Concurrent processes: The affect-cognition relationship within the context of the "mere exposure" phenomenon

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The affect-cognition relationship and Zajonc's (1968) "mere exposure" hypothesis were examined in two studies that involved ratings of: (1) preference and familiarity for geometric forms previously scaled for complexity and (2) preference or height and familiarity for male yearbook pictures previously scaled for attractiveness or height. Two exceptions to his hypothesis were noted: simple geometric forms and unattractive faces showed satiation, and faces seen once before were rated more attractive than both novel faces and faces seen twice before. Moreover, mere exposure effects were noted with a nonaffective dimension (height). The major finding was that presentation frequency generally manifested independent relations to affect and rated familiarity, as well as to height and rated familiarity, therefore evoking a concurrent response process (Eriksen, 1960).

Zajonc (1968) argued that "mere repeated exposure of the individual to a stimulus object enhances (attitudes) toward it" (p. 1)—the *mere exposure* hypothesis. Subsequent research has indeed confirmed that (overt) preferential ratings do generally increase with presentation frequency, which supports the most general form of the hypothesis (for reviews of the literature, see Bornstein, 1989; Harrison, 1977). However, it is controversial whether (1) increased presentation frequency directly modifies the affect associated with preference or (2) this change is mediated by cognition. According to Interpretation 1, changes in affect occur unconsciously. This is not true according to Interpretation 2. Moreland and Zajonc (1979) presented a causal model in which there were separate paths from presentation frequency to an affective construct, and a cognitive construct. It also contained reciprocal paths from the affective construct to the cognitive construct, and vice versa. They concluded that this model fit better than one in which cognition mediated the path from presentation frequency to the affective construct, which they took as evidence for an unconscious affect.

In contrast, Birnbaum and Mellers (1979a, 1979b) argued that this conclusion was an artifact of Moreland and Zajonc's (1979) failure to incorporate correlated error in their model. Birnbaum and Mellers attributed the correlated error to shared nonlinearity among certain indicator variables. Another possible source of this correlated error

is that Moreland and Zajonc used percentage correct and confidence ratings as independent indicators of the cognitive construct. In fact, standard signal detection logic (Macmillan & Creelman, 1991) can show how the two covary with changes in response bias. Nevertheless, once correlated error is incorporated, it is not necessary to include reciprocal causation between the cognitive and affective constructs. Therefore, Birnbaum and Mellers (1979a) found that a model that incorporated correlated error and in which cognition mediated both preference and familiarity ratings fit better than Moreland and Zajonc's (1979) proposed model.

In response, Moreland and Zajonc attempted to turn around Birnbaum and Mellers's (1979a) interpretation that a single mediator could explain all relevant effects by noting that this common mediator could be affective instead of cognitive. More recently, however, Brooks and Watkins (1989) found that the relation between presentation frequency and preferential ratings did not differ significantly from zero when familiarity was held constant, which is consistent with a process of cognitive mediation.

The predictions made by previous theorists are only part of what is at issue in this paper; equally important are the assumptions underlying these predictions. The analysis of the relation between cognitive and affective judgments offered here begins with three general assumptions. First, preferential ratings are like any other judgment, in that they are derived in part from the physical attributes of the stimulus. Clearly, preference is correlated with a wide variety of physical properties, depending on the nature of the task. For example, universal geometric features, such as the Pythagorean golden mean, may affect preferential ratings. Ratings may also reflect personal norms, again of a geometric nature, derived from one's having been raised in a particular culture (Bernstein, Lin, & McClellan, 1982), or they may be idiosyncracies of

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personal experience. Consequently, preferences are partially cognitive even though they may be affective as well. This assumption explicitly contrasts with Moreland and Zajonc's (1977, 1979) model, in which it is assumed that preferential ratings are purely affective. To argue that these physical norms are causal is stronger than to argue that they are correlates, but physical norms have one key property of a causal relationship in that they predate the specific object being judged.

The second assumption relevant to this study is that repeated presentations can provide new information that may potentially affect any form of judgment, including preferential judgments. This assumption merely states that people can learn from repetition, which is hardly novel (Berlyne, 1970; Stang, 1975).

The third assumption is that repetition need not affect all judgments equally. Hasher, Zacks, Rose, and Sanft (1987; see also Hasher & Zacks, 1979, 1984) have suggested that frequency information is ordinarily processed automatically, and depending on how attention is directed, other things about the stimulus may also be learned, but with more effort. This assumption is not made here, because Kunst-Wilson and Zajonc (1980) have indicated that there are circumstances in which it is possible to learn preferences without learning about prior exposure.

These three assumptions in turn have three testable consequences. First, the effects of previous exposure frequency may depend on characteristics of the stimuli. If this is true, the term "mere exposure" is a misnomer because it implies an automatic process of increased preference that is independent of the nature of the stimulus. Indeed, Zajonc (Zajonc, Crandall, Kail, & Swap, 1974; Zajonc, Shaver, Tavis, & Van Kreveld, 1973) has noted that some stimuli do in fact satiate with repeated viewing. Bornstein, Kale, and Cornell (1990) attributed this effect to a passive process of boredom, but it could just as well reflect the active acquisition of new, negative information about the stimuli.

Second, systematic changes may occur with increased presentation that involve other dimensions, including those that are independent of attractiveness. These changes would reflect any new information gained from repeated exposures.

Finally, changes should occur in any rated dimension holding constant other rated dimensions because of the partial independence of the information gained. In particular, preference and familiarity should be affected by presentation frequency, independently of the other. Eriksen termed this effect a *concurrent process* (Eriksen, 1960; see also Eriksen, Azuma, & Hicks, 1959), an interpretation that Birnbaum and Mellers (1979a) clearly acknowledged. In its general form, a concurrent process begins with the immediate perception of an event which mediates judgments of multiple attributes, such as preference and familiarity, and causes them to be correlated. However, other factors operate differentially on the judgments to attenuate this correlation. For example, information

about the frequency of previous exposure ordinarily influences perceived familiarity more than preference, whereas particular pleasant or unpleasant events may affect preference more than familiarity.

Methodologically, studies concerned with causal relations among presentation frequency, preference, and rated familiarity have used linear methods, although Birnbaum and Mellers (1979a) first transformed presentation frequency logarithmically to achieve linearity. In particular, Birnbaum and Mellers and Moreland and Zajonc (1977, 1979) used the analysis of covariance structures (LISREL; see Jöreskog & Sörbom, 1989), which models latent variables, and Brooks and Watkins (1989) used ordinary multiple regression, which models observables. Linear methods are generally appropriate as long as relevant relations are monotonic (Parker, Casey, Zirias, & Silberberg, 1988). However, certain relations may be nonmonotonic—in particular, the effect of presentation frequency on preference when satiation occurs. In the present study, this potential problem was dealt with by using discriminant analysis / multivariate analysis of variance to examine the effects of presentation frequency on preferential and familiarity ratings. This analysis provides a matrix of the form $W^{-1}B$, where W^{-1} is the inverse of the matrix of variances and covariances between the two ratings within presentation frequencies and B is the corresponding matrix between presentation frequencies. The diagonal entries of this product provide F ratios for each dependent variable partialing out the other and therefore provide a direct test of a component process. If there is a concurrent process, each of these *partial F* ratios should be significant, denoting that each dependent variable covaries with the experimental manipulation, holding the other constant. For further details, see Bernstein (1988, p. 257).

A second methodological consideration is that subjects provide dual ratings on every trial, the procedure followed by Brooks and Watkins (1989). In contrast, Moreland and Zajonc (1977) yoked pairs of subjects that provided either a preference or a familiarity rating. Their otherwise reasonable intent was to avoid having method variance inflate the correlation between the two ratings. They reported a low correlation between the two ratings. This underestimates the effect of partialing by excluding the natural covariation that arises. Although Moreland and Zajonc (1979) did not interpret their results in terms of a concurrent process, their findings in fact reflect the partial independence of the various ratings.

In Experiment 1, we examined how the relations among exposure frequency, preference, and familiarity might be affected by stimulus complexity. In Experiment 2, we examined the same relations, but we specifically looked at how preference and familiarity for pictures of faces (perceived attractiveness) depend on their consensually defined attractiveness. Both of these issues relate to the first of the consequences listed above. In Experiment 2, we also evaluated the second consequence that "mere exposure" effects may occur for dimensions other than affect-

tive ones. In both experiments, the previously mentioned multivariate procedures were used, to explore possible component process effects.

EXPERIMENT 1

Effects of Presentation Frequency on Preference and Familiarity for Geometric Forms Previously Scaled for Complexity

Smith and Dorfman (1975) had subjects judge *simple*, *medium*, and *complex* geometric designs that were 2×2 , 4×4 , and 6×6 square grids, respectively. The elements of each design were randomly black or white, with .5 probability. *Complexity* was defined as the number of elements in each matrix. Using presentation frequencies of 1, 5, 10, and 20, the investigators found that simple stimuli bore a U-shaped relation to liking (preference), medium stimuli bore an inverted U-shaped relation, and complex stimuli increased monotonically. The same paradigm was used in this experiment, with the exception that novel stimuli were introduced during the test phase.

Method

Subjects

A total of 120 subjects were obtained from the introductory psychology subject pool. They received course credit for their participation and were tested individually.

Procedure

Eight stimuli were constructed at each of the three complexity levels (for sample stimuli, see Smith & Dorfman, 1975). The figures were 12.7×12.7 cm (5×5 in.), laser printed onto 21.6×27.9 cm ($8\frac{1}{2} \times 11$ in.) loose-leaf sheets, mounted in cellophane holders, and placed in three binders, separated according to their complexity. For the exposure phase, two randomization orders were made of the eight stimuli to provide different serial orderings. The specific stimuli, each of which appeared a given number of times, were completely counterbalanced. Following the exposure phase, the subjects made paired preferential and familiarity ratings on 8-point scales, again in counterbalanced order. Because analyses at the level of individual subjects are based on somewhat unstable individual categorical responses, a subject who saw one randomization of a given complexity was yoked to a subject who saw the other, based on their order of participation. This provides more conservative inferential tests. It does not affect the size of mean differences, but it does have a marginal effect on the magnitude of the correlation between the two judgments. Neither the visual angle nor the luminance was calculated, since viewing was free.

Complexity was a between-subject variable. Within each complexity level, a stimulus was shown 1, 5, 10, or 20 times. Each was presented for about 3 sec by the experimenter. At the end of the exposure phase, the subjects were left alone to rate the four designs that they had been shown, along with four novel designs, in random order. No time limit was set for this test phase. The subjects provided ratings of preference and familiarity on 8-point Likert scales in counterbalanced order. Higher scores denoted greater preference and familiarity.

Results

Preferential Ratings

As is shown in Table 1, the analysis of variance indicated that both the main effect of presentation frequency and its interaction with complexity were significant [$F(4,228) = 17.90$ and $F(8,228) = 3.24$, respectively, $MS_e = 1.18$, $p < .01$].

A trend analysis was employed to explore these effects in greater detail. Logarithmic spacing was used for reasons noted in Birnbaum and Mellers (1979a). Linear and quadratic coefficients for unequal intervals were generated according to the procedure described by Gaito (1965; see also Winer, Brown, & Michels, 1991). The left data column of Table 2 contains the slope estimates for the three functions (linear components). These all significantly exceed zero, implying that increased frequency led to more positive ratings. The three slopes were then compared by forming two orthogonal contrasts. One was the difference between the medium and complex stimuli, which was nonsignificant [$F(1,228) < 1$], and the other was that between the average of the medium and complex stimuli and the simple stimuli, which was significant [$F(1,228) = 12.49$, $p < .01$]. The latter effect indicates that a preference for simple stimuli is less affected by repetition than is a preference for more complex stimuli.

The corresponding quadratic components were nonsignificant (all values of $F < 1$). The residual (pooled cubic and quartic components) was significant for the medium stimuli [$F(2,228) = 8.37$, $p < .01$], but not for the simple or the complex stimuli [$F(2,228) = 2.15$ and 3.48].

Familiarity Ratings

Table 3 contains the familiarity ratings as a function of presentation frequency for the three types of stimuli. The main effects of complexity and presentation fre-

Table 1
Experiment 1: Means and Standard Deviations of Preference Ratings as a Function of Scaled Complexity and Presentation Frequency

Presentation Frequency	Complexity					
	Simple		Medium		Complex	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
0	4.38	.63	4.41	.82	4.26	.75
1	4.78	1.19	4.90	1.34	4.33	1.20
5	5.30	1.17	4.40	1.84	4.48	1.30
10	5.40	1.32	5.45	1.05	5.40	1.23
20	5.03	1.57	6.38	1.10	5.98	1.46

Note—Presentation frequency refers to the number of times that each stimulus was shown.

Table 2
Experiment 1: Slopes for Preference and
Familiarity as a Function of Complexity

Complexity	Slopes	
	Preference	Familiarity
Simple	.61*	2.83*
Medium	1.23*	3.72*
Complex	1.28*	3.55*

Note— $df = 1,228$. * $p < .01$.

quency, and their interaction, were significant [$F(2,57) = 30.62$, $MS_e = 3.03$, $F(4,228) = 112.36$, $MS_e = 1.78$, and $F(8,228) = 6.41$, $MS_e = 1.78$, all $ps < .01$]. The right data column of Table 2 contains the slopes of the functions. All clearly exceed zero. However, these three values do not differ from one another, for neither the contrast between the medium and complex slopes nor the contrast between their average and the simple slope was significant [$F(1,228) < 1$ and 1.66]. None of the quadratic trends were significant ($F < 1$). The residual was significant for the simple and complex stimuli [$F(1,228) = 20.60$, 4.38 , $ps < .01$], but not for the medium stimuli ($F < 1$).

Joint Ratings

The three partial F ratios for preference, with familiarity held constant (3.18, 10.67, and 3.85, for the simple, medium, and complex stimuli, respectively), and the three partial F ratios for familiarity, with preference held constant (34.83, 46.37, and 41.67), were all significant ($df = 4,288$, all $ps < .05$). This implies that separate paths link presentation frequency to preference and familiarity. These F ratios are related to various indices of effect strength. The ratios for preference were clearly smaller, implying that presentation frequency is more strongly related to familiarity judgments than to preference, with the other held constant in each case.

Discussion

These results are consistent with the many studies (see Bornstein, 1989) showing that preferential ratings increase as presentation frequency increases. However, the use of the term "mere" in these studies suggests that the effects occur automatically and independently of the characteris-

tics of the stimuli. A main finding in the present study is that preferential ratings for stimuli differing in complexity increase at different rates, which is counter to the ordinary usage of the term "mere." Moreover, presentation frequency independently affected each type of judgment, but no unconscious processes need be assumed for one to reach this conclusion. Rather, the contention is that preferential judgments involve one set of (partially) cognitive cues and that familiarity judgments involve a related, yet distinct, set. This is a concurrent process, as described above.

Matlin (1971) found that previously presented stimuli were rated more favorably than novel stimuli, regardless of whether they were rated as "old" or "new." This type of analysis is simply an alternative (but less powerful) way of studying variation in one type of judgment with the other held constant, without utilizing multivariate analysis directly. When familiarity ratings were dichotomized in the present study, Matlin's findings were replicated. However, the converse, which Matlin did not examine, was also true—old designs were more likely to be rated as "old" than were novel designs, regardless of whether they were liked or not liked. Collectively, these results are simply another way of describing a concurrent process.

The interaction between complexity and presentation frequency was significant in Smith and Dorfman's (1975) study and was found to be significant in the present study, but the shapes of the functions that they obtained differed considerably from the ones obtained here. Therefore, another experiment was conducted, with the same stimuli and with Smith and Dorfman's presentation schedule. The results were similar to those presented above.

It may be noted that complexity, as defined by the number of independent squares, was confounded with the size of the individual squares. The fact that either can moderate the relation between exposure frequency and preference, however, establishes the point that increased preference is stimulus dependent and not automatic. In addition, a pilot experiment with 23 students was run prior to our gathering the present data. The resulting correlation between physical complexity and mean rated complexity was .91 over the 24 stimuli. It therefore did not appear profitable to conduct an experiment in which the sizes of the individual squares were held constant, which would have

Table 3
Experiment 1: Means and Standard Deviations of Familiarity
Ratings as a Function of Scaled Complexity and Presentation Frequency

Presentation Frequency	Complexity					
	Simple		Medium		Complex	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
0	3.26	1.29	2.41	.96	2.61	.77
1	6.53	1.90	3.58	1.56	2.65	1.31
5	7.23	1.30	5.63	1.82	4.48	1.92
10	7.53	.97	6.20	1.78	6.13	1.68
20	7.50	1.03	7.35	1.10	6.90	1.27

Note—Presentation frequency refers to the number of times that each stimulus was shown.

caused the overall pattern sizes to vary, as a means of obtaining converging operations.

EXPERIMENT 2

Effects of Presentation Frequency on Preference and Familiarity Ratings of Pictures of Faces Previously Scaled for Attractiveness or Height

In a pilot study, 214 subjects rated 100 pictures, presented as black and white slides, which were obtained from college yearbooks. To reduce extraneous sources of variability, all pictures were of white males with no facial hair or glasses. The pictures were rated for preference (attractiveness) plus the apparent age, intelligence, likability, and body height of the individuals. The latter attributes were chosen because people commonly make such judgments in ordinary life. Of importance in this study was that attractiveness correlated most poorly with height ($r = -.12$, n.s.). Height was therefore chosen as a second dimension to be explored for "mere exposure" effects. Both the attractiveness and height ratings were highly reliable, having alpha coefficients of .93 and .89, respectively (see Nunnally, 1978).

Method

Subjects

A total of 192 subjects were obtained from the introductory psychology subject pool. They received course credit for their participation and were run individually.

Procedure

The pictures that were rated in the pilot study were rank ordered according to their mean attractiveness and height ratings. Four picture sets were then assembled in the following manner. The extreme-attractive set consisted of the five individuals judged most attractive and the five judged least attractive. The moderate-attractive set consisted of the five pictures between the 36th and 40th percentiles of attractiveness and between the 56th and 60th percentiles. The extreme-height and moderate-height sets were analogously defined, using the height ratings. No picture appeared in more than one set. Using the four picture sets, as defined, allowed a comparison of subjects judging polar groups of stimuli with subjects judging relatively similar stimuli.

Each subject was randomly assigned to view and rate only one picture set. Those rating the extreme-attractive and moderate-attractive picture sets made joint attractiveness and perceived familiarity ratings, and those judging the extreme-height and moderate-height picture sets made joint height and perceived familiarity ratings. Neither

the visual angle nor luminance was calculated; viewing was free. The distance from subjects to the projected images was approximately 2 m.

During the exposure phase, subjects later making preferential (attractiveness) ratings were shown slides of an attractive and an unattractive picture 1, 2, 4, or 16 times for 1 sec each. Two randomization orders were again used to provide different serial orderings. There was also a partial counterbalancing of which specific pictures appeared a given number of times. Specifically, an attractive and an unattractive picture that were not presented in one randomization were presented 16 times in the other. Likewise, an attractive and an unattractive picture that were presented 1 time in one randomization were presented 4 times in the other. Following the exposure phase, subjects made the appropriate paired ratings of these stimuli plus two novel stimuli (one attractive and one unattractive) on 8-point scales in counterbalanced order. An analogous procedure was followed for subjects who later rated height. Higher scores denoted greater attractiveness, apparent height, and familiarity.

Results

Stimuli Previously Scaled for Attractiveness

Preferential ratings. The analysis employed the extreme versus moderate sets of pictures as a between-subject variable; the attribute attractive versus unattractive (as defined by the pilot experiment) and presentation frequency were the within-subject variables. The responses of pairs of subjects were yoked as in Experiment 1. As is shown in Table 4, two main effects were significant. First, pictures classified as attractive in the pilot experiment were preferred to (rated more attractive than) pictures previously rated unattractive [$F(1,46) = 66.41$, $MS_e = 3.06$, $p < .01$]. Second, ratings varied over presentation frequencies [$F(4,184) = 11.50$, $MS_e = 1.02$, $p < .01$]. In addition, two interactions were significant. First, ratings of attractiveness varied more within the extreme picture set than within the moderate picture set [$F(1,46) = 31.58$, $MS_e = 3.06$, $p < .01$]. Consequently, the rank ordering from extreme-attractive through extreme-unattractive, established in the pilot experiment, was preserved. The other interaction was that differences between the extreme and moderate picture sets varied over presentation frequencies [$F(4,184) = 3.49$, $MS_e = 1.02$, $p < .01$]. Even though the three-way interaction was not significant [$F(4,184) = 2.24$], group trends over presentation frequencies are presented in Table 4 to facilitate comparisons with other criterion measures and because of differences that appeared in the trend analysis.

Table 4
Experiment 2: Means and Standard Deviations of Preference Ratings as a Function of Judged Attractiveness and Presentation Frequency

Presentation Frequency	Attractiveness							
	Extreme Attractive		Moderate Attractive		Moderate Unattractive		Extreme Unattractive	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
0	4.92	.78	3.79	1.23	3.71	1.25	2.77	1.29
1	5.21	1.28	4.83	.95	4.25	1.49	3.23	.94
2	4.65	1.20	4.44	1.17	3.98	1.08	2.69	1.42
4	5.79	1.28	4.67	1.17	4.00	1.02	3.79	.92
16	5.94	1.22	4.67	1.41	4.44	1.02	3.02	1.15

Note.—Presentation frequency refers to the number of times that each stimulus was shown.

Table 5
Experiment 2: Slopes for Preference and
Familiarity as a Function of Attractiveness

Attractiveness	Slopes	
	Preference	Familiarity
Extreme attractive	.92†	3.76†
Moderate attractive	.52†	3.58†
Moderate unattractive	.47*	4.23†
Extreme unattractive	.27	4.39†

Note— $df = 1,184$. * $p < .05$. † $p < .01$.

The left data column of Table 5 contains the estimated slopes for the four functions. All but the extreme-unattractive significantly exceed zero. Orthogonal contrasts indicated that the extreme-attractive slope is steeper than the extreme-unattractive slope [$F(1,184) = 13.69$, $p < .01$], but the corresponding difference within the moderate set and the overall differences between the extreme and moderate sets were both nonsignificant. These slope differences denote that the ratings of the different sets fan out as the stimuli are presented more often.

All four quadratic trends were nonsignificant ($F < 1$). The residuals were significant for the extreme-attractive, moderate-attractive, and extreme-unattractive groups [$F(2,184) = 6.78, 5.71$, and 9.45 , $p < .05, .05$, and $.01$], but not the moderate-unattractive group [$F(2,184) = 1.66$]. One reason for this residual variance was that the mean rating for pictures shown once is significantly higher ($M = 4.38$) than the mean ratings for pictures shown never or twice [$M = 3.90$ and 3.94 ; $F(1,184) = 16.32$, $p < .01$].

Familiarity ratings. As is shown in Table 6, the major effect obtained from the familiarity ratings for pictures previously scaled in terms of attractiveness was presentation frequency [$F(4,184) = 184.06$, $MS_e = 2.67$, $p < .01$]. The three-way interaction among presentation frequency, attractive versus unattractive pictures, and extreme versus moderate pictures also reached significance [$F(4,184) = 2.46$, $MS_e = 1.34$, $p < .05$]. As can be seen in Table 6, this interaction seems to have arisen because novel extreme-attractive pictures evoke a higher (false) mean rating than do the remaining pictures, which lends a certain empirical credence to the statement often made to attractive individuals: "Haven't I seen you somewhere before?" Otherwise, the four group means increase monotonically with presentation frequency and reach ap-

parent ceiling at four presentations. Table 6 presents the familiarity trends of the four picture sets over presentation frequency.

The right data column of Table 5 contains the slopes of the four functions, all of which clearly exceed zero. The slopes for the unattractive stimuli within the extreme and moderate sets were steeper than those for their attractive counterparts [$F(1,184) = 12.32$ and 4.83 , $p < .01$ and $.05$], so that eventually the functions converged. The remaining orthogonal component, reflecting the overall difference between extreme and moderate sets, was not significant [$F(1,184) < 1$].

The quadratic trend for the extreme-unattractive group was significant [$F(1,184) = 4.04$, $p < .05$], but the remaining quadratic trends were nonsignificant [$F(1,184) = 3.36, 2.51$, and 3.86]. All residuals were significant [$F(2,184) = 73.48, 61.83, 64.72$, and 47.17 , $ps < .01$].

Joint ratings. When preference was controlled, the partial F ratios for familiarity were clearly significant, ranging from 54.19 to 71.09 ($ps < .01$, $df = 4,76$). However, when familiarity was controlled, only the partial F ratios obtained from the two extreme picture sets were significant for preference ($F = 7.14$ and 7.33); those obtained with the moderate sets were $F < 1$ (all $df = 4,92$). In sum, a concurrent process was demonstrable for the extreme picture sets in which the presentation frequency/familiarity relation was clearly stronger than the presentation frequency/preference relation. In contrast, there is little evidence for a concurrent process involving the moderate picture sets.

Stimuli Previously Scaled for Height

Height ratings. The analysis design for pictures previously scaled in terms of height was the same as above. The results paralleled the previous results of the attractiveness ratings. As is shown in Table 7, the two corresponding main effects were both significant. Pictures rated as tall in the pilot experiment were rated taller than pictures rated short in the pilot experiment [$F(1,46) = 136.59$, $MS_e = 1.75$, $p < .01$], and there was a main effect of presentation frequency [$F(4,184) = 5.06$, $MS_e = .65$, $p < .01$]. The two corresponding interactions were also significant. The rank ordering from extreme-tall through extreme-short, established in the pilot experiment, was preserved [$F(1,46) = 74.88$, $MS_e = 1.75$, $p < .01$], and presentation frequency interacted with extreme versus

Table 6
Experiment 2: Means and Standard Deviations of Familiarity
Ratings as a Function of Judged Attractiveness and Presentation Frequency

Presentation Frequency	Attractiveness							
	Extreme Attractive		Moderate Attractive		Moderate Unattractive		Extreme Unattractive	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
0	2.48	1.78	1.81	1.36	1.52	1.16	1.35	1.31
1	6.04	2.06	6.02	2.12	5.46	2.65	5.94	1.96
2	6.42	1.84	6.56	1.83	6.17	1.79	6.38	1.98
4	7.54	.85	6.38	1.69	7.23	1.35	7.15	1.43
16	7.60	1.04	7.13	1.55	7.27	1.45	7.54	1.18

Note—Presentation frequency refers to the number of times that each stimulus was shown.

Table 7
Experiment 2: Means and Standard Deviations of Height
Ratings as a Function of Height and Presentation Frequency

Presentation Frequency	Height							
	Extreme Tall		Moderate Tall		Moderate Short		Extreme Short	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
0	6.50	.74	5.29	1.02	5.19	.98	4.52	1.03
1	6.94	.43	6.06	.76	5.56	.86	4.50	1.14
2	6.48	.65	6.19	.94	5.71	.88	4.02	1.03
4	7.19	.62	5.98	.99	5.75	.90	4.54	.90
16	6.98	.70	6.00	1.20	5.48	1.42	4.21	1.08

Note—Presentation frequency refers to the number of times that each stimulus was shown.

moderate picture sets [$F(4,184) = 4.61$, $MS_e = .65$, $p < .01$]. Again, even though the three-way interaction was nonsignificant [$F(4,184) < 1$], Table 7 depicts the height trends for the four groups of picture sets over presentation frequencies.

The left data column of Table 8 contains the slopes for the four functions. The slopes for the moderate-tall and extreme-tall picture sets were significantly greater than zero [$F(1,184) = 4.96$ and 4.45 , $p < .05$], but the slopes for the extreme-short and moderate-short picture sets were not [$F(1,184) = 1.22$ and 1.09]. The slope for the extreme-tall picture set was therefore significantly steeper than the slope for the extreme-short picture set [$F(1,184) = 14.27$, $p < .01$], but the corresponding difference within moderate sets and the overall difference between extreme and moderate sets were nonsignificant [$F(1,184) < 1$ and 1.28]. Thus, these functions also fan out like the attractiveness ratings.

The individual quadratic trends were nonsignificant. The residual variances for the extreme-short and moderate-short picture sets were nonsignificant [$F(2,184) = 3.07$ and 2.77], but the residuals for the extreme-tall and moderate-tall picture sets were significant [$F(2,184) = 5.81$ and 4.44 , $ps < .05$]. Paralleling what was found with attractiveness judgments, the residual variance reflects in part the overall difference between pictures seen once ($M = 5.77$) and pictures seen never or twice [$M = 5.38$ and 5.60 ; $F(1,184) = 5.21$, $p < .01$].

Familiarity ratings. As is shown in Table 9, the effects observed with familiarity ratings were somewhat complex because of several significant effects. The largest effect was that of presentation frequency [$F(4,184) = 206.26$, $MS_e = 2.22$, $p < .01$]. Pictures of individuals rated as tall in the pilot experiment evoked higher familiarity rat-

ings than did pictures of individuals rated as short [$M = 6.61$ vs. 6.21 , respectively; $F(1,46) = 7.87$, $MS_e = 1.43$, $p < .01$]. Extreme versus moderate picture sets interacted with pictures previously rated tall versus short [$F(1,46) = 4.49$, $MS_e = 1.43$, $p < .05$] and with presentation frequency [$F(4,184) = 5.80$, $MS_e = 2.22$, $p < .01$]. The three-way interaction was also significant [$F(4,184) = 3.88$, $MS_e = 1.44$, $p < .01$]. Table 9 shows the familiarity trends of the four picture sets over presentation frequency.

The slopes for the rated familiarity functions are found in the right data column of Table 8. All differed significantly from zero, but they did not differ from one another. The quadratic components were all nonsignificant (all $Fs < 1$), but all four residuals were significant [$F(2,184) = 25.90, 57.60, 39.84$, and 57.22 , $ps < .01$]. These residual terms, which reflect higher order components of the trend, make it difficult to interpret the differences among the four functions.

Joint ratings. When rated height was controlled, all partial F ratios for familiarity were clearly significant, ranging from 48.49 to 80.65 ($p < .01$). When rated familiarity was controlled, the partial F ratio for height in the extreme-short condition was not significant ($F = 1.30$), but the remaining three F ratios were significant, ranging from 2.47 ($p < .05$) to 7.98 ($p < .01$). Generally, height ratings are affected by presentation frequency with familiarity controlled, but the relation is much weaker than that between presentation frequency and familiarity with rated height controlled.

Discussion

The results of Experiment 2 indicate, first, that the effects of repeated presentations upon preference, as defined by the functions' slopes, are related to the consensually defined attractiveness of the stimuli. Second, the "mere exposure" phenomenon can be obtained with height—a dimension that is statistically independent of preference (attractiveness). Third, analysis of the joint effects of presentation frequency on the two judgments further illustrates a concurrent process in which presentation frequency is related independently to the two judgments.

Again, Matlin's (1971) finding that previously presented stimuli were preferred to novel stimuli, regardless of whether they were rated old or new, held true.

Table 8
Experiment 2: Slopes for Height
and Familiarity as a Function of Perceived Height

Perceived Height	Slopes	
	Preference	Familiarity
Extreme tall	.39*	3.99†
Moderate tall	.41*	4.00†
Moderate short	.19	4.07†
Extreme short	~.20	4.29†

Note— $df = 1,184$. * $p < .05$. † $p < .01$.

Table 9
Experiment 2: Means and Standard Deviations of Familiarity
Ratings as a Function of Judged Height and Presentation Frequency

Presentation Frequency	Height							
	Extreme Tall		Moderate Tall		Moderate Short		Extreme Short	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
0	1.83	1.63	1.98	1.15	1.63	1.32	2.29	1.86
1	4.96	2.05	5.38	2.24	6.00	2.02	3.81	1.54
2	7.15	1.58	6.38	1.92	5.88	1.90	6.31	1.99
4	7.02	1.86	6.92	1.57	6.98	1.35	6.15	1.84
16	7.56	1.18	7.50	1.17	7.29	1.37	7.27	1.45

Note—Presentation frequency refers to the number of times that each stimulus was shown.

However, the converse—that old stimuli were judged older than new stimuli, regardless of whether they were rated favorably or unfavorably—also held true.

One possible criticism of this experiment is that the slope differences in the four functions are an artifact of the different levels at which the functions start. One may argue that a suitable nonlinear transformation of the preference and height scales might be found to equate the slopes, perhaps by using methods derived from Anderson (1981, 1982). Recall, however, that the three preference functions of Experiment 1 began at the same level, yet the slope for the simple figures was less than the slopes for the medium and complex figures. In addition, the extreme-unattractive preference ratings in Experiment 2 had the most opportunity to improve, since they started at the lowest level, but actually increased least. Consequently, scale transformations would not suffice to eliminate differential effects of repetition.

GENERAL DISCUSSION

The preceding results first illustrate that subjects generally prefer the familiar over the novel, as Zajonc (1968; see also Bornstein, 1989, and Harrison, 1977) suggested. However, Zajonc's "mere exposure" hypothesis does not provide a sound basis for *why* the preference change occurs; it simply asserts that it does occur. The results presented here show that preferences for some stimuli (simple geometric designs and pictures of unattractive faces) become incremented less with repetition than do preferences for others, and perhaps they even decline. Repetition effects, therefore, depend on the characteristics of the stimuli, in contrast with the "mere" (i.e., presumably automatic) portion of Zajonc's hypothesis.

Second, similar effects of repetition also occur in judgments of height, a dimension that in the pilot research was found to be unrelated to attractiveness. Stimuli that had previously been rated as average or taller "grew" with repetition. Perhaps both height and attractiveness are "affective" in Zajonc's (1980) sense, but this seems a bit strained, given their independence. Mandler, Nakamura, and Van Zandt (1987) reported that similar changes took place in judgments of brightness, but they used the procedures of Kunst-Wilson and Zajonc (1980), discussed below.

Third, these results support a concurrent process model (Eriksen, 1960) in which rated preference (or rated height) and rated familiarity are both derived from immediate perception, but are also influenced separately by stimulus properties such as complexity and consensually defined attractiveness. These three consequences follow from the assumptions that: (1) preference is partially cognitive, (2) repeated presentation provides new information, and (3) new information need not affect all judgments equally.

Moreland and Zajonc (1977, 1979; Zajonc, 1980) found that repetition affects preference independently of familiarity. They suggested that the changed preference could be attributed to the effects of an unconscious affect. The argument offered in the present paper, however, is that this partial independence arises because all judgments contain a cognitive component. This is reflected in the moderating influences on repetition effects of stimulus properties such as complexity and consensually defined attractiveness. Unconscious mechanisms are therefore not needed. If the concept of an unconscious affect is avoided, the rather cumbersome reciprocal causation between affect and cognition can be avoided as well. The key point is to treat preferential ratings as partly cognitive. This conclusion is quite consistent with Birnbaum and Mellers (1979a), who first raised the possibility of a concurrent process affecting the cognitive/affective relationship. It is also consistent with Mandler et al.'s (1987) view that processing information involves two factors: item activation (integration) and elaboration.

Specifically, repetition can affect preference cognitively in at least two ways. The first is for frequency to partially *define* preference. One possibility follows from Hebb (1949, p. 149), who suggested that mild discrepancies from previous input are perceived as positive, whereas large discrepancies are perceived as negative. In other words, seeing a new feature of a familiar stimulus would appear to be a mild discrepancy, leading to a positive evaluation.

The second is that stimulus attributes defining preference normally tend to be positively correlated, but some attributes are more obvious than others. Consequently, new attributes of a stimulus that was initially judged positively will also tend to be positive rather than negative, and vice versa. A variant of this view that is better suited to the results of Experiment 1 is that the availability of

new information in more complex stimuli prevents boredom (Bornstein et al., 1990).

The present results also indicate that sheer repetition is insufficient as a determinant of preference. Specifically, the stimuli presented once in Experiment 2 were rated higher than stimuli seen twice. This could have occurred because the stimuli seen once appeared only after the remaining stimuli had appeared several times, a perhaps fortuitous artifact of the randomizations. It seems quite reasonable that they were seen as a breath of fresh air amid otherwise boring repetitions. In fact, Berlyne (1970) noted that preference increases "when a monotonous sequence is interrupted by a single appearance of a contrasting stimulus" (p. 280; see also Saegert & Jellison, 1970).

It has been argued that the effects of repeated presentation can be unconscious because the stimuli apparently do not have to be consciously perceived on each trial to elicit preference through repetition. The first study of this form was reported by Kunst-Wilson and Zajonc (1980). Similar findings have been reported by Mandler et al. (1987); Seamon, Brody, and Kauff (1983a, 1983b); and Seamon, Marsh, and Brody (1984). Bornstein, Leone, and Galley (1987) have reviewed the literature. The basic paradigm is to present stimuli such as random polygons very briefly (for less than 12 msec; see Seamon et al., 1984). The same stimuli are later presented at longer durations along with similar, but novel, stimuli in a dual recognition memory and preferential rating task. The critical finding is that previously presented stimuli are preferred to novel stimuli, even though subjects cannot identify the stimuli that have been presented previously. This is commonly interpreted as an instance of subliminal perception.

An alternative explanation to the Kunst-Wilson and Zajonc (1980) data is that subjects initially "see" the stimuli, but that when recognizability is tested, an implicit measure is more sensitive than an explicit measure. This is an example of a limiting case of dissociating different judgments, a possibility alluded to by Merikle and Reingold (1991). If this is plausible, the phenomenon would be more of interest to students of memory than to students of perception.

To decide between a "subliminal perception" explanation and a "memory" explanation, it is vital to know whether the subjects can actually see the stimuli *at the time when they are originally presented*. This was not studied in any of the research cited previously. Some (e.g., Bornstein et al., 1987; Silverman, 1966) have used a *detection* task in which subjects judge the presence versus absence of target stimuli, but this is not an adequate substitute. Merikle (1982) has noted that subjects typically adopt a very high criterion in such tasks, causing both hit and false alarm rates to be low. A much more appropriate perceptual task is to have subjects make *same-different* judgments of the briefly presented test stimuli immediately after the stimulus has been presented. The fact that Kunst-Wilson and Zajonc (1980) presented the stimuli at 1 msec is irrelevant without such an identification task, for it is uncertain what the subjects had seen during training.

Studies such as Kunst-Wilson and Zajonc's (1980) and subsequent replications illustrate circumstances under which subjects learn little about prior frequency but learn more about other information, which is contrary to the findings of Hasher and Zacks (1984; Hasher et al., 1987). Indeed, as stated earlier, subjects can learn more about other aspects of the stimuli when they are not attending to frequency.

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