

## Critical Importance of Exposure Duration for Affective Discrimination of Stimuli That Are Not Recognized

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Previous research has found that repeated exposure to briefly presented visual stimuli can increase the positive affect for the stimuli without enhancing their recognition. Subjects could discriminate target and distractor shapes by affective preference in the absence of recognition memory. This study examined this phenomenon as a function of stimulus exposure duration. Over exposure durations of 0, 2, 8, 12, 24, and 48 ms, the functions for affect and recognition judgments exhibited different temporal dynamics. Target selection by affect was possible at very brief exposures and was influenced little by increasing durations; target selection by recognition required longer stimulus exposures and improved with increasing durations. Affective discrimination of stimuli that are not recognized is a reliable phenomenon, but it occurs only within a narrow band of time. This parametric study has specified the relationship between exposure duration and affect and recognition judgments and has located that temporal window.

The exposure effect is defined as the increase in positive affect that results from the repeated presentation of unfamiliar stimuli (see Harrison, 1977). What makes this phenomenon especially interesting is a recent finding by Kunst-Wilson and Zajonc (1980) that showed that the exposure effect could be obtained with stimuli that are not recognized. Kunst-Wilson and Zajonc presented subjects with 10 irregular polygons shown unmasked five times each at a 1-ms exposure duration. At this duration, the subjects reported that they saw something, but they were unsure of what they saw. After viewing the repeated stimuli, the subjects made forced-choice affect judgments (Which stimulus do you like?) or recognition judgments (Which stimulus did you see before?) on target and distractor pairs. Kunst-Wilson and Zajonc found target selection to be greater than chance in the affect condition alone. Target discrimination by affect occurred in the absence of recognition.

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Seamon, Brody, and Kauff (1983a, 1983b) replicated the exposure effect finding and showed that affect and recognition judgments were based on different processes, by means of response contingency analyses and the differential effects of independent variables. Lateralized presentation of the study stimuli showed affect judgments were best for right visual field presentation (left hemisphere), whereas recognition judgments were best for left visual field presentation (right hemisphere). When the judgment task was delayed for 1 hr or 1 week after the study stimuli were shown, only target selection by affect remained significantly greater than chance. Collectively, although these studies have replicated and extended the Kunst-Wilson and Zajonc finding, they have offered a fundamentally different interpretation of the data. Zajonc (1980) had used the finding of an exposure effect for unrecognized stimuli as empirical support for the separation of affective reactions and cognitive processing. The present studies differed by interpreting the phenomenon from within the framework of existing models of recognition memory (see Seamon et al., 1983a, 1983b).

The purpose of this study is to explore further this unusual phenomenon by doing a parametric study of the effect of exposure duration during study on subsequent affect and

recognition judgments. Several factors suggest that an understanding of the effect of stimulus exposure duration may be critically important for determining the occurrence of target selection by affect in the absence of recognition.

First, by manipulating stimulus exposure duration, it is possible to plot the temporal development of affect and recognition judgments. By all that is known of human memory, recognition performance must increase from chance to an asymptotic ceiling level with an increase in stimulus exposure. This expectation, however, does not necessarily hold for affect judgments, as the exposure effect is presumably influenced more by the number of stimulus repetitions than by the length of stimulus exposures. To the extent that the functions for affect and recognition judgments over exposure durations are qualitatively different, additional evidence of process independence is obtained along with descriptions of their temporal dynamics.

Second, manipulation of exposure duration permits an examination of Zajonc's (1980) claim that affect judgments occur early during the processing of information. Based on his belief that, under some circumstances, affective reactions can occur without the involvement of cognitive processes, Zajonc has schematized stimulus encoding as consisting of sensory processes, affective reactions, and recognition processes. Though these processes are shown as overlapping, they differ in their assumed time of onset (Zajonc, 1980, Figure 5). Again, this study is not concerned with Zajonc's interpretation of the exposure effect, but it can test the hypothesis that target selection by affect can occur following shorter stimulus exposures than those for target selection by recognition. The results of an earlier study suggested that less stimulus exposure was needed for target selection by affect than by recognition, but a direct test of exposure duration had not been provided (Seamon et al., 1983a).

Finally, an examination of affect and recognition judgments over different exposure durations may provide a basis for understanding why some researchers have found target selection by affect in the absence of recognition (Kunst-Wilson & Zajonc, 1980; Seamon et al., 1983a, 1983b), whereas others have not (Mandler & Shebo, 1981). Assuming that (a) target selection by affect can be made at 60%

to 65% accuracy following brief stimulus exposures (this assumption seems plausible given the existing data), (b) target selection by affect does not change dramatically beyond a sufficient duration of stimulus exposure, and (c) target selection by recognition increases monotonically given a sufficient duration of exposure, then the exposure effect for unrecognized stimuli should be found to exist for only a narrow band of time. At extremely brief exposure durations, neither affect nor recognition judgments should exceed chance, as some minimal processing is needed for each type of judgment. At slightly longer exposure durations, if affect judgments are based on a process more primitive than conscious recognition (see Zajonc, 1980, and Seamon et al., 1983a, for different possible processes), they should exceed chance while recognition performance remains at chance. With longer exposure durations, target selection by recognition should occur, and the recognition function, now elevated, should cross that for affect (the second temporal point where affect and recognition performance are equal) and then surpass it at all longer exposure durations.

Given this relationship between affect and recognition judgments and stimulus exposure duration, only those researchers who employ durations from within the critical band of exposure durations will find target selection by affect in the absence of recognition. Conceived in this fashion, the exposure effect for unrecognized stimuli is the exception rather than the rule. But with this conception, questions about the reliability of the phenomenon may now be addressed. Through a parametric study of exposure duration, the locus of this phenomenon can be specified in time.

## Method

### *Subjects*

The subjects were 160 Wesleyan University students, 18-24 years old, who served as paid volunteers. None of the subjects had participated in any prior research involving affect or recognition judgments.

### *Materials and Apparatus*

The study and test stimuli and experimental apparatus were the same as those used previously by Seamon et al. (1983a, 1983b). To briefly review, 20 irregular, eight-sided polygons were selected from those of Vanderplas and Gar-

vin (1959). Each shape was photographed as a negative slide and presented by a Gerbrands projection tachistoscope. The stimuli appeared reddish-pink in color as they were shown through a No. 3.5 red gelatin filter attached to the lens shutter of each projector.

### Procedure

The procedure was similar to that of prior studies from this laboratory. Subjects were shown 10 irregular polygons five times each in five random orders of 10 under conditions of low illumination. The study stimuli were projected on a screen approximately 2.5 m from the subjects, 16° above eye level, and they averaged 8.5 cm and 7.5 cm in height and width. Prior to viewing the stimuli, the subjects were told to look at the screen for the geometric shapes that would appear; additional instructions followed their presentation. The subjects were warned at the start, however, that, depending on experimental conditions, it might be very difficult to see the briefly exposed stimuli.

Each of the 50 study stimuli was shown at an exposure duration of 0, 2, 8, 12, 24, or 48 ms and was followed immediately by a 30-ms bright-field energy mask and a 2.5-s interstimulus interval (see Seamon et al., 1983a, Experiment 4, for energy masking details). The subjects were assigned to one of six different groups that corresponded to the six different stimulus exposure durations, and they were tested in small groups of 4 to 8 people. There were 40 subjects in the 0-ms exposure duration condition, 40 subjects in the 2-ms exposure duration condition, and 20 subjects in each of the four remaining exposure duration conditions. The 0-ms condition served as a control condition in which only the energy mask was presented during the study trials. Because no targets were shown during study, this 0-ms condition provided a baseline measure of the 10 test trials for affect and recognition judgments in each of the other conditions in which the study stimuli were shown.

After the study portion of the experiment, the subjects were presented with 10 test trials. Each trial contained a previously shown target stimulus and a distractor stimulus of comparable complexity shown for 1 s on the display screen followed by a group-paced intertrial interval of approximately 5 s per trial. For subjects in the 0-ms group, this was the first time they had seen the targets. The target and distractor shapes were counterbalanced over trials for side of location of the target stimulus (i.e., left or right side) and were randomly ordered over trials. On a written test form, the subjects were asked to select the stimulus in each pair that they liked best (forced-choice affect judgment) or the stimulus in each pair that they had seen before (forced-choice recognition judgment). After making one type of judgment for all 10 test trials, the trials were repeated and the alternate judgment task was used. Half of the subjects in each exposure duration condition made affect judgments before recognition judgments, and half made recognition judgments before affect judgments. Only after the first 10 trials were completed were the subjects told of the alternate judgment task and the additional test trials. Lastly, half of the subjects in each exposure duration condition and judgment order grouping saw the study and test stimuli in the same orientation as previous studies from this laboratory, whereas half saw all of the stimuli as mirrored images to create, in effect, two classes of stimuli.

In all other respects the experimental conditions were the same as those used before.

### Results

The design of the experiment was a mixed design in which task order for affect and recognition judgments, study and test stimulus orientation, and study stimulus exposure duration were between-subjects variables, and affect versus recognition judgments was a within-subject variable. (A  $p < .05$  confidence level was used for each of the analyses performed.) Because neither task order nor stimulus orientation had an effect on affect or recognition performance ( $ps > .05$ ), the data were collapsed across these variables for all subsequent analyses.

The data of primary interest are shown in Figure 1, which presents target selection by affect or recognition as a function of stimulus exposure duration. Confirming expectations, both functions originated at chance in the 0-ms control condition and then exhibited different temporal dynamics. The function for affect judgments rose quickly with a brief increase in the exposure duration, whereas the function for recognition judgments remained unchanged through 8 ms of exposure. Beyond this interval, recognition performance improved sharply, but target selection by affect was largely unaffected even though there was a sixfold increase in exposure duration from 8 to 48 ms.

These results were confirmed by analyses of variance that showed significant effects of exposure duration,  $F(5, 154) = 13.56$ ,  $MS_e = 3.24$ ; judgment task,  $F(1, 154) = 5.62$ ,  $MS_e = 2.09$ ; and their interaction,  $F(5, 154) = 5.99$ ,  $MS_e = 2.09$ . Comparing judgment tasks over exposure durations of 0 to 8 ms, target selection by affect was greater than that by recognition,  $F(1, 97) = 4.95$ ,  $MS_e = 2.19$ , whereas for exposure durations of 12 ms or longer, target selection by recognition surpassed that by affect,  $F(1, 57) = 26.48$ ,  $MS_e = 1.91$ . Finally, target selection by affect did not differ from that by recognition in the 0-ms control condition nor was performance for either affect,  $t(39) = 1.41$ , or recognition,  $t(39) = 1.34$ , significantly greater than chance (see also the data from an earlier control study reported in the caption of Figure 1). At 2 ms of stimulus

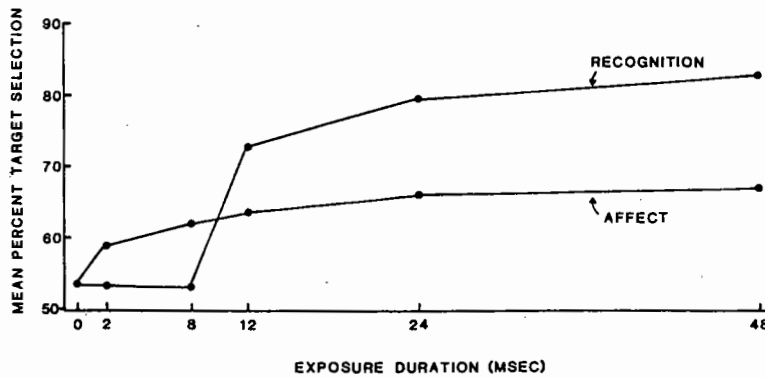


Figure 1. Mean target selection performance for affect and recognition judgments as a function of stimulus exposure duration during study. (Chance performance is 50%. No study stimuli were shown during the 0-ms control condition that yielded performance scores of 47.5%, affect, and 46.6%, recognition, in a comparable condition of an earlier study, Seamon et al., 1983a.)

exposure, recognition performance was unchanged, but affect target selections significantly exceeded both chance,  $t(39) = 3.72$ , and recognition,  $t(39) = 1.96$ , one-tailed. At 8 ms of stimulus exposure, the same statistical outcomes were obtained. Overall, the statistical analyses confirmed what is readily apparent in the figure: Affect and recognition judgments exhibit different temporal dynamics as a function of exposure duration.

#### Discussion

This experiment has shown that stimulus exposure duration has different effects on affect and recognition judgments. It replicates earlier research that has shown that subjects can select previously shown target stimuli on the basis of affective preference even when they fail to do so by recognition memory. More importantly, the present findings extend the earlier research by showing how affect and recognition judgments vary over an extended range of stimulus exposure durations. The exposure effect for unrecognized stimuli occurs only within a limited range of exposure durations, because the temporal dynamics of the affect and recognition functions are fundamentally different. Affective judgments can be made following very brief exposures, but they are thereafter influenced very little by increases in duration. Recognition judgments, in sharp contrast, require longer stimulus exposures, and they are more directly influenced by the exposure duration. Exposure duration is therefore another independent variable to add

to stimulus lateralization during study and to length of interpolated delay between study and test that differentially affects affect and recognition performance and argues that they are based on different processes.

In addition, this experiment has provided empirical support for the hypothesis that target selection by affect can occur following briefer stimulus exposures than those for target selection by recognition. This finding is in agreement with reasonable predictions from Zajonc's (1980) theory that affective processing precedes recognition processing. However, because the finding of an exposure effect for unrecognized stimuli is open to more than one theoretical interpretation, discussing the present findings in terms of underlying processes is still premature. It may be that affective reactions and recognition processes are separate and different. Yet, it is also possible that affective preference for target stimuli is based on a judgment of familiarity that is obtained through repeated exposures. Subjects may like target stimuli more than distractor stimuli because they are familiar with processing them, but even with this perceptual fluency, they may still fail to recognize target stimuli if they have not retrieved contextual information about their prior occurrence (see Seamon et al., 1983a, 1983b, for a discussion of the position). Until an understanding of the process that underlies affective judgments is provided, the present findings are merely not inconsistent with either theoretical position.

One last point about the affect and recog-

dition functions shown in Figure 1 needs to be made. Each observed function must represent a single member of a family of functions for each type of judgment over different exposure durations. Though other functions for affect and recognition judgments may be qualitatively similar to those observed in this experiment, they should vary quantitatively by changes in such factors as illumination level and masking conditions that influence what is seen. The function for affect judgments, in particular, is likely to be influenced by the number and spacing of stimulus repetitions (e.g., Elmes, Dye, & Herdelin, 1983) and the degree of similarity of the targets and distractors as the exposure effect can generalize across similar stimuli (Gordon & Holyoak, 1983). Conceivably, the small window in time in which the exposure effect for unrecognized stimuli is observed can be opened or closed through the effects of such variables. The fact that the window is small and likely to be influenced by experimental conditions suggests a basis for understanding the failure of other researchers to find evidence of its existence. Research from this laboratory has shown that the original phenomenon reported by Kunst-Wilson and Zajonc (1980) can be reliably produced. More work is now needed to determine its cause.

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