What Drives Priming Effects in the Affect Misattribution Procedure?

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Abstract

The affect misattribution procedure (AMP) is one of the most promising implicit measures to date, showing high reliability and large effect sizes. The current research tested three potential sources of priming effects in the AMP: affective feelings, semantic concepts, and prepotent motor responses. Ruling out prepotent motor responses as a driving force, priming effects on evaluative and semantic target responses occurred regardless of whether the key assignment in the task was fixed or random. Moreover, priming effects emerged for affect-eliciting primes in the absence of semantic knowledge about the primes. Finally, priming effects were independent of the order in which primes and targets were presented, suggesting that AMP effects are driven by misattribution rather than biased perceptions of the targets. Taken together, these results support accounts that attribute priming effects in the AMP to a general misattribution mechanism that can operate on either affective feelings or semantic concepts.

Keywords: affective priming; misattribution; implicit measures; validity; semantic priming

Implicit measures arguably represent one of the most important additions to the tool-box of research instruments in the recent history of psychology (Payne & Gawronski, 2010). In contrast to traditional explicit measures, implicit measures assess mental contents by means of performance-based paradigms that do not require a verbal report of these contents. As such, implicit measures are often regarded as particularly useful to assess mental contents that people might be unwilling or unable to report (Greenwald & Banaji, 1995). Although the relation between implicit and explicit measures turned out to involve a more complex interplay of factors that go beyond introspective limits and differential susceptibility to social desirability (Gawronski, LeBel, & Peters, 2007; Hofmann, Gschwendner, Nosek, & Schmitt, 2005), the exponentially growing number of studies using implicit measures clearly attests to their usefulness as a window into people's minds (for an overview, see Gawronski & Payne, 2010).

Despite their popularity, however, a significant concern about implicit measures is the wide range of reliability estimates they have revealed in empirical studies. Whereas some implicit measures consistently show reliabilities that are comparable to explicit measures, others show reliabilities that are clearly unsatisfactory (Gawronski & De Houwer, in press). These differences may at least partly account for the popularity of the implicit association test (IAT; Greenwald, McGhee, & Schwartz, 1998), which was the first implicit measure that consistently revealed satisfying psychometric properties. However, the IAT has also been criticized for several structural characteristics that question the internal validity of its measurement scores (see Teige-Mocigemba, Klauer, & Sherman, 2010). These concerns have inspired the development of new procedures that overcome the structural problems of the IAT.

One of the most promising alternatives to the IAT to date is the affect misattribution procedure (AMP; Payne, Cheng, Govorun, & Stewart, 2005). Similar to the IAT, the AMP has consistently shown high reliability and large effect sizes. At the same time, the AMP employs the theoretically simpler structure of sequential priming, which makes it less susceptible to methodological criticism than the IAT (Payne & Gawronski, 2010). Nevertheless, the mechanisms underlying the AMP are still not well-understood, which is essential for evaluations of its internal validity and construct-appropriate interpretations of its measurement scores (Nosek, Hawkins, & Frazier, 2011). The main goal of the current research was to address this concern by testing three potential sources of priming effects in the AMP: (1) affective feelings, (2) semantic concepts, (3) prepotent motor responses.

Affect Misattribution Procedure

The AMP is a sequential priming task inspired by an earlier study by Murphy and Zajonc (1993). On a typical AMP trial, participants are briefly presented with a positive or negative prime stimulus which is followed by an evaluatively neutral target stimulus—usually a Chinese ideograph. After a short delay, the target stimulus is replaced by a black-and-white pattern mask and participants are asked to indicate if they consider the target stimulus as visually more pleasant or visually less pleasant than the average Chinese ideograph. The modal finding is that the targets are evaluated more favorably when participants have been primed with a positive stimulus than when they have been primed with a negative stimulus. Although such influences may seem rather obvious and easy to control, priming effects in the AMP have been shown to be unaffected by explicit instructions to avoid the influence of the primes even when participants received detailed information on how the primes influence responses to the targets (Payne et al., 2005).

In the original presentation of the AMP, Payne et al. (2005) reported an average internal consistency of .88 (Cronbach's α) and a mean effect size of 1.25 (Cohen's *d*). These properties have been confirmed in a recent summary of reliability estimates revealed by different implicit measures, with estimates reported for the AMP varying between .70 and .90 (Gawronski & De Houwer, in press). Evidence for its construct validity comes from various studies, showing that AMP scores reveal patterns of results that are consistent with current theorizing about implicit measures. For example, in a study by Payne et al. (2005), the relation between implicit prejudice measured by the AMP and explicit prejudice measured by a feeling thermometer was moderated by individual differences in the motivation to control prejudiced reactions (Dunton & Fazio, 1997), such that implicit and explicit prejudice were positively related for participants low in motivation to control, but not for those high in motivation to control. Additional support comes from studies demonstrating its validity in predicting judgments and behavior (for a meta-analysis, see Cameron, Brown-Iannuzzi, & Payne, 2012), including voting decisions (Payne et al., 2010), addictive behavior (Payne, McClernon, & Dobbins, 2007), sexual preferences (Imhoff, Schmidt, Bernhardt, Dierksmeier, & Banse, 2011), and moral judgments (Hofmann & Baumert, 2010). AMP scores have also been shown to vary in theoretically meaningful ways in response to experimental manipulations of attitudes (cf. De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009), including pairings of neutral conditioned stimuli and valenced unconditioned stimuli in evaluative conditioning (Rydell & Jones, 2009), descriptive information about targets (Gawronski, Rydell, Vervliet, & De Houwer, 2010; Rydell & Gawronski, 2009), and newly created associations between an attitude object and the self (Gawronski & LeBel, 2008; Prestwich, Perugini, Hurling, & Richetin, 2010).

Underlying Mechanisms

Payne et al. (2005) argued that priming effects in the AMP are due to the misattribution of the affective feelings that are elicited by the primes to the evaluatively neutral targets.

According to this account, the primes cause rudimentary pleasant or unpleasant feelings, depending on their affective quality. Although these feelings are subjectively experienced by the participants, they may be unaware of the processes that gave rise to their momentary affective state. As a result, the feeling elicited by the prime may be mistakenly attributed to the target, unless the affective state is less diffuse and bound to a specific object such as the prime (Oikawa, Aarts, & Oikawa, 2011).

Although misattribution of affective feelings explains the effects of prime stimuli with a clear affective quality, it is unable to explain priming effects of semantic stimuli in AMP variants using non-evaluative, semantic judgments. For example, Deutsch and Gawronski (2009) asked participants to guess whether the Chinese ideographs depicted an animate or inanimate object after being presented with word primes referring to animate or inanimate objects. Participants were more likely to guess that the Chinese ideograph depicted an animate object when they were primed with an animate object than when they were primed with inanimate object (see also Imhoff et al., 2011; Sava et al., 2012). The available evidence for priming effects on non-evaluative, semantic judgments has led some researchers to conclude that priming effects in the AMP might be driven by the activation of “cold” semantic concepts rather than “hot” affective feelings (e.g., Blaison, Imhoff, Hühnel, Hess, & Banse, 2012). According to this account, positive and negative primes may influence responses to the targets by activating the semantic concepts of *good* versus *bad* or *pleasant* versus *unpleasant*. Although these concepts are clearly evaluative, they may not necessarily involve the activation of “hot” affective feelings, as suggested by Payne et al.’s (2005) original account.

To test the contribution of affective feelings versus semantic concepts to priming effects in the AMP, Blaison et al. (2012) used a modified version of the task in which participants’ were asked to judge whether the Chinese ideograph visually evoked either fear or anger. Shortly before the presentation of target stimuli, participants were primed with pictures of either angry or fearful faces. Their results showed that angry face primes increased the likelihood of judging a given ideograph as anger-evoking, and this effect occurred even for participants high in social anxiety. Based on these findings, Blaison et al. concluded that priming effects in the AMP are driven by the activation of “cold” semantic concepts rather than “hot” affective feelings. According to their account, angry faces activated semantic concepts of anger which in turn influenced participants’ responses to the Chinese ideographs. For affective feelings, the authors expected the opposite effect, given that angry faces may induce fear and therefore a tendency to judge the target ideograph as fear-evoking, not anger-evoking.

Although activation of semantic concepts parsimoniously explains priming effects in AMP variants using either evaluative or semantic judgments, it is important to note that Blaison et al.’s (2012) results are still ambiguous with regard to the hypothesized role of affective feelings and semantic concepts. Specifically, one could argue that priming effects in Blaison et al.’s study could also be driven by processes of automatic facial mimicry (Dimberg, 1982; Lundqvist & Dimberg, 1995), which may elicit prime-congruent affective feelings through facial feedback (Strack, Martin, & Stepper, 1988). To the extent that these feelings are misattributed to the neutral Chinese ideographs, angry face primes should increase the likelihood of judging a given ideograph as anger-evoking, as observed by Blaison et al. (2012). Thus, although the available evidence suggests that priming effects in the AMP are not limited to primes with a clear affective quality (Deutsch & Gawronski, 2009; Imhoff et al., 2011; Sava et al., 2012), the respective contributions of affective feelings and semantic concepts are still unclear.

This ambiguity is further enhanced by the fact that both types of priming effects are consistent with a third explanation. Drawing on the notion of response priming, Wentura and Degner (2010) agued that priming effects in the AMP are driven by the activation of prepotent motor responses (see also Scherer & Lambert, 2009). A central aspect of response priming is that the mapping of valence to a given set of response options (e.g., *positive* mapped to a right-hand button press; *negative* mapped to a left-hand button press) creates a short-term association between the relevant stimulus features and their corresponding motor responses (see De Houwer, 2003). Importantly, the activation of this association is not limited to the intentional evaluation of the targets, but it can also be activated unintentionally by response-irrelevant stimuli. As a result, brief presentations of a positive or negative prime may activate a prepotent response tendency to press the valence-congruent key, which may increase the likelihood of showing a corresponding response to the neutral target. This mechanism also accounts for priming effects in non-evaluative, semantic variants of the AMP (Wentura & Degner, 2010). In Blaison et al.'s (2012) study, for example, the mapping of *anger* and *fear* to a particular set of response options may have created a short-term association between the task-relevant stimulus features and their corresponding motor responses. As a result, brief presentations of angry and fearful faces may activate a prepotent motor response to press the key that is congruent with the emotional expression of the presented face. These considerations imply that angry face primes should increase the likelihood of judging a given ideograph as anger-evoking, as observed in Blaison et al.'s study.

In sum, although there is clear evidence that priming effects in the AMP are not limited to stimuli with a clear affective quality, previous research remains ambiguous about the role of affective feelings, semantic concepts, and prepotent motor responses as driving forces in the task.

Both the semantic concepts account and the motor response account parsimoniously explain priming effects in evaluative and semantic variants of the AMP. However, there are no data that could rule out affective feelings as a potential source of priming effects in evaluative variants of the AMP. Moreover, the currently available evidence remains ambiguous as to whether priming effects in semantic variants of the AMP are driven by the activation of semantic concepts or prepotent motor responses.

The Present Research

The main goal of the present research was test the three potential sources of priming effects in the AMP: (1) affective feelings, (2) semantic concepts, (3) prepotent motor responses. Testing the potential contribution of prepotent motor responses, Experiment 1 investigated whether priming effects in evaluative variants of the AMP are limited to conditions in which participants can form a short-term association between valence and a particular set of response options. Experiment 2 replicated the findings of Experiment 1 for a non-evaluative, semantic dimension. Addressing the potential contribution of affective feelings, Experiment 3 tested whether priming effects in the AMP occur for stimuli that elicit affective responses in the absence of semantic knowledge about these stimuli. Expanding on the results of the first three studies, Experiment 4 investigated whether the prime stimuli influence target responses through perceptual or misattribution processes.

Experiment 1

The main goal of Experiment 1 was to test the potential contribution of prepotent motor responses to priming effects in evaluative variants of the AMP. A central assumption of the motor response account is that the mapping of the task-relevant stimulus features (e.g., positive vs. negative) to a particular set of response options (e.g., right-hand button press vs. left-hand button press) creates a short-term association between the two dimensions. These short-term associations are assumed to be activated by task-relevant features of the primes, such that the primes may elicit a prepotent response tendency to press a particular key. This account implies that priming effects in the AMP should be limited to conditions under which there is a consistent mapping between stimulus features and a particular set of response options. However, in the absence of a consistent stimulus-response mapping, priming effects should disappear. The latter outcome can be expected when the key assignment in the task varies randomly on a trial-by-trial basis, such that participants do not know which stimulus features will be mapped onto which response key at the time the prime appears on the screen. In other words, the activation of motor responses can be expected to produce reliable priming effects only when the key assignment in the AMP is fixed, but not when the key assignment varies randomly from trial to trial.

A different prediction is implied by accounts in terms of affective feelings and semantic concepts. According to these accounts, the biasing effects of affective feelings or semantic concepts on target judgments do not require a consistent mapping of stimulus features and response sets. Instead, participants may use whatever response options they have to express their biased judgments of the targets, regardless of whether they do or do not know which key will be mapped onto which stimulus feature at the time the prime appears on the screen. Hence, from the perspective of these accounts, the activation of affective feelings or semantic concepts should produce reliable priming effects regardless of whether the key assignment in the task is fixed or random.

To test these competing predictions, participants in Experiment 1 were primed with pleasant and unpleasant images before they were presented with the Chinese ideographs that were used as target stimuli. Participants' task was to indicate whether they considered the

Chinese ideograph as visually more pleasant or visually less pleasant than the average Chinese ideograph. For half of the participants, the particular key assignment of *more pleasant* and *less pleasant* responses was fixed throughout the task. For the remaining half, the key assignment varied randomly on a trial-by-trial basis.

Method

Participants and Design. Fifty-five summer students (14 women, 41 men) at The University of Western Ontario were recruited for a study entitled “How do we make moral and evaluative judgments?” Subjects were paid CAD-$ 10 as a compensation for their participation in a one-hour session that included the current study and one additional study on an unrelated topic. The study included a 2 (Prime Valence: positive vs. negative) × 2 (Key Assignment: fixed vs. random) mixed-model design with the first variable as a within-subjects factor and the second one as a between-subjects factor.

Materials and Procedure. The procedure of the AMP largely followed the general recommendations by Payne et al. (2005). On each trial of the task, participants were first presented with a fixation cross for 500 ms, which was replaced by a prime stimulus of either positive or negative valence for 75 ms. The presentation of the prime was followed by a blank screen for 125 ms, after which a Chinese ideograph appeared for 100 ms. The Chinese ideograph was then replaced by a black-and-white pattern mask, and participants were asked to make their response. Participants’ task was to indicate whether they considered the Chinese ideograph as visually more pleasant or visually less pleasant than the average Chinese ideograph. The pattern mask remained on the screen until participants gave their response. The next trial started after an inter-trial interval of 500 ms. In the fixed key-assignment condition, participants had to press a right-hand key (*Numpad 5*) when they considered the Chinese ideograph as visually more pleasant than average and a left-hand key (*A*) when they considered the Chinese ideograph as visually less pleasant than average. In the random key-assignment condition, the key assignment was randomized on a trial-by-trial basis by the computer. Participants in both conditions were told that the key assignment will be displayed individually for each trial. The particular key assignment for a given trial appeared on the screen together with the black-and-white pattern mask that replaced the Chinese ideograph. As prime stimuli we used 5 positive and 5 negative pictures from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2008). Each prime was presented 10 times, summing up to a total of 100 trials. As target stimuli, we used 100 distinct Chinese ideographs from Payne et al. (2005). Order of trials and prime-target combinations were randomized by the computer for each participant. Following the original instructions by Payne et al. (2005), participants in both conditions were told that the photographs can sometimes bias people’s responses to the Chinese ideographs, and that they should try their absolute best not to let the photographs bias their judgments of the Chinese ideographs in any possible way.

Results

Participants’ responses were aggregated by calculating the proportion of *more pleasant* responses for each of the two prime categories. Submitted to a 2 (Prime Valence) × 2 (Key Assignment) mixed-model ANOVA, these scores revealed a significant main effect of Prime Valence, $F(1, 53) = 21.11$, $p < .001$, $\eta_p^2 = .285$, indicating that positive primes led to more favorable evaluations of the Chinese ideographs than negative primes (see Figure 1). Importantly, the two-way interaction of Prime Valence and Key Assignment was far from statistical significance, $F(1, 53) = 0.06$, $p = .80$, $\eta_p^2 = .001$. The effect of Prime Valence was statistically significant when the key assignment was fixed, $F(1, 27) = 13.62$, $p = .001$, $\eta_p^2 =$

.335, and when they key assignment varied randomly from trial to trial, $F(1, 26) = 8.83$, $p = .006$, $\eta_p^2 = .254$.

Discussion

The main goal of Experiment 1 was to test whether priming effects in the AMP depend on consistent stimulus-response mappings. According to the motor response account, priming effects in the AMP should be limited to conditions under which the task-relevant stimulus features are consistently mapped to a particular set of response options. Counter to this prediction, we found significant priming effects regardless of whether they key assignment in the task was fixed or random. These findings challenge the activation of prepotent motor responses as a viable explanation of priming effects in the AMP (e.g., Wentura & Degner, 2010). Yet, they are consistent with accounts that attribute priming effects in the AMP to the activation of affective feelings (e.g., Payne et al., 2005) or semantic concepts (e.g., Blaison et al., 2012). In contrast to the motor response account, these accounts imply that participants may use whatever response options they have to express their biased judgments of the targets, regardless of whether the key assignment in the task is fixed or random.

Experiment 2

The main goal of Experiment 2 was to replicate the findings of Experiment 1 for an AMP variant using semantic rather than affective materials. Toward this end, participants were primed with images of men and women before they were presented with the Chinese ideographs that were used as target stimuli. Participants' task was to guess whether the Chinese ideographs referred to either a male or a female name. For half of the participants, the key assignment of *male* and *female* responses was fixed throughout the task. For the remaining half, the key assignment varied randomly on a trial-by-trial basis. Drawing on the findings of Experiment 1, we expected that the primes would produce a gender-congruent bias in participants' responses to the Chinese ideographs regardless of whether the key assignment in the task is fixed or random.

Method

Participants and Design. Ninety-nine undergraduates (79 women, 20 men) at The University of Western Ontario were recruited for a battery of studies entitled "How do we make visual judgments?" which included the current experiment and two additional experiments on unrelated topics. Subjects received research credit for an introductory psychology course. The study included a 2 (Prime Gender: female vs. male) × 2 (Key Assignment: fixed vs. random) mixed-model design with the first variable as a within-subjects factor and the second one as a between-subjects factor. Eighteen participants of Asian background reported knowing the meaning of the Chinese ideographs. Data from these participants were excluded from analyses.

Materials and Procedure. The procedural details of the AMP were similar to the ones in Experiment 1 with a few exceptions. Instead of using evaluative target categorizations, participants were asked to guess whether the Chinese ideograph referred to a male or a female name. In the fixed key-assignment condition, participants had to press a right-hand key (*Numpad 5*) when they thought that the Chinese ideograph referred to a female name and a left-hand key (*A*) when they thought that the Chinese ideograph referred to a male name. In the random key-assignment condition, the key assignment was randomized on a trial-by-trial basis by the computer. Participants in both conditions were told that the key assignment will be displayed individually for each trial. The particular key assignment for a given trial appeared on the screen together with the black-and-white pattern mask that replaced the Chinese ideograph. As prime stimuli, we used head-and-shoulder photographs of 5 women and 5 men. Each prime was presented 10 times, summing up to a total of 100 trials. The target stimuli were identical to

Experiment 1. Order of trials and prime-target combinations were again randomized by the computer for each participant. As with Experiment 1, participants were told that the photographs can sometimes bias people's responses to the Chinese ideographs, and that they should try their absolute best not to let the photographs bias their judgments of the Chinese ideographs in any possible way.

Results

Participants' responses were aggregated by calculating the proportion of *female* responses for each of the two prime categories. Submitted to a 2 (Prime Gender) × 2 (Key Assignment) mixed-model ANOVA, these scores revealed a significant main effect of Prime Gender, $F(1, 79) = 24.63$, $p < .001$, $\eta_p^2 = .238$, indicating that participants were more likely to guess *female* when they were primed with a female face than when they were primed with a male face (see Figure 2). The two-way interaction of Prime Gender and Key Assignment was far from statistical significance, $F(1, 79) = 0.48$, $p = .49$, $\eta_p^2 = .006$. The effect of Prime Gender was statistically significant when the key assignment was fixed, $F(1, 39) = 8.33$, $p = .006$, $\eta_p^2 = .176$, and when they key assignment varied randomly from trial to trial, $F(1, 40) = 17.57$, $p < .001$, $\eta_p^2 = .305$.

Discussion

The results of Experiment 2 corroborate our conclusion that prepotent motor responses do not function as a driving force of priming effects in the AMP. Replicating the pattern obtained in Experiment 1, male and female prime stimuli produced a gender-congruent bias in guessing the meaning of the Chinese ideographs, and this priming effect occurred regardless of whether the key assignment in the task was fixed or random. Thus, taken together, the two studies challenge the motor response account as a viable explanation for priming effects in both evaluative and semantic variants of the AMP.

Experiment 3

Although the results of Experiments 1 and 2 are inconsistent with the hypothesis that priming effects in the AMP are driven by the activation of prepotent motor responses, they do not provide definite information about the contribution of affective feelings versus semantic concepts. On the one hand, one could argue that the semantic concepts account is superior, because it can explain the results of both studies. Yet, affective feelings provide a viable explanation only for the results of Experiment 1, but not the results of Experiment 2. On the other hand, it is important to note that positive evidence for the contribution of semantic concepts in Experiment 2 does not rule out the potential contribution of affective feelings in Experiment 1. After all, it is possible that affective feelings and semantic concepts jointly contribute to priming effects in evaluative variants of the AMP. An unambiguous test of these assumptions would require prime stimuli that elicit affective feelings in the absence of semantic knowledge about these stimuli. To the extent that priming effects in evaluative variants of the AMP are eliminated in the absence of semantic knowledge about the primes, one could conclude that semantic concepts are indeed the exclusive source of priming effects in the AMP (cf. Blaison et al., 2012). However, if priming effects emerge for affect-eliciting primes even in the absence of semantic knowledge, the appropriate conclusion is that both affective feelings and semantic concepts can contribute to priming effects in the AMP (cf. Loersch & Payne, 2011).

To test these competing predictions, Experiment 3 utilized a mere exposure manipulation to induce positive affective feelings toward unfamiliar stimuli in the absence of semantic knowledge about these stimuli (for a meta-analysis, see Bornstein, 1989). A central characteristic of mere exposure effects is that prior exposure to a stimulus can elicit positive affective feelings toward that stimulus through the enhanced fluency of processing the stimulus (Winkielman, Huber, Kavanagh, & Schwarz, 2012). Because the elicitation of fluency-related positive affect does not require semantic knowledge about the stimulus, mere exposure provides an ideal means to test the role of affective feelings and semantic concepts in evaluative variants of the AMP. To the extent that the activation of semantic concepts represents the only source of priming effects in the AMP, prior exposure to unfamiliar prime stimuli should be insufficient to produce a priming effect. In contrast, if priming effects in the AMP can also be driven by affective feelings, unfamiliar prime stimuli that have been encountered before should produce more favorable responses to the target stimuli than unfamiliar prime stimuli that have not been encountered before. In the current study, we tested these predictions by comparing priming effects of artificial words that have been presented in a preceding task to the effects of artificial words that have not been presented before. To avoid inferences on the basis of a null effect in case mere exposure fails to produce a significant priming effect, we also included a control condition in which prior exposure to artificial words involved the simultaneous presentation of positive English words that ostensibly described the meaning of the artificial words. Based on the evidence for the role of semantic concepts in Experiment 2, we expected that positive translations of the artificial words should produce a significant priming effect regardless of whether affective feelings do or do not contribute to priming effects in the AMP.

Method

Participants and Design. Seventy undergraduates (39 women, 31 men) at The University of Western Ontario were recruited for a study entitled “How Do We Form First Impressions and Learn Foreign Languages?” The study was part of a one-hour session that included the current study and two additional studies on unrelated topics. Subjects received research credit for an introductory psychology course. The study included a 2 (Prime Type:

presented vs. not presented) × 2 (Presentation Context: mere exposure vs. positive translation) mixed-model design with the first variable as within-subjects factor and the second one as a between-subjects factor.

Materials and Procedure. Before participants completed the AMP, they were presented with artificial words as part of a language learning task. For half of the participants, the artificial words appeared individually on screen (mere exposure condition). For the remaining half, the artificial words were presented together with positive English words that ostensibly described the meaning of the artificial words (positive translation condition). Participants in both conditions were asked to memorize the artificial words. The presentations included five artificial words, each of which was presented 10 times for 1000 ms slightly above the center of the screen. For participants in the positive translation condition, a positive English word was simultaneously presented slightly below the center of the screen. The intertrial interval was 2000 ms. Order of trials was randomized individually for each participant. For the artificial words, we created two sets of five words. The artificial words of the first set were: *nijaron*, *kadirga*, *felkani*, *lokanta*, *safmeri*; the artificial words of the second set were: *vikesta*, *tunbalo, latipor*, *belnica*, *gorikas*. The artificial words of one set were presented as target stimuli in the language learning task (presented condition); the artificial words of the other set were used as control stimuli in the AMP without prior presentation (not-presented condition). The assignment of the two sets to the two conditions was counterbalanced across participants. As positive English words in the translation condition, we used: *love*, *friend*, *happiness*, *holiday*, *summer*.

The basic procedure of the AMP was similar to the evaluative AMP with a fixed key-assignment in Experiment 1. To test the effects of prior presentation and presentation context on priming effects in the AMP, the task included 12 presentations of the five artificial words that were presented during the language learning task and 12 presentations of the five artificial words that were not presented before, summing up to a total of 120 trials. Order of trials and prime-target combinations were randomized by the computer for each participant.

Results

AMP responses were aggregated by calculating the proportion of *more pleasant* responses for each of the two prime categories. Submitted to a 2 (Prime Type) × 2 (Presentation Context) mixed-model ANOVA, these scores revealed a marginally significant main effect of Presentation Context, $F(1, 68) = 3.20$, $p = .08$, $\eta_p^2 = .045$, indicating that participants tended to evaluate the Chinese ideographs more favorably in the positive translation condition compared to the mere exposure condition. More importantly, the ANOVA also revealed a significant main effect of Prime Type, $F(1, 68) = 15.40$, $p < .001$, $\eta_p^2 = .185$, indicating that artificial words that were presented before elicited more favorable evaluations of the Chinese ideographs than artificial words that were not presented before (see Figure 3). The two-way interaction of Prime Type and Presentation Context was far from statistical significance, $F(1, 68) = 0.06$, $p = .81$, $\eta_p^2 = .001$. The effect of Prime Type was statistically significant in the mere exposure condition, $F(1, 34) = 9.34$, $p = .004$, $\eta_p^2 = .215$, as well as the translation condition, $F(1, 34) = 6.34$, $p = .017$, $\eta_p^2 = .157$.

Discussion

The results of Experiment 3 demonstrate that the activation of semantic concepts is not the exclusive source of priming effects in the AMP. Instead, priming effects can also be due to the affective feelings that are elicited by the primes. Using a mere exposure manipulation to create positive feelings toward unfamiliar prime stimuli in the absence of semantic knowledge about these stimuli, artificial prime words that were presented before led to more favorable evaluations of the neutral Chinese ideographs when these words presented before than when they were not presented before. Together with the results of Experiment 2, these results suggest that priming effects in the AMP can be driven by either affective states or semantic concepts.

Experiment 4

The results of Experiments 1-3 specify *what* drives priming effects in the AMP: affective feelings and semantic concepts, but not prepotent motor responses. However, these studies do not provide any evidence regarding *how* affective feelings and semantic concepts produce priming effects in the AMP. The main goal of Experiment 4 was to test two alternative mechanisms by which affective feelings and semantic concepts may influence judgments about ambiguous target stimuli in the AMP: (1) misattribution of mental states and (2) biased perception of the target stimuli.

Payne et al. (2005) argued that priming effects in the AMP are driven by the misattribution of the affective feelings that are elicited by the primes to the neutral target stimuli. Expanding on this hypothesis, Loersch and Payne (2011) proposed a general account that attributes priming effects of affective feelings and semantic concepts to a single misattribution mechanism. According to their situated-inference model, primes tend to influence behavior by altering the mental state of the perceiver (e.g., accessibility of semantic concepts; momentary affective feelings). In some cases, people mistakenly attribute these changes to their internal thought processes instead of the actual external source. If such misattribution occurs, the information implied by the mental state may influence behavior by serving as a basis for whatever behavioral decision is afforded by the current situation. As outlined by Loersch and Payne (2011), this account parsimoniously integrates various kinds of priming effects in the literature, including priming effects on judgments, behavior, and goal pursuit. Applied to the

AMP, an important aspect of the situated-inference model is that it includes both affective feelings and semantic concepts as potential mediators. For example, positive and negative primes may influence responses to the targets by altering either affective feelings or the accessibility of semantic concepts related to valence (e.g., *good* versus *bad*; *pleasant* versus *unpleasant*), which may be misattributed to the neutral targets unless these changes are directly bound to a specific object such as the prime (Oikawa et al., 2011).

Although the AMP is commonly described as a misattribution task, Payne et al. (2005) also discussed an alternative mechanism that attributes priming effects to biased perceptions of the neutral Chinese ideographs. Instead of serving as a *direct* basis for judgments about the target stimuli as a result of misattribution, the biased perception account states that affective feelings and semantic concepts may influence judgments *indirectly* through the encoding of ambiguous stimulus characteristics (Srull & Wyer, 1980). Applied to the AMP, this account implies that the affective feelings and semantic concepts that are activated by the primes bias participants' perception of the Chinese ideographs, and these biased perceptions may then provide the basis for their judgments (Payne et al., 2005).

An important difference between the two accounts is that they make unique assumptions about the conditions under which a prime stimulus should influence judgments about an unrelated target stimulus. According to the misattribution account, priming effects depend on the mental state of the perceiver at the time of making the judgment. Thus, granted that the prime is presented close enough to the required judgment, it should not make a difference whether the mental state of the perceiver is altered before or after the encoding of the target stimulus. In contrast, the biased perception account implies that priming effects depend on the mental state of the perceiver at the time of encoding the target stimulus. If a prime stimulus influences the mental state of the perceiver after the target has been encoded, the subjective perception of the target cannot be reversed, which should eliminate the impact of the prime (e.g., Srull & Wyer, 1980; Trope, Cohen, & Alfieri, 1991). In the current study, we exploited these conflicting predictions to test the role of misattribution versus biased perception in the AMP. Whereas the misattribution account implies that priming effects in the AMP should occur regardless of whether the primes precede or follow the targets, the biased perception account implies that priming effects should be limited to trials on which the primes precede the targets. To ensure the generality of our findings, we tested these predictions for an evaluative and a semantic variant of the AMP using identical stimuli.

Method

Participants and Design. One-hundred summer students (75 women, 25 men) at The University of Western Ontario were recruited for a study entitled "Impression Formation and Visual Perception." Subjects were paid CAD-$ 10 as a compensation for their participation in a one-hour session that included the current study and three additional studies on unrelated topics. The study used a 2 (Prime Valence: positive vs. negative) × 2 (Prime Semantics: animate vs. inanimate) × 2 (Prime-Target Order: prime-target vs. target-prime) × 2 (Target Categorization: evaluative vs. semantic) mixed-model design with the first three variables as within-subjects factors and the last one as a between-subjects factor. Thirteen participants of Asian background reported knowing the meaning of the Chinese ideographs. Data from these participants were excluded from analyses.

Materials and Procedure. The AMP was similar to the one in Experiment 3 with a few important differences. First, instead of using artificial words as primes, the current study used 40 English words depicting animate or inanimate objects of either positive or negative valence (see

Deutsch & Gawronski, 2009). Second, the current study manipulated the order of prime and target presentations on a within-subjects basis. On half of the trials the primes were presented first followed by the targets; on the remaining half the targets were presented first followed by the primes. Each of the 40 primes was presented once within each order condition, summing up to a total of 80 trials. Third, to ensure equal presentation times in the two order conditions, both primes and targets were presented for 100 ms with a blank screen being presented for 100 ms between the two stimuli. Fourth, the current study manipulated the type of target categorization. Participants in the semantic categorization condition were asked to guess whether the Chinese ideograph referred to an animate or inanimate object. Participants in the evaluative categorization condition were asked to guess whether the Chinese ideograph referred to a positive or negative object. The assignment of the two response keys (*A* and *Numpad 5*) to the respective responses was counterbalanced. Participants in both categorization conditions were instructed to focus on the Chinese ideographs and ignore the words. Participants were also told that the words can bias people's guesses about the meaning of the Chinese ideographs, and that they should try their absolute best not to let the words bias their guesses about the meaning of the Chinese ideographs in any possible way.

Results

Participants' responses were aggregated by calculating the proportion of *positive* or *animate* responses (depending on the categorization condition) for each of the eight within-subjects conditions implied by the manipulations of prime valence, prime semantics, and prime-target order. Thus, for the following analyses, *animate* responses in the semantic categorization condition were treated as equivalent to *positive* responses in the evaluative categorization condition and *inanimate* responses were treated as equivalent to *negative* responses. Submitted to a 2 (Prime Valence) × 2 (Prime Semantics) × 2 (Prime-Target Order) × 2 (Target Categorization) mixed-model ANOVA, these scores revealed a significant main effect of Prime-Target Order, $F(1, 85) = 5.25$, $p = .02$, $\eta_p^2 = .058$, a significant two-way interaction of Prime-Target Order and Target Categorization, $F(1, 85) = 4.45$, $p = .04$, $\eta_p^2 = .050$, and a significant three-way interaction of Prime Valence, Prime Semantics, and Order, $F(1, 85) = 5.35$, $p = .02$, $\eta_p^2 = .059$. More important for the current investigation, the ANOVA also revealed a significant main effect of Prime Valence, $F(1, 85) = 23.01$, $p < .001$, $\eta_p^2 = .213$, and a significant main effect of Prime Semantics, $F(1, 85) = 11.32$, $p < .001$, $\eta_p^2 = .118$. Both main effects were qualified by significant two-way interactions with Target Categorization (see Figure 4). The significant two-way interaction of Prime Valence and Target Categorization, $F(1, 85) = 8.95$, $p = .004$, $\eta_p^2 = .095$, indicates that positive primes led to more *positive* responses than negative primes in the evaluative categorization condition, $F(1, 42) = 21.70$, $p < .001$, $\eta_p^2 = .341$. Yet, positive primes did not lead to more *animate* responses than negative primes in the semantic categorization condition, $F(1, 43) = 2.63$, $p = .11$, $\eta_p^2 = .058$. Conversely, the significant two-way interaction of Prime Semantics and Target Categorization, $F(1, 85) = 15.03$, $p < .001$, $\eta_p^2 = .150$, indicates that animate primes led to more *animate* responses than inanimate primes in the semantic categorization condition, $F(1, 43) = 14.47$, $p < .001$, $\eta_p^2 = .252$. However, animate primes did not lead to more *positive* responses than inanimate primes in the evaluative categorization condition, $F(1, 42) = 0.89$, $p = .35$, $\eta_p^2 = .021$. These results replicate earlier findings by Deutsch and Gawronski (2009) showing significant effects of prime valence when the categorization task was evaluative but not when it was semantic, and significant effects of prime semantics when the categorization task was semantic but not when it was evaluative.

More important for the current investigation, the obtained two-way interactions remained unqualified by the order in which primes and targets were presented. Neither the three-way interaction of Prime Valence, Target Categorization, and Prime-Target Order, $F(1, 85) = 0.55$, $p = .46$, $\eta_p^2 = .006$ (see Figure 4, left panel), nor the three-way interaction of Prime Semantics, Target Categorization, and Prime-Target Order was statistically significant $F(1, 85) = 0.32$, $p = .57$, $\eta_p^2 = .004$ (see Figure 4, right panel). The effect of Prime Valence in the evaluative categorization condition was statistically significant regardless of whether the primes preceded the targets, $F(1, 42) = 18.75$, $p < .001$, $\eta_p^2 = .225$, or the primes followed the targets, $F(1, 42) = 22.84$, $p < .001$, $\eta_p^2 = .352$. Similarly, the effect of Prime Semantics in the semantic categorization condition was statistically significant regardless of whether the primes preceded the targets, $F(1, 43) = 12.50$, $p = .001$, $\eta_p^2 = .225$, or the primes followed the targets, $F(1, 43) = 14.50$, $p < .001$, $\eta_p^2 = .256$. The size of the two kinds of priming effects did not differ as function of Prime-Target Order for Prime Valence within the evaluative categorization condition, $F(1, 42) = 0.22$, $p = .64$, $\eta_p^2 = .005$, and for Prime Semantics within the semantic categorization condition, $F(1, 43) = 0.06$, $p = .81$, $\eta_p^2 = .001$.

Discussion

The results of Experiment 4 are consistent with accounts that attribute priming effects in the AMP to a general misattribution of prime-related mental states to the neutral Chinese ideographs (Loersch & Payne, 2011). However, they are inconsistent with accounts in terms of biasing effects of the primes on the perception of the target stimuli (Payne et al., 2005). Specifically, we found that word primes influenced participants’ responses to the Chinese ideographs regardless whether the primes were presented before or after the target stimuli. Supporting the generality of our conclusion, these effects emerged for both an evaluative and a semantic variant of the AMP using identical materials. Thus, together with the results of Experiments 1-3, these findings support accounts that attribute priming effects in the AMP to a general misattribution mechanism that can operate on both affective feelings and semantic concepts (Loersch & Payne, 2011).

General Discussion

The main goal of the current research was to investigate whether priming effects in the AMP are driven by the activation of (1) affective feelings, (2) semantic concepts, or (3) prepotent motor responses. Counter to the hypothesis that priming effects in the AMP might be driven by the activation of prepotent motor responses, priming effects on evaluative and semantic target responses occurred regardless of whether the key assignment in the task was fixed or random (Experiments 1 and 2). Moreover, priming effects emerged for semantic primes in the absence of affective feelings (Experiment 2) and for affect-eliciting primes in the absence of semantic knowledge (Experiment 3), indicating that both affective feelings and semantic concepts can contribute to priming effects in the AMP. Finally, priming effects on evaluative and semantic target responses were independent of the order in which primes and targets were presented, suggesting that priming effects in the AMP are driven by misattribution processes rather than biased perceptions of the target stimuli (Experiment 4). Taken together, these findings are consistent with the hypothesis that priming effects in the AMP are the result of a general misattribution mechanism that can operate on either affective feelings or semantic concepts (Loersch & Payne, 2011). According to this account, the prime stimuli alter the mental state of the perceiver (e.g., accessibility of semantic concepts; momentary affective feelings), which may be mistakenly attributed to internal thought processes rather than the primes. As a result, the information implied by the mental state may be used as a basis for judgments about the ambiguous target stimuli, unless they are less diffuse and bound to a specific object such as the prime (Oikawa et al., 2011).

Although activation of prepotent motor responses can explain the effects of both evaluative and semantic primes (Wentura & Degner, 2010), it is inconsistent with the finding that priming effects in the AMP emerged even when the key assignment in the task varied randomly on a trial-by-trial basis. According to this account, the mapping of a particular stimulus dimension to a particular set of response options creates a short-term association between the two dimensions. As a result, task-relevant stimulus features of the primes may activate associated motor reactions, which in turn influences the likelihood of showing a corresponding response to the neutral targets. Because the formation of short-term associations between stimulus features and response options is not limited to "hot" affective materials, this account can explain why priming effects in the AMP occur also for "cold" semantic materials. However, an important requirement for the activation of prepotent motor responses is the prior formation of a stimulus-response association, which is undermined if the particular key assignment changes randomly from trial to trial (cf. De Houwer, 2003). Hence, the motor response account is unable to explain the current finding that priming effects occurred even when the key assignment in the AMP varied randomly on a trial-by-trial basis.

An important question is how our findings can be reconciled with Blaison et al.'s (2012) conclusion that priming effects in the AMP are driven by "cold" semantic concepts rather than "hot" affective feelings. This conclusion was based on their finding that angry face primes increased the likelihood of judging a given ideograph as anger-evoking rather than fear-evoking, which may seem at odds with the results of our mere exposure study showing that affect-eliciting primes can influence target-responses in the absence of semantic knowledge about the primes.

There are at least two possible explanations that may resolve this inconsistency. First, it is possible that the primes in Blaison et al.'s study elicited processes of automatic facial mimicry (e.g., Dimberg, 1982; Lundqvist & Dimberg, 1995), which may induce prime-congruent affective feelings through facial feedback (Strack et al., 1988). Because priming effects of such mimicry-induced feelings would be congruent with the ones resulting from activated semantic concepts, there would be no inconsistency with our conclusion that priming effects in the AMP can be due to either affective feelings or semantic concepts. Second, the angry face primes in Blaison et al.'s study may have activated both affective feelings of fear *and* semantic concepts of anger, and their relative impact may depend on the nature of the categorization task. Specifically, one could argue that priming effects in the AMP are limited to those mental states that are most applicable to the judgmental task (cf. Loersch & Payne, 2011). In the current research, for example, priming effects of positive versus negative words were limited to evaluative target judgments, whereas priming effects of animate versus inanimate words were limited to corresponding semantic judgments. Applied to Blaison et al.'s findings, it is possible that the target judgment in their study involved a stronger cognitive focus (e.g., what are the visual characteristics of the ideograph?), thereby enhancing the impact of semantic concepts and reducing the impact of affective feelings. Yet, a target judgment that involves a stronger affective focus (e.g., how does ideograph make you feel?) might enhance the impact of affective feelings and reduce the impact of semantic concepts. Future research may help to clarify the potential influence of different target categorizations on priming effects of affective feelings and semantic concepts.

An important issue in the context of the present studies is the possibility that participants intentionally use features of the primes to judge the targets. Evidence for such intentional effects would not only undermine the suitability of the AMP as an implicit measure (De Houwer et al., 2009); it would also provide an alternative explanation for the current findings, given that participants may use whatever prime characteristic can help to resolve the judgmental task regardless of whether the key assignment is fixed or random. Consistent with this concern, Bar-Anan and Nosek (2012) found that AMP effects were positively correlated with self-reported intentional use of the primes in judging the targets. However, follow-up research by Payne et al. (2013) indicates that the value of such retrospective self-reports is rather limited for illuminating the causal mechanisms underlying AMP effects. In a series of studies, Payne et al. found that AMP effects were related to incoherent self-reports of both intentional and unintentional influences of the primes. Moreover, giving participants the option to skip a target judgment when they felt that their judgment would be influenced by the prime failed to reduce priming effects. Taken together, these results suggest that relations between AMP effects and self-reported intentional use of prime characteristics reflect retrospective confabulations rather than genuine causal effects of intentional processes. On the basis of this conclusion, it seems more appropriate to explain the current results in terms of misattributions of affective feelings and semantic concepts instead of intentional use of prime characteristics.

Conclusion

The main goal of the current research was to investigate the mechanisms underlying the AMP, which represents one of the most promising alternatives to the IAT to date. Our findings suggest that priming effects in the AMP are driven by the misattribution of affective feelings and semantic concepts, but there is no supportive evidence for the hypothesized role of prepotent motor responses. Although some researchers may interpret the two sources of priming effects as a threat against the validity of the AMP, we do not think that such a conclusion is warranted. Of course, the current evidence indicates that priming effects in the AMP should not be interpreted as an unambiguous indicator of affective feelings, because priming effects in evaluative variants may also be driven by semantic concepts related to valence (e.g., *good* versus *bad*; *pleasant* versus *unpleasant*). However, this caveat does not imply that the AMP is an unreliable measure that lacks construct validity. Previous research has clearly demonstrated the validity of the AMP in predicting important real-life behaviors (for a meta-analysis, see Cameron et al., 2012). The current findings indicate that the predictive relations in these studies may be due to either affective feelings or semantic concepts (or both), and future research is needed to identify their affective versus cognitive underpinnings. Nevertheless, the finding that priming effects in the AMP can be driven by the activation of semantic concepts provides a theoretical foundation for applications involving the measurement of semantic associations. Thus, we hope that the current studies will stimulate future research on the affective versus cognitive underpinnings of previous findings with the AMP and novel applications to questions involving semantic associations.

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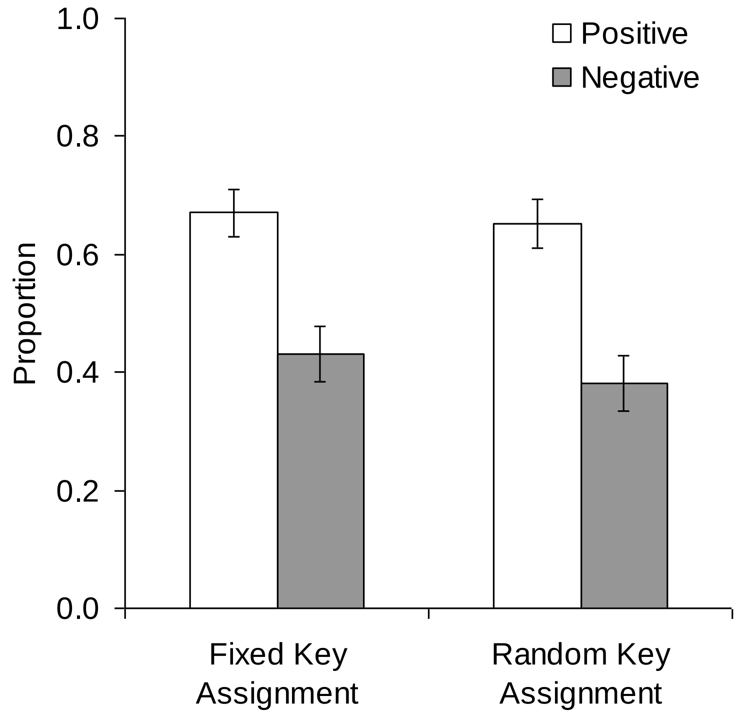

Figure 1. Priming effects as a function of prime valence (positive vs. negative) and key assignment for evaluative target categorizations (fixed vs. random), Experiment 1. Higher values indicate higher proportions of positive responses. Error bars depict standard errors.

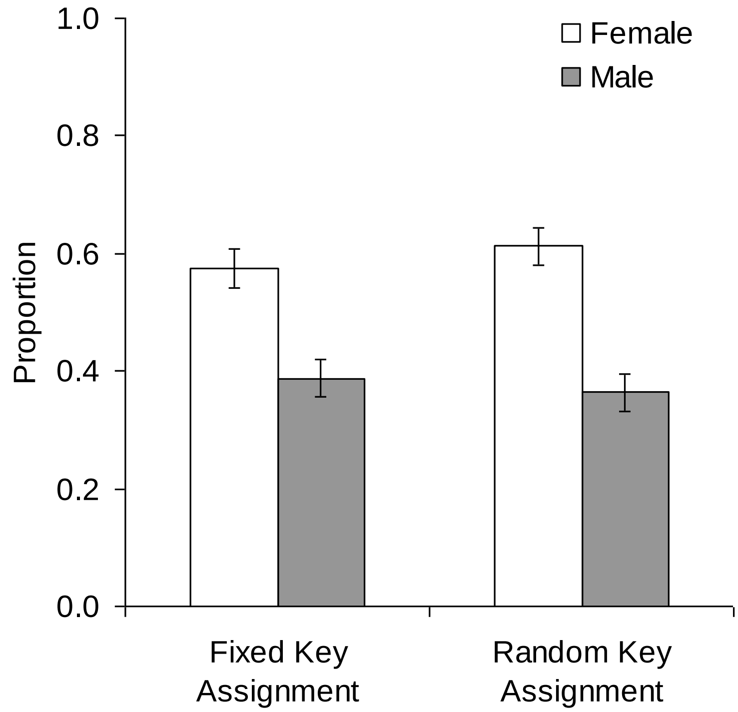

Figure 2. Priming effects as a function of prime gender (female vs. male) and key assignment for target gender guesses (fixed vs. random), Experiment 2. Higher values indicate higher proportions of female responses. Error bars depict standard errors.

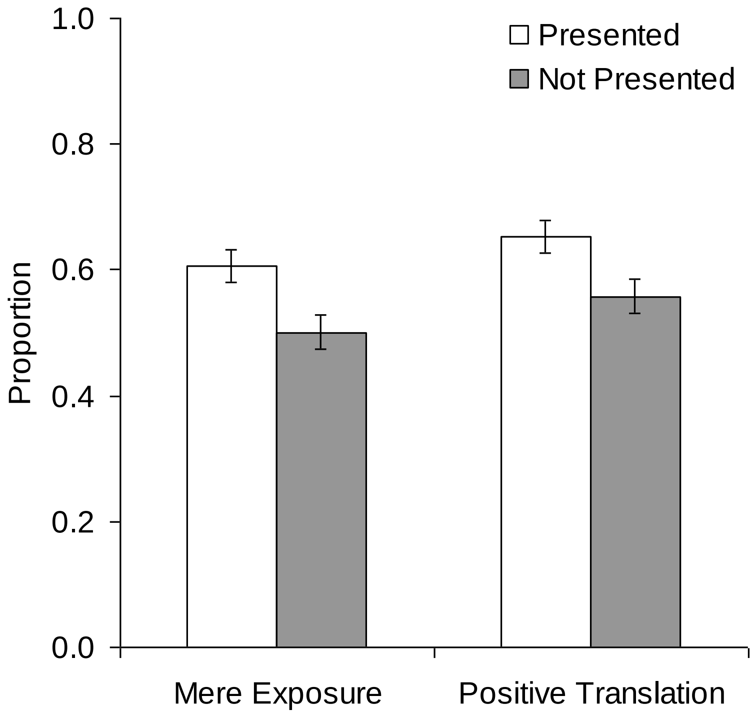

Figure 3. Priming effects as a function of prior presentation of prime (presented vs. not presented) and context during prior presentation (mere exposure vs. positive translation), Experiment 3. Higher values indicate higher proportions of positive responses. Error bars depict standard errors.

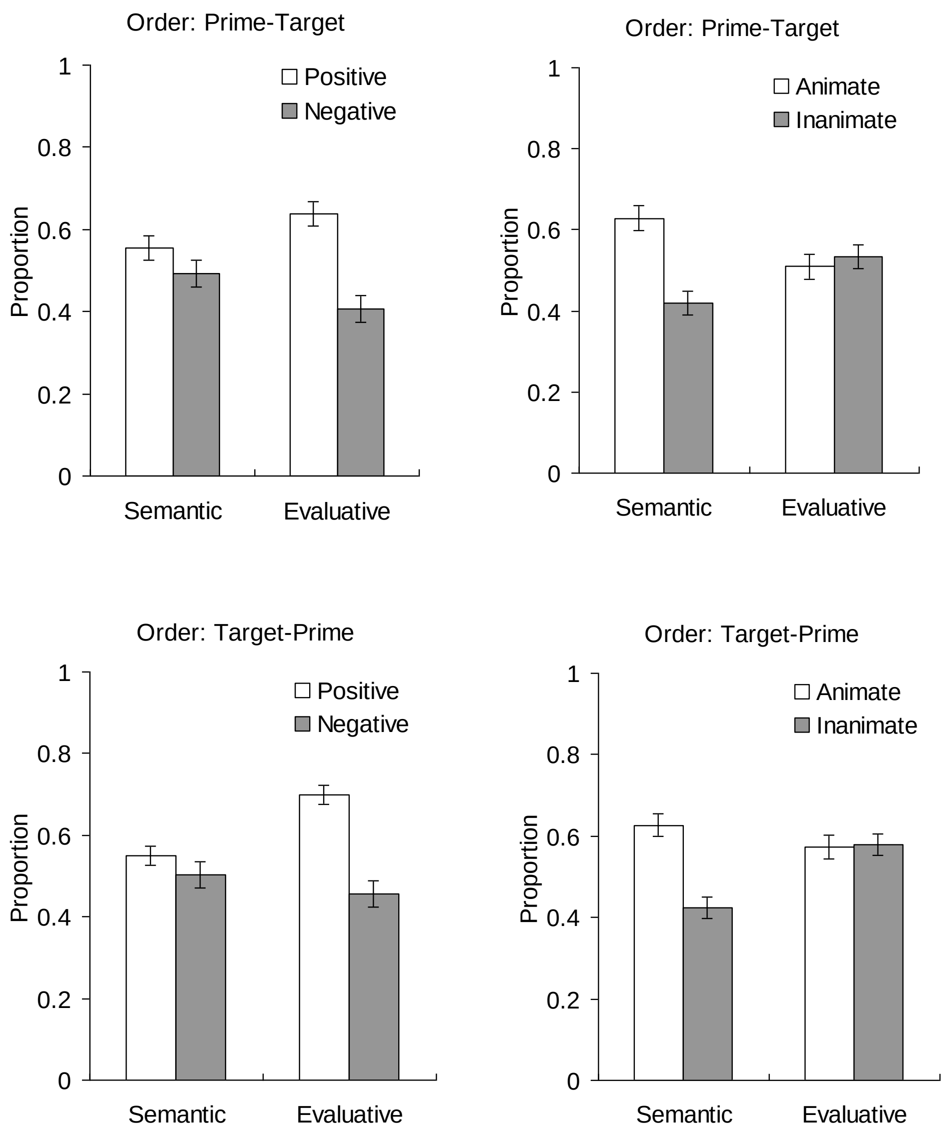

Figure 4. Priming effects as a function of prime valence (positive vs. negative; see left panel), prime semantics (animate vs. inanimate; see right panel), and order of primes and targets (prime-target vs. target-prime) on guesses regarding the evaluative versus semantic meaning of the target, Experiment 4. Higher values indicate higher proportions of positive responses for evaluative guesses and higher proportions of animate responses for semantic guesses. Error bars depict standard errors.