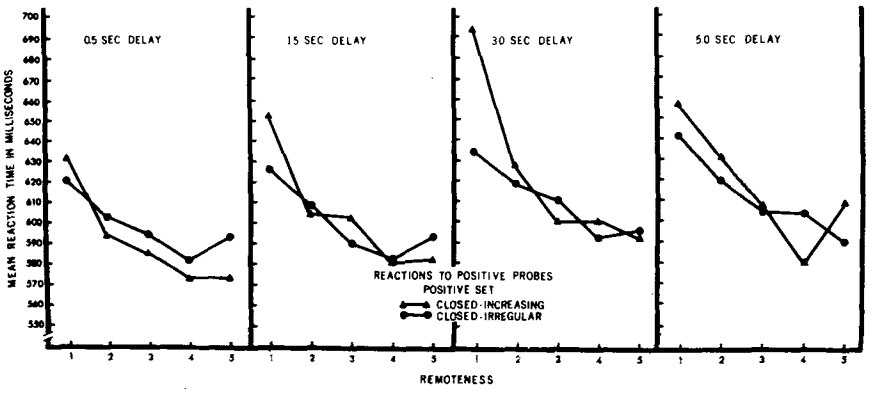

Fig. 2. Mean RT in milliseconds as a function of remoteness from the positive set.

probes at a remoteness of 1 are longest when the positive set is closed and increasing. This is not the case for elements at a remoteness greater than 1. Here the two curves tend to be much more comparable.

Although the results for negative reactions should be viewed with some caution since all digits did not appear equally often at each remoteness, the results are remarkably consistent with previous findings. In three markedly different experimental situations remoteness has been shown to be an important determinant of RTs to negative probes. In addition, variation due to remoteness is operative regardless of the pattern of results observed for positive responses. It appears that the finding is quite general and not affected by temporal organization to the degree which positive reactions are.

The remoteness effect illustrates the fact that the categorization process (yes-no) is influenced by features of stimuli which are not physical in nature. The features of negative elements which produce a retardation of reactions to items closest to the positive set are difficult to specify, but it is conceivable that one feature a digit may possess is its position within an ordered continuum (its magnitude). The positive set may define a *region* of a particular magnitude, and negative digits close in magnitude to the positive set are more similar to elements in the positive set than are elements which are more remote. This similarity might result in some form of response competition leading to slower reactions.

In summary, the results demonstrate that retrieval from a set of subspan items is influenced by temporal variables for a short time after presentation. In general, this influence is greatest and longer lasting when alternative means of organization are not available. After 3 sec temporal organization is not an important determinant of retrieval time. Within the limits of the present investigation, no evidence was found to indicate that the U-shaped functions observed by DeRosa & Morin (1970) were simply the result of a more permanent storage of information. Instead, it seems likely that their result for positive probes may have been due to the fact that sets did not change from trial to trial. Reactions to negative probes were influenced by remoteness and the result was independent of temporal variables.

REFERENCES

DeROSA, D. V., & MORIN, R. E. Recognition reaction time for digits in consecutive and nonconsecutive memorized sets. Journal of Experimental Psychology, 1970, 83, 472-479.

MORIN, R. E., DeROSA, D. V., & STULTZ, V. Recognition memory and reaction time. Acta Psychologica, 1967, 27, 298-305.

TULVING, E. Theoretical issues in free recall. In T. R. Dixon and D. L. Horton (Eds.), *Verbal behavior and general behavior theory*. Englewood Cliffs, N.J: Prentice-Hall, 1968. Pp. 2-36.

NOTE

1. In a closed-increasing set, a digit's serial position in the series is confounded with its ordinal value in the set. This is not the case for closed-irregular or open-irregular sets. The RTs for items in these sets were rearranged, using ordinal value as an independent variable. For example, with a positive set (6, 3, 5, 4) the ordinal value of items in the set would be 4, 1, 3, and 2, respectively. The resulting mean RTs were nearly equal.

Analytic and intuitive perceivers in the form constancy task

DALE W. KAESS*
Washington State University, Pullman, Wash. 99163

Two alternatives for the method used by Ss to solve the form constancy task were tested by varying the range of angles to which rectangles were rotated. Results indicate that response consistency improves as the angles become less discriminable, contrary to Koffka's invariance hypothesis. Thus, an alternative intuitive mode of perceiver operation is supported.

Students of form constancy have proposed at least two alternative methods by which the S might determine the objective shape of a rotated object. Koffka's "invariance hypothesis" supposes tha judgments of the objective shape are determined by an analytic process of combining the retinal image shape and the perceived slant of the object. Thus, errors in judgments of the objective shape result from errors in perception of the slant or rotation. Despite attempts by Stravrianos (1945), Beck & Gibson (1955), and Epstein, Bontrager, & Park (1962) to demonstrate the covariance of these errors, there remain seemingly unsystematic variations in the S's judgments of objective shape which do not covary with judgments of slant. However, it may be that explicit judgments of shape and slant, taken separately, do not correspond to that which the S actually perceives in the form constancy experiment.

Hake, Faust, McIntyre, & Murray (1967) suggest an alternative mode of perceiver operation in the constancy situation. They suggest the "nondiscriminating," or intuitive perceptual mode, by which the S does not determine separately the retinal image shape and the apparent slant. Rather, the perceiver simply obtains an intuitive shape-at-a-slant judgment.

A major difference between the two models of perceiver operation is the role of the angles to which the forms are rotated. When forms are presented at several discriminably different angles of rotation, the analytic perceiver should not perform well, due to the increased confusion in his judgment of slant. The nonanalytical or intuitive perceiver's performance should show the opposite trend with decreases of angle variation, however. To the intuitive perceiver, angle variation is basically "error variance," which must be overcome to achieve veridical perception of objective

*This experiment was supported in whole by Washington State University Graduate School research funds. The author wishes to thank Constance C. Kaess and Ronald Slater for assistance in data collection and reduction.

Table 1
The Average B/W Values in Each Condition

Instructions	0 Deg Only	Range of Angle Variation 0	20	40	60
Shape Only	1.83	0.87	0.80	0.39	0.25
Angle Only*	—	—	1.21	1.57	1.92
Shape and Angle†	1.62	0.80	0.75	0.43	0.30

*Angle judgments were not required when a single angle was used.
†B/W values for judgments of objective shape.

shapes. Consequently, the less the variation of the angles, the less the "error variance" and the better the intuitive perceiver's performance should be. The limiting case would be that in which all forms are presented at a single angle of rotation.

The present study is designed to test this proposition with children and adults, following five sessions of practice trials to overcome age differences of familiarity with experimental situations.

METHOD

Two male children and two male undergraduates were used. Their ages were 9, 11, 18, and 20 years. All had normal vision without correction. They were paid to participate in the study. Apparatus and viewing conditions were similar to that described previously (Kaess, 1970). Individual Ss were presented one of three rectangular sandpaper forms on each trial. These objective forms were all 90 mm tall and were 110, 120, and 130 mm wide. The sandpaper was changed frequently to minimize the effects of scars and identifying marks caused by use. Each objective form was rotated about its vertical axis to each of three angles to produce an orthogonal set of nine objective shape/angle combinations. On each trial, S identified the single form presented by pressing one of three buttons marked "wide," "middle," and "narrow."

A session consisted of 162 trials, during which each of the nine stimulus combinations followed every other combination an equal number of times. Each S participated in 15 sessions, one each weekday for 3 weeks. The first five sessions were practice trials, with the forms rotated to 25, 45, and 65 deg to familiarize the Ss with the experimental task. During the following 10 sessions, the five conditions denoted by the angle variation were presented in the same random order to all Ss. These conditions were: (1) 0 deg only, (2) 50 deg only, (3) 40, 50, 60 deg, (4) 30, 50, 70 deg, and (5) 20, 50, 80 deg.

One session with each of the five conditions was run in each week of the experiment. However, during the last week, the S was required to identify the angle of rotation before he identified the objective shape. This procedure was included to provide an assessment of the S's ability to identify the angles in the various conditions and of the effect of forced consideration of the angles on judgments of objective shape.

RESULTS AND DISCUSSION

The basic data were the number of times each S labeled each form wide, middle, or narrow with each objective shape/angle combination. Scores denoting consistency of responses were generated by computing the ratio of the variance between the three response class means to the average variance within the response classes (B/W). Thus, B/W is a measure of the consistency with which S placed each wide, middle, and narrow form in the same categories on every trial. It has been used previously in the context of multiple discriminant analysis by Hake et al (1967). These values for each of the five conditions and both instruction conditions are presented in Table 1. These values for the four Ss are averaged to conserve space.

There is a direct inverse relationship between the B/W values and the range of angle variations with all Ss. The more narrow the range of angle variation, the more consistent were the S's responses, regardless of whether the Ss were required to identify the objective shape only or both the angle and the objective shape. B/W values for the angle judgments show definite improvement in discriminability of the angles with increases of angle variation. Considered together, the data presented in Table 1 imply that these Ss approached the form constancy task in an intuitive nonanalytic manner. Apparently, these Ss did not rely upon accurate perception of the angles for judgments of the objective shapes.

Further evidence for the intuitive mode of perceiver operation results from analyses of the errors of judgments of the angles. Product-moment correlations were computed for those trials in which either the angle or the objective shape judgment were incorrect, in each of Conditions 3-5 for each S. The average of these 12 correlations was −0.05, and no individual correlation exceeded chance expectancy.

The only effect of age apparent with these data is an increase of response consistency with age. The mode of perceptual operation appears to be the same at all ages. Thus, apparently both 9- to 11-year-olds and adults are able to approach the form constancy task in the same intuitive manner. Additional data are necessary, however, to allow determination of the probability of each type of perceiver at various ages. There may be population differences among different age groups.

Thus, it is possible that some individuals at every age are able to separate perceptually the effect of angle and shape. Possibly, the percentages of Ss who are either analytical or intuitive changes with age, as well. The present data imply only that the Ss of various ages tested approached the form constancy task in an intuitive nonanalytical manner.

In summary, these data provide evidence for the intuitive nonanalytic mode of perceptual operation by both 9- to 11-year-olds and college undergraduates. Errors of angle identification increased as the range of angles decreased, but the errors did not covary with judgments of objective shapes, as predicted by Koffka (1935). The consistency of responses decreased as the angles became more discriminable (range increased), contrary to the invariance hypothesis. Consequently, Koffka's invariance hypothesis is rejected as an explanation of these particular Ss' modes of perceptual operation. Apparently, these Ss approached the form constancy task in an intuitive manner. They apparently judged "shape-at-a-slant" rather than analyzing angles and shapes separately.

REFERENCES

BECK, J., & GIBSON, J. J. The relation of apparent shape to apparent slant in the perception of objects. Journal of Experimental Psychology, 1955, 50, 125-133.

EPSTEIN, W., BONTRAGER, H., & PARK, J. The induction of nonveridical slant and the perception of shape. Journal of Experimental Psychology, 1962, 63, 472-479.

HAKE, H. W., FAUST, G. W., McINTYRE, J. S., & MURRAY, H. G. Relational perception and modes of perceiver operation. Perception & Psychophysics, 1967, 2, 469-478.

KAESS, D. W. Form constancy and the perceptual task: A developmental study. Journal of Experimental Psychology, 1970, 83, 465-471.

KOFFKA, K. *Principles of Gestalt psychology*. New York: Harcourt, Brace, 1935.

STRAVRIANOS, B. K. The relation of shape-perception to explicit judgments of inclination. Archives of Psychology, New York, 1945, No. 296.