The effects of stimulus familiarization on patterns of visual selection*

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Patterns of visual selection were recorded as Ss viewed pairs of stimulus drawings in which the two members were either both incongruous or both banal. Prior to presenting the paired stimuli, S was preexposed to either one member of the stimulus pair or to the incongruous or banal counterpart of one member of the stimulus pair. The results indicate that: (1) preexposure to a stimulus reduced its potential to elicit looking responses, and the magnitude of that reduction was greater for incongruous stimuli than for banal stimuli; (2) preexposure to an incongruous stimulus affected the potential of its banal counterpart to elicit looking responses, but preexposure to a banal stimulus did not affect the potential of its incongruous counterpart to elicit similar responses; and (3) the reduced potential of the preexposed member of a stimulus pair to elicit looking responses waned after 10 sec. These results were discussed in light of an "information-conflict resolution" model of visual selection.

Recently, a body of literature, which concerns the effects of familiarizing S with a stimulus on the subsequent dominance of that stimulus in visual selection, has accumulated. A consistent report is that preexposure to a stimulus diminishes its potential to subsequently elicit looking responses. This "familiarity effect" has been obtained using both children and adults as Ss, numerous types of stimuli, and a variety of experimental paradigms (e.g., Berlyne, 1958; Cantor & Cantor, 1964; Faw & Nunnally, 1970, 1971; Leckart, 1966).

While a familiarity effect has been consistently reported in studies concerning visual selection, little research has been undertaken to examine the stimulus characteristics, experimental conditions, and subject variables which might influence that effect. One previous study (Faw & Nunnally, 1971) demonstrated that the magnitude of the familiarity effect is an increasing function of the level of incongruity represented by the preexposed stimulus, i.e., the magnitude of the familiarity effect was greater when S was preexposed to a stimulus depicting a cow with its hind quarters replaced by an airplane's tail than when S was preexposed to a stimulus depicting a banal cow. Citing the earlier work of Berlyne (1960), the authors suggest that incongruous stimuli generate greater "informational-conflict" than their banal counterparts, i.e., are more difficult to identify, categorize, or attribute meaning to; to the extent that their assumption is correct, they suggest that the aforementioned

results provide support for an "information-conflict resolution" model of the familiarity effect. One purpose of the present experiment was to replicate, in part, those earlier findings and, in so doing, further examine the adequacy of an information-conflict resolution model of the familiarity effect.

Within the literature concerning the familiarity effect in visual selection, there has been speculation that preexposure to a stimulus affects not only its own potential to elicit looking responses but also the potential of stimuli to which it is conceptually related to elicit those responses. In particular, the suggestion has been made that exposure to an incongruous stimulus may diminish the potential of its banal counterpart to elicit looking responses (Faw & Nunnally, 1970). A second purpose of the present experiment was to examine the adequacy of that speculation and, contrariwise, to determine if preexposure to a banal stimulus would affect the potential of its incongruous counterpart to elicit looking responses. A final purpose of the present experiment was to examine the duration of the familiarity effect.

METHOD

Subjects

The Ss were 48 male college students.

Apparatus

The apparatus for recording eye movements is described in detail elsewhere (Faw & Nunnally, 1967). It consisted of a viewing box, with a translucent screen at one end and a goggle-like opening at the other end. The S rested his head in the opening and viewed stimulus slides projected onto the screen at the far end of the

box. A chinrest was used to reduce head movements, and ear protectors were used to reduce potentially distracting noises. A movie camera, mounted on the side of the box, photographed the movements of the S's left eye.

Stimuli

The stimuli consisted of 16 line drawings of banal figures (e.g., a cow) and, for each of those banal figures, an incongruous counterpart (e.g., a cow with an airplane's tail). The 16 banal drawings with their incongruous counterparts were divided randomly into four sets. Each of the four sets consisted of four banal drawings and their four incongruous counterparts. Within each set, the four banal drawings were paired with one another and photographed as stimulus slides, for a total of six paired stimuli. Similarly, the four incongruous drawings in each set were paired with one another and photographed as 35-mm stimulus slides, for an additional six paired stimuli. The projected drawings in the paired-stimulus slides measured 4 x 5½ in. The drawings were separated horizontally on the screen by 13 in., and the distance between their centers subtended an arc of approximately 36 deg, as measured from the center of the goggle opening. This separation forced S to make a gross eye movement in order to bring either stimulus into his direct line of sight. To allow for potential position preferences, each of the paired drawings was rephotographed with the left-right positions of the drawings reversed. In addition to the paired slides, each stimulus drawing was individually photographed as a 35-mm slide. The single drawings were centered on the slide, and, when projected onto the viewing screen, the size of these drawings was the same as the projected size of the drawings in the stimulus pairs. These single drawings served as preexposure stimuli in the experiment.

Design and Procedure

The design of the experiment included two factors: (1) the level of incongruity of the preexposed stimulus drawing, either banal or incongruous, and (2) the level of incongruity of the paired stimuli—either both drawings were banal or both were incongruous. Combining these two factors resulted in four experimental conditions. For each S, one set of stimuli was assigned randomly to be used in each of the four experimental conditions. Across Ss, each set of stimuli was employed equally often in each of the four experimental conditions.

*This research was supported by a grant from the University of California, Los Angeles, Research Council.

After assigning the sets of stimuli to the four experimental conditions, two stimulus pairs from each set were selected to be shown to S. For each S, the selection was random, except for the following restrictions: (1) The two stimulus pairs drawn from each set were either both banal or both incongruous, depending on the experimental condition represented by that set of stimuli; (2) the same drawing did not appear in both stimulus pairs; and (3) across Ss, all pairs of stimuli within each set were represented in each of the four experimental conditions an equal number of times. For the eight paired stimuli thus selected, one drawing from each pair was chosen to be preexposed. The preexposed drawing was selected randomly with the following restrictions: (1) Across Ss, each drawing served as the familiarized stimulus an equal number of times; (2) for each S, and within each experimental condition, the preexposed drawing was seen once in the left and once in the right position of the pair; and (3) across Ss, the preexposed drawing of each paired stimulus was seen an equal number of times in the left and right positions.

To reduce the possibility of Ss' merely responding to the demand characteristics of the experiment, it was explained that the experiment concerned the relationship between changes in the size of the pupil of the eye and different patterns of eye movements. The S was told that different arrangements of pictures would be projected onto the screen in front of the viewing box and that those arrangements had, in the past, been shown to produce the kind of eye movements of interest in the study (e.g., either small eye movements restricted to a small area or gross eye movements covering large areas). It was emphasized that the stimuli viewed by S during the experiment were irrelevant to the outcome of the study, as long as he continued to direct his eyes towards the screen.

Following the instructions, a series of eight paired stimuli was shown to S. Four of the eight paired stimuli depicted banal drawings, and four depicted incongruous drawings. Each paired stimulus in the series was immediately preceded by a single drawing. For two of the incongruous stimulus pairs, the preceding single drawing depicted one of the incongruous drawings in the pair, while for the other two incongruous stimulus pairs the single drawing depicted the banal counterpart of one of the incongruous drawings in the pair. Similarly, for two of the banal stimulus pairs, the preceding single drawing depicted one of the banal drawings in the pair, while for the

other two banal stimulus pairs the single drawing depicted the incongruous counterpart of one of the banal drawings in the pair. Each single drawing was exposed for 12 sec and each paired stimulus for 30 sec. The stimuli were presented in four blocks of two paired stimuli each. During a period of approximately 45 sec between each block, S was allowed to take his head from the box and rest.

Analysis of Photography

Each frame of movie film was analyzed by an experienced judge who was uninformed about the stimuli shown to S. The judge recorded the position of the eye fixation as left, right, or uninterpretable (e.g., in the center or eye closed). In an earlier study, this procedure resulted in an interjudge agreement of 97.5% over a sample of 4,000 frames (Faw & Nunnally, 1967).

For each S, data were combined for the two stimulus pairs representing the same experimental treatment condition. Subsequently, the percentage of time spent viewing the nonpreexposed stimuli in each of those conditions was computed. Those calculations were performed separately for each of the 10-sec time intervals during which the paired stimuli were exposed to S. In computing the percentage scores, uninterpretable fixations were not included; thus, each score was equal to the time spent viewing the nonpreexposed drawing divided by the time spent viewing either of the drawings in the pair.

RESULTS

One purpose of the present experiment was to partially replicate an earlier report by Faw and Nunnally (1971) concerning the familiarity effect in visual selection. In that study, paired stimuli were presented to S for 12 sec. In order to compare the results of the present experiment with those of that earlier study, the four percentage scores representing S's patterns of visual selection during the first 10-sec time interval were employed in a 2 by 2 analysis of variance. The two factors of that analysis were: (1) level of incongruity of the preexposed stimulus and (2) level of incongruity of the paired stimuli. That analysis revealed a significant main effect attributable to the level of incongruity of the preexposed stimulus, $F(1,47) = 7.88$, $p < .01$. However, that significant main effect must be interpreted in light of a significant interaction between the level of incongruity of the preexposed stimulus and the level of incongruity of the paired stimuli: $F(1,47) = 7.22$, $p < .05$. Figure 1 depicts that interaction.

Faw and Nunnally (1971) report

Fig. 1. The relationship between the level of incongruity of the preexposed stimulus and the level of incongruity represented in the paired stimulus for the first 10-sec viewing interval.

that when S was preexposed to an incongruous drawing and, subsequently, when that same drawing was paired with a second incongruous drawing, the magnitude of the familiarity effect was greater than when S was preexposed to a banal drawing which was subsequently paired with another banal drawing. Newman-Keuls tests revealed that, in the present study, a significant difference in those two conditions also existed ($p < .01$). Furthermore, t tests revealed that, for both the aforementioned conditions, the percentage of time spent viewing the nonpreexposed stimulus was significantly greater than the value of 50% expected by chance: banal pair, $t(47) = 2.87$, $p < .05$, and incongruous pair, $t(47) = 6.32$, $p < .01$.

A second question posed in the present study concerned the effect of exposure to a banal stimulus on subsequent looking time towards its incongruous counterpart and, conversely, the effect of exposure to an incongruous stimulus on subsequent looking time towards its banal counterpart. Figure 1 clearly shows that preexposure to an incongruous stimulus reduced the potential of its banal counterpart to elicit looking responses. In contrast, preexposure to a banal stimulus did not reduce the potential of its incongruous counterpart to elicit looking responses. Analysis of the simple main effects revealed a significant effect of the level of incongruity of the preexposed stimulus for paired incongruous stimuli [$F(1,47) = 18.27$, $p < .01$] but not for paired banal stimuli [$F(1,47) = 1.22$, $p > .05$]. As noted previously, t tests revealed a significant familiarity effect when one member of an incongruous pair was preexposed. Additional t tests, however, showed that when the banal counterpart of one member of an incongruous pair was preexposed, no significant familiarity effect was observed. In

contrast, in both the conditions in which banal pairs were presented, *t* tests revealed a significant familiarity effect.

A final purpose of the present experiment was to extend the findings of previous studies by examining potential changes in the magnitude of the familiarity effect which might result from continued exposure to the paired stimuli. To examine these time-related changes, the 12 percentage scores computed for each S were employed in a 2 by 2 by 3 analysis of variance. The analysis was identical to the initial analysis, except for the addition of a third factor, the three consecutive 10-sec time intervals. This second analysis, like the first, revealed a significant main effect attributable to the level of incongruity of the preexposed stimulus, $F(1,47) = 4.52$, $p < .05$, and a significant interaction of that factor with the factor representing the level of incongruity of the paired stimuli: $F(1,47) = 14.09$, $p < .01$. In addition, the analysis revealed a significant main effect attributable to the time interval factor: $F(2,94) = 6.31$, $p < .01$. The mean percentage scores for the three time intervals were: Interval 1, $M = 56.9\%$; Interval 2, $M = 52.0\%$; Interval 3, $M = 51.1\%$. Subsequent Newman-Keuls tests revealed that the mean percentage score for Time Interval 1 was significantly greater than those for Time Intervals 2 and 3 ($p < .01$) but that the latter two means did not differ significantly from one another. For each treatment condition, *t* tests of the mean percentage of time spent viewing the nonpreexposed stimulus in Time Intervals 2 and 3 revealed that they did not differ significantly from the value of chance ($p > .05$), except, however, for the condition in which one member of the incongruous pair was preexposed. In that condition a significant familiarity effect was observed [Interval 2, $M = 56.1\%$, $t(47) = 2.10$, $p < .05$; Interval 3, $M = 56.8\%$, $t(47) = 2.27$, $p < .05$].

DISCUSSION

In the present experiment the magnitude of the familiarity effect was significantly larger when a member of an incongruous pair was preexposed than when a member of a banal pair was preexposed. This finding replicates, in part, the results reported in an earlier study (Faw & Nunnally, 1971). In replicating those earlier results, the present study lends further support to a model which emphasizes the role of "information-conflict resolution" as the psychological process which underlies the general behavior referred to as visual selection and the familiarity effect in visual selection in particular.

The information-conflict resolution model of visual selection assumes that an individual, by looking at a stimulus, is attempting to resolve the "informational conflict" generated by that stimulus. Here, informational conflict refers to the difficulty one has in identifying, categorizing, or attributing meaning to a stimulus. It is assumed that the greater the informational conflict generated by a stimulus, the longer it will take to resolve that conflict and, consequently, the longer that stimulus will be looked at.

The information-conflict resolution model of the familiarity effect postulates that exposure to a stimulus provides S the opportunity to resolve informational conflict. Because a banal stimulus initially has little informational conflict to resolve, the subsequent difference in the informational conflict between the preexposed and nonpreexposed drawings of a banal pair is still small; consequently, the magnitude of the familiarity effect should be small. In contrast, the amount of information initially inherent in an incongruous stimulus provides the opportunity for a great deal of information-conflict resolution. Consequently, the difference in informational conflict between the preexposed and nonpreexposed drawings of an incongruous pair is great, and the observed magnitude of the familiarity effect should be large.

Although an information-conflict resolution model of the familiarity effect is supported by some of the results of the present study, not all of the results clearly support that model. The information-conflict resolution model would predict that with increased exposure to a pair of stimuli, the dominance in looking responses towards the nonpreexposed stimulus would dissipate until no familiarity effect would be observed. If the dissipation was equal for both banal and incongruous stimuli, then an information-conflict resolution model would predict an interaction between the level of incongruity of the paired stimuli and the duration of exposure to that pair. During the first 10-sec interval, the familiarity effect would be large for the incongruous pair and small for the banal pair; but during the last 10-sec interval, the effect would be small or nonexistent for both incongruous and banal pairs. Perhaps, with exposure periods longer than 30 sec, one would observe the predicted interaction; but in the present experiment no such interaction was evident. Clearly, before conclusive statements can be made concerning the variables which influence the familiarity effect in visual selection and the adequacy of

the models which attempt to explain that effect, further research will be needed to examine the longevity of the familiarity effect.

A second purpose of the present study was to examine the effects, if any, that familiarization with an incongruous stimulus has on the potential of its banal counterpart to elicit looking responses and, conversely, whether or not familiarization with a banal stimulus has an effect on the potential of its incongruous counterpart to elicit looking responses. It was observed that preexposure to an incongruous stimulus produced a significant reduction in the potential of its banal counterpart to elicit looking responses. In contrast, exposure to a banal stimulus had no subsequent influence on the potential of its incongruous counterpart to elicit looking responses. It is interesting to speculate on the basis of these results. One might argue, for example, that the banal and incongruous stimuli share certain physical characteristics, e.g., both may have the head of a cow; thus, exposure to the incongruous drawing also exposes S to the shared physical properties of the banal drawing. If this explanation of the observed behavior were true, it would seem plausible to predict that exposure to a banal stimulus would similarly diminish subsequent looking time towards its incongruous counterpart. Such, however, was not the case in the present experiment.

A second speculation concerning the basis of the observed results employs the language of, and is derived from the literature concerning cognitive development. In accordance with the information-conflict resolution model of the familiarity effect, one might argue that, during preexposure to a stimulus, S is attempting to identify, categorize, or otherwise attribute meaning to that stimulus. This description of S's activities is similar to the cognitive activities characterized by the term "assimilation," as it is used by Piaget. One might say that, during preexposure to a stimulus, S is attempting to assimilate the stimulus into an available schema. Assimilation of an incongruous stimulus, however, would require that the already present schema be modified before assimilation could take place (e.g., assimilation of an incongruous cow would first require the modification or accommodation of the banal "cow" schema). Thus, exposure to an incongruous stimulus may require S to engage in cognitive activities involving the banal counterpart of that incongruous stimulus and, in so doing, provide a set for S which would make subsequent assimilation of the banal

stimulus easier, i.e., would familiarize S vicariously with the banal stimulus. In contrast, assimilation of a banal stimulus would not require accommodation of presently available schema. Consequently, preexposure to a banal stimulus would not facilitate the subsequent assimilation of its incongruous counterpart, and no familiarization effect would be observed. Obviously, this speculation will require further research to determine its adequacy. However, should the explanation prove adequate, it would suggest that the familiarity effect may be a useful

nonverbal tool in studying certain conceptual processes of both adults and children.

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(Accepted for publication December 7, 1970.)