Adults' performance on a multidimensional sorting task for the dimensions of "shape" and "internal design"

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Thirty-two adults judged which two of three figures were most alike and also which two were most different. The figures differed in shape and internal design. Twenty-four different triads of figures were presented. Twelve Ss significantly preferred shape, 10 preferred internal design, and the remainder had no preference. However, only 4% of the total 768 "most different" judgments indicated a failure to consider both dimensions, indicating that the dimensions were available whether preferred or not. The elicitation of both same and different judgments is discussed as a means whereby dimension "availability" and dimension "preference"—ordinarily confounded in multidimensional sorting tasks—can be distinguished from one another.

In the usual multidimensional sorting task (e.g., Brian & Goodenough, 1929; Mitler & Harris, 1969; Harris, Mitler, & Schaller, 1970), the S is shown a card depicting two figures different, say, in color and shape. He then is asked which of the figures is more like a third figure that is identical to one of the original figures in color and to the other in shape. The question is, on the basis of which dimension will the judgment be made?

Performance in such a task generally is said to reflect the extent to which the S is "sensitive" to the dimensions involved, the usual inference being that such "sensitivity" is indicative of a greater saliency of the chosen dimension for the S.

The usual procedure, however, does not permit a distinction to be made between a dimension that is "unavailable" and one that simply is not "preferred." Preference and availability, as Mitler & Harris (1969) have argued, are logically different factors, and both can be involved in a person's conceptual treatment of stimulus dimensionality. They suggest that a particular dimension is "available" for an individual if he can respond both to two objects' mutual similarity to and their qualitative difference from a third object along that dimension. Whether, in a sorting task, he chooses to sort along that dimension or along another available dimension is a matter of preference. And while the decision to sort for one dimension (i.e., a preference for that dimension) logically implies that the dimension is available, it cannot be assumed that the other dimension is not. In studies with adults, this problem is perhaps not too serious, since ordinarily one can assume that most dimensions along which objects can be made to vary (e.g., color, shape, size, number) *are* available, so that preference for one dimension would not reasonably be interpreted to indicate nonavailability of the other. The problem is more serious with children, however, since the a priori assumption that all the dimensions are available would be much less warranted. Indeed, it is for purposes of assessing their availability that the multidimensional sorting task has been used in developmental studies.

What is needed, then, is a means to permit availability and preference to be distinguished from one another. Different measures have been used. Mitler & Harris (1969), for example, found that both children who matched for shape and children who matched for color could solve a concept-identification task in which the nonpreferred dimension was the cue. The nonpreferred dimension thus was shown to have been available. Lacking data on such learning tasks, there are still other possibilities. For example, Harris et al (1970), in a study of color-form sorting with preschoolers through third graders, asked whether the absence of preference for either dimension was indicative of the nonavailability of either dimension. If so, then Ss lacking preference ought to have alternated their choices more or less haphazardly between one dimension and the other on successive trials. Most such Ss did not; analysis of their performance on individual *blocks* of trials disclosed that they instead had shifted from one dimension to another. Both dimensions, therefore, were available, though over all trials neither was preferred.

In the present report, we describe still a third—and very simple—procedure for making the preference-availability distinction. Again, a multidimensional sorting task was used, though this time the shape dimension was paired with internal features instead of with color, and the task was to judge whether one of three figures was more like another figure of identical shape or one of identical internal design. But, in addition, the Ss were asked which two of the three figures were *most different* from each other.

The elicitation of "most different" judgments permits the distinction between preference and availability to be made in the following way: if the two triangles in the left-hand circle in Fig. 1 are called most alike (shape judgment), then the square and empty triangle should be called most different if the S, in fact, has attended to and weighed both dimensions in his judgment. Such a S, then, though failing to make even a single internal-design judgment, can be said to prefer shape but obviously cannot be assumed to have ignored or failed to detect the internal design. Similarly, for the right-hand circle, a S who calls the square and half-shaded hexagon most alike (internal-design judgment) should call the square and hexagon with parallel lines most different if both dimensions are available to him.

While the focus in this study was primarily methodological, there were several substantive questions at issue as well. The decision to match shape with internal design was made in hopes that the task might prove to be an analogue to the embedded figures task so prominent in research on cognitive style (e.g., Witkin et al, 1962). For example, one way of looking at performance on the embedded figures task is to view it as a test of the ability to detect or pick up information in the stimulus array that specifies the outline or shape of the figure and, simultaneously, to ignore other information—most particularly, information that specifies the figure's internal features or design. (In this task, the latter would be information simultaneously specifying the shape of *other* figures in the array.) Might such an ability to ignore or shut out the internal design be related to a preference for shape matching in a multidimensional task? That is, is shape generally a more salient or important dimension of figures for persons who are skillful at detecting embedded figures?

One indication, short of testing persons on both tasks (which was not done in the current study) would be to look for sex differences in frequency of shape judgments, since in the embedded figures task one of the most consistent findings is better performance in males than in females

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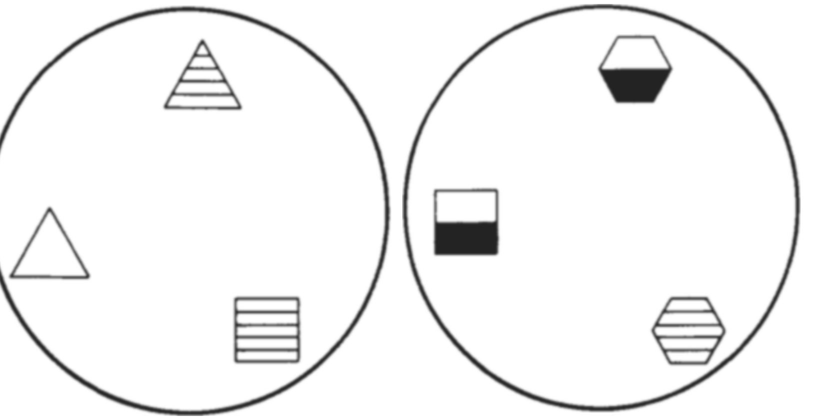

Fig. 1. Examples of 2 of the 24 different triads used in the shape/internal-design sorting task.

(Witkin et al, 1962). The expectation, therefore, would be of more frequent shape judgments by men than by women.

SUBJECTS

The Ss were 32 undergraduate volunteers, all of whom were enrolled in an introductory psychology class at Michigan State University. There were 11 men and 21 women.

STIMULUS MATERIALS

Combinations of shapes and internal designs were constructed as follows: four shapes (circle, equilateral triangle, square, and hexagon) were paired with four internal designs (half-shading, parallel lines, cross-hatching, and plain, i.e., blank) such that two of the three figures displayed on any trial were of the same shape and two figures contained the same internal design (one of the latter figures being one of the two with the same shape, the other being the third figure). Twenty-four different combinations of three figures were generated.

The three figures were printed by photo-offset on 4-in.-diam white paper circles. Each figure was approximately ¾ in. in diam. The figures were spaced equidistantly, just within the circle's edge. The figures were placed in identical orientations so that this variable would not be a factor in the judgments. An example of two circles is shown in Fig. 1.

PROCEDURE

Each S was given a 10 x 14 in. manila envolope which contained the 24 paper circles (hereafter called "triads"). The 24 different triads had been assembled in different orders and then literally dumped into the envelopes. The envelopes then were vigorously shaken. This procedure ensured a very high degree of mix. Thus, control for order of presentation of the triads was deliberately sacrificed in favor of haphazard (it was hoped, near-random) presentation.

The Ss were instructed to open the envelopes and to remove the triads one at a time, then to draw one line connecting those two figures that they judged to be most alike and another line connecting those two figures they judged to be most different. They were instructed to mark the first line with an "A" (alike) and the second with a "D" (different). Total testing time took approximately 8 to 10 min.

RESULTS

For each S, the number of triads for which the shape of the figures served as the basis for the "most alike" judgments was calculated. The mean number of shape judgments for the 32 Ss was 13.13, the range being 0-24.

Sex Differences

The difference between males and females was in the predicted direction. The mean number of shape judgments for the 11 men was 13.91, range 3-24, and for the 21 women, 12.71, range 0-24. A two-sample t test of the means disclosed, however, that this difference was not significant ($t < 1.0$).

Individual Subject Analysis

The mean number of shape judgments indicates that for the group as a whole, neither shape nor internal design was significantly preferred as the basis for judged similarity. The large range of scores, however, suggested that an analysis of individual scores would provide a more sensitive index of performance and thereby perhaps disclose differences between male and female Ss that the group analysis might have obscured.

According to a binomial expansion test ($N = 24$, $Q = P = 0.5$, two-tailed), at least 17 of the 24 judgments would have to be of either shape or internal design for an individual S to be said to have a significant preference ($p < .032$). By this criterion, 12 Ss (8 women and 4 men) showed significant preference for shape and 10 Ss (7 women, 3 men) for internal design. By a somewhat less stringent criterion, requiring only 16 of 24 judgments ($p < .076$), 14 Ss (9 women, 5 men) showed significant preference for shape and 11 Ss (7 women, 4 men) for internal design. The use of chi-square tests to compare the proportions of men and women having significant preferences for either shape or internal design failed to disclose any differences. Men were no more nor less likely than women to have strong preferences (i.e., to lie at the extreme ends of the distribution of judgments) or to have no preferences at all (to lie in the center of the distribution). Further chi-square tests indicated that for the group as a whole, the number of shape Ss was not different from the number of internal-design Ss. However, more than twice as many Ss showed a significant preference (for either shape or internal design) than failed to show a preference for either dimension ($\chi^2 = 4.5$, $df = 1$, $p < .05$).

"Most Different" Judgments

An analysis of the "most different" judgments indicated that only 4% of the judgments (31 of 768 total) indicated a failure to consider both dimensions in the choice made. Of these choices, 10 were accounted for by a single female "no-preference" S, while the remaining were spread quite evenly across the rest of the Ss. The results obviously indicate that both dimensions were available and taken into account through the 24 trials, irrespective of which dimension was preferred or whether there was a preference at all.

Triad Effect

The wide range of judgments, even within the majority of the Ss showing significant preference for one of the two dimensions, was unexpected. It had been anticipated that Ss having a preference would show it consistently, the 24 trials having been used as a means of detecting inconsistent, or no-preference, Ss. Examination of the distribution of judgments across particular triads indicated differential likelihoods of shape and internal-design judgments.

The mean proportion of internal-design judgments of the total of 24 triads was .47, which, of course, corresponds to the mean number of choices of internal design by the 32 Ss as a group. The proportion of internal-design judgments for individual triads ranged widely, however—from .25 to .72. In other words, certain triads were far more likely to elicit internal-design judgments than were other triads. An examination of the distribution suggested that the particular combination of shape and internal-design incorporated into the figures affected the basis for judged similarity. The two triads at the extremes of the distribution are those depicted in Fig. 1. For the left-hand triad, 75% of the Ss judged the two triangles most alike. For the right-hand triad, however, only 28% of the Ss judged the two hexagons most alike. The characteristics of these two triads were typical of the triads at their respective ends of the distribution of judgments. That is, triads made up of figures containing no features (plain internal design) tended to elicit shape-based similarity judgments, while triads incorporating figures containing half-shading tended to elicit internal-design-based similarity judgments. Triads made up of figures containing parallel lines together with cross-hatching tended to elicit internal-design-based and shape-based similarity judgments with more nearly equal frequency. The results do not, however, allow a measure of the absolute effect of any particular internal design or shape by itself, since not all combinations of the four different shapes and internal designs were used in the construction of individual triads.

The obtaining of a wide distribution of judgments for particular triads permits another kind of examination of the scores of individual Ss. Did Ss who made only a few internal-design-based similarity judgments (i.e., who had significant but not perfect shape preferences) make those judgments for those particular triads which, for the group of Ss as a whole, elicited a large proportion of internal-design-based judgments? Similarly, did Ss who made only a few shape-based judgments make those judgments for those triads which, for the total group of Ss, elicited a large proportion of shape-based judgments? The answer to both questions was yes. For Ss with significant shape preferences, 77% of their internal-design-based judgments were made for triads with proportion of internal-design judgments for all Ss equal to .58 and above. For Ss with significant internal-design preferences, 71% of their shape-based judgments were made for triads with proportion of shape judgments for all Ss equal to .60 and above. The implication is that the difference, say, between shape preferrers and Ss with no preference is quantitative, not qualitative: when the no-preference Ss made shape-based judgments, they were selecting from the same subset of triads as the shape preferrers, though less consistently.

DISCUSSION

The method described proved extremely easy to use. Analysis of the "most different" judgments seems to be a simple and powerful way to distinguish dimension preference from dimension availability. Experiments now are under way to see whether this method can be used with equal success with children.

Though the large majority of Ss showed significant preferences for either shape or internal design, the analysis of performance on individual trials indicates that their preferences grew stronger or weaker as the cues specifying one dimension or the other were made more or less salient. These results were not expected with adults for whom preferences were expected to be strongly entrenched. It is noteworthy that Corah & Gross (1967) obtained similar results with a color-shape sorting task with kindergarten-age children. These investigators found that reducing the brightness and saturation of the colors increased the proportion of shape choices. The current results suggest that the likelihood of use of the internal design of a figure in an internal-design/shape-sorting task with adults might be manipulable in a similar fashion. (Of course, it may have been the case that Corah and Gross had made the color dimension nonavailable rather than nonpreferred.) More generally, the results indicate that, in adults, dimension preference for either shape or internal design is clearly labile and thus could not yet be called an attribute of personality, in the sense of perceptual style.

As for sex differences, there clearly are none, at least in this sample of adult Ss. Though this finding certainly does not support the notion that shape-preference on a multidimensional sorting task and skillful performance on an embedded figures task might be related, the crucial test—actual comparison between performance on both tasks—remains to be carried out.

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