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Recognising what you like: Examining the relation between the mere-exposure effect and recognition

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The perceptual fluency/attributional model of the mere-exposure effect proposed by R. F. Bornstein and P. D'Agostino (1992) predicts that when recognition of a previously presented stimulus is above chance, feelings of fluency associated with that stimulus are discounted and thus the amount of fluency (mis)attributed to liking is reduced. This correction process results in smaller mere-exposure effects for supraliminal stimuli than for "subliminal" stimuli because when recognition is below chance participants are unaware of the source of fluency and they do not engage in correction. We tested this prediction in three experiments by presenting photographs of faces (Experiments 1 and 2) and polygons (Experiment 3) at varying exposure frequencies for 40 ms and 400 ms durations. Contrary to the prediction of the model, a significant mere-exposure effect was only found when recognition performance was at its highest level. Furthermore, across the three experiments liking and recognition were positively correlated.

According to the perceptual fluency/attributional model of the mere-exposure effect, the unreinforced repeated presentation of a neutral stimulus enhances the subjective feeling of perceptual fluency associated with that stimulus when it is reencountered. This feeling of fluency is then (mis)attributed to liking resulting in an increase in positive affect towards that stimulus—a "mere-exposure" effect (Bornstein, 1992; Bornstein & D'Agostino, 1992, 1994).

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Such mere-exposure effects are ubiquitous. They have been demonstrated in over 200 experiments involving a diverse range of stimuli from strings of consonants (Newell & Bright, 2001) to sequences of tones (Szpunar, Schellenberg, & Pliner, 2004) (for a review, see Bornstein, 1989). Moreover, mere-exposure effects have been obtained when the initial presentation of the stimuli is "subliminal" or at least at a level where subsequent recognition of the stimuli is not reliably different from chance (Bornstein, Leone, & Galley, 1987; Kunst-Wilson & Zajonc, 1980; Mandler, Nakamura, & Van Zandt, 1987; Seamon, Brody, & Kauff, 1983; Zajonc, 2001).

Interestingly, the size of mere-exposure effects obtained under these subliminal or suboptimal (Murphy, Monahan, & Zajonc, 1995) conditions is said to be larger than that obtained when presentations are supraliminal or optimal. According to Bornstein and D'Agostino (1992, 1994; see also Bornstein, 1992), such a difference in magnitude is expected because when participants are aware of the initial presentations they engage in a correction process in which they revise their preliminary feelings of fluency and then discount some of the positive affect that they feel towards a particular stimulus. In contrast, when participants are unaware of the source of the enhanced fluency, because of the initial suboptimal exposure conditions, they do not engage in a correction process and the subsequent liking ratings are not discounted.

Attributional effects of perceptual fluency have been reported in a number of situations, and awareness of the source of familiarity does appear to be a mediating factor in the size of the effects (Jacoby, Allan, Collins, & Larwill, 1988; Jacoby & Whitehouse, 1989). For example, Whittlesea, Jacoby, and Girard (1990) influenced the probability of judging a word as "old" (seen before) by manipulating the clarity with which words could be seen on a screen. The more easily a word could be perceived the more likely it was to be judged old regardless of its actual new/old status. This effect was eliminated by alerting participants to the influence of the clarity manipulation on fluency and thus the source of their diminished feelings of familiarity.

In spite of this converging evidence in support of the correction process, there is little direct empirical evidence to substantiate the claim that "subliminal" mere-exposure effects are larger than supraliminal ones. The majority of the evidence comes from Bornstein's (1989) meta-analysis in which he showed that the mean effect size, *r*, for subliminal mere exposure effects was .528, whereas it was only .140 for longer exposure durations. Yet the only empirical demonstration of a significant difference in magnitude was reported by Bornstein and D'Agostino (1992). They exposed participants to different types of stimuli (photographs of faces, polygons, and Welsh figures) for either 5 ms or 500 ms at a range of exposure frequencies

(1, 5, 10, 20) and then asked participants to rate the stimuli on recognition and liking scales. They reported that stimuli presented for 5 ms produced significantly larger exposure effects than those presented for 500 ms, while simultaneously showing that recognition ratings for the 5 ms stimuli were significantly lower than those for the 500 ms stimuli. Bornstein and D'Agostino (1992) argued that awareness of the stimuli inhibits the mere-exposure effect because awareness engages the correction process and causes participants to discount their ratings for the supraliminal stimuli.

However, Ste. Marie, Latimer, and Brunet (2001) noted that such an interpretation predicts that as recognition performance improves, the mere-exposure effect should be attenuated. Ste. Marie et al. tested this prediction by presenting nonwords supraliminally for 1, 5, or 10 exposures and then recording participants' liking and recognition ratings on old and new stimuli. They found that words exposed five and ten times during the presentation phase were recognised *and liked* significantly more than words that had not been presented. In other words, they found the opposite relation to that predicted by the correction hypothesis.

Further potentially difficult findings for the correction hypothesis come from studies by Brooks and Watkins (1989) and Szpunar et al. (2004). In five experiments (again using nonwords) Brooks and Watkins showed that liking and recognition were positively correlated, and furthermore that recognition appeared to mediate liking. In two experiments, Szpunar et al. used sequences of tones as stimuli and found monotonic increases in both liking and recognition confidence as a function of exposure frequency.

Although these findings appear to challenge the correction hypothesis, none of the studies mentioned used stimuli presented at suboptimal durations. It is possible that the differential effect of the correction process proposed by Bornstein and D'Agostino (1992) can only be observed when comparing suboptimal and optimal presentations. It may be that a correction process is engaged when participants are aware of the source of their feelings of liking, but that once some threshold of awareness is surpassed (i.e., above chance recognition) the amount of discounting is unaffected by any subsequent improvements in recognition. If the amount of discounting were constant once above-chance recognition was achieved then liking and recognition would improve in the way observed by Brooks and Watkins (1989), Ste. Marie et al. (2001), and Szpunar et al. (2004).

The current experiments provide a more direct test of the correction-process hypothesis by using stimuli presented at both optimal and suboptimal durations.

OVERVIEW OF EXPERIMENTS

It follows directly from Bornstein and D'Agostino's (1992, 1994) formulation of the correction hypothesis that when recognition is at chance mere-exposure effects should be greater than when recognition performance is above chance. To test this prediction we exposed participants to photographs of faces (Experiments 1 and 2) or polygons (Experiment 3) at suboptimal durations (40 ms) and optimal durations (400 ms). We then gave participants forced-choice liking and recognition decisions in which previously exposed faces (polygons) were paired with unseen faces (polygons). Support for the correction hypothesis would come from finding a larger mere-exposure effect for the suboptimal short (40 ms) than for the optimal long duration condition (400 ms).

GENERAL METHOD

All three experiments were divided into an exposure phase and a test phase. In the exposure phase stimuli were presented on a computer monitor using a rapid serial visual presentation (RSVP) mode of presentation with no interval between stimuli.[1] This method has been shown to produce reliable mere-exposure effects (Whittlesea & Price, 2001). Participants were told to concentrate and watch the screen very carefully throughout the presentations because their memory for the stimuli was to be tested later.

Immediately following the presentations each participant made forced-choice recognition ("Which face/shape have you seen before?") and liking ("Which face/shape is more likeable?") decisions on paired novel and old (seen during initial exposure) faces/shapes. In both experiments half the participants made the liking decision first and half made the recognition decision first. To avoid any stimuli-specific effects, the faces shown during exposure and test were selected at random from a set taken from the AR Face database (Martinez & Benavente, 1998). Thus each participant saw different faces during exposure and different pairings at test. All faces were black and white photographs of nonfamous people taken from the same orientation (frontal) and under the same lighting conditions. In Experiment 1 the people in the photographs all had neutral expressions; in Experiment 2 they were all smiling. The photographs appeared in the centre of the screen, approximately 4 cm $\times$ 4 cm in size. Similar precautions were taken in Experiment 3: A set of 80 simple line drawings of polygons was created (all

[1] The monitor had a refresh rate of 60 Hz so the minimum deviation from the programmed presentation rates was 0 ms and the maximum was 16.7 ms.

approximately 4 cm × 4 cm) and the stimuli shown at exposure and test were selected at random from this set.

EXPERIMENT 1

Method

Participants. Thirty-two undergraduate students from University College London participated in the experiment in return for course credit. There were 16 male and 16 female participants. All participants were tested individually in testing cubicles. Equivalent lighting and seating distance from the computer monitor was maintained for all participants.

Stimuli. Black and white photographs of the head and shoulders of nonfamous individuals were used. An example of a neutral face used in Experiment 1 is shown in Figure 1. Eighty photographs were selected (40 male and 40 female). Of these 80 faces, 40 were shown during initial exposure. Ten faces were shown 3 times at 40 ms, ten 9 times at 40 ms, ten 3 times at 400 ms, and ten 9 times at 400 ms for a total of 240 presentations. For the test phase the remaining 40 faces were paired with the 40 used during the exposure phase.

Design. The experiment was a 2 (exposure number: 3, 9) × 2 (exposure duration: 40 ms, 400 ms) within-subjects factorial design. The dependent variables were the proportion of "old" faces selected in the forced-choice recognition and liking tasks.

Procedure. As outlined above, participants saw all the faces in an RSVP format. There were 240 presentations in total (30 + 30 + 90 + 90) with the different duration times intermixed. Following training there was a self-paced

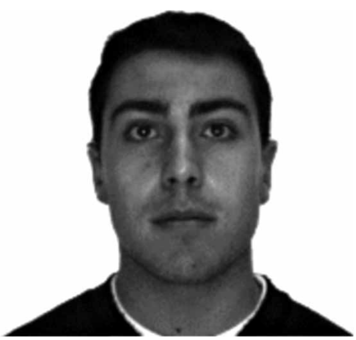

Figure 1. Example of a "neutral expression" face used in Experiment 1.

test phase in which recognition and liking forced-choice judgements were made for each of 40 pairs of faces.

Results and discussion

No effect of order of judgement was found on either recognition judgements, $F(1, 30) = 0.399$, $p > .5$ or liking judgements, $F(1, 30) = .035$, $p > .8$, so the judgements from both orders were combined for subsequent analyses. The mean proportion of old faces (seen during initial exposure) selected in the forced-choice test for both recognition and liking are displayed in the first and fourth row of Table 1.

A 2 (exposure number: 3, 9) $\times$ 2 (exposure duration: 40 ms, 400 ms) within-subjects ANOVA on the recognition decisions showed a main effect of exposure number, $F(1, 31) = 67.2$, $p < .0001$, indicating more accurate recognition with greater numbers of exposures, and a main effect of exposure duration, $F(1, 31) = 7.62$, $p < .01$, indicating more accurate recognition with longer stimulus duration. There was also a significant interaction of the two factors, $F(1, 31) = 7.97$, $p < .01$, due to the fact that the improvement in accuracy between the two exposure conditions was much larger for the longer duration condition (improvement of .14) than the shorter duration condition (improvement of .02).

A parallel analysis of the liking judgements showed no significant main effects of exposure, $F(1, 31) = 2.87$, $p > .05$, or duration ($F < 1$) and no interaction ($F < 1$). The absence of a duration effect is contrary to the prediction of the correction hypothesis: Shorter durations (40 ms) should produce larger mere-exposure effects than longer (400 ms) durations.

By using a two-alternative forced choice procedure we were able to compare performance against chance, i.e., selecting the old face on 50% of occasions. Comparisons against chance performance revealed that for recognition judgements, participants were reliably above chance in selecting the old face in the nine exposure 40 ms condition, $t(31) = 1.75$, $p = .045$, one-tailed, and for both three and nine exposures at 400 ms, $t(31) = 7.00$, $p < .001$; $t(31) = 13.5$, $p < .001$, respectively; but not in the three exposure 40 ms condition ($p = .62$). For the liking judgements, the only condition in which the old face was judged more likeable at a rate reliably above chance was the nine exposure, 400 ms condition, $t(31) = 2.95$, $p = .006$ (remaining conditions all ps $> .2$).

The results of Experiment 1 provide little support for the claim that mere-exposure effects are larger for stimuli that are not recognised. The only condition in which a mere-exposure effect was found was the condition in which recognition performance was at its highest. Experiment 2 examined two methodological factors that might be responsible for this pattern of results.

TABLE 1

Experiment 1 (N =32) Experiment 2 (N =44) Experiment 3 (N =40): Proportion of old faces (Expts 1&2) or shapes (Expt 3) selected in a forced choice test. (Mean and standard deviation)

	Number of exposures and durations							
	3exp, 40msec		*9exp, 40msec*		*3exp, 400msec*		*9exp, 400msec*	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Exp 1 Recognition	.52	.17	.54*	.13	.69**	.16	.83**	.14
Exp 2 Recognition	.50	.14	.52	.12	.66**	.12	.81**	.09
Exp 3 Recognition	.51	.12	.58**	.12	.72**	.14	.83**	.12
Exp 1 Liking	.52	.16	.52	.17	.53	.14	.58**	.14
Exp 2 Liking	.50	.11	.50	.09	.50	.10	.56*	.16
Exp 3 Liking	.51	.10	.48	.10	.53	.13	.58*[a]	.22

Note: Asterisks indicate significantly above-chance selection of the previously seen face/shape at $p < .05$ *one tailed, **two tailed, *[a]$p < .07$ one-tailed. In Experiment 1 duration and exposure were manipulated within subjects, in Experiments 2 and 3 exposure was manipulated within and duration between subjects.

EXPERIMENT 2

In Experiment 1 participants were instructed to concentrate on the faces very carefully as their memory was to be tested following the presentations. Whittlesea and Price (2001) have suggested that given such instructions participants tend to engage in an "analytic" processing strategy in which they attempt to encode distinctive features of particular stimuli. Whittlesea and Price argue that if such a strategy is used consistently it will prevent fluent processing of the stimulus as a whole "global" item. This means that when the repeated stimulus is encountered at test there will be less, or no, reexperiencing of processing fluency and hence no (mis)attribution of fluency to liking.

In Experiment 1 presentation durations of 400 and 40 ms were intermixed across training trials. It is plausible that given the instructions to look at the faces carefully during the exposure phase, participants might have simply concentrated on the longer duration presentations (perhaps reasoning that if they could remember those, they could perform "well enough" in the test phase) and thus essentially ignored the shorter duration faces.[2] Adoption of such a strategy would impact on the results in two ways: Firstly, the overall fluency generated at test would be reduced, thus decreasing the likelihood of obtaining liking effects, and secondly there may be no fluency at all associated with the 40 ms stimuli.

To mitigate this possibility of an "overshadowing" of the 40 ms stimuli, Experiment 2 employed a between-subjects manipulation of exposure duration. One group saw all the faces for 40 ms; the other saw all the faces for 400 ms. The suggestion is that participants in the 40 ms condition will be unable to encode the distinctive features of the faces (because of the rapid presentations) and are thus more likely to engage in a global or nonanalytic processing of the training stimuli. In turn, this strategy is more likely to produce (mis)attributions of fluency when previously seen faces are re-encountered at test.

Informal interviews with participants of Experiment 1 revealed that many of the faces used were "difficult to like" or "not liked very much" because of the neutral (sometimes "scowling", according to some participants) expressions on the faces. In Experiment 2 we aimed to improve the overall likeability of the stimuli by showing the same faces but with smiling, happy expressions. Figure 2 shows an example of a "smiley face" used in Experiment 2.

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[2] The above-chance recognition performance in the 9×40 ms condition suggests that the stimuli were not completely ignored.

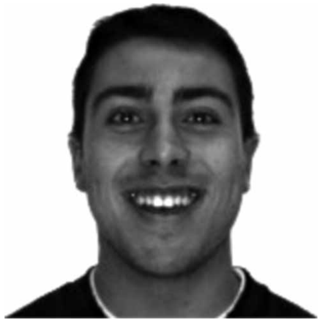

Figure 2. Example of a "happy expression" face used in Experiment 2.

Method

Participants. Forty-four undergraduate students from University College London took part in the experiment in return for £2.50 participation fee. Twenty-two participants (11 male, 11 female) were assigned to the 40 ms condition and 22 (11 male, 11 female) were assigned to the 400 ms condition.

Design and stimuli. Experiment 2 used a mixed design with number of exposures (3, 9) manipulated within subjects and duration of exposures (40 ms, 400 ms) manipulated between subjects. The same 80 faces were used but instead of having 10 faces per condition, 20 faces were used. Thus a participant in the 400 ms group saw 3×20 faces and 9×20 faces for a total of 240 faces. This ensured that the duration of the experiment was the same as in Experiment 1.

Procedure. The procedure was identical to Experiment 1 with the exception that during training participants saw either all pictures for 40 ms or all pictures for 400 ms in the RSVP format. Thus in both conditions the total number of exposures was 240 (60 + 180). The test phase was identical with 40 pairs of old and novel faces. All faces had smiley, happy expressions.

Results and discussion

No effect of order of judgement made was found on either recognition judgements or liking judgements so the judgements from both orders were combined for subsequent analyses. The mean proportion of old faces (seen during initial exposure) selected in the forced-choice test for both recognition and liking are displayed in the second and fifth row of Table 1.

A 2 (exposure number: 3, 9) $\times$ 2 (exposure duration: 40 ms, 400 ms) mixed-model ANOVA with repeated measures on the first factor showed a very similar pattern of results to that found in Experiment 1. There was a main effect of exposure number, $F(1, 42) = 13.1$, $p < .001$, indicating more accurate recognition with greater number of exposures, and a main effect of exposure duration, $F(1, 42) = 64.1$, $p < .001$, indicating more accurate recognition with longer stimulus duration. There was also a significant interaction of the two factors, $F(1, 42) = 8.54$, $p < .01$, due to the fact that the improvement in accuracy between the two exposure conditions was much larger for the longer duration condition (improvement of .15) than the shorter duration condition (improvement of .02).

The liking judgements also showed a similar pattern to those of Experiment 1. There were no significant main effects of exposure, $F(1, 42) = 1.37$, $p > .5$, or duration, $F(1, 42) = 2.11$, $p > .1$, and no interaction, $F(1, 42) = 1.37$, $p > .5$.

Comparisons to chance selection of the old face (.50) showed that for the recognition judgements, selection was above chance in both exposure conditions of the 400 ms duration group, $t(21) = 6.26$, 15.31, $p < .001$, for three and nine exposures, respectively. In the 40 ms group neither condition showed above chance selection of the old face (ps $> .5$). For the liking judgements, consistent with Experiment 1, the only condition to show an above chance selection of the old face was the condition in which recognition was highest, the nine exposures 400 ms duration condition, $t(21) = 1.85$, $p = .039$, one tailed (remaining conditions all ps $> .1$).

The results of Experiment 2 are highly consistent with those of Experiment 1.There is no suggestion that poorer recognition leads to larger mere-exposure effects. Manipulating the duration of training stimuli between subjects instead of within subjects had no impact on the overall pattern of results. It appears that the failure to find a mere-exposure effect for the 40 ms stimuli was not due to their being "overshadowed" in the intermixed presentations of Experiment 1.

Contrary to the predictions of the correction hypothesis (Bornstein & D'Agostino, 1992), in Experiments 1 and 2 we found no evidence that liking increases as recognition decreases. In both experiments the only condition in which a significant liking effect was found was the one in which recognition performance was at its best. Although we did not attempt a direct replication of Bornstein and D'Agostino's (1992) experiments, it is important to consider why they found a difference in the magnitude of subliminal and supraliminal mere-exposure effects and we did not.

We note that in their Experiment 1, the crucial interaction between exposure duration and exposure frequency for liking ratings appears to arise primarily because of the different magnitude of the liking effect for the polygons at the different exposure durations and not for the photographs of faces. Although the main effect of stimuli was significant, the interaction terms for the different stimuli are not reported. In their Experiment 2, a similar pattern is reported with the interaction appearing to be primarily due to the difference between liking ratings for Welsh figures (simple line drawings of abstract shapes) at the long and short durations rather than the photographs. It is possible that a correction process only operates on abstract stimuli about which participants are emotionally ambivalent; photographs of faces, on the other hand, may elicit stronger emotional reactions that are not so easily discounted.

To examine this possibility, in Experiment 3 we replicated the design of Experiment 2 using abstract polygons as stimuli rather than photographs of faces.

EXPERIMENT 3

Method

Participants. Forty undergraduate students from the University of New South Wales took part in the experiment in return for course credit. Twenty participants (11 female) were assigned to the 40 ms condition and 20 (15 female) were assigned to the 400 ms condition.

Design and stimuli and procedure. The design was identical to Experiment 2. The stimuli were 80 simple line drawings of polygons created for the experiment (see Figure 3 for examples). Each participant saw a different set of randomly selected polygons in the exposure and test phase. The procedure was identical to Experiment 2.

Results and discussion

No effect of order of judgement made was found on either recognition judgements or liking judgements, so the judgements from both orders were

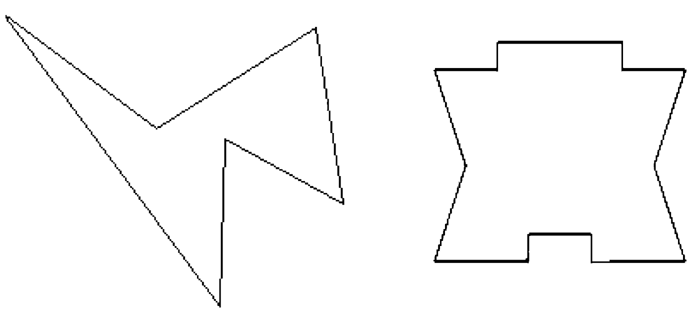

Figure 3. Examples of the abstract shapes used in Experiment 3.

combined for subsequent analyses. The mean proportion of old polygons (seen during initial exposure) selected in the forced-choice test for both recognition and liking are displayed in the third and sixth row of Table 1.

A 2 (exposure number: 3, 9) × 2 (exposure duration: 40 ms, 400 ms) mixed-model ANOVA with repeated measures on the first factor showed a very similar pattern of results to that found in Experiments 1 and 2. There was a main effect of exposure number, $F(1, 38) = 12.4$, $p < .001$, indicating more accurate recognition with greater number of exposures, and a main effect of exposure duration, $F(1, 38) = 51.8$, $p < .001$, indicating more accurate recognition with longer stimulus duration. The interaction between the two factors was not significant ($F < 1$).

The liking judgements also showed a similar pattern to those of Experiments 1 and 2. There were no significant main effects of exposure, $F(1, 38) = .13$, $p > .5$, or duration, $F(1, 38) = 2.28$, $p > .1$, and no interaction, $F(1, 38) = 2.20$, $p > .5$.

Comparisons to chance selection of the old polygon (.50) showed that for the recognition judgements, selection was above chance in both exposure conditions of the 400 ms duration group, $t(19) = 7.17$, 12.0, $p < .001$, for three and nine exposures, respectively. In the 40 ms group only the nine exposure condition showed above-chance selection of the old polygon: 3 exposure, $t(19) = .45$, $p > .001$; 9 exposure, $t(19) = 2.89$, $p < .01$. For the liking judgements, consistent with Experiment 1 and 2, the only condition to show an above-chance selection of the old face was the condition in which recognition was best, the nine exposure 400 ms duration condition, $t(19) = 1.57$, $p = .066$, one tailed (remaining conditions all ps > .30).[3]

The high degree of consistency between the results for Experiments 2 and 3 suggests that the nature of the stimuli used is not responsible for our failure to find an increase in liking as recognition decreases. There is no suggestion of a stronger liking effect for the polygon stimuli when recognition is at chance levels. In summary, under the conditions we have employed we have found no evidence for the operation of a correction process acting on face or polygon stimuli.

Power of Experiments 1–3 to obtain a liking effect

In all three experiments the only condition in which recognition was reliably at chance was the three exposure/40 ms condition. According to the correction hypothesis this is the condition in which a large liking effect

[3] This marginal liking effect was influenced by the presence of one participant whose liking score (.10) was more than two standard deviations away from the mean ($M = 0.58$, $SD = 0.22$). Excluding this one participant from the analysis resulted in a much stronger liking effect, $t(18) = 2.30$, $p = .034$, two-tailed.

should have been found. Collapsing across this condition for all three experiments provides an overall selection rate of the old stimulus of .51 ($SD = 0.13$). This rate was not significantly different from chance, $t(73) = .614$, $p < .05$. Our power to detect an estimated liking effect of .54 with an estimated standard deviation of .13, (i.e., equivalent to the weakest reliable effect found in the current experiments) collapsed across these three conditions was .75 (two-tailed) (Howell, 2002). Thus our failure to find a mere exposure effect at suboptimal durations is not due to a lack of power.

Correlation analyses

The results of Experiments 1, 2, and 3 were highly consistent and comparable so we decided to pool the results to conduct an exploratory correlation analysis. The correction hypothesis states clearly that there should be a negative correlation between recognition and liking (Bornstein & D'Agostino, 1992). To examine whether this was indeed the case, we calculated a single recognition score and a single liking score for each participant. This was done by averaging a participant's score for each condition. For example, if a participant in Experiment 1 had recognition scores of .50, .60, .80, and .90 and liking scores of .40, .60, .60, and .70 for the 3×40 ms, 9×40 ms, 3×400 ms, and 9×400 ms conditions, respectively, he or she would have an overall recognition score of .70 and an overall liking score of .575. Correlating these data for all 116 participants (32 from Experiment 1, 44 from Experiment 2, and 40 from Experiment 3) we found that, rather than the predicted negative relation, liking and recognition were significantly positively correlated, $r = .20$, $p < .05$.

GENERAL DISCUSSION

In three experiments we tested the key prediction of the correction hypothesis—that, as recognition decreases liking should increase. In all three experiments using both photographs of faces and abstract polygons as stimuli we found no evidence for such a correction process. When recognition performance was at chance levels, there was no suggestion of a mere-exposure effect.[4] Furthermore, correlation analysis shows a clear positive relation between liking and recognition.

One possible explanation for our results is that by requiring the same participants to make both liking and recognition judgements on the same trial for each pair of stimuli, we prevented participants from experiencing

[4] In several further experiments using the same methods as described here we have failed to obtain any evidence that selection of familiar stimuli can be more probable in liking than recognition or that the mere exposure effect occurs for stimuli that are not recognised.

fluent reprocessing of the stimuli. According to Whittlesea and Price (2001), recognition judgements induce an analytic processing strategy in which participants treat a stimulus as a collection of separate and potentially recognisable features (e.g., hair colour, nose size). Knowledge of these distinctive features is thought to underlie recognition performance. In contrast, liking judgements induce a nonanalytic strategy in which the global properties of a stimulus are encoded. This global feeling of familiarity is what is responsible for experiencing fluent reprocessing of the stimuli and the subsequent (mis)attribution of liking. Although the results of Experiments 2 and 3 appear to preclude the adoption of these different strategies as a function of the presentation duration of training stimuli, it is possible that requiring both liking and recognition judgements at test led to the dominance of an analytic strategy.

The order of liking and recognition judgements was counterbalanced, but after the first trial participants would have known that both judgements were required. Given that the test was framed in terms of a memory experiment, there may have been a strong demand characteristic to adopt a strategy that would lead to good recognition performance. Reliance on such an analytic strategy might have prevented, or at least attenuated, the generation of the feelings of fluent processing necessary for the liking judgements.

This possibility could be explored in an experiment in which either recognition or liking ratings are elicited from participants at test (e.g., Whittlesea & Price, 2001). However, such an experiment would lack the compelling impact of demonstrating above-chance liking but chance recognition *in the same person*. Furthermore, the sole empirical demonstration of larger mere-exposure effects for suboptimal than optimal stimulus durations was obtained under conditions in which both liking and recognition ratings were made simultaneously, by the same participants on the same stimuli (Bornstein & D'Agostino, 1992). Thus there is no reason to suspect that our procedure is inappropriate for finding evidence of the proposed correction process.

Our findings can still be interpreted within the context of a perceptual fluency/attributional model; albeit one that does not hypothesise the operation of a correction process. In all three experiments we found a small but reliable liking effect in the nine presentation, 400 ms duration condition. Presentation of a stimulus nine times at 400 ms presumably establishes a perceptual representation of that stimulus which is activated when it is re-encountered during the test. This activation of the representation leads to the stimulus being processed more fluently, and this fluency is then (mis)attributed to the increased likeability of the stimulus. This explanation implies that even if participants adopted an analytic strategy at test, the numerous repetitions combined with long exposure duration were sufficient to generate the fluency necessary to obtain the small liking effect. However, recognition that the stimulus had been seen during the earlier exposure phase did not lead participants to discount their liking judgement. This explanation is consistent with the one offered by Ste. Marie et al. (2001) for their finding of a parallel increase in recognition and liking for non-word stimuli.

We are not alone in failing to replicate subliminal mere exposure effects. Our results are consistent with Fox and Burns (1993) who reported finding significant liking effects only when stimuli (abstract polygons and "meaningful" drawings) were above recognition threshold. Recent findings by Berry, Shanks, and Henson (in press) are also consistent with the absence of subliminal effects. In four experiments Berry et al. were unable to replicate Merikle and Reingold's (1991) often cited finding of greater sensitivity to an indirect than a direct test of memory. Taken together, these and the current findings, raise serious questions about apparent demonstrations of unconscious influences on memory.

In conclusion, our results support the suggestion that liking and recognition are closely associated (e.g., Brooks & Watkins, 1989; Ste. Marie et al., 2001; Szpunar et al., 2004; Whittlesea & Price, 2001) and that attribution of perceptual fluency mediates liking, but do not support the correction hypothesis proposed by Bornstein and D'Agostino (1992).

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