RESEARCH REPORT

Identity Priming Consistently Affects Perceptual Fluency but Only Affects Metamemory When Primes Are Obvious

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Perceptual fluency manipulations influence metamemory judgments, with more fluently perceived information judged as more memorable. However, it is not always clear whether this influence is driven by actual experienced processing fluency or by beliefs about memory. The current study used an identity-priming paradigm—in which words are preceded by either matched (identical) or mismatched primes—to examine the 2 influences. Participants named and made judgments of learning (JOLs) for critical words and then completed a memory test. In Experiment 1, we briefly presented the primes and found a priming effect on naming latencies but not on JOLs. In Experiment 2, we presented the primes for longer durations and, again, found an effect on naming in addition to an effect on JOLs. A mediation analysis revealed that naming latencies did not account for the prime–JOL relationship. This pattern of results demonstrated a manipulation of perceptual fluency that influenced JOLs only when belief-based information was readily available.

Keywords: metamemory, perceptual fluency, judgments of learning, experiences, memory beliefs

Research in metamemory has uncovered numerous cues that people use to make predictions about future memory, some diagnostic of actual memory performance and some not (Bjork, Dunlosky, & Kornell, 2013; Koriati, 1997). In particular, the fluency of processing information (Alter & Oppenheimer, 2009) can guide predictions, such that material processed in a more fluent manner is often predicted to be better remembered on a later test (e.g., Benjamin, Bjork, & Schwartz, 1998; Besken & Mulligan, 2013, 2014; Matvey, Dunlosky, & Guttentag, 2001).

Perceptual fluency is one instantiation of processing fluency that has received recent scrutiny. In an initial investigation of this cue, Rhodes and Castel (2008) had participants study words presented in large (48-point) or small (18-point) font, make judgments of learning (JOLs; a 0–100 confidence rating) on each one, and then take a recall test. Across six experiments, participants consistently gave higher JOLs to the large than small items despite recall being equivalent for the two. Under the assumption that the larger words were easier to read, Rhodes and Castel concluded that ease of perception informs JOLs. Furthermore, the finding that participants recalled large- and small-font words equally well demonstrated that perceptual fluency acted as a metacognitive illusion. Subsequent studies have used a variety of manipulations to provide

further and more direct support for the notion that manipulations of perceptual ease might affect metamemory (e.g., Besken & Mulligan, 2013, 2014; Rhodes & Castel, 2009; Yue, Castel, & Bjork, 2013).

In addition to understanding which cues impact metamemorial judgments, researchers are also interested in *how* participants make use of such cues. Specifically, the effect of a cue may stem from experienced processing fluency driven by direct interaction with materials or from a belief that people have about the effect of the cue on memory (or perhaps a mix of both; e.g., Koriati, Bjork, Sheffer, & Bar, 2004; Matvey et al., 2001; Mueller, Dunlosky, Tauber, & Rhodes, 2014; Mueller, Tauber, & Dunlosky, 2013; Undorf & Erdfelder, 2015). Importantly, despite claims that a cue exerts its effect on JOLs through experienced fluency—and fluency-based hypotheses propose this to be the case—only a few studies have directly investigated the contributions of experiences and beliefs to a JOL effect. The studies that have focused on this issue with regard to perceptual fluency have produced mixed results.

Mueller et al. (2014) used a variety of methods and analytic techniques to assess the roles of fluency and beliefs in the font-size effect on JOLs (see Rhodes & Castel, 2008). Mueller et al. assessed processing fluency of large and small words through two measures: lexical-decision latencies and self-paced study times. The researchers found no differences across font size in either fluency measure but did find the expected effect on JOLs. This combination of results was taken as evidence that beliefs are the locus of the font-size effect. However, because font size did not influence processing fluency, this study does not provide decisive evidence on the larger question of whether perceptual fluency, *per se*, actually affects metamemory. Rather, it implies that font size,

This article was published Online First September 14, 2015.

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initially taken as a manipulation of perceptual fluency, did not actually affect perceptual fluency.

Other studies have reported evidence consistent with an experiential basis for perceptual fluency effects. Besken and Mulligan (2014) had participants listen to and name aloud recordings of study words presented intact or interspersed with brief silences. Participants were faster at naming the intact words and provided higher JOLs for them, despite recall being enhanced for the degraded words. Critically, the researchers correlated the difference in naming latencies between intact and degraded words with the difference in JOLs between the two conditions and found a negative correlation. This result indicates that the degree of slowing produced by the interspersed silences (a measure of a change in perceptual fluency) predicted the degree of reduction in JOLs, suggesting that experience at least partially drove the JOLs. Ball, Klein, and Brewer (2014) also argued that the experience of perceptual fluency influences metamemory. These authors used font-size and bolding manipulations of educationally relevant materials and found that smaller font—not larger—and bolded fonts were associated with less study time (their measure of processing fluency) and greater JOLs. Mediation analyses revealed that study time either partially or fully mediated the effects of item type on JOLs, suggesting that fluency experience accounted for at least some of the JOL effects. However, the materials in this study differed greatly from those in prior research, and the measure of fluency did not isolate perception, per se, making strong conclusions about the role of perceptual fluency unclear.

Prior research on this topic has, reasonably enough, used manipulations thought to affect perceptual fluency and examined their effects on JOLs. Said differently, prior research has manipulated (or tried to manipulate) perceptual experience to draw conclusions about the extent to which experience or beliefs mediate effects in this domain of metamemory. An alternative approach used in the present experiments is to manipulate perceptual fluency (as indexed by naming latencies) and, at the same time, alter the availability of people's beliefs about the material. We think this might provide a more direct way to assess the role of beliefs in purported perceptual fluency effects in metamemory.

A standard way to assess a priori metacognitive beliefs is through a questionnaire that provides participants with a description of an experiment and asks them to predict recall for various conditions (e.g., Koriat et al., 2004; Kornell, Rhodes, Castel, & Tauber, 2011; Mueller et al., 2014). An advantage of this methodology is that participants do not experience any manipulations and therefore cannot be influenced by this experienced-based information. However, disadvantages of this technique are that each participant provides few data points (e.g., one or two JOLs each) and may generate beliefs only after being prompted by the questionnaire (see Mueller et al., 2014). Furthermore, if a questionnaire study indicates that participants have an a priori belief about the effect of a cue, this does not mean that direct experience plays no role; experience still might contribute to JOLs even when these beliefs exist.

Given the ambiguity in the prior research, the current study extended work on the role of experiences and beliefs in perceptual fluency manipulations. Using perceptual fluency allowed us to approach the experience–belief issue from a novel perspective and to design experimental situations that altered the nature of beliefs while holding experienced fluency constant. Specifically, we bor-

rowed the identity-priming paradigm used by Jacoby and Whitehouse (1989) and others (e.g., Westerman, Lloyd, & Miller, 2002) to investigate fluency effects at retrieval and adapted it for encoding and metamemory. Participants named aloud and made JOLs for study words primed with an identical prime or a mismatched prime (i.e., a different word); the identical (matched) primes produced greater perceptual fluency of their target words (measured here through naming latencies). Across two experiments we varied the duration of the prime words, thereby altering their noticeability and the scope for beliefs to contribute to the metamemorial judgment. Prior research examining recognition phenomena has used a similar strategy to assess how people attribute fluency in making memory decisions (Jacoby & Whitehouse, 1989; Joordens & Merikle, 1992). In the realm of metamemory, some research has studied the effects of priming (e.g., Narens, Jameson, & Lee, 1994), but this method has not been applied to the question of perceptual-fluency effects or to the attempt to tease apart experience- and belief-based influences.

Experiment 1

Method

Participants. Twenty-five undergraduates participated in exchange for course credit.

Materials and design. The critical study words were 36 medium-frequency, 5-letter words (30–70 per million; Kucera & Francis, 1967). Four additional words were presented at the beginning and end of the list as primacy and recency buffers, and six more were used as practice and to calibrate the microphone voice key (see *Procedure*). Twenty-eight additional prime words (22 for the study list and six for practice) were selected from the same pool. All words were presented in lowercase letters in the center of a CRT monitor.

Prime type (match vs. mismatch) was manipulated within-subject. Matched primes were identical to the critical study words they preceded, whereas mismatched primes differed from the critical study words. Items were pseudorandomly intermixed such that no more than two trials from a condition were presented consecutively. Two versions of the list were constructed, counterbalancing words across prime type.

Procedure. The experiment had four phases: calibration, encoding, distraction, and recall. Prior to the start of the experiment, participants were instructed that they would see individual study words preceded by a row of number signs and that they should use these signs as warning signals that a word was about to appear (these instructions and the following design were adapted from Jacoby & Whitehouse, 1989; see also Westerman et al., 2002). On each trial of the calibration phase, participants saw a premask (#####) for 250 ms, a mismatched prime word for 32 ms, a postmask (#####) for 250 ms, a delay for 800 ms, and then a study word for 4 s. Participants read each study word aloud into a handheld microphone as quickly as possible and received feedback about whether they had spoken loudly enough. There were six calibration trials in all. The encoding trials followed the same structure, except that primes were either matched or mismatched, no feedback was given, and participants rated their confidence in recalling each study word on the later test, from 0 (*not confident at all*) to 100 (*extremely confident*).

Following the encoding phase, participants completed 3 min of arithmetic problems. Then, participants were given up to 5 min for the recall test; they were asked to write down as many of the study words as they could remember.

Results and Discussion

One participant did not speak loudly enough, resulting in a loss of naming latencies. This participant was eliminated, leaving an effective sample size of 24.

Median naming latency (in milliseconds) was computed for each participant separately for the match and mismatch conditions. A matched-samples *t* test conducted on median naming latencies¹ demonstrated faster naming for the matched ($M = 793.02$, $SD = 172.75$) than mismatched ($M = 828.00$, $SD = 175.41$) items, $t(23) = -3.09$, $p = .005$, $d = 0.63$.

A matched-samples *t* test on participants' JOLs (see Figure 1) revealed equivalent JOLs for matched and mismatched items, $t(23) = -0.44$, $p = .662$. Likewise, another *t* test revealed no differences in recall for matched ($M = .23$, $SD = .09$) and mismatched ($M = .19$, $SD = .10$) items, $t(23) = 1.44$, $p = .164$. Resolution (the gamma correlation between JOLs and recall performance) was significantly greater than 0 ($G = .19$, $SE = .08$), $t(23) = 2.24$, $p = .035$, $d = 0.46$.

The effect of prime type on naming latencies demonstrated that this manipulation influenced perceptual fluency. However, the difference in perceptual fluency across study words was not used as a cue for JOLs: Matched and mismatched words received similar predictions. This pattern of results indicates that when perceptual fluency is manipulated inconspicuously, the cue may not inform predictions.

Experiment 2

In Experiment 1, we found that rapid identity priming can influence naming latencies, an objective measure of perceptual fluency, without affecting JOLs. In Experiment 2, we presented the primes for longer durations, making them easily identifiable and making it obvious whether a study item was in the match or mismatch condition. Jacoby and Whitehouse (1989) and others (e.g., Gellatly, Banton, & Woods, 1995; Joordens & Merikle, 1992) found that more salient primes changed the effect of per-

ceptual fluency on recognition memory due to changes in participants' beliefs about the basis of the fluency experience (i.e., a change in attribution). We approached the present experiment in a similar manner: Increasing the obviousness of the primes, and thus the obviousness of the prime–study word relationship, should provide a broader scope for beliefs to operate. In other words, in Experiment 2 the relationship between the prime and the subsequent word was much more accessible to participants than in Experiment 1. However, we again expected the identical primes to produce facilitation on perceptual fluency itself (measured by naming latencies), consistent with Experiment 1 (e.g., Burt, Kipps, & Matthews, 2014).

Method

Participants. Twenty-eight undergraduates participated in exchange for course credit.

Materials, design, and procedure. Prior to the start of the experiment, participants were instructed that each study word would be preceded by another word for a brief duration and that they should silently read this first word. Otherwise, the methods were identical to those in Experiment 1, except that the prime word was presented for 200 ms.

Results and Discussion

A matched-samples *t* test conducted on median naming latencies² demonstrated faster naming for the matched ($M = 733.70$, $SD = 183.40$) than mismatched ($M = 767.21$, $SD = 184.08$) items, $t(27) = -3.07$, $p = .005$, $d = 0.58$.

A matched-samples *t* test on participants' JOLs (see Figure 1) revealed greater JOLs for matched than mismatched items, $t(27) = 4.74$, $p < .001$, $d = 0.91$. To further dissect the relationship between prime type and JOLs, we ran a partial correlation analysis to assess the mediating effect of experienced fluency (measured by naming latencies; see Hertzog, Dunlosky, Robinson, & Kidder, 2003; Susser & Mulligan, 2015). Within-subject gamma correlations (Nelson, 1984) between prime type (0 = *mismatched*; 1 = *matched*) and JOLs were significantly greater than 0 ($G = .33$, $SE = .06$), $t(27) = 5.62$, $p < .001$, $d = 1.06$. When controlling for naming latencies, this relationship did not change (*partial* $G = .35$, $SE = .06$), $t(27) = -0.58$, $p = .568$, and remained significantly greater than 0, $t(27) = 5.57$, $p < .001$, $d = 1.05$. This result indicates that no mediation took place and that experienced perceptual fluency did not explain the relationship between prime type and JOLs.

A matched-samples *t* test on recall performance revealed no difference in memory for matched ($M = .18$, $SD = .10$) and

Figure 1. Mean judgments of learning (JOLs) in Experiments 1 (32 ms prime duration) and 2 (200 ms prime duration). Error bars represent ± 1 SE.

¹ Some of the naming data (1.6%) was lost from trials on which the voice key did not trip, resulting from a quieter-than-usual response from the participant. This amount is comparable to that in prior research (e.g., Burt & Heffernan, 2012; Prull, 2010).

² As in Experiment 1, some of the naming data (2.9%) was lost from trials on which the voice key did not trip, resulting from a quieter-than-usual response from the participant.

mismatched ($M = .18$, $SD = .10$) words, $t(27) = -0.16$, $p = .878$. The resolution of JOLs was weak and only marginally greater than 0 ($G = .13$, $SE = .07$), $t(27) = 1.84$, $p = .077$.

Consistent with Experiment 1, study words preceded by matched primes were named faster than those preceded by mismatched primes. This effect validates the manipulation of perceptual fluency. However, unlike in Experiment 1, participants in Experiment 2—who saw the primes for a longer duration—gave higher JOLs for the matched than mismatched items. In other words, when the primes were more identifiable and the item conditions more obvious, participants incorporated the information into metamemorial predictions. At first glance, this pattern of results may seem supportive of a role for perceptual fluency in metamemory: The matched words were named faster and given higher JOLs. However, the results of Experiment 1 imply that this is not the case. In that experiment, matching primes similarly facilitated perceptual fluency but produced no effect on JOLs. Likewise, the results of the mediation analysis imply that the effect of prime type on JOLs was not driven by fluency. To shed further light on the role of prime duration, we conducted a combined analysis using the data from Experiments 1 and 2.

Cross-Experiment Analysis

Naming latencies, JOLs, and recall were submitted to separate 2 (prime type: matched or mismatched) $\times$ 2 (experiment: Experiment 1 or Experiment 2) analyses of variance. For naming latencies, the analysis produced a main effect of prime type, indicating faster naming for matched than mismatched items, $F(1, 50) = 18.88$, $MSE = 1.61 \times 10^3$, $p < .001$, $\eta_p^2 = 0.27$. The effect of experiment was not significant, $F(1, 50) = 1.49$, $MSE = 6.27 \times 10^4$, $p = .229$, nor, critically, was the interaction ($F < 1$).

Regarding JOLs, a significant main effect of prime type, $F(1, 50) = 9.45$, $MSE = 37.45$, $p = .003$, $\eta_p^2 = 0.16$, was qualified by a significant interaction between prime type and experiment, $F(1, 50) = 13.57$, $MSE = 37.45$, $p = .001$, $\eta_p^2 = 0.21$, as described earlier. The main effect of experiment was not significant, $F(1, 50) = 1.60$, $MSE = 358.64$, $p = .212$.

Recall performance produced no significant effect of prime type, $F(1, 50) = 1.08$, $MSE = 0.01$, $p = .303$; experiment, $F(1, 50) = 1.99$, $MSE = .01$, $p = .165$; or interaction, $F(1, 50) = 1.53$, $MSE = 0.01$, $p = .222$.

General Discussion

Recent research in metamemory has sought to understand the contributions of experience-based and belief-based influences on JOLs (e.g., Koriat et al., 2004; Mueller et al., 2014). Although fluency-based hypotheses propose experience to be the root of JOL effects, the potential role of beliefs in these effects—particularly in the context of perceptual fluency—has not been thoroughly investigated.

The current study used an identity-priming design to assess how experiences and beliefs may contribute to JOLs. Results from two experiments—the sole difference between which was the presentation duration of the prime word—revealed an effect on metamemory only when primes and item conditions were obvious, despite equivalent effects on naming latencies. Coupled with the

findings from a mediation analysis, this pattern suggests that the divergent JOL results were driven not by perceptual fluency, per se, but by increased knowledge of the prime words, a type of belief. Further, the change in JOL patterns occurred in the absence of any recall differences across experiments.

Our results are consistent with research using the Jacoby–Whitehouse paradigm, which has found distinct patterns in recognition responses when prime salience is manipulated (e.g., Gellatly et al., 1995; Jacoby & Whitehouse, 1989; Joordens & Merikle, 1992), differences thought to be due to an attribution (belief) process. We argue that the differences in prime duration across our experiments resulted in changes in the obviousness of the primes and item conditions, which altered participants' ability to apply their beliefs to their JOLs.

Given the evidence for this belief-based effect, we can speculate about what form this belief takes. On the one hand, people could have a belief about perceptual fluency and memory, in that they believe that more fluently perceived information will be better remembered. On the other hand, people could hold a belief about item repetition: They may believe that repetition benefits memory. The present data do not clarify the locus of the belief, and other possibilities exist, so this will be an intriguing direction for future studies.

To our knowledge, this is the first example of an objective manipulation of perceptual fluency that affects JOLs solely through beliefs (but see Mueller et al., 2013, for a similar finding using an item-relatedness manipulation). Ball et al. (2014) found that processing fluency only partially mediated the effect of bolding on JOLs, suggesting beliefs played a role, but they did not measure perceptual fluency directly, instead measuring study time. Consequently, it is unclear whether their manipulations actually impacted perceptual experience. Mueller et al. (2014) demonstrated that font size exerted its effect on JOLs primarily through a belief; however, it was shown that font size does not actually influence perceptual fluency. In contrast, other manipulations thought to influence perceptual fluency—such as letter transposition (Susser, Mulligan, & Besken, 2013) and inverted text (Sungkhasettee, Friedman, & Castel, 2011)—have failed to affect JOLs. Therefore, these studies demonstrate neither experience-based nor belief-based effects.

Our results present a challenge to prior studies claiming effects of perceptual fluency on metamemory. At face value, our findings suggest that perceptual fluency effects on JOLs do not exist. That is, when (assumed) perceptual fluency manipulations affect JOLs, perhaps they do so only via beliefs and not via actual experience (i.e., perceptual fluency itself). This proposal can accommodate the results of prior studies that used perceptual manipulations and found JOL effects but did not objectively measure perceptual fluency (e.g., Rhodes & Castel, 2008, 2009). At least one of these manipulations has since been shown to have no effect on fluency (see Mueller et al., 2014), raising doubts about contributions of experience. Other studies used manipulations known to affect perceptual fluency (or are reasonably supposed to do so) and found JOL results in the direction predicted by the perceptual-fluency hypothesis (e.g., Besken & Mulligan, 2013; Yue et al., 2013). However, in these studies the perceptual manipulations were very obvious (i.e., perceptual interference and blurred text). Therefore, it is possible that participants either applied an a priori belief about the manipulation or developed one in the context of the

experiment. Such a belief, coupled with the ability to apply it to the items (because it is apparent which items are in which condition), may account for the pattern of metamemory judgments.

Although many of the results in the literature can be accommodated by the notion that apparent perceptual fluency effects are actually mediated by beliefs, one of our studies resists this interpretation. In this study, participants were presented with recorded words varying in auditory clarity (Besken & Mulligan, 2014). The researchers found a negative correlation between the difference in naming latencies for intact and degraded words and the difference in JOLs between the two conditions. In other words, the degree of slowing produced by the degraded words predicted the degree of reduction in JOLs, suggesting that actual perceptual experience contributed to the effect on JOLs. Of course, it is also possible that the studies mentioned in the previous paragraph (i.e., Besken & Mulligan, 2013; Yue et al., 2013) might have produced similar support for a role of perceptual fluency in JOLs if objective measures of perceptual fluency had been used (and the correlations assessed). Therefore, future research will have to take these issues into account to determine whether there are other manipulations that may produce actual perceptual fluency effects, as opposed to belief-based effects, on memory predictions.

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Received April 2, 2015

Revision received July 14, 2015

Accepted July 19, 2015 ■

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If you are interested in reviewing manuscripts for APA journals, the APA Publications and Communications Board would like to invite your participation. Manuscript reviewers are vital to the publications process. As a reviewer, you would gain valuable experience in publishing. The P&C Board is particularly interested in encouraging members of underrepresented groups to participate more in this process.

If you are interested in reviewing manuscripts, please write APA Journals at Reviewers@apa.org. Please note the following important points:

- To be selected as a reviewer, you must have published articles in peer-reviewed journals. The experience of publishing provides a reviewer with the basis for preparing a thorough, objective review.
- To be selected, it is critical to be a regular reader of the five to six empirical journals that are most central to the area or journal for which you would like to review. Current knowledge of recently published research provides a reviewer with the knowledge base to evaluate a new submission within the context of existing research.
- To select the appropriate reviewers for each manuscript, the editor needs detailed information. Please include with your letter your vita. In the letter, please identify which APA journal(s) you are interested in, and describe your area of expertise. Be as specific as possible. For example, “social psychology” is not sufficient—you would need to specify “social cognition” or “attitude change” as well.
- Reviewing a manuscript takes time (1–4 hours per manuscript reviewed). If you are selected to review a manuscript, be prepared to invest the necessary time to evaluate the manuscript thoroughly.

APA now has an online video course that provides guidance in reviewing manuscripts. To learn more about the course and to access the video, visit <http://www.apa.org/pubs/authors/review-manuscript-ce-video.aspx>.