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Accessing abstract categories

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Subjects learned categories based on sentences that illustrated the figurative meaning of proverbs. The categories were either narrow, based on sentences that sampled similar contexts, or wide, otherwise. Width was a within-subjects factor in Experiment 1 and a between-subjects factor in Experiment 2. In general, transfer performance on novel examples suggested that width produces more flexible, decontextualized mental representations, but that subjects can overcome narrow experience.

People learn thousands of abstract categories. What sorts of factors affect the accessibility of these categories? Certainly the events that shape the categories play a crucial role, as do the test stimuli. For example, Posner and Keele (1968) found that training on moderately distorted dot patterns, versus mildly distorted patterns, significantly improved classification of novel, highly distorted examples of the original category. Homa and Vosburgh (1976) also found this "width effect," but more training with the more distorted patterns was required to produce it. Nitsch (1977) found it by using sentences that, for example, described people in different situations engaging in socially inappropriate behaviors.

In the present study, we focused on the width factor, by using, like Nitsch (1977), semantically based categories. Specifically, the subjects learned categories based on sentences that illustrated the figurative meaning of a proverb. The contexts sampled by the sentences were similar (narrow categories) or different (wide categories). Category accessibility was tested by using novel examples. Two experiments were conducted: the first made width a within-subjects factor, the second made width a between-subjects factor.

EXPERIMENT 1

Method

Subjects

The subjects were 26 students in the introductory psychology courses at the University of Cincinnati. Their participation satisfied a course requirement or earned them extra credit.

Materials

Acquisition. There were four families of three sentences each. The sentences within each family were written to be excellent positive instances of an interpretation of a proverb. For example, one proverb, its interpretation, and three instances were as follows: *A net with a hole in it won't catch any fish. / Something that's crucially flawed can't perform its normal function. / Because the astronaut's suit was poorly designed, he was burned by the high temperatures; The missionary who didn't speak the natives' language couldn't convert any of them; After its computer became unreliable, the space capsule was unable to take pictures of the craters.* The three instances here include two from the same domain, "space," and one from a different domain. The interpretations were used in previous research (Dorfmueller & Honeck, 1980; Honeck, Voegtle, & Sowry, 1981). For two of the families (narrow category) the contents of their three sentences were in the same semantic domain (sports, space travel). For the other two families (wide category) the contents of the three sentences were in quite different semantic domains.

Transfer. Transfer materials consisted of 32 sentences, 8 per acquisition family. Four of the 8 sentences were positive instances and four were negative instances. Positive instances described situations that were consistent with a proverb's interpretation. Most positive instances, including acquisition family sentences, had been ranked among the best instances of the interpretation by an independent group of subjects; the others were constructed by experimenter consensus.

Negative instances described situations that were not entirely consistent with a proverb's interpretation. For example, for the "net" proverb, a negative instance was the following: "A string busted on his guitar but he still played beautifully." Here, the flaw theme is present but it is negated because he played beautifully anyway. Thus, all negative instances were semantically related to a particular acquisition family, but were inconsistent with the wholistic family meaning. For each family, half of the positive and half of the negative instances were designated *same* because they sampled the same semantic domain as one (for wide categories) or all (for narrow categories) of their acquisition sentences. The other half were designated *different* because they sampled different semantic domains. Thus, for each family, there were two positive-same, two positive-different, two negative-same, and two negative-different instances.

Design

A within-subjects transfer design was used. The subjects learned the wide and narrow families through study and paired-associates trials, and they were then tested with the four types of transfer items.

Procedure

The family materials were presented in booklets. The subjects were given an initial 1 min 30 sec per family to think of the underlying meaning of the family. The first paired-associates trial followed immediately, with 10 sec poststimulus intervals and 5-sec postresponse feedback intervals. The responses were the family names; "net" family sentences, for example, were called "Merbee." The stimuli for this and subsequent paired-associates trials were presented with an overhead projector. The subjects were then given 1 min 30 sec to write down the meaning underlying each family. The second paired-associates trial with feedback followed. The subjects were then given 1 min per family to rate the sentences in each family on a 9-point scale, in terms of how well they expressed the family meaning. The mean ratings for the families ranged from 7.02-7.47 and were not significantly different [all $ts(25) \leq 1.42$, $p > .05$]. The third paired-associates trial, without feedback, followed.

On each study trial, four different orders of families and two different orders of family members were used. These orders were approximately balanced across subjects.

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After the acquisition stage, the booklets were collected, and transfer booklets were distributed. The experimenter went through and illustrated the instructions, making it clear that every new sentence belonged to a family and that only the deeper meaning was important, not the context for the sentence. The subjects circled a family name and either "yes" or "no" (i.e., did the sentence "fit the meaning?") for each of the 32 sentences. Two different quasi-random orders of the sentences were used. The subjects completed the task at their own pace.

Results and Discussion

Acquisition

The subjects were 100% correct on the third paired-associates trial for both wide and narrow family sentences.

Transfer

Comparisons involving width. Three measures of transfer performance were taken: number of correct family identifications, number of correct meaning (yes/no) detections, and number of correct combinations (both family and meaning were correct). Only the results on the combination measure are reported, since it is the least susceptible to bias effects.

A 2(width; wide vs. narrow) × 2(positiveness; positive vs. negative item) × 2(domain; same vs. different item) within-subjects analysis of variance on the number of correct combination responses was computed in order to do planned comparisons. These comparisons indicated that the wide condition produced better performance on positive-sames (87.5% vs. 71.3%) and positive-differents (78.75% vs. 61.50%); worse performance on negative-sames (64.5% vs. 84.5%), with all $ts(25) \geq 2.83$, and $p < .05$; and equal performance on negative-differents (60.5% vs. 60.5%), with $t(25) = 0.00$, and $p > .05$.

In conclusion, wide experience produced better performance on good examples from new domains. Not surprisingly, narrow experience facilitated performance on negative-same items but unexpectedly produced inferior performance on positive-same items. However, extensive pilot work indicated that performance under this condition was quite good, in the mid 80% range. Also, although too lengthy to report here, there was strong evidence that the two positive-same test items for one family did not retain family (learned) meaning very well. Thus, performance on positive-sames under the narrow condition may be invalid and anomalous. Alternatively, the use of a within-subjects design made the subjects realize that domain (context) was an invalid cue for assigning instances to families; this would tend to reduce performance under this condition.

EXPERIMENT 2

In this experiment, we replicated Experiment 1 by using a between-subjects rather than a within-subjects design. A between-subjects design does not allow subjects to compare conditions—in our case, to see that narrow and wide families were just that, and possibly to "widen" the narrow families. Also, this design allowed more families to be used in both wide and narrow conditions, thus decreasing the likelihood of a confound between the semantic content of a family and family width.

Method

Subjects

Sixty-six University of Cincinnati undergraduates participated in order to fulfill an introductory psychology course requirement. Thirty-three were randomly assigned to the wide condition, and 33 to the narrow condition.

Materials

As in Experiment 1, four families of materials, each based on a proverb, were used. The major departure from Experiment 1 was that two sets of acquisition sentences were prepared for each family, and the subjects were balanced across these sets.

Design

A mixed design was used. Width (wide vs. narrow) was the between-subjects factor, while positiveness (positive vs. negative test items) and domain (same vs. different) were crossed and constituted the within-subjects factors.

Procedure

The subjects were instructed, using illustrations, that they would see some families of materials and that they should learn the underlying family meaning and the family names for each member. Then 12 sentences, in groups of 3, were projected on a wall for 4 min. The first paired-associates trial followed, wherein sentences were presented for 15 sec, in random order, with a 5-sec postfeedback interval. Another study trial followed, during which the subjects had 2 min to write their interpretations of family meaning. Another paired-associates trial, with corrective feedback, followed, with sentences presented for 10 sec. On the third study trial, the subjects were given 2 min per family to rate family members on a 9-point scale, in terms of how well they retained family meaning. The mean ratings, which ranged from 6.70–7.23 per family, did not differ between families or conditions. On the last paired-associates trial, sentences were presented for 10 sec each, without feedback.

During transfer, the subjects read the instructions in their booklet, and then, for each of the 32 sentences (one per page), they responded "yes" or "no" and circled a family name. The subjects completed the task at their own pace.

Results and Discussion

Acquisition

The subjects were 100% correct on the third paired-associates trial for all wide and narrow families.

Transfer

Width effects. A 2 (width) × 2 (positiveness) × 2 (domain) analysis of variance was done to provide a basis for planned comparisons. These comparisons revealed ($a = .05$) that the narrow group performed better on positive-sames (72% vs. 59%) and negative-sames (63% vs. 49%), that the wide group was better on positive-differents (37% vs. 50%), and that performance was equal on negative-differents (44% vs. 47%).

Subjects' interpretations. Were the subjects' interpretations related to their transfer performance? To assess this, the subjects were placed in either the *good* interpretation group (all four interpretations were judged good)

or the *poor* interpretation group (one or more interpretations judged poor). Compared with the poor-narrow group, the good-narrow group was better by a margin of 9% on negative-sames, 21% on positive-differents, and 23% on negative-differents. Compared with the poor-wide group, the good-wide group was better by a margin of 18% on negative-sames, 8% on positive-differents, and 14% on negative-differents. Clearly, better interpretations, essentially more abstract, complete, decontextualized interpretations, benefited the narrow group subjects more, especially on test items from new domains. Indeed, good-narrow group performance on positive-differents was equal to the good-wide group's (48% vs. 53%).

GENERAL DISCUSSION

There was a consistent pattern across the two experiments. Narrow experience produced better performance on negative instances from the same domain (negative-sames), wide experience produced better performance on positive instances from novel domains (positive-differents), and performance was equal on negative instances from novel domains (negative-differents). There is a lingering question about performance on positive instances from an old domain (positive-sames), since the within-subjects study yielded better performance under the wide condition whereas the between-subjects study yielded better performance under the narrow condition. However, we believe this difference is due to sentence materials rather than experimental design, and that narrow experience generally favors good performance on positive instances from an old context.

In general, the results are consistent with those reported in the introduction: wide experience facilitates performance on new examples from a new domain. Presumably this occurs because such experience engenders a more decontextualized mental representation for a category. However, some subjects can overcome narrow experience and construct decontextualized representations. This representation is more flexible than that for a category representation typically forged on the basis of narrower experience, although the latter may produce an advantage with respect to items from the same domain. This advantage may occur either because contextual similarity facilitates the comparison of category representation with potential instance, or because the representation actually includes contextual information (for further discussion, see Honeck, Kibler, & Firment, 1987).

There is some evidence in the literature that people often do not apply ideas learned in one context to analogous ideas in another context (e.g., Ratterman & Gentner, 1987; Spencer & Weisberg, 1986). For example, Ratterman and Gentner (1987) had undergraduates read stories and, a week later, read some more. These latter stories matched the original stories in "mere appearance" (e.g., one story was about a hawk, the other about an eagle), "literal similarity" (both stories were about birds, a similar underlying theme), "mere appearance, first-order relations only" (the stories involved similar events, but different objects), and "true analogies" (the stories involved different objects, but a similar underlying theme). The subjects were asked, in the second session, which old stories the new stories reminded them of. From best to worst reminder, the results were literal similarity, mere appearance-first-order relations only, mere appearance, true analogy. Compared with the transfer items in the present study, literal similarity is analogous to positive-sames, mere appearance-first-order relations only is analogous to negative-sames, true analogies are analogous to positive-differents, and false analogies, which produced the worst reminding, analogous to negative-differents. There is a similar but very truncated pattern in performance across our four types of transfer items. Over both experiments and both width conditions, the percentages correct were positive-same = 72%, negative-same = 65%, positive-different = 57%, negative-different = 53%. The major difference between Ratterman and Gentner's study and our own was that their "different" stories—true analogies and false analogies—produced only 5%-10% reminding. Our *different* items yielded about 55% correct responses, which was far above chance and not much below the 68% correct figure for *same* items. We believe that the difference in results between the two studies is that we provided our subjects much more experience with the original verbal materials and emphasized that the theme of the materials had to be learned. It is not clear exactly what was learned by Ratterman and Gentner's subjects, since they were merely told to "read and remember" the original stories.

Thus, our results paint a more optimistic picture of people's ability to access and use categories in the face of new inputs that share only the same underlying idea. If subjects learn the original underlying ideas well, if these ideas are relatively well decontextualized, and if the subjects are mentally prepared to process new inputs on a nonliteral basis, then they will likely be able to apply these ideas in a new realm.

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