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It Felt Fluent, and I Liked It: Subjective Feeling of Fluency Rather Than Objective Fluency Determines Liking

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According to the processing-fluency explanation of aesthetics, more fluently processed stimuli are preferred (R. Reber, N. Schwarz, & P. Winkielman, 2004, Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience? *Personality and Social Psychology Review, Vol. 8,* pp. 364–382.). In this view, the subjective feeling of ease of processing is considered important, but this has not been directly tested in perceptual processing. In two experiments, we therefore objectively manipulated fluency (ease of processing) with subliminal perceptual priming (Study 1) and variations in presentation durations (Study 2). We assessed the impact of objective fluency on feelings of fluency and liking, as well as their interdependence. In line with the processing-fluency account, we found that objectively more fluent images were indeed judged as more fluent and were also liked more. Moreover, differences in liking were even stronger when data were analyzed according to felt fluency. These findings demonstrate that perceptual fluency is not only explicitly felt, it can also be reported and is an important determinant of liking.

Keywords: subjective feeling of fluency, perceptual fluency, liking, feeling of ease, ease of processing

Every day, we evaluate many things in terms of whether we like them. This occurs, for example, when we choose a soft drink, when we inspect advertisements, or when a new fashion item, artwork, or piece of music appeals to us. Even when we are not explicitly aware of why we like an object, we can judge very easily whether we like it or not. For simple spontaneous preferences, liking often seems to be based on "feeling" rather than on rational decisions or explicit insight. In the present study, we investigate how this "feeling"—or the affective component of the judgment—operates when we perceive and like a stimulus.

During stimulus perception, one moderating factor for our liking could be fluency. According to Reber, Schwarz, and Winkielman (2004), if an object can be perceived with ease, this easiness or fluency seems to increase our liking of an object (for further reviews see Alter & Oppenheimer, 2009; Winkielman, Schwarz, Fazendeiro, & Reber, 2003). Thus, according to this concept, people prefer what they experience as fluent, or what they can process fluently. For example, Reber, Winkielman, and Schwarz (1998) have shown that images made more fluent through perceptual priming, higher contrast, or longer presentation duration, were detected faster and preferred over less fluently processed images. Subsequent studies have corroborated these findings (see Reber, Schwarz, et al., 2004, for a review), and have shown that, not only objective perceptual increase of processing fluency, through priming, symmetry, or presentation duration (Reber et al., 1998), but also conceptual manipulations, through higher semantic coherence (Topolinski & Strack, 2009a, 2009b), increase liking. But how does fluency exert its influence on liking? It is assumed that the objective fluency of a perceptual process is accompanied by a subjective experience of fluency (Koriat, 1993), of which humans are not necessarily aware (Reber, Fazendeiro, & Winkielman, 2002). Since "processing fluency is itself hedonically marked and high fluency is subjectively experienced as positive, as indicated by psychophysiological findings" (Reber, Schwarz, et al., 2004, pp. 365–366), this positive experience can subsequently be attributed to an object in the course of automatic object appraisal (Clore, 1992). Accordingly, fluency could exert its influence on our liking through the subjective feelings of ease that accompany the perceptual process.

Uncovering the nature and impact of this subjective experience, or subjective feeling of fluency (Reber et al., 2002), is a pivotal issue not only in the fluency literature ("fringes of consciousness"; Reber & Schwarz, 2002; Reber, Wurtz, & Zimmermann, 2004; Topolinski & Strack, 2009b), but also for our understanding of the role and function of consciousness in general (Craig, 2009; Damasio, 1999; Rolls, 2000), and of judgments and decision making ("cognitive feelings," Clore, 1992; Clore et al., 2001). The term "feeling" as a subjective sensation suggests that the experience of fluency could be relatively faint, fleeting, or unspecific. That this feeling can nevertheless lead to a conscious experience of fluency was first proposed by Bornstein and D'Agostino (1992, 1994) in their perceptual fluency/attributional model. Originally proposed as an explanation for the mere-exposure effect (Kunst-Wilson & Zajonc, 1980; Zajonc, 1968), the model also explains the fluency–liking link by proposing that fluency is subjectively experienced as an unspecific feeling, which can become a powerful source in the formation of evaluations and preferences (Schwarz & Clore, 1988). However, in their studies, Bornstein and D'Agostino only assumed and did not test that a subjective feeling had been elicited

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by their perceptual manipulations, as no direct measure for these feelings was taken.

Reber, Wurtz, and Zimmerman (2004) more directly addressed the status and role of subjective feelings of fluency. They showed that objective perceptual fluency manipulations of both contrast and type of font fed into a subjective feeling of fluency as revealed by effects on experienced readability. These findings indicated that the subjective feeling of fluency can be reported following an objective manipulation of fluency. Still, however, it remained unclear whether experienced readability was a reflection of a subjective feeling of fluency. In other words, the hypothesis that a component of feeling of easiness or fluency can be falsely attributed to an object and facilitate its liking, requires directly showing that the ease of processing leads to a feeling of fluency, and that the latter has the potential to enhance object liking.

In our experiments, we directly addressed the crucial mediating feeling of fluency by asking our participants to explicitly judge how easy it was for them to perceive the just presented stimulus. This is similar to the approach of Topolinski and Strack (2009a, 2009b) who measured subjective feelings of fluency and liking after manipulating semantic coherence of word triads in a between-participants design. Interestingly, they found that higher fluency was not necessarily felt by their participants (as revealed by subjective evaluations), but nevertheless led to higher liking. The authors reasoned that differences in conceptual fluency were strong enough to trigger an affective reaction, but might have been too weak to be consciously detected as higher felt fluency. Thus, despite that study, it is still an open question whether subjective feelings of fluency could facilitate liking. Moreover, each participant of Topolinski and Strack's experiments judged each object only once. In this manner, object repetitions were prevented as one source of increased fluency and liking. A drawback of this approach, however, is that object preferences could have reflected between-participants preferences that existed prior to and regardless of the fluency manipulations. To allow a within-participant manipulation of object evaluation by fluency in the present study, we therefore took another approach. Every stimulus was presented twice, and we used priming and stimulus duration as fluency manipulations. This enables us to track the liking and subjective fluency ratings to our fluency manipulations. Using a perceptual fluency manipulation instead of a conceptual manipulation enables the study of relationships between fluency and liking at an early perceptual level.

To study the role of subjective feelings of experienced fluency, we directly asked our participants for their *felt fluency* (FF). Thus, in two experiments, subjective (feeling of) fluency ratings of stimuli were registered as a dependent variable in every trial. As independent variables, we employed two perceptual manipulations of processing fluency (as in Reber et al., 1998). We call these the manipulations of *ease of processing*. In the first experiment, we used subliminal perceptual priming as an objective manipulation of ease of processing. In the second experiment we explored whether manipulation through varying the presentation duration influences the FF and liking rating. Most crucially, we also compared the FF with the objective manipulation of ease of processing as alternative determinants of liking. If the ease of processing is as powerful as feelings of fluency, liking should be facilitated by ease of processing, regardless of the participants' FF. However, if FF matters, liking should be facilitated even more when the participants felt that perception was easier.

Experiment 1

In the first experiment, we used subliminal perceptual priming to manipulate the ease of processing of line drawings of simple everyday objects. During subliminal priming, one stimulus, the prime, is masked so that it remains below the level of awareness, and it is presented prior to a visible and task-relevant target stimulus (Dehaene et al., 1998; Marcel, 1983). In this situation, a congruent prime that resembles the target in its appearance or meaning facilitates processing of the target (Ansorge, Kiefer, Khalid, Grassl, & König, 2010; Kiefer, 2002). This facilitation is evident when compared with a neutral or incongruent prime that is perceptually less similar to the target or its meaning (Greenwald, Draine, & Abrams, 1996; Martens, Ansorge, & Kiefer, 2011). Through congruent priming, the processing ease of a target image should be increased and, according to the fluency–liking hypothesis, the target should be liked more (see Reber et al., 1998). By prompting FF as well as liking ratings, the relationship between these two dimensions can be studied. Following the recommendation of Bornstein and D'Agostino (1992, 1994), we used subliminal masked priming to conceal the source of fluency and therefore to avoid that fluency would be discounted.

Method

Participants. Fifty undergraduate psychology students (43 women) from the University of Vienna took part in return for partial course credit. Their ages ranged from 18–31 years (M = 22.5, SD = 3.5). Participants signed a written consent form and had normal or corrected-to-normal vision.

Stimuli. We selected 150 images (image size: 3.2 × 2.3 in., or 6.79° × 4.75° of visual angle at a viewing distance of approx. 27.56 in.) from the picture set of Rossion and Pourtois (2004), depicting a variety of everyday objects. Of these images, 100 were selected as target images, and the remaining 50 images were used as incongruent primes. We thereby created the two levels of processing ease: Congruent conditions, with similar prime and target pictures in the same trial, and incongruent conditions, with primes that differed from the subsequent target in the same trial. All images were gray-scale versions. For the line-prime images, we erased all surface texture and shadowing from the original photographic images (see Figure 1 for an example of the images used as prime and target in a trial). We also added 60% Gaussian noise to the original images using Adobe Photoshop CS4. As a consequence, target images were not too easily perceived. Participants had thus no problem understanding their task: to judge how easy they felt it was to perceive the stimuli. Adding noise to the images also fostered perceptual uncertainty, which is favorable for measuring the influence of FF on liking judgments (Schwarz, 2004). To avoid prime visibility, a line mask of 3.2 × 3.2 in. was used. The mask was created (with Adobe Photoshop CS4) by random lines of the same thickness as in the target images. Masking was tested and ensured during pretesting.

Design and procedure. Each image had to be rated twice, once for FF and once for liking. These measurements were taken independently in two different blocks. Order of blocks (liking first

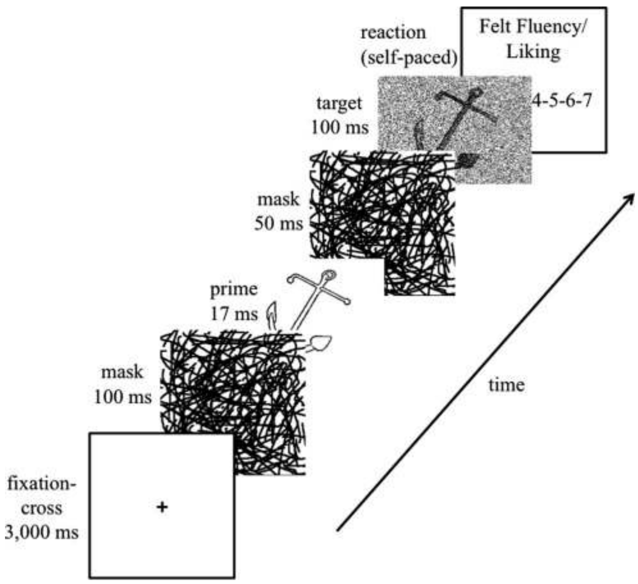

Figure 1. Sequence of a congruent trial (high ease of processing) with respective presentation durations on the left.

vs. fluency first) was counterbalanced across participants. In each block, half of the images were congruently and the other half were incongruently primed. To allow direct comparisons between FF and liking, images that were used as congruent targets in one block were also used as congruent targets in the second block. Also, each image was equally often used in a congruent or incongruent trial. Targets and primes were combined in eight different versions, and each participant was randomly assigned to one of the versions.

To conceal the link between the FF and the liking ratings, participants were told in the instructions that they would take part in two separate experiments: One in which FF would be studied, and another one in which we collected liking ratings for stimulus selection for a later experiment. Each trial started with a fixation cross, presented in the center of the screen for 3 s, and then the mask for 100 ms. Next, the prime was presented for 17 ms (one refresh cycle at 60 Hz), followed again by the mask for 50 ms. Finally, the target was shown for 100 ms, and the participants were subsequently prompted to give their responses (see Figure 1). Depending on block (or task) levels, participants rated either their liking of the stimulus ("How did you like the presented stimulus?") or their FF of perception ("How easy was the perception of the presented stimulus?"). As the images were rather simple, we asked the participants to indicate their FF of each stimulus in comparison with the FF of the other stimuli presented throughout the study. For the trials, the participants were instructed to compare FF with the stimuli from the practice trials, therefore the reference for the subsequent ratings was established during the practice trials. For both ratings, Likert type rating scales from 1 (*not at all*) to 7 (*very much*) were used. Within blocks, the presentation order of the stimuli was random. After completion of all trials, the participants were told about the purpose of the experiment and about the presence of a masked prime. To test the participants' awareness of the primes, in the end participants performed a visibility test: In an additional block, participants were asked to indicate or guess for each trial whether the prime, seen or not, was congruent or incongruent with the target. All these experimental procedures were run with E-Prime 2.0 (Schneider, Eschman, & Zuccolotto, 2002) and presented on a 19-in. display at a resolution of 1,280 × 1,024 pixels and a refresh rate of 60 Hz. After completing all trials, the participants were debriefed and thanked.

Results and Discussion

Visibility test. To test whether the primes were not visible in the first place, we computed d' values for each participant (Macmillan & Creelman, 2005), as d' is a very sensitive index of prime visibility (Reingold & Merikle, 1988). In the present study, d' was calculated as the difference of the z-transformed probability of hits (here, *congruent* judgments in congruent trials) minus the z-transformed probability of false alarms (here, *congruent* judgments in incongruent trials). In the case of the invisibility of the primes, d' equals 0 and can infinitely increase with ever-increasing discrimination performance. The mean d' value significantly deviated from zero, $t(49) = 5.12$, $p < .001$, $M_{d'} = 0.45$, $SD_{d'} = 0.62$, $d = 0.72$. The mean hit rate was 38% and the mean false alarm rate was 25%. This would indicate that in some cases the primes were visible. By and large, priming effects in "aware" and "unaware" conditions show strong resemblances (see Vorberg, Mattler, Heinecke, Schmidt, & Schwarzbach, 2003), but a few qualitative differences exist. For example, participants might be more sensitive for the probabilities of congruent versus incongruent trials in aware than unaware priming conditions (Forster, 1998), and, related to this, they might be able to better actively suppress priming after visible incongruent primes than after invisible incongruent primes (Ansorge, Fuchs, Khalid, & Kunde, 2011; Kunde, 2003; but see Van Gaal, Lamme, & Ridderinkhof, 2010). Furthermore, for the participants, prime visibility might lead to consciously recognizing the priming manipulation as the source of the fluency, and consequently might lead to discounting (Bornstein & D'Agostino, 1992, 1994). Therefore, we computed the 95% confidence interval of d' separately for each participant and excluded all participants ($n = 14$) whose 95% confidence interval did not include zero (Macmillan & Creelman, 2005, p. 325).[1] Consequently, the following analyses are based on participants not aware of the primes ($n = 36$).

Main analysis. To identify rating differences as a function of high and low ease of processing, we performed separate paired t tests for the FF and the liking ratings. The high ease of processing (= congruent) trials ($M = 4.67$, $SD = 0.82$) was perceived as more fluent than the low ease of processing (= incongruent) trials, $M = 4.50$, $SD = 0.81$, $t(35) = 2.18$, $p = .018$ (one-tailed), $d = 0.36$. Furthermore, stimuli in the high ease of processing trials ($M = 4.03$, $SD = 0.56$) tended to be liked more than stimuli in the low ease of processing trials, $M = 3.93$, $SD = 0.45$, $t(35) = 1.66$, $p = .052$ (one-tailed), $d = 0.28$. These results indicated that increasing processing fluency through subliminal perceptual priming influenced both the FF and, to a lesser extent, the liking ratings. Congruently primed stimuli were judged as easier to perceive and were liked slightly more than incongruently primed stimuli.

To analyze the effects of FF on liking (Bornstein & D'Agostino, 1992, 1994), we conducted the following analysis: For each participant, we first split the trials according to whether the subjective

[1] We thank an anonymous reviewer for suggesting this exclusion criterion.

FF rating was below or above this participant's mean FF rating. Next, we computed (a) the mean liking rating and (b) the number of trials contributing to each particular mean liking rating, for (i) low FF trials/low ease of processing, (ii) low FF trials/high ease of processing, (iii) high FF trials/low ease of processing, and (iv) high FF trials/high ease of processing.

Next, to analyze the relative effects and interactions between objective ease of processing and subjective FF, we ran two complementary analyses of variance (ANOVAs), one on mean liking (regardless of the number of trials contributing to each mean), and one on the number of trials (regardless of the mean liking). Table 1 gives an overview of the mean number of trials and the mean liking ratings in each condition separately for high and low FF. Both ANOVAs were run with the independent variables ease of processing (high vs. low) and FF (high FF vs. low FF). The analysis of the mean liking ratings revealed a significant main effect of FF, $F(1, 35) = 166.77$, $p < .001$, $\eta_p^2 = .83$, but neither a main effect of ease of processing, $F(1, 35) = 0.11$, $p = .744$, $\eta_p^2 = .003$, nor an interaction, $F(1, 35) = 0.02$, $p = .881$, $\eta_p^2 = .001$ (see Figure 2). A post hoc paired t test confirmed that liking for high FF trials, $M = 4.48$, $SD = 0.58$, was higher than for low FF trials, $M = 3.35$, $SD = 0.42$, $t(35) = 12.93$, $p < .001$ (one-tailed), $d = 2.15$ (see Figure 3), which is clear support for the perceptual fluency/attributional model of Bornstein and D'Agostino (1992, 1994). The absence of an interaction effect in the ANOVA shows that FF did not interact with ease of processing, and therefore that FF, rather than ease of processing, is associated with differences in liking (see Figure 2). Accordingly, the differences in effect size also indicate that the influence of FF on liking ($d = 2.15$) was much stronger than the influence of objectively manipulated ease of processing ($d = 0.28$), indicating that FF seems to be the major factor for the liking judgment.

The analysis of the number of trials revealed a main effect of FF, $F(1, 35) = 18.07$, $p < .001$, $\eta_p^2 = .34$ and, additionally, an interaction, $F(1, 35) = 5.56$, $p = .024$, $\eta_p^2 = .14$. The main effect of FF was a side effect of the counting procedure (see Table 1) and does not necessarily carry much meaning. Also, the ease of processing could not be computed, as the number of high and low ease-of-processing trials was equal by design. The significant interaction, however, showed that ease of processing did have an effect, at least on feeling of fluency: For low FF judgments, we observed a larger number of low ease-of-processing cases ($M = 23.22$, $SD = 5.30$) than of high ease-of-processing cases for low FF ($M = 20.86$, $SD = 4.98$, $p = .024$), whereas this pattern reversed for high FF judgments, in which there were more high ease-of-processing cases ($M = 29.14$, $SD = 4.98$) than low ease-of-processing cases ($M = 26.78$, $SD = 5.30$, $p = .024$, see Table 1). This interaction shows that ease of processing also had an effect on FF; as expected, proportions of low ease of processing were higher for low FF, and lower for high FF. Nevertheless, these effects were small (23–21, low FF and 27–29, high FF). If the effect were large and FF solely depended on ease of processing, there would have been a much higher difference in the proportion. Furthermore, the analysis also showed that in both ease-of-processing conditions, there were more high than low FF trials.

Correlations. The relation between FF and liking should also be reflected in a significant correlation between the two variables. Thus, we computed the correlation between the FF ratings and the liking ratings for each participant separately. The overall mean correlation was $r(36) = .41$, $p < .001$. Separating the trials by ease of processing revealed significant correlation coefficients, $r_{high}(36) = .40$, $p < .001$, $r_{low}(36) = .42$, $p < .001$, which were similar to each other and also very similar to the overall correlation. These correlations show that the FF is significantly related to the liking rating, a result in line with the assumption that FF is one source for the liking judgments.

Order effects. A repeated-measures ANOVA for FF with block order as a between-participants variable revealed no effect of block order, $F(1, 34) = 0.08$, $p = .776$, $\eta_p^2 = .002$, and no interaction between ease of processing and block order, $F(1, 34) = 2.12$, $p = .15$, $\eta_p^2 = .06$. For the liking ratings there was also neither a main effect of block order, $F(1, 34) = 0.001$, $p = .973$, $\eta_p^2 < .001$, nor a significant interaction between ease of processing and block order, $F(1, 34) =$

Table 1
Mean Number of Trials (N) and Mean Liking Ratings (M-LK) Separately for Low/High Ease of Processing and Low/High Felt Fluency In Both Experiments (for Clarity the Mean Number of Trials Is Rounded)

	Experiment 1			Experiment 2				
	Incon.	Con.	Σ	100	200	300	400	Σ
Low FF								
n	23	21	44	12	10	9	9	40
M-LK	3.35	3.36	3.35	2.95	2.89	3.08	3.13	3.02
High FF								
n	27	29	56	13	15	16	16	60
M-LK	4.47	4.50	4.48	4.36	4.41	4.36	4.45	4.39
Σ								
n	50	50	100	25	25	25	25	100
M-LK	3.91	3.93	3.92	3.66	3.65	3.72	3.79	3.70

Note. FF = felt fluency; Incon. = incongruent; Con. = congruent. The mean FF ratings were floating-point numbers, but all raw-score judgments were integers (from 1 to 7). Therefore, dividing the total number of all trials into those above versus below the mean FF led to a different number of trials above and below the mean. In Experiment 1, compared with the analysis including all participants, an analysis excluding participants with proportions of low FF to high FF trials over 30/70 or 70/30 ($n = 3$) showed a similar effect size ($d = .24$, with a weaker trend of $p = .088$) in differences of liking in relation to ease of processing. All other effects did not change after exclusion of the three participants. In Experiment 2, exclusion of participants over the stated criterion ($n = 24$) led to absence of significance for the main effect of ease of processing and for the interaction between ease of processing and FF in the 2×2 ANOVA, with liking as the dependent variable. As effects of these factors were small in the analysis using all participants, this change in the results may be mainly due to the reduction of sample size.

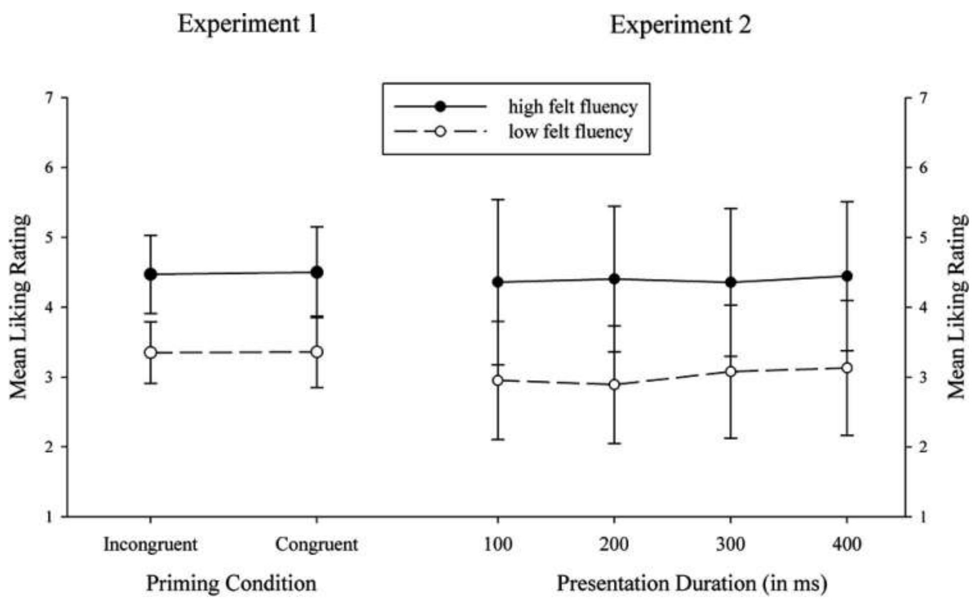

Figure 2. Mean liking ratings for high FF (solid line) and low FF (dashed line) trials in Experiment 1 (left) and Experiment 2 (right). Error bars represent standard deviations.

0.83, $p = .370$, $\eta_p^2 = .02$. Thus, neither the FF nor the liking rating depended on whether the respective judgments were collected first or second.

Experiment 2

In Experiment 1, we found small effects of ease of processing on liking, whereas effects of FF on liking were much stronger. To extend our conclusions from Experiment 1 to supraliminal presentation of stimuli, we conducted a second experiment. In Experiment 2, we tested whether fluency is also experienced as a feeling of ease when the ease-of-processing manipulation concerned an implicit but clearly visible feature of the images.

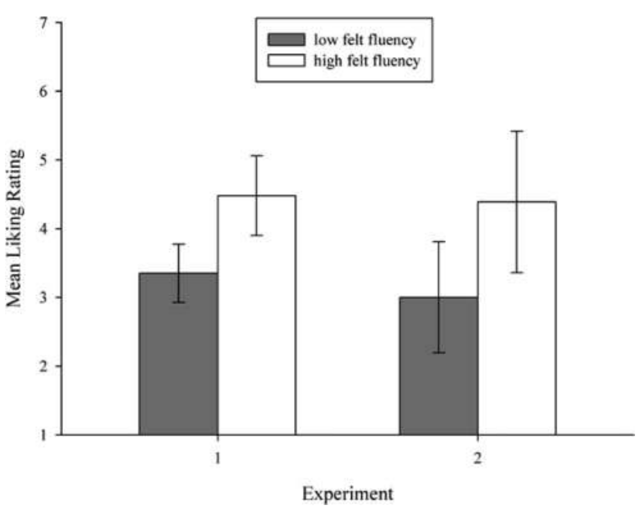

Figure 3. Liking ratings in Experiment 1 (left, $n = 36$) and Experiment 2 (right, $n = 96$) for each ease-of-processing condition and high/low FF. Error bars represent standard deviations.

First, the participants' unawareness of the primes might be a necessary, or at least favorable, precondition for the fluency effect and/or the link between fluency and liking. According to the arguments put forward by Bornstein and D'Agostino (1992, 1994), the fact that the prime remains below the level of awareness is a favorable condition for the misattribution of the ease-of-processing-induced FF to the target stimulus, and hence a liking of this stimulus. On a general level, this assumption is well in line with the known qualitative processing differences between supraliminal and subliminal stimuli. In particular, it has been shown that willing inhibition of priming influences can indeed be stronger with supraliminal than subliminal primes (see Ansorge et al., 2011; Kunde, 2003). For example, Kunde (2003) observed that his participants successfully inhibited the impact of clearly visible primes after an incongruent prime-target sequence. However, the same participants were unable to also ignore subliminal primes if they had just seen an incongruent sequence consisting of a subliminal prime and a supraliminal target. This backs up the reasoning of Bornstein and D'Agostino (1992, 1994). On the other hand, some authors found that manipulations in ease of processing affected fluency even when a supraliminal stimulus feature was used. In their Experiment 3, Reber, Winkielman, and Schwarz (1998) varied the presentation duration of the stimulus, in 100-ms steps, between 100 and 400 ms. As longer presentation durations enabled the perceiver to extract more information from the stimulus image (Mackworth, 1963) and increased ease of processing, accordingly more fluency was experienced by Reber et al.'s (1998) participants. Based on these observations, we wondered whether the link between FF and liking could be confirmed if the ease-of-processing manipulation concerned the supraliminal duration of the primes. If this is the case, we expected that the FF and liking should be higher with longer presentation durations, too.

Method

Participants. Ninety-six undergraduate psychology students (83 women) from the University of Vienna took part for partial course credit. Their age ranged from 18–36 years (M = 22.1, SD = 3.1). All participants signed a written consent form and had normal or corrected-to-normal vision. None of the participants had taken part in Experiment 1.

Stimuli. The stimuli were the same as the target stimuli in Experiment 1.

Design and procedure. The design was similar to Experiment 1. Each image was rated twice, in one block for FF and in the other for liking. Different from Experiment 1, in which ease of processing was manipulated by congruent versus incongruent subliminal priming, in Experiment 2, ease of processing was manipulated through different presentation durations. The 100 images were divided into four sets of 25 images each. Different presentation durations (100, 200, 300, or 400 ms) were assigned to each of the four sets. The assignment of durations to images was counterbalanced across participants. As in Experiment 1, the order of blocks (liking first vs. fluency first) was balanced across participants. An instruction phase (similar to that in Experiment 1) in the beginning concealed a connection between the liking ratings and the subjective fluency ratings. Each trial started with a fixation cross for 3 s, followed by the target image for 100, 200, 300, or 400 ms. A random noise mask (60% Gaussian noise) followed the target for 500 ms. Then the response was prompted. The FF and liking questions and the rating scales were the same as in Experiment 1. The experimental procedure was controlled by E-Prime 2.0 (Schneider et al., 2002) on a 19-in. display with a refresh rate of 60 Hz at a resolution of 1,280 × 1,024 pixels. After completing all the trials, the participants were debriefed and thanked.

Results and Discussion

As in Experiment 1, effects of ease of processing on FF and liking were analyzed separately. A repeated measures ANOVA with *presentation duration* (or ease of processing) as a between-participants factor and FF rating as a dependent variable showed a significant main effect, $F(3, 285) = 31.57$, $p < .001$, $\eta_p^2 = .25$. The means (see Table 2) show a constant increase in the FF rating from 100 to 400 ms. Except for the comparison between the 300 ms and 400 ms condition, all Bonferroni corrected pairwise comparisons were significant (all ps $< .01$). The mean liking ratings show a similar pattern; they also increased constantly from 100 to 400 ms. A repeated measures ANOVA revealed a significant main effect of presentation duration for liking, too, $F(3, 285) = 13.59$, $p < .001$, $\eta_p^2 = .13$. Bonferroni corrected pairwise comparisons showed a significant difference between the 100-ms condition and both the 300-ms and 400-ms conditions (ps $< .001$, means and standard deviations, see Table 2) and a significant difference between the 200- and the 400-ms condition ($p < .001$). Thus, ease of processing (here, varied across duration) influenced both the FF and the liking ratings in a similar way. Longer presented, objectively easier to process stimuli, were felt to be easier to process and were liked more than shorter presented stimuli. Contrary to the reasoning of Bornstein and D'Agostino (1992, 1994), the supraliminal ease-of-processing manipulation in Experiment 2 apparently did not lead to a correction process and therefore did not discount the effect of ease of processing on liking.

As in Experiment 1, we analyzed ease of processing and FF as within-participant factors with respect to liking in a one-way ANOVA. This analysis revealed a significant effect of FF, $F(1, 94) = 388.06$, $p < .001$, $\eta_p^2 = .81$; a significant main effect of ease of processing, $F(3, 282) = 3.99$, $p = .008$, $\eta_p^2 = .04$; and an interaction between ease of processing (presentation duration) and FF, $F(3, 282) = 2.67$, $p = .05$, $\eta_p^2 = .03$ (see Figure 2). A post hoc paired t test showed that high FF trials ($M = 4.39$, $SD = 1.03$) were liked significantly more than low FF trials, $M = 3.00$, $SD = 0.81$, $t(95) = 20.39$, $p < .001$ (one-tailed), $d = 2.08$ (see Figure 3). For ease of processing, pairwise comparisons only showed a significant difference between the 200-ms condition ($M = 3.65$, $SD = 0.86$) and the 400-ms condition ($M = 3.79$, $SD = 0.94$, $p = .011$). Regarding the interaction, pairwise comparisons revealed that only in one condition, namely, for the low FF stimuli in the 200-ms condition ($M = 2.90$, $SD = 0.84$), liking was lower than in the 400-ms condition ($M = 3.13$, $SD = 0.97$, $p = .003$). No other comparison was significant. As indicated by the differences in the means and the magnitude of the effect sizes, the effect of FF on liking was strong, whereas the main effect of ease of processing and the interaction effect both showed smaller differences in the means and smaller effect sizes (see also Figure 2). We therefore conclude from the ANOVA that there is an impact of both ease of processing and FF on liking, but the impact of FF is relatively stronger than the impact of ease of processing.

As in Experiment 1, we also analyzed the number of cases of high-FF and low-FF trials at all of the four levels of ease of processing (100 ms to 400 ms). The ANOVA revealed a main effect of FF, $F(1, 94) = 80.78$, $p < .001$, $\eta_p^2 = .46$, and an interaction between ease of processing and FF, $F(3, 282) = 25.11$, $p < .001$, $\eta_p^2 = .21$. Also in this analysis, the main effect for ease of processing cannot be computed, as high and low ease-of-processing trials were equally distributed by design. Also, as was the case in Experiment 1, there was a, not particularly meaningful, higher number of high FF trials than low FF trials, which was due to the sorting of raw-score integers, according to a floating point number of mean FF. As in Experiment 1, the interaction effect showed a larger number of low ease-of-processing cases than high ease-of-processing cases for low FF (all pairwise comparisons significant at $p < .002$, except 300 ms vs. 400 ms, $p = 1.00$; means, see Table 1), whereas there were more high ease-of-processing cases than low ease-of-processing cases for high FF (all pairwise comparisons significant at $p < .009$, except 300 ms vs. 400 ms, $p = 1.00$; means, see Table 1). This interaction shows again that ease of processing had an effect on FF. As expected, proportions of low ease of processing were higher for low FF, and

Table 2
Means and Standard Deviations (in Parentheses) Separated by Presentation Duration in Experiment 2

	Presentation duration			
	100 ms	200 ms	300 ms	400 ms
Felt fluency				
M (SD)	4.97 (0.91)	5.23 (0.89)	5.40 (0.85)	5.44 (0.89)
Liking				
M (SD)	3.71 (0.93)	3.78 (0.90)	3.90 (0.96)	3.98 (0.97)

lower for high FF. Also as in Experiment 1, there were again only small differences between the levels of ease of processing (max. difference 3, low FF and 3, high FF).

Correlations. In Experiment 2 the correlation between the FF rating and the liking rating was $r(96) = .46$, $p < .001$. Computing the correlation for each presentation duration separately revealed very similar coefficients, $r_{100}(96) = .49$, $p < .001$; $r_{200}(96) = .49$, $p < .001$; $r_{300}(96) = .48$, $p < .001$; $r_{400}(96) = .45$, $p < .001$. These results again underline the significant relationship between the FF and the liking of a stimulus.

Order effects. A repeated-measures ANOVA for FF, with block order as a between-subjects factor, revealed a main effect of block order, $F(1, 94) = 7.71$, $p = .007$, $\eta_p^2 = .08$, but no interaction between block order and ease of processing, $F(3, 282) = 0.57$, $p = .64$, $\eta_p^2 = .01$. For liking there was also a significant main effect of block order, $F(1, 94) = 19.26$, $p < .001$, $\eta_p^2 = .17$, but again no interaction between block order and ease of processing, $F(3, 282) = 1.02$, $p = .39$, $\eta_p^2 = .01$. When fluency was tested first and liking second, ratings for both fluency and liking were higher. This effect might well simply reflect a difference between the participants. However, block order did not produce any interaction with ease of processing.

General Discussion

In this study, we investigated whether the manipulated ease of processing is indeed felt fluent and whether this feeling accounts for the liking of objects. In two experiments, it was shown that the feeling of fluency strongly affected liking and varied with ease of processing.

We directly analyzed the relationship between manipulating ease of processing and subjective feeling of fluency with respect to liking and found that ease of processing influenced the liking ratings to a lesser extent than feelings of fluency. This conclusion is drawn on findings from separate analyses, where effects of FF were much larger than of ease of processing, and from joint analyses. In the latter, no effects of ease of processing were found in Experiment 1, whereas in Experiment 2, effects of ease of processing were significant, but the effect size was small. Nevertheless, additional analyses of the number of cases of low and high FF trials as a function of low and high ease of processing revealed small effects of ease of processing in both experiments. Thus, FF was affected by ease of processing, but liking was mainly determined by FF. Together the results suggest that the feeling of fluency could be a powerful facilitator of attraction in many everyday situations.

A by-product of perceiving a stimulus is a subjective experience (Koriat, 1993). The feeling of fluency of a perceptual process can be seen as an instance of this experience. Our results clearly show that participants reported a subjective difference between the stimuli with respect to the ease of processing, which converged with the objective ease-of-processing manipulation. In our experiments, we directly tested this feeling for each stimulus by asking the participants about the ease of perceiving the stimulus. To our knowledge, this is the first time that this feeling, which is claimed to be the inner representation of the ease of processing (Bornstein & D'Agostino, 1992, 1994; Reber & Schwarz, 2002), has been directly tested for each participant in each trial. Previously used measures, such as effects on experiences of font readability (Reber, Wurtz, et al., 2004) or brightness (Mandler, Nakamura, & Van Zandt, 1987) were more indirect reflections of the feelings, based on assumed connections between feelings of ease as sources of these judgments. Also, FF and liking ratings in between-participants designs (Reber, Wurtz, et al., 2004; Topolinski & Strack, 2009b) did not allow the clear separation of effects of objective congruency manipulations from preexperimentally existing interindividual differences concerning the FF of perception and the liking of different objects. When exploring the relationship between the feeling elicited by fluency and the liking judgments about the stimuli, we found that measuring both dimensions for each participant ruled out the possibility that preexisting differences between participants account for the ease-of-processing-elicited rating effects. The absence of block order effects in Experiment 1 underlines the feasibility of a within-participant design because this indicates that a one-time stimulus repetition did not negate the influence of more local manipulations of FF or liking, and was, in fact, too weak to be measurable at all.

Different from Topolinski and Strack (2009b), who found no effects of feeling of fluency after conceptual ease-of-processing manipulations, our results do show a substantial effect of FF after perceptual ease-of-processing manipulations. Therefore, manipulating perceptual ease of processing seems to exert a stronger or different effect on the feelings of fluency. The manipulations used here apparently were strong enough. We assume that this can also be a result of the within-participant design, in which there would be less variance to mask the close relationship between the ease-of-processing manipulation and each of the object's evaluations. The new conclusion is that, in every instance in which a stimulus is perceived, there could be a new subjective evaluation that is not simply consistent with a relatively recent—and related—subjective evaluation. Moreover, different contexts (here experimental manipulations) could be powerful sources of independence between repeated evaluations of the same stimulus. Thus, higher fluency through perceptual manipulations does not always enhance liking (see also Unkelbach, 2006). Rather, it is the subjective feeling that determines whether we like something or not. This is akin to many everyday situations, in which one assesses an object very differently in one situation than in another situation. For example, in the summer, one values the removable hard top of a convertible because it will cool down the ride, but in the winter, the same feature can be annoying.

Furthermore, the experiments showed that the feeling could have served as a source for the liking of a stimulus. Thus, the elicited feeling, which was reported by the participants, is one possible source of information relevant to the liking of the stimulus (Clore et al., 2001; Schwarz, 2001; Schwarz & Clore, 1988). Our experiments showed that a higher feeling of fluency led to a higher liking judgment, but not necessarily via the manipulated objective conditions. This suggests that, irrespective of the actual conditions, it was the human feeling or belief about how easy a stimulus was perceived that came along with increased liking. This finding is fully commensurate with the emotion theories, which put an emphasis on the beliefs of humans as one source of the elicitation of emotions. For example, according to the phenomenologist's view on emotions, it is the subjective beliefs about the state of affairs rather than the actual facts that are important for the emotional experience (e.g., Arnold, 1960).

As the liking differences elicited by objective ease-of-processing manipulations such as priming were relatively small, one might argue that the ease-of-processing manipulation was too weak to show robust effects. However, objective ease of processing did influence the feeling of fluency to a sufficiently reliable extent. Furthermore, there were small but existing effects of ease of processing on liking, which are in accordance with classical research on fluency (Reber et al., 1998). However, the effects of FF on liking were much stronger. This calls for a search for additional factors influencing the relationship between FF and liking, which cannot be explained by the manipulation. From our experiments, we cannot conclude what these additional factors might be. One possibility, however, could be the preexisting differences in liking (or fluency) that we mentioned as a potential threat to the between-participants design. Liked or familiar objects are faster to process than less liked objects, and this preexperimental influence could have shaped our participants' appreciation of at least a few specific stimuli (Schupp, Markus, Weike, & Hamm, 2003; Stolarova, Keil, & Moratti, 2006). For example, the participants could have experienced the presentation of a preexperimentally appreciated stimulus in the incongruent (low ease of processing) and in the congruent (high ease of processing) condition as equally fluent, because the object was appreciated to a maximal extent in the first place and facilitation by appreciation was strong enough to counteract the ease-of-processing manipulation.

Our findings are in accordance with the feeling-as-information account (Schwarz, 2001; Schwarz & Clore, 1983, 1988), which indicates that our feelings are a source for judgment. Based on our experiments, we suggest that the subjective feeling of fluency can be seen as an instance of a feeling, which is then used for a liking judgment. However, we cannot formally rule out the possibility that liking preceded fluency and was subsequently attributed to the stimuli. This, however, does not seem very plausible, because according to this possibility, our objective manipulation of processing fluency, such as our manipulation of stimulus congruence and presentation duration, would have first affected liking, which then would have been felt as fluency. It seems more reasonable to assume that it was the subjective feeling of fluency, which, as the more proximal outcome and more direct measurement, was influenced by objective fluency. Then, the resulting subjective feeling was attributed to liking. Future studies should address this issue, for example, by studying the time course of the interplay between liking and fluency judgments.

Regarding the relationship between our experimental variables, we cannot conclude whether ease of processing influenced FF, which in turn influenced liking, or whether ease of processing and FF both influence liking independently from each other. One possible factor, which could be on the bottom of both the FF judgment and the liking judgment, might be an unspecific activation or arousal. This activation, elicited by the ease-of-processing manipulation, could be felt as the feeling of fluency, which in turn could form the basis for liking ratings. Future experiments measuring this unspecific activation, and furthermore, applying path models, could help test these different courses of processing.

Regarding FF and liking, it is possible that factors besides congruence affected these judgments. For instance, the longer the experiment took, the more stimuli and instances were available for the relative FF judgments. In the current study, these effects of prior experience within the experiment were only tested with respect to block order of judgments, but future studies could include these variables to fully account for FF as well as liking judgments.

Comparing both experiments, the effects were rather similar, which suggests that our effects do not depend on the visibility or conscious experience of the manipulation. This means that FF is used as a source for liking judgments regardless of visibility of the manipulation. For ease of processing, findings of Bornstein and D'Agostino (1992, 1994) suggest that visibility of the manipulation leads to a correction process, in which fluency is discounted as a source of the liking judgment. However, our findings in Experiment 2 suggest that the participants did not correct their liking judgment on the basis of their (assumed) awareness of the objective duration manipulation. There are two possible explanations for this discrepancy. First, some participants might not have perceived the differences in presentation duration and therefore did not discount fluency. Second, for supraliminal variations in presentation duration, fluency is simply not corrected. In a supraliminal priming experiment, participants should consciously experience a repetition of the stimulus (or at least two closely related versions of the stimulus) due to priming. Therefore they may more explicitly recognize the relationship between perceptual priming, that is, the manipulation and fluency, and consequently correct their liking rating (Bornstein & D'Agostino, 1992). In our Experiment 2 however, fluency was manipulated through presentation duration and therefore, though supraliminal, perhaps not explicitly recognized as a fluency manipulation. The reported effects and the absence of any correction in Experiment 2 are in line with the findings of Reber et al. (1998, Experiment 3) and Winkielman and Cacioppo (2001), who also found differences in liking due to manipulations of presentation duration. Consequently, susceptibility of different manipulations of fluency to correction of the liking rating clearly warrants further research.

The fact that the feeling of fluency showed a stronger relationship to liking than the objective ease of processing suggests that the FF, or felt ease, is a more central variable in the fluency-liking link than the objective ease of processing. Furthermore, FF was, at least in our experiments, not influenced by conscious discounting. Analyzing the FF could therefore be a fruitful way of resolving some inconsistencies between experimental results and fluency theories (Reber, Schwarz, et al., 2004). For example, aesthetic preference of complex stimuli, such as artwork, can be explained by the ambiguity elicited by the artwork (Jakesch & Leder, 2009). In the light of the fluency-liking link this may seem counterintuitive at first glance, because ambiguity should be less fluent, and stimuli therefore less liked. In light of our findings, this antagonism may be dissipated by proposing that resolving the cognitive challenge posed by an ambiguous work of art may result in a stronger feeling of fluency, which in turn leads to higher liking, without direct impact of objective ease of processing (less vs. more ambiguity) on the experience of fluency and liking. It will be interesting to test these hypotheses in the future.

Our findings are in line with theories about the feeling of fluency, such as the perceptual fluency/attributional model (Bornstein & D'Agostino, 1992, 1994), which explicitly predicted a connection between felt ease of stimulus perception and liking. In an evaluation phase in which the stimuli were slightly more difficult to perceive, the experience of fluency was attributed to the judgment dimension, which, in our experiments, was the liking. To sum up, our findings suggest that we like what we feel to be fluent rather than what really is fluent.

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