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THREE KINDS OF CONCEPTS?

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For many years researchers assumed that all concepts could be adequately described by a set of defining (necessary and sufficient) features: analyses of concepts such as <u>bachelor</u> into features such as "unmarried" and "male" were thought to be extendible to ordinary concepts such as <u>bird</u> and <u>chair</u> (Katz & Fodor, 1963). A more recent view is that features are distributed across members of most categories in a "family resemblance" fashion such that features will be true of some subset of members of the category, but will never be singly necessary or jointly sufficient for category membership (Rosch & Mervis, 1975; Wittgenstein, 1953). Under this view, many common concepts consist of a set of features that are only associated with the category with some probability.

The importance of non-defining features in concept representations is by now undeniable (Rosch & Mervis, 1975; Smith, Shoben, & Rips, 1974). Their importance does not, however, preclude the possibility that defining features are also involved in concept representations. Armstrong, Gleitman, and Gleitman (1983) have shown that patterns of reaction times and typicality ratings taken as support for the family resemblance view can also be obtained for concepts such as <u>bachelor</u> that presumably do involve defining features. Others (e.g. Osherson & Smith, 1981; Rey, 1985) have argued on logical grounds that a pure family resemblance view may not be sufficient to account for facts about how we use concepts.

To solve these problems, concepts are now sometimes said to contain both non-defining features and a concept "core" of defining features (e.g. Armstrong et al., 1983;, Keil, 1986; Medin & Smith, 1984; Rey, 1985). Yet even this sort of hybrid proposal is not entirely satisfactory. A variety of evidence suggests that artifact concepts (<u>toy</u>, <u>furniture</u>, <u>game</u>, etc.) may differ in important ways from natural kind concepts (<u>bird</u>, <u>fish</u>, <u>tree</u>, etc.) For instance, even the most atypical members of natural kind categories seem to truly belong to their category (e.g. a penguin is a full-fledged member of the category "bird" no matter how little it resembles other birds), whereas atypical members of artifact categories seem to only "sort of" belong to the category (e.g. a lamp is a very marginal member of the category "furniture") [Rey, 1985; Lakoff, 1987]. Similarly, unclear cases seem to arise for natural kind categories due to insufficient knowledge about critical properties of the categories (e.g. in trying to decide- whether a tomato is a fruit or a vegetable), while they seem to arise for artifact categories due to lack of clear boundaries between the categories (e.g. in trying to decide whether a TV is furniture or an electrical appliance) [Rey, 1983; Malt, 1985]. These observations suggest that natural kind concepts possess something much more core-like than artifact concepts do.

But if, as previous investigations (e.g. Rosch & Mervis, 1975) suggested, people often do not know necessary and sufficient features for natural kinds,

then what underlies the difference between the two types of concepts? First, the nature of the feature information may still differ between the two in a subtle but important way: While natural kind concepts may include at least vague notions about the existence of core features, artifact concepts may not include anything resembling potential core features at all. Second, very different beliefs may be held about the completeness of the features as a description of the category they represent: While natural kind concepts may include a belief that more complete core information is in principle knowable, and is in fact known by experts, artifact concepts may include a belief that the characteristic features represented are all there is to know about the category.

The experiments reported below explore the possibility that these two separate types of concepts exist. They also investigate the possibility that a third kind of concept exists: those such as <u>bachelor</u> and <u>grandmother</u> for which the traditional analysis in terms of defining features have seemed most satisfactory (henceforth to be referred to as "relational kinds", since their definition often involves a relationship between one person or object and another). These latter concepts would presumably include both necessary and sufficient features and a belief that knowledge of relevant features is complete.

EXPERIMENT 1

Lakoff (1972) argued that linguistic hedges (e.g. "loosely speaking;" "technically") differ among themselves in the kinds of features that they refer to. If so, looking at acceptability judgments for sentences combining different hedges with various category terms should shed light on what sorts of features the concept representations contain. Subjects in this experiment read sentences containing a hedge and a category term (e.g. "Loosely speaking, that's a bird" and "Technically, that's a piece of clothing"), and judged whether each sentence was sensible or not.

The four hedges used were by "by definition," "technically," "according to experts," and "loosely speaking." A variety of arguments (Lakoff, 1972; Malt, 1985) suggest that "by definition" should only be acceptable in combination with categories for which one knows defining features; "technically" should be acceptable with those for which defining features are either known or are believed to exist; "according to experts" should be acceptable only when the complete meaning of the word is assumed to be known to experts in a domain but not to everyone else; and "loosely speaking" should be acceptable when a category does not have clear boundaries. Thus if the proposed distinctions among concepts are correct, "by definition" should be most acceptable with relational kind categories such as "bachelor"; "technically" with both relational kinds and natural kinds; "according to experts" with natural kinds; and "loosely speaking" with artifact categories.

A previous experiment (Malt, 1985) tested similar predictions using a total of twelve categories. Results supported the predictions: for instance, sentences combining "loosely speaking" with natural kind terms (e.g. "Loosely speaking, that's a tree") received low ratings, while sentences combining "loosely speaking" with artifact terms (e.g. "Loosely speaking, that's a tool") received significantly higher ratings. People clearly treated the different concepts differently in this task, and the differences corresponded

to the proposed distinctions in the nature of the representations. The present experiment was designed to provide additional support for these results in two ways: first, to establish their generality by using 12 new categories; and second, to address a possible criticism of the earlier experiment. In the previous experiment, the hedge used to differentiate natural kind concepts from the others was "scientifically speaking." "Scientifically speaking" may have been rated as most acceptable with natural kind terms simply because they are the only categories studied by people called scientists, not because part of their meaning is known only to experts. This hedge was therefore replaced by the hedge "according to experts." Subjects should find "according to experts" acceptable only if they believe the term in question has some aspect of its meaning that is known to an expert but not to the average language user.

Method

Twenty-four Lehigh University undergraduates participated. Four artifact terms (sport, toy, appliance, machine), four natural kind terms (star, planet, mineral, grass), and four relational kind terms (orphan, majority, hole-in-one, stealing) were used. As noted above, the four hedges were "technically," "by definition," "loosely speaking," and "according to experts." Each hedge was paired with each category, and every subject saw all target stimuli. Target stimuli were mixed with filler sentences involving hedges and categories not of interest in this experiment, and two random orders of sentences were constructed. The rating scale was from "1" to "7," with high numbers indicating high judged sensibility and low numbers indicating low judged sensibility.

Results

Mean ratings for each category type and hedge combination are given in the table below.

	relational kind	natural kind	artifact
by definition	5.8	5.5	5.3
according to experts	3.4	5.5	3.7
loosely speaking	3.3	3.0	4.2
technically	5.5	5.1	5.3

TABLE 1

Results replicated those of Malt (1985): As predicted, "loosely speaking" was judged more sensible with artifact categories than with the others; "according to experts" was judged most sensible with natural kind categories, and "by definition" was judged most sensible with relational kinds. The pattern for "technically" was not as predicted; it received approximately equal ratings for all category types. This finding is consistent with a marginal result for "technically" in the earlier experiment,

and will be discussed later. For the other three hedges, ratings again support the proposal that artifact, natural kind, and relation kind concepts differ in the information contained in the mental representation. (Note that column comparisons are not meaningful, since the hedges themselves vary somewhat in familiarity and "goodness").

Statistical analysis confirms these observations. An overall ANOVA showed a significant interaction between hedge and category type, $F(6, 138) = 33.54$, $p < .001$. Individual contrasts on rows showed that "loosely speaking" was judged more sensible with artifact categories than with the others [$F(1, 69) = 22.05$, $p < .001$]; "according to experts" was judged most sensible with natural kind categories [$F(1, 69) = 61.25$, $p < .001$]; and "by definition" was judged most sensible with relational kinds [$F(1, 69) = 3.20$, $.10 < p < .05$]. Ratings for "technically" did not conform to the predicted pattern [$F(1, 69) = 0.$]

EXPERIMENT 2

The second experiment asked about beliefs about concept completeness more explictly. Subjects were told to imagine they were trying to teach object names to a visitor from another planet. They were then given scenarios in which they encounter an artifact, natural kind, or relational kind exemplar that is difficult to classify. For instance, a scenario with natural kinds was as follows:

"In an orchard on the outskirst of town, you see a tree that seems to you to be sort of halfway between an orange tree and a lemon tree. You explain the dilemma to the visitor, and you say:

    a. "If I could think about it long enough, I could tell you which it is."
    b. "We'd have to ask an expert to tell us which it is."
    c. "Well, I guess you can call it whichever you want."

If people actually know the defining features for a category, they should believe that they will be able to make a correct classification decision even in difficult cases, and they should choose option (a). If they believe that they don't have all the relevant information but an expert does, they should feel that consulting someone else would be necessary [option (b)]. If they believe that they have all the possible information but the boundaries of the categories are fuzzy, they should feel that the classification is simply indeterminate [option (c)].

Method

Forty Lehigh University undergraduates participated. There were 22 target scenarios, consisting of 8 natural kind scenarios, 8 artifact scenarios, and 6 relational kind scenarios. Each scenario involved a description of an object that appeared to be halfway between two familiar categories. The pairs of categories for natural kinds were robin-sparrow; oak-maple; sardine-anchovy; rose-carnation; chicken-turkey; orange tree-lemon tree; trout-bass, and marigold-dandelion. The pairs for artifacts were chair-couch; boat-ship; shirt-blouse; hide and seek-tag; bookcase-shelf; car-truck; socks-stockings. The pairs for relational kinds were bachelor-widower;

triangle-square; prime number-odd number; homerun-triple; grandmother-aunt; and even number-odd number. These pairs were obtained in a preliminary experiment in which a separate group of 24 subjects was given the first member of each pair and standard instructions for obtaining linguistic contrast sets ("If it's not an X, what might it be?") The most frequently listed response was used as the second member of each pair.

Target scenarios were mixed with filler scenarios involving categories and response options not of interest in this experiment. Two different stimulus sets were constructed, each containing half the scenarios of each category type. Half the subjects received each set. Two versions of each set were used, differing in the order of scenarios and the order of response options.

Results

The table below gives the number of subjects out of 40 who chose each option on the majority of trials for each of the three category types.

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	option (a) "..think.."	option (b) "..expert.."	option (c) "..whichever.."	mixed
artifact	1	5	25	9
natural kind	1	30	5	4
relational kind	7	10	21	2

TABLE 2

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Chi-square values were computed comparing response patterns for each category type to the pattern expected if choices were random. Responses for all three category types diverged significantly from randomness, x^2 = 32.32 for artifacts and x^2 = 41.18 for natural kinds, $p < .001$ for both; x^2 = 8.58, $p < .025$ for relational kinds.

The pattern of responding clearly supported the predictions for artifact and natural kind categories. Subjects tended to choose option (c) for artifacts and option (b) for natural kinds, suggesting that they believe classificiation is not clear-cut for artifacts but is for natural kinds and can be determined by experts. Response patterns for both types diverged significantly from randomness.

Contrary to prediction, people tended to choose either option (b) or option (c) for relational kinds. One interpretation is that relational kinds are not qualitatively different from artifacts or natural kinds. An alternative, however, is that subjects found it odd to even propose the existence of an entity halfway between two relational kind categories and assumed that their knowledge would be insufficient to deal with such anomalous cases. This possibility would be further evidence for the well-defined nature of these categories and will be explored in future experiments.

DISCUSSION

Armstrong et al.'s (1983) experiments mentioned earlier demonstrate that standard reaction time and typicality rating tasks cannot provide definitive evidence about the existence of defining features in a concept. Alternative tasks must be found that reflect underlying knowledge about a category rather than performance strategies, and that do not require conscious access to the knowledge. The experiments reported here demonstrate that people make distinctions among concepts in tasks that call on their linguistic intuitions rather than performance in a speeded task. Thus, the linguistic judgment tasks used in these experiments appear to provide an approach that is sensitive to subtle variations in the content of concepts.

The most striking outcome of the two experiments is that subjects show a sharp distinction in the extent to which they feel natural kind and artifact concepts can be used in a loose, non-technical way. In both Experiment 1 and the earlier hedges study, subjects found "loosely speaking" much more acceptable with artifacts than with natural kind terms, while they found "according to experts" (or "scientifically speaking" in the earlier study) more acceptable with natural kinds. A subsequent experiment has confirmed that the result holds even when the natural kind and artifact categories are closely equated for level of abstraction; thus, this result is not an artifact of more concrete concepts in the natural kind domain. In Experiment 2, subjects consistently chose the response "You can call it whichever you want" for ambiguous artifacts, while they chose "We'd have to ask an expert" for natural kinds. These results together clearly indicate that the average college student participant believes there is a component of meaning to natural kind terms that may not be present in his or her own mental representation of the category. A similar belief does not seem to exist for artifacts; the students appear to be willing to use the terms in a looser fashion and to believe that such as use is appropriate. These results thus support the idea that natural kind and artifact concept representations differ, and further that beliefs about completeness of knowledge are an important component of a concept in addition to the actual features that are represented.

Given that the linguistic judgments are sensitive to variations in concept representations, one question that remains is why the hedge "technically" did not produce the predicted difference among the category types in Experiment 1 and produced only a marginal difference in the earlier hedges study. Subjects' comments provide some insight on this issue. Several pointed out that it is often possible to imagine contexts where it would be appropriate to speak technically of artifact categories. For instance, a department store might establish a rule to determine when an object should be displayed as sports equipment vs. when it belongs in the toy department. Thus a technical definition can potentially exist for an artifact term even if the general usage is not of this nature.

Finally, it important to note that although there was enough consistency among the natural kind, artifact, and relational kind terms to produce significant differences among the three groups, there was also noticeable item variability in the experiments reported here and in the earlier hedges study and the control study mentioned above. For example, "grass" received received

relatively low ratings for "according to experts" compared to the other natural kind terms, and "ship" received a relatively high number of choices of "you'd have to ask an expert" compared to other artifact categories.

In almost all cases, the discrepancies seem to involve highly familiar natural kinds being treated more like artifact categories and vice versa. These observations suggest that category type per se is not the only determiner of concept representation. Familiar natural kind concepts may tend to be represented more like artifact categories are, and concepts for unfamiliar artifacts used mainly in restricted settings may tend to resemble those for natural kinds. This possibility is being explored in studies in progress.

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