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# Stimulus Recognition and the Mere Exposure Effect

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A meta-analysis of research on Zajonc's (1968) mere exposure effect indicated that stimuli perceived without awareness produce substantially larger exposure effects than do stimuli that are consciously perceived (Bornstein, 1989a). However, this finding has not been tested directly in the laboratory. Two experiments were conducted comparing the magnitude of the exposure effect produced by 5-ms (i.e., subliminal) stimuli and stimuli presented for longer durations (i.e., 500 ms). In both experiments, 5-ms stimuli produced significantly larger mere exposure effects than did 500-ms stimuli. These results were obtained for polygon (Experiment 1), Welsh figure (Experiment 2), and photograph stimuli (Experiments 1 and 2). Implications of these findings for theoretical models of the mere exposure effect are discussed.

Since the publication of Zajonc's (1968) monograph describing the *mere exposure effect* (i.e., the observation that repeated, unreinforced exposure is sufficient to enhance attitude toward a stimulus), there have been more than 200 published experiments investigating the exposure–affect relationship (Bornstein, 1989a). The exposure effect has proven to be a robust, reliable phenomenon, yielding strong results for a variety of stimuli (e.g., polygons, drawings, photographs, nonsense words, and idiographs) and a variety of rating procedures (e.g., liking ratings, pleasantness ratings, and forced-choice preference judgments). Furthermore, researchers have used paradigms and procedures from exposure effects research to investigate a wide variety of psychological phenomena, including advertising effects (Sawyer, 1981), social perceptions and behaviors (Saegert, Swap, & Zajonc, 1973), stereotypes and prejudice (Ball & Cantor, 1974), food preferences (Pliner, 1982), environmental preferences (Herzog, Kaplan, & Kaplan, 1976), aesthetic judgments (Berlyne, 1974), verbal learning (Zajonc, Markus, & Wilson, 1974), implicit memory (Gordon & Holyoak, 1983), and attitude formation (Grush, 1976).

A number of experiments have demonstrated that typical mere exposure effects can be obtained by stimuli that are neither recalled nor recognized by subjects (Bonanno & Stillings, 1986; Bornstein, Leone, & Galley, 1987; Kunst-Wilson & Zajonc, 1980; Mandler, Nakamura, & Van Zandt, 1987; Seamon, Brody, & Kauff, 1983a, 1983b; Seamon, Marsh, & Brody, 1984). These findings suggest that awareness of stimulus content is not required for the production of mere exposure effects. Thus, although it is clear that some type of learning process underlies the exposure effect (Gordon & Holyoak, 1983; Harrison, 1977), this learning process apparently can take place entirely outside of conscious awareness, involving implicit rather than explicit knowledge about a stimulus.

Not only do stimuli perceived without awareness produce robust exposure effects, but a meta-analysis of research on the exposure effect indicated that mere exposure effects produced by stimuli that are not recognized at better-than-chance accuracy are substantially larger than mere exposure effects produced by clearly recognized stimuli. Bornstein (1989a) used meta-analytic techniques to compare the magnitude of attitude enhancement in mere exposure studies involving subliminal stimuli and studies using stimuli presented for longer exposure durations. A mean effect size $r$ of .528 was found for subliminal stimuli, whereas the mean effect size for stimuli presented for longer exposure durations was .140. These data indicate that subliminal mere exposure effects are considerably stronger than typical mere exposure effects and suggest that awareness of stimulus content may somehow inhibit the exposure effect. A subsequent meta-analysis of mere exposure effects research further demonstrated that across all mere exposure experiments there is an inverse relationship between stimulus recognition accuracy and the magnitude of the exposure effect (Bornstein, 1989b).

Bornstein's (1989a, 1989b) meta-analytic findings regarding the inverse relationship of stimulus recognition accuracy to the magnitude of the mere exposure effect have not been replicated in the laboratory. Further examination of this issue is important for two reasons. First, this finding has implications for theoretical models of the exposure effect. Extant models of the exposure effect (i.e., the two-factor, opponent-process, and attitude formation models) cannot easily accommodate this pattern of results (see Harrison, 1977; Stang, 1974b). Thus, if laboratory studies confirm that stimuli perceived without awareness produce significantly stronger mere exposure effects than do stimuli that are clearly recognized, extant models of the exposure effect may need to be revised or replaced.

Second, this issue has important implications for the study of

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subliminal phenomena. Several researchers have argued that the exposure effect paradigm allows for a rigorous test of the hypothesis that stimuli perceived without awareness influence responding (Erdelyi, 1985; Reingold & Merikle, 1988; Zajonc, 1980). In this context, Erdelyi (1985) noted that mere exposure experiments involving subliminal stimuli fulfill the criteria required to demonstrate unconscious influences of briefly presented stimuli within the traditional dissociation paradigm. Furthermore, the exposure effect paradigm is also useful in investigating subliminal phenomena within the context of more recent theoretical approaches to investigating perception without awareness. Reingold and Merikle (1988) argued that whenever an indirect measure of responding is more strongly influenced by stimulus exposures than is a comparable direct measure of responding, perception without awareness can be inferred. Thus, if affect judgments (an indirect measure of responding) are more strongly influenced by stimulus exposures than are recognition judgments (a direct measure of responding) in a subliminal mere exposure experiment, this would constitute strong evidence for the existence of perception without awareness within Reingold and Merikle's direct–indirect framework.

The purpose of this article is to compare directly the magnitude of the exposure effect produced by subliminal stimuli versus stimuli that are consciously perceived. We conducted two experiments to examine this issue. In both experiments, abstract, nonrepresentational stimuli (i.e., polygons or Welsh figures) and meaningful social stimuli (i.e., photographs of college-age women) were presented to subjects at different exposure frequencies (i.e., 0, 1, 5, 10, or 20 exposures per stimulus). Half the stimuli in each experiment were exposed at subliminal (i.e., 5 ms) exposure durations, and half the stimuli were exposed at supraliminal (500 ms) exposure durations. Each stimulus exposure was followed by a 100-ms pattern mask. Following exposure to all stimuli, subjects made affect (i.e., liking) and recognition judgments of the merely exposed stimuli on 9-point scales.[1]

In accord with Bornstein's (1989a, 1989b) meta-analytic results, we predicted that 5-ms stimuli would produce significantly stronger mere exposure effects than would 500-ms stimuli. Specifically, we predicted that 5-ms stimuli would show a greater increase in affect ratings with increasing exposure frequency than would 500-ms stimuli. Thus, we hypothesized that there would be (a) a significant main effect of exposure frequency on affect ratings, with ratings of frequently exposed stimuli being significantly more positive than ratings of infrequently exposed stimuli, and (b) a significant interaction of exposure frequency and exposure duration on affect ratings, with ratings of 5-ms stimuli showing a greater increase with increasing exposure frequency than ratings of 500-ms stimuli.

For recognition ratings, we hypothesized that there would be (a) a main effect of exposure duration on ratings, with stimuli in the 500-ms condition receiving higher recognition ratings than stimuli in the 5-ms condition, and (b) an interaction of exposure frequency and exposure duration on ratings, with recognition ratings of 500-ms stimuli increasing with increasing exposure frequency and recognition ratings of 5-ms stimuli being unrelated to exposure frequency. Furthermore, in the 5-ms condition recognition ratings of merely exposed stimuli in the 1-, 5-, 10-, and 20-exposure conditions should not differ from recognition ratings of stimuli in the 0-frequency condition, indicating that subjects could not distinguish previously seen 5-ms stimuli from stimuli that they had never seen before.

## Experiment 1

### Method

*Subjects.* Subjects were 120 undergraduates (71 women and 49 men) enrolled in introductory psychology classes at Gettysburg College who participated in the study to fulfill a course requirement. Twenty additional subjects (10 women and 10 men) who did not participate in other aspects of the experiment took part in a stimulus discrimination task that was designed to serve as an additional test of the subliminality of the 5-ms stimuli used in Experiment 1.

*Stimuli and apparatus.* Two sets of stimuli were used. The first set consisted of 25 irregular 9- and 10-point polygons similar to those of Vanderplas and Garvin (1959). Polygons were equally complex and were approximately equal in size. The second set of stimuli consisted of 25 black-and-white photographs of women taken from a college yearbook. All photographs depicted college-age women in full frontal pose and included the person's head and shoulders against a neutral background. Photographs were selected that were judged to be comparable in attractiveness. Stimuli were presented using a Gerbrands three-channel tachistoscope, with exposure duration and field illumination electronically controlled.

*Procedure.* Subjects were brought individually to a sparsely furnished laboratory room and were informed that they were participating in a study of how people process visual information. Subjects were then seated at the tachistoscope while the experimenter administered standardized instructions and explained the apparatus. The following instructions were administered to subjects:

> This is a study of how people perceive different types of figures (pictures). During the next few minutes I'll show you a series of pictures. All you need to do is look into the eyepieces of this machine as the pictures are presented. The pictures may go by so quickly that you think you're not seeing anything. That's OK. Please just keep looking into the eyepieces until I tell you that we're done. There will be about 2 seconds between pictures and about 180 pictures overall. Between pictures, you should focus on the dot in the center of the screen. That's where the pictures will appear.

After answering any final questions, the experimenter began stimulus presentations. Stimulus exposures were approximately 2 s apart, with each exposure preceeded by a 2-s blank field with a focus dot in the center. Stimulus exposure duration was either 5 ms or 500 ms depending on which experimental condition a subject had been assigned. Following each stimulus exposure, a 100-ms pattern mask appeared on the screen in the same position as the stimulus had been.

Subjects were exposed either to polygon or photograph stimuli pre-

[1] In these experiments, we use the term *subliminal* to denote those experimental conditions wherein recognition judgments of previously seen stimuli do not differ from recognition judgments of stimuli that have not been seen before. A similar use of the term may be found in Bornstein, Leone, and Galley (1987; see also Seamon, Brody, & Kauff, 1983a, 1983b; Seamon, Marsh, & Brody, 1984; Zajonc, 1984). We recognize the many conceptual ambiguities that have come to be associated with this term (see, e.g., Erdelyi, 1985) and use it primarily as a term of convenience. In the present experiments, *subliminal stimuli* are those that fall below subjects' subjective criterion of awareness (see Reingold & Merikle, 1988).

sented in a homogenous sequence at frequencies of 0, 1, 5, 10, and 20 exposures. Five stimuli were presented at each exposure frequency for a total of 180 stimulus exposures per subject. Order of stimuli was determined using a random number table. Each stimulus appeared in each exposure frequency condition the same number of times, counterbalanced across subjects. Total time taken for all stimuli to be presented was approximately 6.5 min for subjects in the 5-ms condition and 8 min for subjects in the 500-ms condition.

Subjects were then given a booklet containing pictures of each stimulus (1 stimulus per page), along with two 9-point rating scales for each stimulus: a like–dislike scale and an old–new (recognition) scale. Order of rating scales was counterbalanced across subjects. Subjects circled the number on each scale corresponding to their rating of the stimulus pictured on that page. The five 0-frequency stimuli were included in the rating booklet to serve as control stimuli against which subjects' ratings of merely exposed stimuli could be compared.

*Discrimination task.* Twenty additional subjects took part in a stimulus discrimination task similar to that used by Bornstein et al. (1987). This task served as an additional test for stimulus subliminality in the 5-ms exposure condition used in Experiment 1. Thus, subjects who took part in the discrimination task attempted to discriminate stimuli from blank cards under conditions identical to those used in the 5-ms/20 exposure condition of Experiment 1. Subjects were shown a series of 100 stimulus cards presented 20 times each at 5-ms durations, with each stimulus exposure preceeded by a 2-s blank field and followed by a 100-ms pattern mask. Half the cards contained stimuli, and half were blank cards. Subjects were informed of this before the start of the discrimination task. For half the subjects, polygon stimuli were used, and for half the subjects, photograph stimuli were used. The subject was shown sample stimulus cards before the start of the discrimination task. The subject was instructed to report, immediately following 20 exposures of a given card, whether that card was a stimulus or a blank.

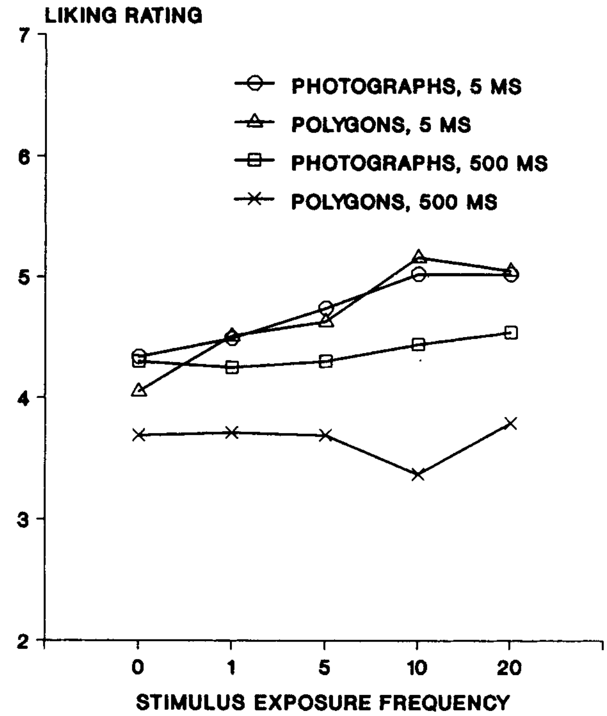


*Figure 1.* Effects of stimulus type and exposure duration on liking ratings of merely exposed stimuli (Experiment 1).

## *Results*

The central results of Experiment 1 are summarized in Figure 1. A 2 × 2 × 5 mixed analysis of variance (ANOVA) was used to analyze these data, with stimulus type (polygon vs. photograph) and exposure duration (5 ms vs. 500 ms) as between-subjects variables and exposure frequency (0, 1, 5, 10, or 20 stimulus exposures) as a within-subjects variable. This ANOVA revealed several significant effects. First, there was a main effect of exposure duration on liking ratings, with 5-ms stimuli receiving more positive ratings than 500-ms stimuli, $F(1, 115) = 11.58$, $p = .001$. There was also a marginally significant main effect of stimulus type on liking ratings, with photograph stimuli receiving more positive ratings than polygon stimuli, $F(1, 115) = 3.45$, $p = .06$. There was a main effect of exposure frequency on liking ratings, with frequently exposed stimuli receiving more positive ratings than infrequently exposed stimuli, $F(4, 460) = 6.57$, $p = .0001$. Finally, there was a significant Exposure Duration × Exposure Frequency interaction, $F(4, 460) = 5.56$, $p < .0005$; 5-ms stimuli showed a more rapid increase in liking ratings with increasing exposure frequency than did 500-ms stimuli. In other words, 5-ms stimuli produced a significantly stronger exposure effect than did 500-ms stimuli.

To investigate further the properties of the frequency–affect functions produced by stimuli in the different exposure conditions, separate one-way ANOVAs were performed for the four frequency–affect functions in Figure 1. These one-way ANOVAs confirmed that both types of stimuli showed a significant increase in liking ratings with increasing exposure frequency in the 5-ms condition, $F(4, 116) = 5.58$, $p = .0006$, for photograph stimuli and $F(4, 116) = 5.81$, $p = .0005$, for polygon stimuli. In the 500-ms exposure condition, neither photograph nor polygon stimuli showed an increase in affect ratings with increasing exposure frequency, $F(4, 116) = 1.21$, *ns*, for photograph stimuli and $F(4, 116) = 0.81$, *ns*, for polygon stimuli.

The effects of stimulus type, exposure duration, and exposure frequency on recognition ratings are summarized in Figure 2. All main effects and interactions were significant, including the triple interaction (the Stimulus Type × Exposure Duration interaction was marginally significant at $p < .07$). The pattern of results depicted in Figure 2 can best be summarized as follows: For photograph stimuli, recognition ratings increased with increasing exposure frequency when 500-ms exposures were used but were unrelated to exposure frequency when 5-ms exposures were used. Furthermore, when 5-ms exposures were used, recognition ratings of photograph stimuli in the 0-frequency condition did not differ from recognition ratings of stimuli in the 1-, 5-, 10-, or 20-exposure conditions. Thus, subjects were unable to distinguish previously seen 5-ms photograph stimuli from 5-ms photograph stimuli that they had not seen before.

For polygon stimuli, recognition ratings were unrelated to exposure frequency for either exposure duration condition. For both 5-ms and 500-ms stimuli, recognition ratings of polygon stimuli in the 0-frequency condition did not differ from recognition ratings of polygon stimuli in the 1-, 5-, 10-, and 20-exposure conditions. However, as would be expected, stimuli in the 500-ms condition received significantly higher recognition ratings overall than did stimuli in the 5-ms condition.

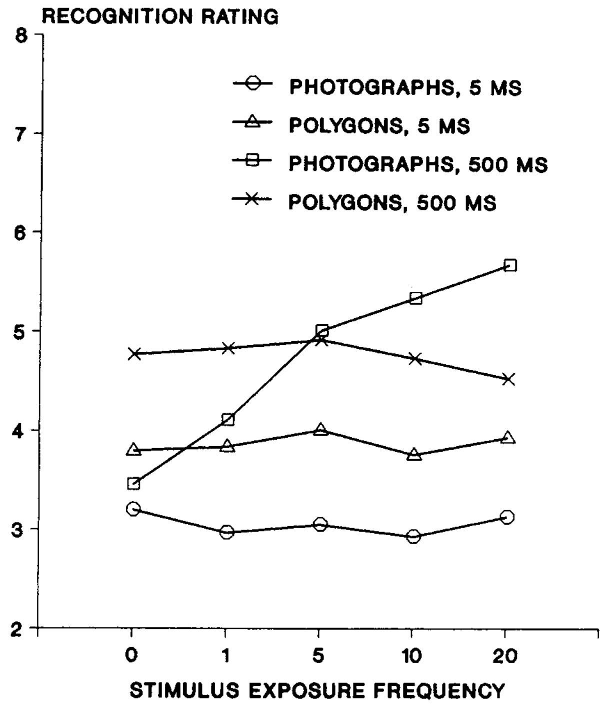


*Figure 2.* Effects of stimulus type and exposure duration on recognition ratings of merely exposed stimuli (Experiment 1).

Because highly similar results were obtained for polygon and photograph stimuli in the discrimination task, analyses of subjects' performance on this task were conducted collapsing across stimulus type. The mean number of cards correctly identified by subjects in the discrimination task was 51.2 (out of 100). Overall, subjects correctly identified 1,024 out of 2,000 cards, which does not differ significantly from chance accuracy, $\chi^2$ (1, $N$ = 2,000) = 1.15, *ns.* The number of correct identifications ranged from 45 to 57. Thus, no subject in the discrimination task did either significantly better or significantly worse than chance performance.

## *Discussion*

The results of Experiment 1 are consistent with Bornstein's (1989a) meta-analytic comparison of the magnitude of the exposure effect produced by subliminal versus supraliminal stimuli. These results indicate that subliminal stimuli produce significantly stronger mere exposure effects than do stimuli that are clearly recognized. This finding held true for both polygon and photograph stimuli in the present experiment, attesting to the robustness and generalizability of these results.

As expected, 500-ms stimuli received significantly higher recognition ratings overall than did 5-ms stimuli. Although recognition ratings of photograph stimuli in the 500-ms condition increased with increasing exposure frequency, recognition ratings of polygon stimuli in the 500-ms exposure condition did not. The nonsignificant effect of exposure frequency on recognition ratings of polygon stimuli in the 500-ms condition likely reflects the fact that polygon stimuli were not easily discriminable. Apparently, subjects in the 500-ms condition were able to recognize some polygons as having been previously seen, but because of the general similarity among the polygon stimuli, subjects could not discriminate previously seen from new polygons and therefore rated all polygons as relatively familiar.

The finding that polygon and photograph stimuli in the 500-ms condition did not produce typical mere exposure effects was unexpected. It may be that the absence of an exposure effect for 500-ms stimuli in Experiment 1 was due to the fact that stimuli were presented in a homogeneous sequence in this experiment. Bornstein's (1989a) meta-analysis of research on the exposure effect indicated that stimuli presented in a homogeneous sequence typically produce much smaller exposure effects than do stimuli presented in a heterogeneous sequence, presumably because homogeneous stimulus presentations become boring more quickly than do heterogeneous stimulus presentations (Bornstein, Kale, & Cornell, 1990; Harrison, 1977).

Experiment 2 was designed to correct these two problems in our initial experiment. Thus, this experiment used the same procedure as Experiment 1, with two changes. First, Welsh figures (Welsh & Barron, 1949) were used in place of polygon stimuli, because Welsh figures are more distinctive than polygons. Welsh figures should therefore be more easily discriminable than are polygons and should yield the expected increase in recognition ratings with increasing exposure frequency in the 500-ms condition.

Second, all stimuli were presented in a heterogeneous exposure sequence in Experiment 2. This was done to minimize boredom effects and to maximize the probability that 500-ms stimuli would show the typical increase in liking ratings with increasing exposure frequency.

# Experiment 2

## *Method*

*Subjects.* Subjects were 120 undergraduates (68 women and 52 men) enrolled in introductory psychology classes at Gettysburg College who participated in the experiment to fulfill a course requirement. As in Experiment 1, 20 additional subjects (10 women and 10 men) who did not participate in other phases of the study took part in the Experiment 2 discrimination task.

*Stimuli and apparatus.* The stimuli and apparatus used in Experiment 2 were identical to those used in Experiment 1, except that Welsh figures (Welsh & Barron, 1949) were used in place of polygons in Experiment 2. The Welsh figures used in Experiment 2 were similar to those used by Bornstein et al. (1990). They consisted of a series of simple line drawings of abstract shapes and designs and were easily discriminable from each other. A detailed description of these figures is provided by Bornstein et al. (1990). Copies of the Welsh figures may be found in Welsh and Barron (1949).

*Procedure.* The procedure used in Experiment 2 was identical to that used in Experiment 1, except that stimuli were presented in a heterogeneous exposure sequence during the familiarization phase of the experiment.

*Discrimination task.* A discrimination task similar to that used in Experiment 1 was used as an additional check for the subliminality of 5-ms stimuli in Experiment 2. However, in the Experiment 2 discrimination task, Welsh figures were used in place of the polygon stimuli that were used in the Experiment 1 discrimination task.

## Results

Mean liking ratings for stimuli in each exposure condition are presented in Figure 3. As in Experiment 1, a 2 × 2 × 5 mixed ANOVA was used to analyze these data. This ANOVA indicated that there was a main effect of exposure frequency on liking ratings, $F(4, 460) = 15.44$, $p = .0001$, with frequently exposed stimuli receiving more positive ratings than infrequently exposed stimuli. There was also a significant Exposure Duration × Exposure Frequency interaction, $F(4, 460) = 5.10$, $p = .0005$. Analysis of simple effects indicated that there was a significant increase in liking ratings with increasing exposure frequency for both 5-ms stimuli, $F(4, 116) = 8.01$, $p = .0001$, and 500-ms stimuli, $F(4, 116) = 4.10$, $p = .02$. Thus, both 5-ms and 500-ms stimuli showed typical mere exposure effects in Experiment 2, but stimuli in the 5-ms condition showed a larger exposure effect than did stimuli in the 500-ms condition.

The effects of stimulus type, exposure duration, and exposure frequency on recognition ratings are summarized in Figure 4. As this figure shows, there was a significant main effect of exposure frequency on recognition ratings, $F(4, 460) = 22.10$, $p = .0001$, with frequently exposed stimuli receiving higher recognition ratings than infrequently exposed stimuli. There was also a significant main effect of exposure duration on recognition ratings, $F(1, 115) = 61.00$, $p = .0001$; 500-ms stimuli received significantly higher recognition ratings than did 5-ms stimuli. Finally, there was a significant Exposure Duration × Exposure Frequency interaction, $F(4, 460) = 35.97$, $p = .0001$. Follow-up one-way ANOVAs revealed that recognition ratings of stimuli in the 500-ms condition increased with increasing exposure frequency, $F(4, 116) = 32.31$, $p = .001$, whereas recognition ratings of stimuli in the 5-ms condition were unrelated to exposure frequency, $F(4, 116) = 1.27$, *ns*.

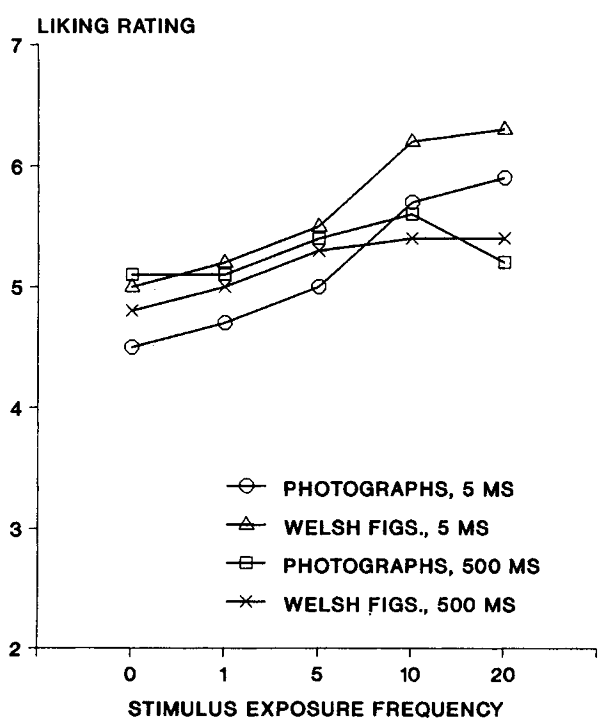


*Figure 3.* Effects of stimulus type and exposure duration on liking ratings of merely exposed stimuli (Experiment 2). (FIGS. = figures.)

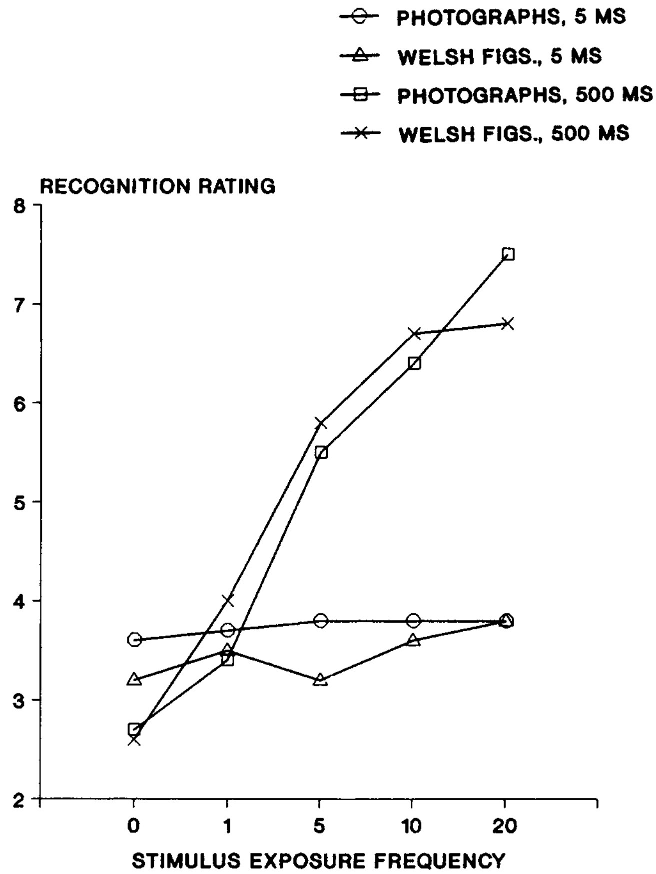


*Figure 4.* Effects of stimulus type and exposure duration on recognition ratings of merely exposed stimuli (Experiment 2). (FIGS. = figures.)

As was the case for the Experiment 1 discrimination task, subjects in the Experiment 2 discrimination task were unable to discriminate stimuli from blank cards at better-than-chance accuracy. Again, analyses were conducted collapsing across stimulus type because Welsh figure and photograph stimuli produced highly similar results. The mean number of cards correctly identified by subjects in the Experiment 2 discrimination task was 49.0. Overall, subjects correctly identified 980 out of 2,000 cards, which did not differ from chance accuracy, $\chi^2(1, N = 2{,}000) = 0.80$, *ns*. The number of correct identifications ranged from 42 to 54. Thus, no subject performed either significantly better or significantly worse than chance on this task.

## Discussion

The results of Experiment 2 are consistent with the results of our first experiment and confirm that subliminal stimuli produce significantly larger mere exposure effects than stimuli that are clearly recognized. The two flaws that characterized Experiment 1 (i.e., failure to obtain a significant exposure effect for stimuli in the 500-ms condition and failure to show increasing recognition ratings with increasing exposure frequency for abstract [polygon] stimuli in the 500-ms condition) were corrected in our second experiment. When more distinctive stimuli (i.e., Welsh figures) were used, recognition ratings of abstract stimuli in the 500-ms condition showed the predicted increase with increasing exposure frequency. Furthermore, when stimuli were presented in a heterogeneous exposure sequence rather than in a homogeneous exposure sequence (thereby minimizing boredom effects), liking ratings of stimuli in the 500-ms condition showed the expected increase with increasing exposure frequency.

As in the first experiment, subjects in Experiment 2 were unable to distinguish previously seen stimuli in the 5-ms condition from stimuli that they had not seen before (i.e., 0-frequency stimuli). Furthermore, as in the first experiment, subjects' recognition ratings of stimuli in the 5-ms condition were unrelated to exposure frequency. Nonetheless, as in the first experiment, 5-ms stimuli produced significantly stronger mere exposure effects than 500-ms stimuli in Experiment 2. Thus, the results of our second experiment again confirm Bornstein's (1989a) meta-analytic finding that stimuli perceived without awareness produce stronger mere exposure effects than stimuli that are clearly recognized.

## General Discussion

There are two plausible explanations for the pattern of results obtained in these experiments. First, the significantly stronger mere exposure effect obtained in the 5-ms condition relative to that obtained when 500-ms exposures were used might be due to boredom associated with 500-ms stimulus exposures. The two-factor learning-satiation model of the mere exposure effect makes this prediction, in that this model hypothesizes that overexposure to merely exposed stimuli results in *satiation* (i.e., boredom), producing a downturn in the frequency–affect curve (Harrison, 1977).

Considerable evidence has accumulated that supports this aspect of the two-factor learning-satiation model (see Bornstein et al., 1990, for a detailed discussion of this evidence). For example, complex stimuli produce stronger exposure effects than do simple stimuli (Saegert & Jellison, 1970). Similarly, stronger exposure effects are obtained when stimuli are presented in a heterogeneous sequence than when stimuli are presented in a homogeneous sequence (Harrison & Crandall, 1972). Moreover, a meta-analysis of research on the exposure effect demonstrated that across all mere exposure experiments there is an inverse relationship between stimulus exposure duration and magnitude of the exposure effect (see Bornstein, 1989a, Table 4). Thus, it is possible that 500-ms stimulus exposures simply become boring more quickly than do 5-ms exposures, resulting in a stronger exposure effect for 5-ms than 500-ms stimuli.

Although it is possible that boredom effects underly the present findings, two pieces of evidence raise questions regarding this explanation of our results. First, the total exposure time for a given stimulus in the 500-ms condition in our experiments was not great. Even in the 20-exposure condition in our experiments, each 500-ms stimulus was exposed for a total of 10 s. It seems likely that a longer period of exposure would be required to induce boredom, especially for interesting stimuli (i.e., photographs of college students) presented in a heterogeneous exposure sequence.

Second, if boredom was responsible for attenuating the mere exposure effect when 500-ms stimuli were used, one would expect to find an inverted U-shaped frequency–liking curve for those stimuli. As Bornstein et al. (1990) demonstrated, boredom effects in mere exposure experiments occur primarily at higher exposure frequencies, with the typical result being that the frequency–affect curves for stimuli with short and long exposure durations are identical at lower exposure frequencies, diverging only at higher frequencies of exposure. That pattern of results was not obtained in these experiments.

An alternative explanation of the present results is that stimulus awareness somehow inhibits the exposure effect, resulting in a stronger exposure effect for subliminal stimuli than for stimuli that are clearly recognized. Bornstein and D'Agostino (1990; see also Bornstein, 1992) outlined a theoretical model that accounts for this pattern of results. The basic premise of the model is that perceptual fluency (Jacoby & Kelley, 1987; Jacoby & Whitehouse, 1989) underlies the exposure effect and that differences in the magnitude of the exposure effect produced by subliminal versus supraliminal stimuli result from subjects' misattribution of perceptual fluency to liking for a stimulus in the subliminal exposure condition. In a typical mere exposure effect study, subjects are aware that they have been exposed to the stimuli that they are about to rate (Stang, 1974a). Thus, subjects can engage in a correction process (Gilbert, 1989; Trope, 1986), revising their initial interpretation of fluency effects. However, in a subliminal mere exposure study, perceptual fluency is enhanced by repeated exposure to a stimulus, yet the subject is unaware that stimulus exposures have taken place (Kunst-Wilson & Zajonc, 1980). Thus, no correction of the subject's initial interpretation of fluency effects is available, and the subject—given the demand characteristics of the experiment—concludes that fluency effects must be due to positive affect toward a stimulus.

The perceptual fluency/attributional model of the mere exposure effect has not yet been tested directly, and some unresolved issues regarding this model remain to be addressed. For example, it is not clear whether subjects must be aware that stimulus familiarization has an effect on subsequent affect ratings to engage in a correction process. Similarly, it is not clear why subjects may be motivated to "correct" their fluency-based affect ratings for clearly recognized stimuli in mere exposure experiments. Although a definitive test of the perceptual fluency/attributional model has yet to be conducted, one subsidiary piece of evidence from the present experiments offers indirect support for this model and furthermore is inconsistent with a key prediction made by the two-factor learning-satiation model.

The perceptual fluency/attributional model predicts that subjects who show strong exposure–recognition effects should show relatively weak exposure–liking effects and vice versa. In contrast, the two-factor learning-satiation model predicts that exposure should have similar effects on recognition and liking ratings (although the exposure–liking relationship will be attenuated at higher exposure frequencies). To test these two predictions, we calculated two composite scores for each subject in Experiments 1 and 2. One composite score represented the effects of exposure on liking, and the other composite score represented the effects of exposure on recognition. These scores were derived by multiplying each subject's liking and recognition scores at different exposure frequencies by the appropriate linear weights (i.e., −2, −1, 0, 1, and 2) and then adding the products together to obtain one exposure–liking score and one exposure–recognition score for each subject. We then calculated the correlation between these two composite scores.[2]

In Experiment 1, the correlation between subjects' exposure–liking and exposure–recognition scores was −.23. In Experiment 2, this correlation was −.26. Although these correlations are small, they are both statistically significant ($p < .02$ in each case) and are both consistent with predictions made by the perceptual fluency/attributional model.

Aside from questions regarding the processes that underly the mere exposure effect, the present results offer strong support for the existence of perception without awareness within the context of Reingold and Merikle's (1988) direct–indirect framework. In both experiments, repeated stimulus exposures had stronger effects on liking judgments (an indirect measure of responding) than on recognition judgments (a comparable direct measure of responding). Other recent experiments have produced similar results using different experimental paradigms (see Merikle & Reingold, 1991). Continued use of the direct–indirect approach to investigating perception without awareness will help to resolve a number of long-standing controversies regarding subliminal phenomena.

Although the present findings indicate that subliminal stimuli produce significantly stronger mere exposure effects than do stimuli that are clearly recognized, it is important to note that these results do not imply that a stimulus must be *subliminal* in the strictest sense of the term (see Holender, 1986) to produce an enhanced mere exposure effect. The critical aspect of stimulus subliminality might well be the subject's lack of awareness of the relationship between stimulus exposures and subsequent affect ratings, not the subject's lack of awareness of properties of the stimulus itself (see Bargh, 1992, for a detailed discussion of this issue). Thus, introduction of other procedures that diminish subjects' ability to perceive the relationship between stimulus exposures and subsequent affect ratings (e.g., divided-attention procedures during the familiarization phase of the study; see Jacoby & Kelley, 1987) might well result in an enhancement of the exposure effect comparable to that obtained when subliminal stimuli are used.

Given the numerous applications of the mere exposure paradigm in applied settings (e.g., in clinical treatment and marketing research; Bornstein, 1989a; Sawyer, 1981), further investigation of the processes that underly the exposure effect—as well as variables that enhance or undermine the exposure effect—is clearly warranted. Because exposure effects research has proved useful in testing basic hypotheses from clinical, social, cognitive, and developmental psychology (Bornstein, 1989a, 1989b, 1990), studies of the exposure–affect relationship will likely yield benefits that go beyond simply elucidating parameters and properties of the mere exposure effect.

[2] We are grateful to Richard Moreland for suggesting this analysis.

## References


Ball, P. M., & Cantor, G. N. (1974). White boys' ratings of pictures of Whites and Blacks as related to amount of familiarization. *Perceptual and Motor Skills, 39,* 883–890.

Bargh, J. A. (1992). Does subliminality matter to social psychology? Awareness of the stimulus versus awareness of its interpretation. In R. F. Bornstein & T. S. Pittman (Eds.), *Perception without awareness: Cognitive, clinical and social perspectives* (pp. 236–255). New York: Guilford Press.

Berlyne, D. E. (1974). Novelty, complexity and interestingness. In D. E. Berlyne (Ed.), *Studies in the new experimental aesthetics* (pp. 175–181). Washington, DC: Hemisphere.

Bonanno, G. A., & Stillings, N. A. (1986). Preference, familiarity and recognition after repeated brief exposures to random geometric shapes. *American Journal of Psychology, 99,* 403–415.

Bornstein, R. F. (1989a). Exposure and affect: Overview and meta-analysis of research, 1968–1987. *Psychological Bulletin, 106,* 265–289.

Bornstein, R. F. (1989b). Subliminal techniques as propaganda tools: Review and critique. *Journal of Mind and Behavior, 10,* 231–262.

Bornstein, R. F. (1990). Subliminal mere exposure and psychodynamic activation effects: Implications for the psychoanalytic theory of conscious and unconscious mental processes. In J. Masling (Ed.), *Empirical studies of psychoanalytic theories* (Vol. 3, pp. 55–88). Hillsdale, NJ: Erlbaum.

Bornstein, R. F. (1992). Subliminal mere exposure effects. In R. F. Bornstein & T. S. Pittman (Eds.), *Perception without awareness: Cognitive, clinical and social perspectives* (pp. 191–210). New York: Guilford Press.

Bornstein, R. F., & D'Agostino, P. R. (1990, August). *Limiting conditions on the exposure effect: Boredom and attributional discounting.* Paper presented at the 98th Annual Convention of the American Psychological Association, Boston.

Bornstein, R. F., Kale, A. R., & Cornell, K. R. (1990). Boredom as a limiting condition on the mere exposure effect. *Journal of Personality and Social Psychology, 58,* 791–800.

Bornstein, R. F., Leone, D. R., & Galley, D. J. (1987). The generalizability of subliminal mere exposure effects: Influence of stimuli perceived without awareness on social behavior. *Journal of Personality and Social Psychology, 53,* 1070–1079.

Erdelyi, M. H. (1985). *Psychoanalysis: Freud's cognitive psychology.* New York: Freeman.

Gilbert, D. T. (1989). Thinking lightly about others: Automatic components of the social inference process. In J. S. Uleman & J. A. Bargh (Eds.), *Unintended thought* (pp. 189–211). New York: Guilford Press.

Gordon, P. C., & Holyoak, K. J. (1983). Implicit learning and generalization of the mere exposure effect. *Journal of Personality and Social Psychology, 45,* 492–500.

Grush, J. E. (1976). Attitude formation and mere exposure phenomena: A nonartifactual explanation of empirical findings. *Journal of Personality and Social Psychology, 33,* 281–290.

Harrison, A. A. (1977). Mere exposure. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 10, pp. 39–83). San Diego, CA: Academic Press.

Harrison, A. A., & Crandall, R. (1972). Heterogeneity–homogeneity of exposure sequence and the attitudinal effects of exposure. *Journal of Personality and Social Psychology, 21,* 234–238.

Herzog, T. R., Kaplan, S., & Kaplan, R. (1976). The prediction of preference for familiar urban places. *Environment and Behavior, 8,* 627–645.

Holender, D. (1986). Semantic activation without conscious identification in dichotic listening, parafoveal vision and visual masking. *Behavioral and Brain Sciences, 9,* 1–23.

Jacoby, L. L., & Kelley, C. M. (1987). Unconscious influences of memory for a prior event. *Personality and Social Psychology Bulletin, 13,* 314–336.

Jacoby, L. L., & Whitehouse, K. (1989). An illusion of memory: False recognition influenced by unconscious perception. *Journal of Experimental Psychology: General, 118,* 126–135.

Kunst-Wilson, W. R., & Zajonc, R. B. (1980). Affective discrimination of stimuli that cannot be recognized. *Science, 207,* 557–558.

Mandler, G., Nakamura, Y., & Van Zandt, B. J. (1987). Nonspecific effects of exposure to stimuli that cannot be recognized. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13,* 646–648.

Merikle, P. M., & Reingold, E. M. (1991). Comparing direct (explicit) and indirect (implicit) measures to study unconscious memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 17,* 224–233.

Pliner, P. (1982). The effects of mere exposure on liking for edible substances. *Appetite, 3,* 283–290.

Reingold, E. M., & Merikle, P. M. (1988). Using direct and indirect measures to study perception without awareness. *Perception and Psychophysics, 44,* 563–575.

Saegert, S. C., & Jellison, J. M. (1970). Effects of initial level of response competition and frequency of exposure on liking and exploratory behavior. *Journal of Personality and Social Psychology, 16,* 553–558.

Saegert, S. C., Swap, W. C., & Zajonc, R. B. (1973). Exposure, context and interpersonal attraction. *Journal of Personality and Social Psychology, 25,* 234–242.

Sawyer, A. (1981). Repetition, cognitive responses and persuasion. In R. E. Petty, T. M. Ostrom, & T. C. Brock (Eds.), *Cognitive responses in persuasion* (pp. 237–261). Hillsdale, NJ: Erlbaum.

Seamon, J. G., Brody, N., & Kauff, D. M. (1983a). Affective discrimination of stimuli that are not recognized: Effects of shadowing, masking and cerebral laterality. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 9,* 544–555.

Seamon, J. G., Brody, N., & Kauff, D. M. (1983b). Affective discrimination of stimuli that are not recognized, II: Effect of delay between study and test. *Bulletin of the Psychonomic Society, 21,* 187–189.

Seamon, J. G., Marsh, R. L., & Brody, N. (1984). Critical importance of exposure duration for affective discrimination of stimuli that are not recognized. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10,* 465–469.

Stang, D. J. (1974a). Intuition as an artifact in mere exposure research. *Journal of Personality and Social Psychology, 30,* 647–653.

Stang, D. J. (1974b). Methodological factors in mere exposure research. *Psychological Bulletin, 81,* 1014–1025.

Trope, Y. (1986). Identification and inferential processes in dispositional attribution. *Psychological Review, 93,* 239–257.

Vanderplas, J. M., & Garvin, E. A. (1959). The association value of random shapes. *Journal of Experimental Psychology, 57,* 147–154.

Welsh, G. S., & Barron, F. (1949). *Barron-Welsh art scale.* Palo Alto, CA: Consulting Psychologists Press.

Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology Monographs, 9*(2, Pt. 2).

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist, 35,* 151–175.

Zajonc, R. B. (1984). On the primacy of affect. *American Psychologist, 39,* 117–123.

Zajonc, R. B., Markus, H., & Wilson, W. R. (1974). Exposure effects and associative learning. *Journal of Experimental Social Psychology, 10,* 248–263.

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## Carr Appointed Editor of the *Journal of Experimental Psychology: Human Perception and Performance*, 1994–1999

The Publications and Communications Board of the American Psychological Association announces the appointment of Thomas H. Carr, PhD, Michigan State University, as editor of the *Journal of Experimental Psychology: Human Perception and Performance* for a 6-year term beginning in 1994. As of December 15, 1992, manuscripts should be directed to

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Manuscript submission patterns for *JEP: Human Perception and Performance* make the precise date of completion of the 1993 volume uncertain. The current editor, James E. Cutting, PhD, will receive and consider manuscripts until December 14, 1992. Should the 1993 volume be completed before that date, manuscripts will be redirected to Dr. Carr for consideration in the 1994 volume.