Proceedings of the Iowa Academy of Science

Volume 68 | Annual Issue Article 75

1961

An Experimental Comparison of Associative Responses to Two Types of Randomly Derived Stimuli

George G. Karas
Iowa State University

Sheldon K. Edelman
Iowa State University

Richard J. Farrell
Iowa State University

Thomas E. DuBois
Iowa State University

An Experimental Comparison of Associative Responses to Two Types of Randomly Derived Stimuli

GEORGE G. KARAS, SHELDON K. EDELMAN, RICHARD J. FARRELL, AND THOMAS E. DUBOIS[1]

Abstract. Two methods for constructing random shapes were compared as to their effect upon latency of the associative response. Attneave and Arnoult had hypothesized that their Method II shapes would contain less stimulus information than would their Method I shapes. In the present study this hypothesis was substantiated only for female subjects. It was concluded that a reduction in stimulus information could not alone account for these results and that subject variables such as set and response threshold variability, must be included in the interpretation of results.

The classic work of Attneave and Arnoult (1956) has provided means for developing stimuli in the area of form and pattern perception. They have described nine techniques or sets of rules for generating so-called nonsense shapes. All of the methods which they set down consist of rules by which points are plotted and connected according to values taken from a table of random numbers. The stimuli thus constructed from these rules have in common the fact that the individual attributes or characteristics of each shape are randomly determined, and those figures generated in accordance with identical rules will be a random sample from the *stimulus-domain* as defined by the particular set of rules.

Their first two methods produce angular shapes with closed contours. The first step with each method is to plot a number of points on coordinate paper, using a table of random numbers. In Method I, the outer points are then connected to form a polygon with no concave angles greater than a small specified number of degrees. The allowance of small concave angles prevents cutting the shape in two. Finally, the points in the polygon are connected to the remaining enclosed points according to a random number table and certain rules. No lines are allowed to cross; as a result each of the final angles is found at one of the original points, and the final shape has the same number of angles as there were original points.

In Method II when the points are plotted they are also numbered. They are connected in the order in which their numbers appear in a random number table. The rules for connecting them prevent the loss of any points from placing them inside

[1] Department of Psychology, Iowa State University, Ames.

the shape. One of the rules states that no two points may be connected directly if they are already connected by perimeter lines which pass through no other points. The final shapes have angles at all the original points, plus other angles which Attneave and Arnoult call "emergent" angles. They may also be cut completely in two. This rule causes many of the final perimeter lines to be continuations of other perimeter lines. Because of this, the authors stated that Method II shapes are characterized by what they call "good continuation."

In discussing the information content of the shapes constructed by each method, they point out that if the same number of initial points are used, Method II shapes will contain more information and, incidentally, more final points. This is because information from the random number table is used to connect all the points, not just the internal points as in Method I. However, if fewer initial points are used for the Method II shapes and the shapes made by each method have the same number of final points, they state that the Method II shapes will contain less information because of the good continuation introduced into them.

The present study was designed to make a preliminary test of the validity of this latter hypothesis. Stated in null form, the actual test made upon this hypothesis was:

$$H_0 = \text{Method I does not differ from Method II.}$$

Ss were asked to respond associatively to shapes constructed by each method. Method I shapes contained 12 points and Method II shapes, because of the variability of final forms, contained 12 ± 1 points.

Cohen (1960), Suci et al. (1960), and others have found that shapes with relatively more information require more processing time for associations than do shapes with lower complexity. Latency to the first response was thus used as a measure of processing time and thus information content of the shapes.

Methods

Subjects

Twenty subjects, 10 males and 10 females, recruited from an introductory psychology course at Iowa State University were tested in the experiment. An additional subject was used for a "trial run" before the start of the actual data gathering. Some semblance of motivational control was attempted by giving the subjects extra credit in the course for taking part in the experiment.

Stimuli

Data were collected on twenty shapes, ten constructed by Attneave and Arnoult's Method I and ten by their Method II (Figure 1).

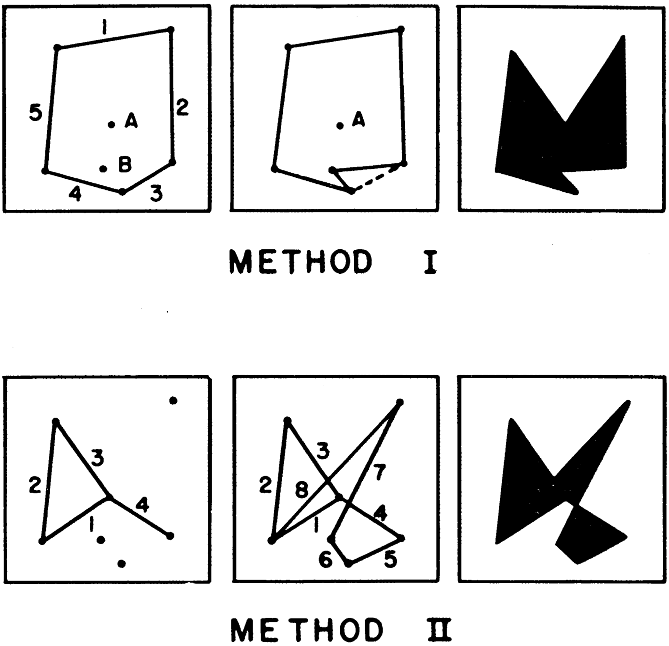

Figure 1. Construction techniques for Method I and Method II shapes.

The Method I shapes were constructed for and used in an earlier experiment. Each contained twelve points. The ten Method II shapes were made by plotting five to eight points and connecting them according to the prescribed rules. Of the ten that were used, six had 12 points, two had 11 points and two had 13 points. Approximately 15 shapes were plotted on the graph paper, they were traced on black construction paper, and mounted on 6 x 6 inch white cardboard.

Apparatus

The apparatus consisted of a modified Dodge tachistoscope controlled by an assortment of timers, keys and relays. The apparatus was set up in an open-topped cubicle as shown in Figure 2. Curtains divided the cubicle into two parts and also covered the back half, isolating the subject from most visual stimuli, including the experimenter.

The tachistoscope was controlled by a power supply which supplied power to either of the two lights shown in the appartus diagram, but never to both. When Light 1 was on, Light 2 was dark, the Lucite acted as a mirror, and the subject saw the blank black wall behind Light 1. When the power supply was switched from Light 1 to Light 2 by the main control, the Lucite functioned as a window and the subject saw the stimulus card in its holder.

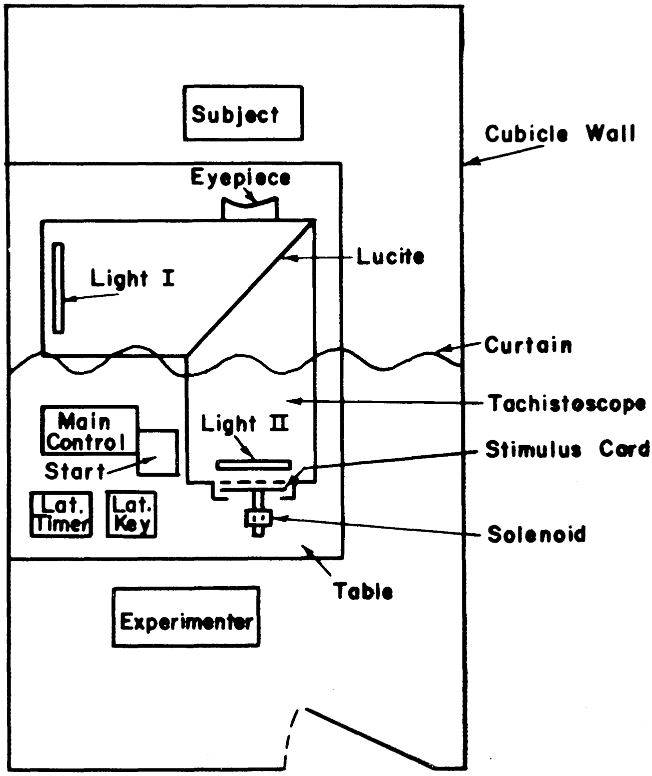

Figure 2. The cubicle in which the experiment was run, showing the approximate location of the apparatus as seen from above.

Figure 3 indicates the functional relationships between the various pieces of the apparatus. The start key started the main control, a Gra-Lab sixty-minute time clock modified with a number of relays and a buzzer. The main control sounded the warning buzzer, then simultaneously started the latency timer and switched the tachistoscope power supply to Light 2, illuminating the stimulus shape for ten seconds. The latency timer was 1/100 second Standard Electric timer. This timer stopped when the experimenter pressed the latency key. The main control also switched the tachistoscope power supply back to Light 1 at the end of the ten second stimulus exposure time.

Procedure

Each subject was given a printed sheet of instructions as he entered the experimental room. The instructions gave the step-by-step procedure to be followed in the experiment. The subject was told that a warning buzzer would sound, following which he would be shown a shape in the tachistoscope for ten seconds. The subject was instructed to look at each shape during the entire exposure period and to tell the experimenter of what it reminded him.

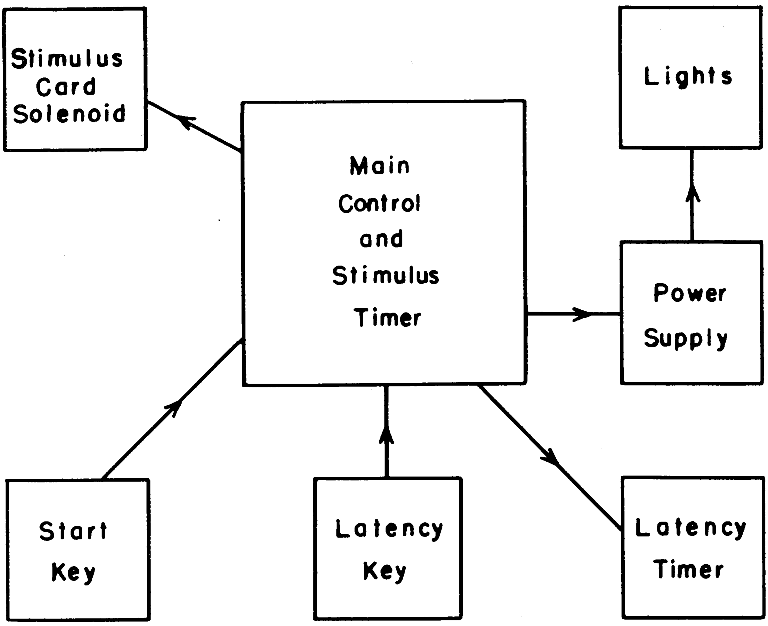

Figure 3. A block diagram of the control apparatus used in the experiment with arrows to indicate functional relationships between the components.

He was instructed to respond as soon as a thought occurred and again afterwards to as many other thoughts which occurred while the figure was exposed. He was further instructed that after the exposure time limit was up he was to tell the experimenter the number of other associations which he did not have time to report while the figure was exposed. The additional association data were gathered for future analysis of response content.

The twenty stimuli were presented in the same predetermined order to all subjects. The order devised was partially random with the limitation that no more than two stimuli constructed by the same method could appear in a row. Each subject was shown three sample stimuli before the actual gathering began.

A four-second buzzer preceded each ten-second stimulus exposure. Response latency was taken as the time from the initial illumination of the stimulus until the subject verbalized a response.

Response

Figure 4 presents graphically the mean response latencies for each method grouped separately by sex. Mean latencies for males were as follows: for Method I, 6.03 seconds, and for Method II, 6.18 seconds. The difference was not statistically significant. For females, the mean response latency for Method I was 7.43 seconds, and for Method II, 6.63 seconds. This difference is statistically significant beyond the .02 level.

Differences among stimuli are also significant; this corresponds with previous work in this area (Edelman, 1960) using a variety of experimental designs. Differences between sexes were found to be not significant. The apparent sex difference in the graph is negated by the use of an error term embodying the individual differences among Ss.

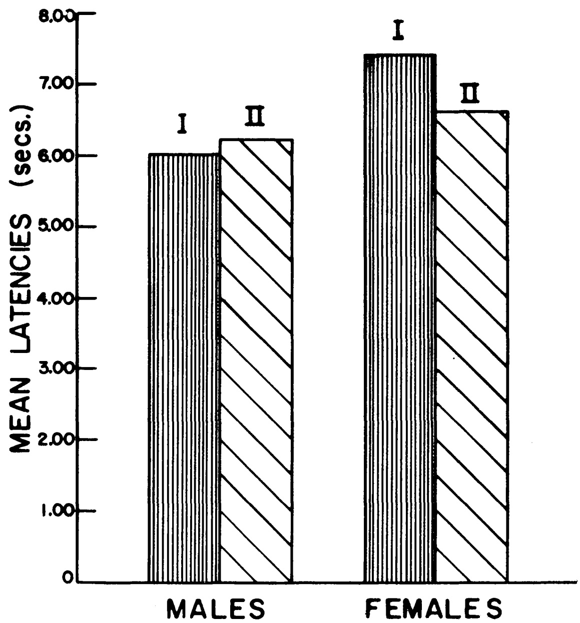

Figure 4. Mean latencies for Method I and Method II shapes for both sexes.

Discussion

The significant finding for females was in the direction predicted by Attneave and Arnoult (1956). Previous work has suggested that, within a single method for constructing random shapes, shapes with greater complexity (number of angles) will contain more information than shapes with lesser complexity. In this comparison of two methods of shape construction, it was expected that Method II shapes, by virtue of the good continuation introduced into the figure by the method, would yield less information than Method I shapes, despite the similar levels of complexity in shapes of both types (12 points vs. 12 ± 1 points). Thus, the hypothesis seems to be borne out, but *only* for women.

The prediction was definitely not substantiated for men. In order to explain this sex by method interaction, we may turn to possible trait and attitudinal differences between the sexes. For example, our Ss may have responded differentially because the shapes, like abstract art, require a certain degree of artistic sensitivity on the part of the S; however, this explanation presupposes a well-defined difference on the part of our men and women Ss, and, although this difference may not hold completely for the general population, the college student population used as Ss may very well dichotomize in this manner.

Assuming that for any specific response there will be associated with it a probability of occurrence, i.e., that the response will be suprathreshold, then it may be the case that the good continuation introduced into the Method II shapes does not reduce informational content but rather serves to lower certain thresholds of response, independent of informational content and that this response-threshold variability is sex-linked. One way in which this could have been enhanced is through differential sensitivity on the part of males and females to different stimulus configurations. Response thresholds could also have been reduced through the facilitation of certain kinds of perceptual sets while reducing others. The instructions may be instrumental in causing this to occur, although it is difficult to understand how the instructions would facilitate set-formation for one set of shapes and not for the other.

On the whole, although the prediction was partially substantiated, it does not seem likely that a simple reduction in information because of good continuation accounts for the interaction between sex and method. Nor is it likely that simple sex differences account for our result. The nature of the task of association to random shapes is such that neither stimulus elements alone nor subject characteristics alone can account for the results obtained. The results are most logically explained by assuming that both stimulus and subject contribute to the formation of a response. For example, in this study, there is a difference in the manner in which each sex utilizes the informational content of the two different classes of shapes; informational content, in this kind of setting, serves to facilitate certain sets (rather than to elicit certain responses) and to inhibit others. The facilitation of sets leads to a reduction in response threshold. Women are culturally and psychologically different in their perceptual apparatus; therefore, it seems likely that they will be affected differentially by different kinds of shapes.

Then, why don't men also respond differentially? As both explanation and hypothesis for further investigation, it may be posited that we have not tapped the full range of shape types (as defined by construction methods). When we have studied the reactions of both sexes to a full range of shape types, we may be able to find those shapes which enhance or facilitate male sets most effectively and those which do so for females.

References

Attneave, F., and Arnoult, M. D. 1953. The quantitative study of shape and pattern perception. Psychol. Bull. 53: 452-471.

Cohen, B. J. 1960. Contributions of complexity and symmetry to the perception of randomly designed visual stimuli. Unpublished master's thesis, Iowa State University.

Edelman, S. K. 1960. Analysis of some stimulus factors involved in the associative response. Unpublished doctoral thesis, Purdue University.

Suci, G. J., Davidoff, M. D., and Surwillo, W. W. 1960. Reaction time as a function of stimulus information and age. J. exp. Psychol. 60: 242-244.