleitman, & Gleitman, 1983; Medin & Smith, 1984; Rey, 1985). The hybrid view assumes that concepts contain both probabilistically associated features, used primarily for quick identification, and a concept “core” that can be called on when use of non-defining features is inadequate.

A hybrid model provides a convenient resolution to some of the problems associated with either pure view. However, it also resurrects an issue dropped in the move from the traditional view to the family resemblance view. One of the persistent problems for the traditional view was the difficulty of identifying features that would apply to all and only the exemplars of a given category (Wittgenstein, 1953; Rosch & Mervis, 1975). The hybrid view faces the same challenge the traditional view did in specifying exactly what the “core” features for various concepts might be. In addressing this issue for natural kind concepts (e.g., *tiger, gold, water*), many psychologists have adopted a view of the core derived from Putnam’s (1975) analysis of word meaning, and they take the core to be an underlying trait such as a genetic code in the case of species concepts, and chemical composition or atomic weight in the case of inorganic substances (Putnam, 1975; see also Carey, 1985; Keil, 1986; Smith, in press; among others). For artifact concepts such as *chair, pencil, or toy*, however, the philosophical literature is less helpful (Putnam, 1975, refers only to an “artifactual nature”), and most psychologists have looked elsewhere for ideas about the core.

The primary psychological hypothesis about a core for artifacts is that it is the artifact's function (Keil, 1986, 1987; Rips, 1986). Intuitively, function seems to be a central aspect of artifact concepts; the function of chairs, for instance, seems to vary less than their appearance. Empirically, function appears to play an important role in classification decisions about artifacts. For instance, Rips (1986) found that if something umbrella-like in appearance is described as having been manufactured for use as a lampshade, subjects tend to classify the object as a lampshade; the function information appears to be weighted more heavily than the appearance information.

Nevertheless, there is reason to question whether function is truly a core for artifact concepts in the sense of providing a clear criterion for category membership. In general, people do seem to treat natural kinds as if they at least believe in a core of some sort (Barr & Caplan, 1987; Keil, 1986, 1987; Rips, 1986), but it is less clear that they do so for artifacts. For instance, even the most atypical members of natural kind categories are held to truly belong to their category (e.g., a penguin is a full-fledged bird, no matter how atypical), while atypical members of artifact categories seem to only "sort of" belong to their category (e.g., a lamp is a marginal piece of furniture). People are also more willing to accept hedges such as "loosely speaking" with artifact terms than with natural kinds, and they are more willing to say "you can call it whichever you want" when confronted with a difficult-to-classify artifact than a difficult-to-classify natural kind (Malt, 1985, 1988). These various observations suggest that artifact concepts may not conform well to the hybrid view that all concepts have a core providing clear category boundaries.

Furthermore, with respect to function in particular, intuitions suggest that it is possible to invent objects that have the function of a particular artifact category yet might not be considered a member of that category. For example, suppose that the function of a bench is to provide economical seating for several people outdoors. If someone satisfies this function by building a 6-foot high platform holding seats for several people, accessed by a rope ladder, and shielded from the sun by an awning, is the object a bench? It is likely that many people would feel it is not, which suggests that appearance can be critical to the classification of an artifact. This sort of example argues that even if a core of some sort does exist for artifacts, function per se may not be the core.

Thus the status of function as providing a core for artifact concepts is unclear. We conducted two experiments aimed at providing more definitive evidence about whether function truly provides a core for artifact categories; that is, whether it provides clear boundaries for category membership. The first experiment tested whether having the function typically associated with a particular category is *sufficient* for membership in the category. The second tested whether having that function is *necessary* for membership in the category. If the function associated with a category serves as a core, then it should be both necessary and sufficient for membership in the category.

EXPERIMENT 1: SUFFICIENCY

This experiment tested whether having the function normally associated with a particular category was sufficient to cause an object to be considered a member of the category. We first collected detailed descriptions of the functions of a number of common artifact categories. Then we constructed descriptions of objects that preserved the original function but replaced several

standard physical features with new features. We were interested in whether or not these novel objects would be considered members of the original category on the basis of their function.

Method

Pretests. We used a three-phase procedure to arrive at the function statements for our descriptions. A fourth phase of pretesting provided a check on the physical features used in the descriptions.

Phase 1: Generating Contrast Categories. As a first step in eliciting the functions associated with common artifact categories, we gave 24 subjects a set of 28 common basic-level artifact names and asked them to list other categories that were similar to, but not the same as, each target category. Of the 28 categories, 17 yielded at least one response produced by 1/3 or more of the subjects. (For example, for “boots,” 16 subjects listed “shoes,” and for “couch,” 16 listed “chair.”) These 17 categories were used in the next phase of the experiment.

Phase 2: Eliciting Function Statements. We gave a new group of 20 subjects the 17 categories along with the contrast categories generated for each one in Phase 1. We asked subjects to describe the function of each target category in enough detail to distinguish it from the other similar categories. We tabulated responses, and used them to create a function statement for each target category.

Phase 3: Verifying Function Statements. To be sure that our derived function statements really did reflect the function of the intended category, we gave the statements to a new group of 24 subjects and asked them to list the category or categories each brought to mind. The target category was listed by at least half the subjects for each function statement, and in most cases by two-thirds or more of the subjects. Subjects thus did clearly perceive our function statements as belonging to the target categories.

Phase 4: Verifying Physical Features. We also wanted to be sure that the physical features for descriptions of the normal objects would be perceived as associated with the appropriate categories. For each target category, we constructed a 3- or 4-feature statement describing the appearance of a typical category member. We then gave 20 subjects the feature statements and asked them to list what object they thought the features belonged to. For 12 statements, the target category was the most frequent response, being listed by at least 1/2 of the subjects and in most cases substantially more. For these 12 categories, then, the feature statements are strongly associated with the target categories. For the remaining 5, the statements elicited the target category less than half the time, and these categories were eliminated from the stimulus set.

Sufficiency test. Having arrived at statements of both function and appearance that were reliably associated with particular artifact categories, we then constructed two kinds of artifact descriptions: normal and unusual. One description of each kind was constructed for each target category. The normal descriptions consisted simply of the physical feature statement pretested as described above, followed by the function statement pretested as described above. To construct the unusual descriptions, we took each physical feature mentioned in the normal statement and replaced it with an unusual one. We were careful to select only unusual features that would allow

the object to serve the stated function. The unusual features were followed by the normal function statement, as in the normal descriptions.

We asked 40 subjects to read these descriptions and respond whether or not they thought each item described was a member of the specified target category. Subjects made their responses on a 1-to-7 scale, where "1" was labelled "definitely is not," "7" was labelled "definitely is," and "4" was labelled "can't decide." Each subject saw a given target category in only one of its two versions. All subjects received the descriptions mixed with filler descriptions that varied functions as well as physical features to varying extents. Subjects were asked to read each item carefully, and they were given as much time as they wished to complete their ratings.

A sample description for "sweater" in its normal and unusual version is as follows:

(Normal) "This thing is made of wool, has buttons down the front, and has sleeves ending in small openings. It is used to provide extra warmth for the arms and the upper body by being worn over a shirt. Is this thing a sweater?"

(Unusual) "This thing is made of rubber, has buckles across the back, and has sleeves ending in gloves. It is used to provide extra warmth for the arms and the upper body by being worn over a shirt. Is this thing a sweater?"

Results

Descriptions with normal features were consistently rated as belonging to the target category, with a mean rating of 6.58 on the 7-point scale. Descriptions with unusual features received a mean rating of 4.35, which differed significantly from the normal feature mean, $F(1,38) = 315.68, p < .001$. This difference confirms that we were successful in creating descriptions for the unusual set that were perceived as different from normal category members.

The rating for unusual feature descriptions falls just above the midpoint of the scale. It is therefore important to look at ratings for individual items. If all items are rated on the positive side of the scale, this result would be consistent with the idea that having a particular function is sufficient to cause an item to be considered a member of a category. On the other hand, if this middle-of-the-road overall mean reflects a combination of items included in the category and items excluded from it, the result would argue against the sufficiency of function.

Inspection of individual items showed that ratings conform to the latter possibility. Of the 12 target categories, 7 had mean ratings above the midpoint of the scale, but 5 had mean ratings below the midpoint. Of the 7 that did receive positive ratings, in retrospect it seems that at least several may have had features that were not perceived as very different from normal features. Since 5 of the items clearly were denied membership in the target category, it appears that function alone cannot have been determining membership, and that subjects must have also been influenced by physical features in the descriptions. The finding that a substantial number of items with standard functions were excluded from category membership strongly suggests that while function information may be important in membership judgments, it alone is not *sufficient* to determine category membership.

EXPERIMENT 2: NECESSITY

If function provides a core for artifact categories, then having a particular function should also be necessary for membership in a category. In Experiment 2, we tested whether an object must have the function usually associated with a category in order for it to be considered a member of the category. To test the necessity of a particular function, we generated descriptions of objects with the physical appearance of typical members of target categories, but with functions other than the normal one. We were interested in whether or not these items would be excluded from category membership on the basis of their unusual functions.

Method

Physical features for descriptions in this experiment were identical to those pretested in Experiment 1. To create descriptions of objects that retained normal appearance but varied in function, we used 4 different variations of function. *Normal* functions were simply those pretested in Experiment 1. *Related* functions overlapped with the normal function somewhat, but differed from it in some noticeable way. *Bizarre* functions diverged more strongly from the normal function. *Denial* functions were ones that explicitly mentioned that the object could not be used to satisfy the standard function of the target category.

Fifty-six subjects read descriptions containing the normal physical features and either the standard function from Experiment 1 or one of the three types of changed functions. As in Experiment 1, subjects responded on a 7-point scale whether or not they thought the item was a member of the target category. They were again asked to read each item carefully and take as much time as necessary to complete their ratings. Each subject saw a given target category in only one of the four conditions (Normal, Related, Bizarre, or Denial).

A sample description for “boat” in each of its four versions is as follows:

(Normal) “This thing is wedge-shaped, with a sail, an anchor, and wooden sides. It is made to carry one or more people over a body of water for purposes of work or recreation. Is this thing a boat?”

(Related) “This thing is wedge-shaped, with a sail, an anchor, and wooden sides. It is made as a holding area for dangerous criminals or persons in exile by detaining them a certain distance off-shore. Is this thing a boat?”

(Bizarre) “This thing is wedge-shaped, with a sail, an anchor, and wooden sides. It is made to provide a temporary shelter and transportation for marine animals being reintroduced to their natural habitat. Is this thing a boat?”

(Denial) “This thing is wedge-shaped, with a sail, an anchor, and wooden sides. It is made for collecting samples of marine flora and fauna under sterile conditions, and is totally mechanized so that no people are allowed onboard under any circumstances. Is this thing a boat?”

Results

The mean rating for items with normal features and the standard function was 6.54 on the 7-point scale, in line with ratings for similar items in Experiment 1. The mean rating for Related items was 5.17; for Bizarre items, 4.67; and for Denial items, 4.14. An ANOVA showed that ratings for the four types of descriptions differed significantly among themselves, $F(3,156) = 79.00, p < .001$. The overall trend, with Related closest to Normal, followed by Bizarre and then Denial, confirms that we were successful in creating descriptions that systematically varied in how closely the function matched the function typically associated with each category.

Most importantly, these results show that for all three types of function changes, mean ratings of category membership remain positive, indicating that items with atypical functions may still be granted category membership. Examination of individual item ratings shows that 11 out of 12 Related items were rated above the midpoint, and 9 out of 12 Bizarre items were also. Perhaps most striking is the fact that 7 out of 12 items were above the midpoint even in the Denial condition, where descriptions explicitly stated that the item cannot serve the normal function. Thus subjects considered the majority of the items to be members of the target category even though the items did not possess the normal function. These results demonstrate that having the function normally associated with a category cannot be strictly *necessary* for category membership.

GENERAL DISCUSSION

The results of Experiments 1 and 2 together suggest that having a particular function does not constitute either a necessary or a sufficient condition for membership in an artifact category. They indicate that while function may be an important factor in determining classification for artifacts, it may not provide a core for artifact concepts in the sense intended in current hybrid views of concepts.

One might object to the conclusion of these experiments by arguing that function was defined too narrowly for each category. Thus, perhaps the reason some Related, Bizarre, or Denial items in Experiment 2 were included in the target category is that those functions were actually within the normal scope of the category function. This line of argument does not, however, salvage the function-as-core position, for it makes it more difficult to see how a function could provide the basis for classification decisions. If the function of "boat," for instance, is taken to be generally to carry or suspend any sort of objects above water, then the function is also compatible with a number of other categories, such as rafts, life preservers, and cruise ships. This problem is likely to arise for most or all categories. For instance, expanding a function for "couch" from the specific "made to seat 3-4 people comfortably, or for relaxing in a fully prone position" (used in our experiments), to a more general "for people to sit on," results in a function compatible with chairs, stools, etc. Thus it appears that to entertain the possibility that functions can serve as a concept core, function must be taken to be quite specific and restricted.

A related concern about the general viability of functions as concept cores is whether they could serve as cores for superordinate level categories. Our experimental stimuli were restricted to basic level categories such as "couch," "boat," and "tractor" for which it was not difficult to obtain detailed function statements. However, for superordinates such as "furniture," "toy," or

“vehicle,” it is less clear what function could be given that would encompass most common exemplars while excluding members of other categories. A broad function for “vehicle” such as “made to get people from one place to another without much effort on their part” might apply to most vehicles, but it would also apply to escalators, moving sidewalks, and time warp machines that most likely would not be called vehicles. More restricted versions of the function, with appeals to the use of engines or wheels, would exclude various exemplars such as horse-drawn buggies or sleighs (with the precise subset excluded depending on the formulation of the function). Furthermore, it is not clear that such restricted versions are really pure function statements, since they gain their specificity by adding information about appearance. Thus finding a function that could conceivably serve as a true core appears to be even more difficult for superordinates than for basic level categories.

In sum, while appeals to function may appear to solve the dilemma of what could serve as a core for artifact concepts, closer examination suggests that function alone may not provide the answer to membership in artifact categories. Although our experiments do not directly address what the basis for classification might be, they do suggest that wide variations in both physical appearance and function can be acceptable for artifact categories. Membership might be determined by the sort of family resemblance relationship described by Rosch and Mervis (1975); by more complex relationships such as those described by Lakoff (1987); or by a core composed of still-to-be discovered sorts of information.

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