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Hemispheric Asymmetry of the Affective Priming Effect

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HEMISPHERIC ASYMMETRY OF THE AFFECTIVE PRIMING EFFECT

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Abstract

The present study examined the role of prime strength on the lateralized affective priming effect. Participants were presented unilateral primes (i.e., either to the left or right visual field) and then made evaluative decisions on centrally presented targets. Across both experiments, the affective congruity effect occurred for high, but not low, arousing primes. In Experiment 1, when stimuli were primes or targets but not both, the affective priming effect occurred in the right visual field (left hemisphere) for high arousing primes. However in Experiment 2, when stimuli were presented as both primes and targets receiving repeated parafoveal and foveal exposure of primes, the affective priming effect occurred in the left visual field (right hemisphere) for high arousing primes. The present experiments support the right hemisphere hypothesis of superior affective and arousal processing, but only when stimuli receive adequate foveal exposure of prime stimuli. Thus, the present results emphasize task structure (i.e., mode of repeated exposure) in producing lateralized affective priming.

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Chapter 1: Introduction

The scientific literature demonstrating that the cerebral hemispheres process affective information asymmetrically is vast (e.g., see Borod, Zgaljardic, Taberta, & Koff, 2001; Davidson, 1992, 1998; Demaree, Everhart, Youngstrom, & Harrison, 2005; Heller, 1993; Heller, Nitschke, & Miller, 1998; Tucker & Frederick, 1989). For instance, the left and right frontal regions of the brain differ in electrophysiological responses depending on motivational direction (e.g., approach vs. withdrawal; Harmon-Jones, 2003) as well as positive and negative valence (e.g., Davidson & Fox, 1982; Graham & Cabeza, 2001). Also, a wealth of studies found that damage to the right hemisphere significantly impairs affective perception (Borod, Bloom, Brickman, Nakhutina, & Curko, 2002). Thus, the hemispheres appear to contribute uniquely to affective perception aiding in important determinations such as whether a stimulus is hostile or hospitable.

While there are a variety of theoretical positions on affective processing and hemispheric asymmetry, systematic reviews most strongly favor the idea that affective information is preferentially processed in the right-hemisphere (Borod et al., 2002; Borod, Zgaljardic, Taberta, & Koff, 2001). The *right-hemisphere hypothesis* (see Demaree, et al., 2005 for review) maintains that the posterior portion of the right-hemisphere processes affective information regardless of the valence and modulates arousal (see Heller, 1993). Heller's (1993) arousal and hemispheric asymmetry hypothesis is supported in studies ranging from autonomic measures (Meadows & Kaplan, 1994; Zoccolotti, Scabini, & Violani, 1982) to self-reported assessments linked to the right-hemisphere (Heller, Nitschke, & Lindsay, 1997h). The aim of the present study was to explore the right-hemisphere hypothesis in the affective priming paradigm.

Inspired by methods and theory of cognitive psychology (see Neely, 1991), the affective priming paradigm[1] has boomed in the social psychological literature in recent decades (see De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009; Fazio, 2001; Ferguson & Bargh, 2003; Klauer & Musch, 2003;

Wittenbrink, 2007 for reviews). In the affective priming paradigm, pairs of stimuli are quickly presented sequentially. An affective priming effect occurs when the response latency to the second stimulus (i.e., target) is quicker following a congruent valent stimulus (i.e., prime) than an incongruent valent stimulus. For instance, the target word SAINT is responded to quicker if preceded by the prime word CARNIVAL than FUNERAL. In addition to contributing to basic theory, the affective priming paradigm has been used to examine racial prejudice (Fazio, Jackson, Dunton, & Williams, 1995), body image evaluations (Watts, Cranney, & Gleitzman, 2008), and a number of clinical conditions (Dannlowski et al., 2006; Kerns, 2005; Suslow, Arolt, & Junghanns, 1998). Twenty-five years of research demonstrate that the affective priming effect is robust (e.g., Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Hermans, De Houwer, & Eelen, 1994; Herring, Taylor, White, & Crites, 2011; Spruyt, Hermans, De Houwer, Eelen, & Vandromme, 2007).

A limitation of prior conceptualizations is that researchers almost exclusively studied affective priming with regard to how the hemispheres operate jointly. That is, in a typical affective priming paradigm, both the prime and target are presented to the participant centrally (i.e., to the fovea) rather than presenting these stimuli unilaterally in order to examine separate hemispheric contributions. By the author's count, only three recent studies by Calvo and his group (Calvo & Avero, 2008; Calvo & Nummenmaa, 2007; Calvo, Nummenmaa, & Avero, 2010) examined hemispheric asymmetry of the affective priming effect. Rather than presenting primes centrally like most affective priming paradigms, Calvo and colleagues presented affective pictures as primes parafoveally (i.e., 2.5° from a central fixation) and targets foveally. In this way, the researchers were able to determine whether the affective priming effect was specific to primes presented in the left visual field (LVF; right hemisphere [RH]) or the right visual field (RVF; left hemisphere [LH]). In line with the hypothesis that the right hemisphere is specialized for affective processing (see Demaree, et al., 2005; Heller, 1993), Calvo and colleagues found an affective priming effect in the LVF (RH) in seven of nine experiments[2] (Calvo & Avero, 2008,

experiments 2 & 3; Calvo & Nummenmaa, 2007, Experiments 1–4 & 6). That is, centrally presented target responses were faster when a congruent prime was presented to the LVF (RH) compared to when an incongruent prime was presented to the LVF (RH); the affective priming effect was not observed in the RVF (LH) for the majority of Calvo and colleagues' experiments (but see Chapter 4 below). This lateralized affective priming effect was, however, contingent on two types of exposure techniques.

The first exposure technique important for obtaining a lateralized affective priming effect was repeated exposure. Calvo and colleagues repeatedly exposed participants to the experimental stimuli across a number of experimental blocks. The lateralized affective priming effect in four of these experiments (Calvo & Nummenmaa, 2007, 2–4 & 6) did not emerge until later in the experiment. Calvo and Nummenmaa (2007) hypothesized that the affective priming effect emerged only toward the end of the experiment because repeated exposure to the primes was necessary. However, Calvo and colleagues failed to find a lateralized affective priming effect in one experiment (Calvo et al., 2010, experiment 2). In sum, the repeated exposure technique produced lateralized affective priming effects in four of five experiments.

The second exposure technique important for obtaining a lateralized affective priming effect was pre-exposure to the stimuli prior to the lateralized affective priming task. In three experiments a LVF (RH) lateralized affective priming effect was found when pre-exposure was used. Specifically, the lateralized affective priming effect occurred in three experiments with a preview phase that exposed all of the participants to the experimental pictures (Calvo & Avero, 2008, experiments 2 & 3; Calvo & Nummenmaa, 2007, experiment 1). Yet, an experiment that did not use a preview phase (Calvo & Avero, 2008, experiment 1) failed to reveal a lateralized affective priming effect. Calvo and colleagues concluded that repeated exposure of stimuli is necessary to achieve lateralized affective priming effects. Thus, Calvo and colleagues' research suggests that this repeated exposure can occur either via a pre-exposure to stimuli prior to the priming paradigm or via repeated exposure to stimuli in the priming

paradigm itself (i.e. the effect will only emerge later in the paradigm; see Table 1 for a summary). There is evidence in keeping with Calvo and colleagues' perspective specifying that affective information cannot be processed without identification of the stimulus first (Lazarus, 1982; Storbeck, Robinson, & McCourt, 2006; cf. Bargh, 1997; Zajonc, 1980). Given that evaluative processes vary in strength (Norris, Gollan, Berntson, & Cacioppo, 2010; Russell & Feldman Barrett, 1999), which in turn can interact with the cerebral hemispheres (Heller, 1993), it follows that the evaluative strength of stimuli may be linked to the lateralized affective priming effect.

An important question in the affective priming literature (see Fazio, 2001; Klauer & Musch, 2003; Wittenbrink, 2007) is whether the affective priming effect is modulated by prime strength[3]. Interest on the topic was sparked by theory positing that evaluative information is stored in memory varying in strength (see Fazio, 2007). Some studies, for instance, found prime strength moderates the affective priming effect for strong primes when participants evaluate (e.g., "pleasant" vs. "unpleasant") targets (i.e., evaluative decision task; Bargh, Chaiken, Govender, & Pratto, 1992, experiment 1; Fazio et al., 1986, experiments 1 & 2; Giner-Sorolla, Garcia, & Bargh, 1999, experiment 1; but cf. Bargh et al., 1992, experiment 3; Klauer et al., 2009, experiment 5). However, some studies have failed to replicate this effect (Bargh, Chaiken, Raymond, & Hymes, 1996; Giner-Sorolla, et al., 1999, experiment 2; but see also Glaser & Banaji, 1999). Despite mixed findings, prime strength as a moderator of the affective priming paradigm appears strongest when there is an explicit goal to evaluate targets.

Examining the role of prime strength with regard to lateralized affective priming is relevant because prime strength may contribute to Calvo and colleagues' findings. Specifically, Calvo and Avero (2008) manipulated affective pictures by valence to satisfy a manipulation check; this procedure ensured that the normed ratings of their pleasant and unpleasant affective pictures were different from one another. Interestingly, the arousal ratings of their stimuli also differed; the arousal ratings for the unpleasant pictures were significantly greater than the arousal ratings for pleasant pictures. This is a

potential problem because some evidence suggests that prime strength moderates lateralized affective priming. Specifically, Robinson and Compton (2006) presented participants with foveally presented affective pictures as primes (manipulating prime strength by altering arousal) and then either one or two dots to the parafovea. Participants were quicker to respond when primes high in strength (i.e., arousal) were presented to the LVF (RH) than the RVF (LH), regardless of valence. This evidence in conjunction with theory linking the right posterior hemisphere with arousal (see Heller, 1993) suggests that prime strength may moderate the lateralized affective priming effect.

Experiment 1

The aim of Experiment 1 was to replicate and extend Calvo and colleagues' (Calvo & Avero, 2008; Calvo & Nummenmaa, 2007) lateralized affective priming effect by specifically examining the impact of prime strength. First, a preview phase exposed participants to the prime stimuli because all experiments of Calvo and colleagues' that used this technique found a LVF (RH) advantage. Next, participants underwent an affective priming paradigm with unilateral prime stimulus presentations (2.5° from fixation) making evaluative decisions on targets. In addition, the stimuli were repeated across a number of blocks, which will allowed us to examine whether lateralized affective priming emerged only later in the experiment.

Hypotheses

Consistent with past literature (e.g., Fazio, et al., 1986; Hermans, et al., 1994; Spruyt, De Houwer, et al., 2007), (1) target responses should be quicker when preceded by affectively congruent than incongruent primes, (2) the affective priming effect should be specific to strong primes (Bargh, Chaiken, Govender, & Pratto, 1992; Fazio et al., 1986; Giner-Sorolla, García, & Bargh, 1999), and (3) the affective priming effect should be present in the LVF (RH; Calvo & Avero, 2008; Calvo & Nummenmaa, 2007). Further, if prime strength influences the lateralized affective priming effect similar to related priming paradigms

(e.g., Robinson & Compton, 2006), (4) then the lateralized affective priming effect should occur for high prime strength.

Chapter 2: Method

2.1 Participants

The final sample consisted of fifty-seven participants[4] (47 females; ages 16–52; *M* = 21.65, *SD* = 6.30) who received course credit for the experiment. An additional five participants were run; however, data from three were unusable due to computer problems and two participants' accuracy rates were 2.5 *SD*s below the grand mean so their data were not used. All participants reported normal or corrected-to-normal vision (*M* = 20/22.17) and 50 participants were right-handed (Oldfield, 1971).

2.2 Stimuli

One hundred and ninety-two pictures from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008) were used. These stimuli are based on normed ratings of valence and arousal dimensions (1 = *unpleasant/calm*, 9 = *pleasant/excited*). These stimuli (760 X 600 pixels) were diverse in semantic categories (i.e., people, animals, environmental scenes), presented in original color against a dark background. These 192 pictures were divided into two stimulus sets of 96 pictures each, and within each set stimuli were grouped by valence ratings (pleasant vs. unpleasant) and arousal ratings (high vs. low). For each participant one set served as primes and the other served as targets (counterbalanced across participants). The stimuli were carefully matched based on groupings of the valence and arousal dimensions of the stimuli. Grouped by valence, half of the stimuli (48) in each set (96) were pleasant and the other half were unpleasant, equated on arousal. Grouped by arousal, half of the stimuli in each set were high whereas the other half were low in arousal, equated for valence. There were no differences between the two sets in valence or arousal ratings based on either grouping variable. Collapsing across both sets and grouping by valence, the valence dimension significantly differed, t (171.63) = 46.18, $p < .001$, between pleasant (*M* = 7.23, *SD* = .55) and unpleasant (*M* = 2.80, *SD* = .77) stimuli, but the valences were equated for arousal (*M* = 5.37, *SD* = 1.24 vs. *M* = 5.61, *SD* = .83, respectively), t (165.91) = -1.56, p =.12. Finally, collapsing across both sets and grouping by arousal,

the arousal dimension significantly differed, t (190) = 15.53, $p < .001$, between high (M = 6.28, SD = .79) and low (M = 4.70, SD = .59) stimuli, but valence was equated (M = 4.86, SD = 2.27 vs. M = 5.16, SD = 2.36, respectively), t (190) = .89, p =.37. All stimuli were presented with E-Prime 2.0 (Schneider, Eschman, & Zuccolotto, 2002). See Table 2 for a complete summary of the stimuli.

2.3 Procedure

Upon arrival participants were provided informed consent and then filled out a brief questionnaire regarding demographics, handedness, and vision. Next, participants' visual acuity was assessed. Participants were then seated in a chair in front of a 17" monitor (refresh rate 60 Hz) to begin the preview phase (i.e., viewing all of the experimental primes foveally) of the experiment. After the preview phase, participants were taken to an isolated room and seated in front of a 22" monitor (refresh rate 60 Hz) for the experimental phase. The experimenter instructed participants to remain still while seated upright, fixate on the center of the screen, and avoid eye movements from the fixation point. Last, the experimenter instructed participants to ignore the first stimulus presented laterally (i.e., the prime) and indicate whether the second picture (i.e., the target) presented centrally was pleasant or unpleasant (i.e., evaluative decision task) as quickly and accurately as possible with both index fingers (key assignment counterbalanced across participants). Once the experimenter left the room, the participants could initiate the experiment. The experiment ran at the participants' pace so breaks between each experimental block were as long as participants needed. The preview phase until the end of the experimental phase took on average 45 minutes.

Preview phase. During the preview phase participants were presented the primes one at a time centrally. Because the target stimuli received additional foveal exposure by being presented centrally throughout the study (compared to the prime stimuli that were always presented unilaterally), the targets were not included in the preview phase. Participants' task during the preview phase was to assess the arousal of the prime stimuli with a 9-point likert scale using a keyboard with numeric keys

corresponding to the images on the monitor of the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). The timing of a single trial of the preview sequence was "+" (200 ms), inter-stimulus interval (ISI; 100 ms), stimulus display (1,000 ms), ISI (100 ms), arousal assessment (until participant responded), inter-trial interval (ITI; 100 ms). Each trial exposed a single prime stimulus that was not repeated in the preview phase again; thus, the preview phase consisted of 96 trials. The preview phase took on average 10 minutes to complete.

Experimental phase. For the experimental phase participants were seated 50 cm from the monitor in a comfortable armchair in an isolated room. Each prime was presented briefly (150 ms) to preclude eye movements (Banich, 1997; Bradshaw, 1991; Rayner, 1998) and unilaterally 2.5° (2.18 cm) from the center of the screen to project to the parafovea. Each prime subtended a visual angle of 23.47° (width: 21.45 cm) X 16.93° (height: 18.92 cm). The timing of each experimental trial (see Figure 1) was similar to previous affective priming studies.

Each block consisted of 106 trials, 10 practice trials at the start of each block and 96 subsequent experimental trials presented evenly (48 trials) to each visual field. Of the 48 experimental trials presented to each visual field, four types of prime stimuli were paired with either a centrally presented pleasant or unpleasant target: a high arousing pleasant (HP) prime, high arousing unpleasant (HU) prime, low arousing pleasant (LP) prime, or low arousing unpleasant (LU) prime. Thus, eight different prime-target combinations per visual field were possible. Each picture was presented only once per block.

Altogether the experiment consisted of six blocks, resulting in 576 experimental trials. One quarter of the experimental trials (144) were high arousing congruent (HU-unpleasant; HP-pleasant), one quarter high arousing incongruent (HU-pleasant; HP-unpleasant), one quarter low arousing congruent (LU-unpleasant; LP-pleasant), and one quarter low arousing incongruent (LU-pleasant; LP-unpleasant). Irrespective of prime strength, half of the trials (288) were affectively congruent (e.g.,

pleasant-pleasant; unpleasant-unpleasant) and the other half were affectively incongruent (e.g., pleasant-unpleasant; unpleasant-pleasant).

Chapter 3: Results

3.1 Data Analytic Approach & Design

Prior to analysis, two participants' data were removed because their accuracy rates were less than 2.5 *SD*s of the original group mean (adj. M = 88.01%, SD = 6.90%). Response latency data were then filtered so responses prior to 300 ms were removed and responses 2.5 *SD*s above each participant's mean were replaced with the 2.5 *SD* value above each participant's mean (see Wittenbrink, 2007). Last, prior to analysis, response latency data were logarithmically transformed to correct positive skew (Fazio, 1990) and to remain consistent with the majority of affective priming paradigms' analytic approach. Transformed data were analyzed but *M*s and *SD*s of the uncorrected data are reported to ease interpretation. Response latency data were analyzed with a 2 (affective congruity: congruent vs. incongruent) X 2 (prime strength: high vs. low) X 2 (visual field: left vs. right) Repeated Measures ANOVA[5]. Response accuracy and preview phase data are supplemental (see Appendix A).

3.2 Response Latencies

Consistent with the first hypothesis, targets affectively congruent with primes (M = 714 ms, SD = 99 ms) were responded to quicker than targets incongruent with primes (M = 719 ms, SD = 99 ms), F (1, 56) = 7.28, p = .009, η_p^2 = .11. The second hypothesis was also supported, prime strength interacted with affective congruity, F (1, 56) = 4.29, p = .043, η_p^2 = .07. Targets affectively congruent with high arousing primes (M = 715 ms, SD = 100 ms) were responded to quicker than targets affectively incongruent with high arousing primes (M = 723 ms, SD = 100 ms), F (1, 56) = 8.69, p = .005, η_p^2 = .07; no affective congruity effect emerged with low arousing primes (F = .04).

In addition to the above hypothesized findings, there were a few other non-hypothesized effects that reached statistical significance. There was a main effect of prime strength, F (1, 56) = 7.86, p = .007, η_p^2 = .12, such that responses to targets were quicker when primes were low (M = 714 ms, SD = 99

ms) compared to high arousing (*M* = 719 ms, *SD* = 99 ms). This effect appears driven by high arousing primes incongruent with targets that have very slow response latencies (see Figures 2 & 3, bottom panels). An effect of visual field was also found, F (1, 56) = 14.30, $p < .001$, $\eta_p^2 = .07$, such that responses to targets were quicker when preceded by a prime in the RVF (LH; *M* = 715 ms, *SD* = 99 ms) relative to the LVF (RH; *M* = 719 ms, *SD* = 99 ms). Finally, prime strength and visual field interacted such that responses to targets were quicker when high arousing primes were presented to the RVF (LH) relative to the LVF (RH), F (1, 56) = 17.15, $p < .001$, $\eta_p^2 = .07$; however, this trend was not significant for targets preceded by low arousing primes (*F* = .04).

Although the affective congruity by visual field as well as the prime strength by affective congruity by visual field interactions were non-significant (*Fs* = .29 and .80, respectively), planned comparisons were conducted to examine hypotheses three and four. Inconsistent with the third hypothesis, there was no affective congruity effect in the LVF (RH), F (1, 56) = 1.19, $p = .28$, $\eta_p^2 = .02$. Unexpectedly, targets affectively congruent with primes (*M* = 712 ms, *SD* = 98 ms) presented to the RVF (LH) were responded to more quickly than targets affectively incongruent with primes presented to the RVF (LH; *M* = 718 ms, *SD* = 100 ms), F (1, 56) = 8.70, $p = .005$, $\eta_p^2 = .13$ (see Figure 2, top panel). Inconsistent with the hypothesis four, there was no affective congruity effect when high arousing primes were presented to the LVF (RH), F (1, 56) = 1.75, $p = .19$, $\eta_p^2 = .03$. However, targets affectively congruent with high arousing primes (*M* = 708 ms, *SD* = 98 ms) in the RVF (LH) were responded to quicker compared to targets affectively incongruent with high arousing primes in the RVF (LH; *M* = 720 ms, *SD* = 104 ms), F (1, 56) = 8.69, $p = .005$, $\eta_p^2 = .13$ (see Figure 2, bottom panel). Affective congruity effects for low arousing primes were absent for both left and right visual fields (*F*s = .04 and .02, respectively).

Chapter 4: Discussion and Experiment 2 Introduction

Consistent with the first hypothesis, responses were faster to targets affectively congruent with primes than affectively incongruent with primes. This finding replicates recent work from our laboratory (Herring et al., 2011) as well as numerous other affective priming experiments (see Klauer & Musch, 2003). Also, consistent with hypothesis two and studies using an evaluative decision task (Bargh et al., 1992; Fazio et al., 1986; Giner-Sorolla et al., 1999) we found that targets affectively congruent with high arousing primes were responded to quicker than targets affectively incongruent with high arousing primes, but the affective congruity effect did not occur for low arousing primes.

The third hypothesis that the affective congruity effect would occur in the LVF (RH) was not supported, contradicting the majority of Calvo and colleagues' studies (Calvo & Avero, 2008; Calvo & Nummenmaa, 2007). Unexpectedly, the affective congruity effect was present in the RVF (LH). That is, participants responded more quickly to targets affectively congruent with primes presented in the RVF (LH) than targets affectively incongruent with primes presented in the RVF (LH). Hypothesis four, that participants would respond faster to targets affectively congruent with high arousing primes in the LVF (RH) than targets affectively incongruent with high arousing primes in the LVF (RH), also failed to gain support. Instead, targets were quicker to high arousing primes affectively congruent in the RVF (LH) versus targets affectively incongruent with high arousing primes in the RVF (LH). These findings contradict theory positing that the right hemisphere is specialized for affective processing (Borod et al., 2001; Demaree, Everhart, Youngstrom, & Harrison, 2005), in addition to theory maintaining that the right hemisphere is sensitive to arousal (Heller, 1993; Heller, Nitschke, & Miller, 1998).

In one of Calvo and colleagues' studies, in addition to obtaining a LVF (RH) affective congruity effect, an affective congruity effect for the RVF (LH) was also uncovered (Calvo & Nummenmaa, 2007, experiment 6). A major similarity between Experiment 1 and Calvo and Nummenmaa's (2007)

Experiment 6 is how primes were repeatedly exposed. In both the current experiment as well as Calvo and Nummenmaa (2007) half the stimuli were always primes and half the stimuli were always targets. Thus, only repeated *parafoveal* exposure of primes was received. Another one of Calvo and colleagues' experiments (Calvo, Nummenmaa, & Avero, 2010) that failed to replicate the lateralized affective priming effect also used repeated parafoveal exposure of primes. In contrast, Calvo and colleagues' experiments (Calvo & Nummenmaa, 2007, experiments 2 & 3) that intermixed stimuli so each stimulus could serve as both primes and targets (i.e., parafoveal and foveal exposure of primes), found consistent evidence of the affective congruity effect in the LVF (RH; see Table 3). In neither of these experiments was a pre-exposure phase used; hence we used a pre-exposure phase in Experiment 1 to provide repeated foveal exposure.

Experiment 2

The objective of Experiment 2 was to determine whether mode of repeated exposure of the prime stimuli matters. Rather than presenting half the stimuli as just primes and the other half as just targets as in Experiment 1 (i.e., parafoveal repeated exposure), participants now viewed each picture in half the blocks as primes and the other half of blocks as targets. In this way, prime stimuli receive additional exposure both parafoveally and foveally. As in Experiment 1, (1) target responses should be quicker when preceded by affectively congruent than incongruent primes (e.g., Fazio, et al., 1986; Hermans, et al., 1994; Spruyt, De Houwer, et al., 2007), (2) the affective priming effect should be specific to strong primes (Bargh et al., 1992; Fazio et al., 1986; Giner-Sorolla et al., 1999), and (3) the affective priming effect should occur in the LVF (RH; Calvo & Avero, 2008; Calvo & Nummenmaa, 2007). Further, if prime strength influences the lateralized affective priming effect similar to related priming paradigms (e.g., Robinson & Compton, 2006), (4) then the lateralized affective priming effect should occur for high prime strength.

Chapter 5: Method & Results

5.1 Participants

The final sample consisted of thirty-six participants (27 female; ages 18–32; *M* = 20, *SD* = 2.82) who received course credit for the experiment. An additional participant was run; however, data from this participant were unusable due to an accuracy rate 2.5 *SD*s below the original grand mean (adj. *M* = 84.86%, *SD* = 11.89%). All participants reported normal or corrected-to-normal vision (*M* = 20/22.15) and 33 participants were right-handed (Oldfield, 1971).

5.2 Stimuli and Procedure

The stimuli were identical to those used in Experiment 1. The only changes to the procedure were that (1) all of the stimuli were presented during the preview phase and (2) stimuli were primes in half of the blocks and targets the other half of blocks.

5.3 Response Latencies

The response latency data were analyzed the same as in Experiment 1. As in Experiment 1, response accuracy and preview phase data are supplemental (see Appendix B). The overall analysis revealed no significant findings from the omnibus *F*-tests. Contrary to Hypothesis 1, there was no affective congruity effect, F (1, 35) = 1.38, p = .25, η_p^2 = .04, though the trend for participants to respond faster to targets affectively congruent with primes (*M* = 742 ms, *SD* = 86 ms) than targets affectively incongruent with primes (*M* = 746 ms, *SD* = 79 ms) was present. The interaction between prime strength and affective congruity approached significance, F (1, 35) = 2.65, p = .11, η_p^2 = .07. Simple effect tests revealed that participants responded more quickly to targets affectively congruent with high arousing primes (*M* = 742 ms, *SD* = 85 ms) than affectively incongruent with high arousing primes (*M* = 750 ms, *SD* = 82 ms), F (1, 35) = 4.56, p = .04, η_p^2 = .12. No affective congruity effect

emerged with low arousing primes (*F* = .04). This finding supports hypothesis two and replicates Experiment 1.

Although the affective congruity by visual field as well as the prime strength by affective congruity by visual field interactions were non-significant (*Fs* = .15 and .002, respectively) as in Experiment 1, planned comparisons were conducted. Inconsistent with the third hypothesis, there was no affective congruity effect in the LVF (RH), $F(1, 35) = 1.18$, $p = .28$, $\eta_p^2 = .03$, nor was there an affective congruity effect in the RVF (LH) as in Experiment 1, $F(1, 35) = 1.58$, $p = .22$, $\eta_p^2 = .04$ (see Figure 3, top panel). Consistent with the fourth hypothesis, there was a strong trend for participants to respond quicker to targets affectively congruent with high arousing primes presented in the LVF (RH; *M* = 741 ms, *SD* = 81 ms) than targets affectively incongruent with high arousing primes presented in the LVF (RH; *M* = 751 ms, *SD* = 85 ms), $F(1, 35) = 3.84$, $p = .058$, $\eta_p^2 = .10$. This effect was not present in the RVF (LH), $F(1, 35) = 1.60$, $p = .21$, $\eta_p^2 = .04$ (see Figure 3, bottom panel). Affective congruity effects for low arousing primes were absent for both left and right visual fields (*F*s = .001 and .097, respectively).

Chapter 6: General Discussion

The present experiments have implications for how task structure influences the lateralized affective priming paradigm. For example, two variables that have received attention with respect to task structure are prime strength and type of task the participants use when responding to target stimuli (e.g., Klauer & Musch, 2003; Wittenbrink, 2007). A major advancement of the present study was the examination of mode of repeated exposure. Understanding how task structure influences the affective priming effect is significant because it can help understand how evaluations are structured in memory (e.g., Fazio, 2007) and provide clues for processing mechanisms of the affective priming effect (Wittenbrink, 2007).

Simple effects analysis in both experiments revealed that target responses were quicker to high arousing affectively congruent primes relative to high arousing affectively incongruent primes. An affective congruity effect was not found, however, for low arousing primes. These findings are consistent with the notion that evaluations vary in strength (e.g., Fazio, 2007; Feldman Barrett & Russell, 1999; Norris et al., 2010) and with several studies that found an affective congruity effect for only high arousing primes using an evaluative decision task (see Bargh, Chaiken, et al., 1992; Fazio, Sanbonmatsu, Powell, et al., 1986; Giner-Sorolla, García, et al., 1999). The present study extends previous research on attitude prime strength by demonstrating that this effect is also obtained by manipulating prime arousal. Thus, the finding that affective congruity occurs for strong primes seems less of a specific evaluative process (i.e., just due to attitude strength), but more of a global evaluative process (occurs for attitude strength and affective arousal).

Experiments 1 and 2 were nearly identical, but the main difference was the task structure. In Experiment 1, the stimuli were divided such that half were presented only as primes and the other half were presented only as targets. In this way, prime stimuli only received repeated parafoveal exposure. However, in Experiment 2, the stimuli were intermixed so the stimuli received additional foveal

exposure. The primary hypothesis, that the lateralized affective priming effect would occur for high arousing primes, received partial support through simple effects analysis. In Experiment 1, target responses were quicker to affectively congruent than incongruent high arousing primes presented in the RVF (LH; as opposed to the LVF [RH] as predicted). Interestingly, in Experiment 2 when repeated foveal and parafoveal exposure of primes was used, the lateralized affective priming effect no longer occurred for high arousing primes in the RVF (LH). Instead, there was a strong trend of the lateralized affective priming effect as expected: affectively congruent targets were responded to faster compared to affectively incongruent targets preceded by high arousing primes in the LVF (RH). This finding supports the views that the right hemisphere is generally involved in affective perception (Borod et al., 2001; Demaree et al., 2005) and is sensitive to arousal (Heller, 1993; Heller et al., 1998). This finding also advances prior lateralized affective priming studies, which did not control arousal, by showing that arousal level contributes to the lateralized affective priming effect.

The finding that the RVF (LH) was sensitive to affective congruity, particularly for high arousing primes, is paradoxical. One possibility is that semantic and not affective priming occurred in Experiment 1, as the present stimuli were not systemically controlled for semantics. It may be that semantic pre-processing can occur (see Fuentes, Carmona, Agis, & Catena, 1994; Van den Bussche, Van den Noortgate, & Reynvoet, 2009) via repeated parafoveal exposure of primes. In addition to semantics potentially driving the RVF (LH) effect found in Experiment 1, the moderation of high arousing primes could have resulted from strongly associated stimuli instead of arousal, per se. Recent evidence supports the position that the left hemisphere is sensitive to semantic processing of high associative strength (e.g., Lovseth & Atchley, 2010).

The above findings underscore two important points regarding lateralized affective priming. First, the finding that mode of repeated exposure influences affective priming provides additional support for the notion that affective priming effects are susceptible to task structure. Second, these

findings have important theoretical implications considering the longstanding debate of whether affective information is processed prior to identification (Bargh, 1997; Robinson, 1998; Zajonc, 1980), or vice versa (Cave & Batty, 2006; Lazarus, 1984; Storbeck & Clore, 2007; Storbeck, Robinson, & McCourt, 2006). These findings are notable given continued debate over whether affective processing bypasses normal cortical processing via a "low route" (LeDoux, 1996; but cf. Pessoa & Adolphs, 2010). The present finding that additional foveal exposure of primes is needed to obtain a lateralized affective priming effect is in keeping with Cave and Batty's (2006) position that practice (or repetition in this case) improves performance by connecting simple features of stimuli that are presented peripherally with high-level processing mechanisms of affect. Presumably this process occurs because a bottom-up system finds specific affective features that stand out (e.g., shapes associated with certain affective displays) and works through attentional gates reaching the high-level semantic representation of affect that then engages a top-down system to enhance performance for affective information (see Cave, 1999; but see also Treisman & Gelade, 1980; Wolfe, 1994).

One curious finding is the failure to find an overall affective congruity effect, though affective congruity did emerge in both experiments for high arousing primes. A large number of studies show that the affective priming effect is robust, particularly when an evaluative decision task is carried out (see Klauer & Musch, 2003). Experiment 1 was consistent with this large affective priming literature as well as previous studies using pictures (e.g., Avero & M. Calvo, 2006; Hermans, De Houwer, et al., 1994; Herring et al., in press; Spruyt, Hermans, Houwer, & Eelen, 2002), as responses were quicker to targets affectively congruent than incongruent with primes. However, Experiment 2 failed to replicate this effect. One explanation is that the second experiment was underpowered by having fewer participants than the first experiment.

Future investigations of lateralized affective priming could profit from a couple of extensions. First, just testing the right hemisphere hypothesis of affective processing, which does not lend itself well

to explaining left hemispheric contributions, was perhaps a narrow focus of the present study. For instance, the *approach-withdrawal model* (see Demaree et al., 2005; Harmon-Jones, 2003 for reviews) posits that the left and right hemispheres are associated with approach and avoidance tendencies, respectively. Future studies that adopt a motivational direction perspective (i.e., approach-withdrawal) may account better for the lateralized affective priming data. Second, the present findings examined only the effect of affective hemispheric asymmetry on behavior (i.e., response latencies). Future studies could augment behavioral data by providing additional electrophysiological data. A component elicited in prior affective priming studies (Herring et al., 2011; Hinojosa, Carretié, Méndez-Bértolo, Míguez, & Pozo, 2009; Kissler, Herbert, Winkler, & Junghofer, 2009; Taylor, 2010; Werheid, Alpay, Jentzsch, & Sommer, 2005; Zhang, Li, Gold, & Jiang, 2010), the late positive potential (LPP), may be used in conjunction with behavioral measures to examine mode of repeated exposure. For example, the current position that repeated foveal exposure is needed for a lateralized affective priming effect would receive stronger support if the LPP was elicited with repeated foveal exposure but was not elicited with parafoveal repeated exposure.

Conclusion

The present experiments extend previous literature in two important ways. First, the present experiments showed that the lateralized affective priming effect is sensitive to prime strength, whereas previous studies (Calvo & Avero, 2008; Calvo & Nummenmaa, 2007; Calvo et al., 2010) did not systematically control prime strength possibly masking contributions of this variable. Assessing prime strength via arousal also allows for a more complete understanding of affective processing given the view that arousal and valence contribute to the structure of affect (e.g., Feldman Barrett & Russell, 1998, 1999; Russell, 1980; Russell & Feldman Barrett, 1999). The most important extension of the present experiments was the finding that mode of repeated exposure of stimuli influences the lateralized

affective priming effect. This finding adds to a growing body of affective priming literature suggesting that the affective priming effect is sensitive to task structure. When stimuli receive both parafoveal and foveal exposure the affective priming effect occurs in the LVF (RH). These findings suggest that the lateralized affective priming effect emerges when repeated foveal exposures of stimuli activate high-level mechanisms of affect that then engage a top-down system that actively seeks affective information. Thus, lateralized affective priming is contingent on identification first.

References

Avero, P., & Calvo, M. G. (2006). Affective priming with pictures of emotional scenes: The role of perceptual similarity and category relatedness. *The Spanish Journal of Psychology*, *9*, 10-18.

Banich, M. T. (1997). *Neuropsychology: The neural bases of mental function*. Boston: Houghton Mifflin Co.

Bargh, J. A. (1997). The automaticity of everyday life. In R. S. Wyer (Ed.), *The automaticity of everyday life: Advances in social cognition* (Vol. 10, pp. 1-61). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Bargh, J. A., Chaiken, S., Govender, R., & Pratto, F. (1992). The generality of the automatic attitude activation effect. *Journal of Personality and Social Psychology*, *62*, 893-912. doi:10.1037/0022-3514.62.6.893

Bartholow, B. D., Riordan, M. A., Saults, J. S., & Lust, S. A. (2009). Psychophysiological evidence of response conflict and strategic control of responses in affective priming. *Journal of Experimental Social Psychology*, *45*, 655-666. doi:10.1016/j.jesp.2009.02.015

Borod, J. C., Bloom, R. L., Brickman, A. M., Nakhutina, L., & Curko, E. A. (2002). Emotional processing deficits in individuals with unilateral brain damage. *Applied Neuropsychology*, *9*(1), 23-36. doi:10.1207/S15324826AN0901_4

Borod, J. C., Zgaljardic, D., Taberta, M. H., & Koff, E. (2001). Asymmetries of emotional perception and expression in normal adults. In G. Gainotti & J. Grafman (Eds.), *Handbook of neuropsychology*, Emotional behavior and its disorders (Vol. 2, pp. 181-205). Amsterdam: Elsevier.

Bradley, Margaret M., & Lang, Peter J. (1994). Measuring emotion: The Self-Assessment Manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, *25*, 49-59. doi:10.1016/0005-7916(94)90063-9

Bradshaw, J. L. (1991). Methods for studying human laterality. *Neuromethods*, *17*, 225–280. doi:10.1385/0-89603-133-0:225

Calvo, M. G., & Avero, P. (2008). Affective priming of emotional pictures in parafoveal vision: Left visual field advantage. *Cognitive, Affective & Behavioral Neuroscience*, *8*, 41-53. doi:10.3758/CABN.8.1.41

Calvo, M. G., & Nummenmaa, L. (2007). Processing of unattended emotional visual scenes. *Journal of Experimental Psychology: General*, *136*, 347-369. doi:10.1037/0096-3445.136.3.347

Calvo, M. G., Nummenmaa, L., & Avero, P. (2010). Recognition advantage of happy faces in extrafoveal vision: Featural and affective processing. *Visual Cognition*, *18*, 1274-1297. doi:10.1080/13506285.2010.481867

Cave, K. R. (1999). The FeatureGate model of visual selection. *Psychological research*, *62*, 182–194. doi:10.1007/s004260050050

Cave, K. R., & Batty, M. J. (2006). From searching for features to searching for threat: Drawing the boundary between preattentive and attentive vision. *Visual Cognition*, *14*, 629-646. doi:10.1080/13506280500193107

Dannlowski, U., Kersting, A., Lalee-Mentzel, J., Donges, U., Arolt, V., & Suslow, T. (2006). Subliminal affective priming in clinical depression and comorbid anxiety: A longitudinal investigation. *Psychiatry Research*, *143*, 63-75. doi:doi:10.1016/j.psychres.2005.08.022

Davidson, R. J. (1992). Emotion and affective style: Hemispheric substrates. *Psychological Science*, *3*, 39-43. doi:10.1111/j.1467-9280.1992.tb00254.x

Davidson, R. J. (1998). Affective style and affective disorders: Perspectives from affective neuroscience. *Cognition & Emotion*, *12*, 307-330. doi:10.1080/026999398379628

Davidson, R. J., & Fox, N. A. (1982). Asymmetrical brain activity discriminates between positive and negative affective stimuli in human infants. *Science*, *218*, 1235. doi:10.1126/science.7146906

De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: A normative analysis and review. *Psychological Bulletin*, *135*, 347-368. doi:10.1037/a0014211

Demaree, H. A., Everhart, D. E., Youngstrom, E. A., & Harrison, D. W. (2005). Brain Lateralization of Emotional Processing: Historical Roots and a Future Incorporating "Dominance." *Behavioral and Cognitive Neuroscience Reviews*, *4*, 3-20. doi:10.1177/1534582305276837

Fazio, R. H. (2001). On the automatic activation of associated evaluations: An overview. *Cognition & Emotion*, *15*, 115-141. doi:10.1080/0269993004200024

Fazio, R. H. (2007). Attitudes as object-evaluation associations of varying strength. *Social Cognition*, *25*, 603-637. doi:10.1521/soco.2007.25.5.603

Fazio, R. H., Jackson, J. R., Dunton, B. C., & Williams, C. J. (1995). Variability in automatic activation as an unobstrusive measure of racial attitudes: A bona fide pipeline? *Journal of Personality and Social Psychology*, *69*, 1013-1027. doi:10.1037/0022-3514.69.6.1013

Fazio, R. H., Sanbonmatsu, D. M., Powell, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology*, *50*, 229-238. doi:10.1037/0022-3514.50.2.229

Feldman Barrett, L., & Russell, J. A. (1998). Independence and bipolarity in the structure of current affect. *Journal of Personality and Social Psychology*, *74*, 967-984. doi:10.1037/0022-3514.74.4.967

Feldman Barrett, L., & Russell, J. A. (1999). The structure of current affect. *Current Directions in Psychological Science*, *8*, 10-14. doi:10.1111/1467-8721.00003

Ferguson, M. J., & Bargh, J. A. (2003). The constructive nature of automatic evaluation. In J. Musch & K. C. Klauer (Eds.), *The psychology of evaluation: Affective processes in cognition and emotion*. (pp. 169-188). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Fuentes, L. J., Carmona, E., Agis, I. F., & Catena, A. (1994). The role of the anterior attention system in semantic processing of both foveal and parafoveal words. *Journal of Cognitive Neuroscience*, *6*, 17–25. doi:10.1162/jocn.1994.6.1.17

Giner-Sorolla, R., García, M. T., & Bargh, J. A. (1999). The automatic evaluation of pictures. *Social Cognition*, *17*, 76-96. doi:10.1521/soco.1999.17.1.76

Glaser, J., & Banaji, M. R. (1999). When fair is foul and foul is fair: Reverse priming in automatic evaluation. *Journal of Personality and Social Psychology*, *77*, 669-687. doi:10.1037/0022-3514.77.4.669

Graham, R., & Cabeza, R. (2001). Event-related potentials of recognizing happy and neutral faces. *Neuroreport*, *12*(2), 245.

Harmon-Jones, E. (2003). Clarifying the emotive functions of asymmetrical frontal cortical activity. *Psychophysiology*, *40*, 838–848. doi:10.1111/1469-8986.00121

Heller, W. (1993). Neuropsychological mechanisms of individual differences in emotion, personality, and arousal. *Neuropsychology*, *7*, 476-489. doi:10.1037/0894-4105.7.4.476

Heller, W., Nitschke, J. B., & Lindsay, D. L. (1997). Neuropsychological Correlates of Arousal in Self-reported Emotion. *Cognition & Emotion*, *11*, 383.

Heller, W., Nitschke, J. B., & Miller, G. A. (1998). Lateralization in emotion and emotional disorders. *Current Directions in Psychological Science*, *7*, 26-32. doi:10.1111/1467-8721.ep11521823

Hermans, D., De Houwer, J., & Eelen, P. (1994). The affective priming effect: Automatic activation of evaluative information in memory. *Cognition & Emotion*, *8*, 515-533. doi:10.1080/02699939408408957

Herring, D. R., Taylor, J. H., White, K. R., & Crites, S. L. (2011). Electrophysiological Responses to Evaluative Priming: The LPP is Sensitive to Incongruity. *Emotion*. doi:10.1037/a0022804

Hinojosa, J. A., Carretié, L., Méndez-Bértolo, C., Míguez, A., & Pozo, M. A. (2009). Arousal contributions to affective priming: Electrophysiological correlates. *Emotion*, *9*, 164-171. doi:10.1037/a0014680

Howell, D. C. (2002). *Statistical Methods for Psychology* (Vol. 5). Pacific Grove, CA: Thomson Learning.

Kerns, J. G. (2005). Positive Schizotypy and Emotion Processing. *Journal of Abnormal Psychology*, *114*, 392-401. doi:10.1037/0021-843X.114.3.392

Kissler, J., Herbert, C., Winkler, I., & Junghofer, M. (2009). Emotion and attention in visual word processing--An ERP study. *Biological Psychology*, *80*, 75-83. doi:10.1016/j.biopsycho.2008.03.004

Klauer, K. C., & Musch, J. (2003). Affective priming: Findings and theories. In J. Musch & K. C. Klauer (Eds.), *The psychology of evaluation: Affective processes in cognition and emotion*. (pp. 7-49). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Klauer, K. C., Teige-Mocigemba, S., & Spruyt, A. (2009). Contrast effects in spontaneous evaluations: A psychophysical account. *Journal of Personality and Social Psychology*, *96*, 265-287. doi:10.1037/a0013248

Krosnick, J. A., Boninger, D. S., Chuang, Y. C., Berent, M. K., & Carnot, C. G. (1993). Attitude strength: One construct or many related constructs? *Journal of Personality and Social Psychology*, *65*, 1132-1151. doi:10.1037/0022-3514.65.6.1132

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2008). *International affective picture system (IAPS): Affective ratings of pictures and instruction manual. Technical Report A-8*. University of Florida, Gainesville, FL.

Lazarus, R. S. (1984). On the primacy of cognition. *American Psychologist*, *39*, 124-129.

LeDoux, J. (1996). *The emotional brain: The mysterious underpinnings of emotional life*. New York, NY: Simon & Schuster.

Lovseth, K., & Atchley, R. A. (2010). Examining lateralized semantic access using pictures. *Brain and cognition*, *72*, 202–209. doi:10.1016/j.bandc.2009.08.016

Meadows, M.-E., & Kaplan, R. F. (1994). Dissociation of autonomic and subjective responses to emotional slides in right hemisphere damaged patients. *Neuropsychologia*, *32*, 847-856. doi:10.1016/0028-3932(94)90022-1

Neely, J. H. (1991). Semantic priming effects in visual word recognition: A selective review of current findings and theories. In D. Besner & G. W. Humphreys (Eds.), *Basic processes in reading: Visual word recognition*. (pp. 264-336). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Norris, C. J., Gollan, J., Berntson, G. G., & Cacioppo, J. T. (2010). The current status of research on the structure of evaluative space. *Biological Psychology*, *84*, 422-436. doi:10.1016/j.biopsycho.2010.03.011

Oldfield, R. C. (1971). The assessment and analysis of handedness: The Edinburgh inventory. *Neuropsychologia*, *9*, 97-113. doi:10.1016/0028-3932(71)90067-4

Pessoa, L., & Adolphs, R. (2010). Emotion processing and the amygdala: from a'low road'to'many roads' of evaluating biological significance. *Nature Reviews Neuroscience*, *11*, 773–783. doi:10.1038/nrn2920

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin*, *124*, 372-422. doi:10.1037/0033-2909.124.3.372

Robinson, M. D. (1998). Running from William James' Bear: A Review of Preattentive Mechanisms and their Contributions to Emotional Experience. *Cognition & Emotion*, *12*, 667. doi:10.1080/026999398379493

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *39*, 1161-1178. doi:10.1037/h0077714

Russell, J. A., & Feldman Barrett, L. (1999). Core affect, prototypical emotional episodes, and other things called emotion: Dissecting the elephant. *Journal of Personality and Social Psychology*, *76*, 805-819. doi:10.1037/0022-3514.76.5.805

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). *E-Prime user's guide*. Pittsburgh, PA: Psychology Software Tools, Inc.

Spruyt, A., Hermans, D., De Houwer, J., Eelen, P., & Vandromme, H. (2007). On the nature of the affective priming effect: Effects of stimulus onset asynchrony and congruency proportion in naming and evaluative categorization. *Memory & Cognition*, *35*, 95-106. doi:10.3758/BF03195946

Spruyt, A., Hermans, D., Houwer, J. D., & Eelen, P. (2002). On the nature of the affective priming effect: Affective priming of naming responses. *Social Cognition*, *20*, 227-256. doi:10.1521/Soco.20.3.227.21106

Storbeck, J., & Clore, G. L. (2007). On the interdependence of cognition and emotion. *Cognition & Emotion*, *21*, 1212-1237. doi:10.1080/02699930701438020

Storbeck, J., Robinson, M. D., & McCourt, M. E. (2006). Semantic processing precedes affect retrieval: The neurological case for cognitive primacy in visual processing. *Review of General Psychology*, *10*, 41-55. doi:10.1037/1089-2680.10.1.41

Suslow, T., Arolt, V., & Junghanns, K. (1998). [Alexithymia and automatic activation of emotional-evaluative information]. *Psychotherapie, Psychosomatik, Medizinische Psychologie*, *48*, 168-175.

Taylor, J. H. (2010). Examination of the cognitive mechanisms underlying evaluative and semantic priming effects by varying task instructions: An ERP study. Unpublished dissertation. University of Texas at El Paso, El Paso, TX.

Treisman, A. M., & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive psychology*, *12*, 97–136. doi:10.1016/0010-0285(80)90005-5

Van den Bussche, E., Van den Noortgate, W., & Reynvoet, B. (2009). Mechanisms of masked priming: A meta-analysis. *Psychological Bulletin*, *135*, 452-477. doi:10.1037/a0015329

Watts, K., Cranney, J., & Gleitzman, M. (2008). Automatic evaluation of body-related images. *Body Image*, *5*, 352-364. doi:10.1016/j.bodyim.2008.06.001

Werheid, K., Alpay, G., Jentzsch, I., & Sommer, W. (2005). Priming emotional facial expressions as evidenced by event-related brain potentials. *International Journal of Psychophysiology*, *55*, 209-219. doi:10.1016/j.ijpsycho.2004.07.006

Wittenbrink, B. (2007). Measuring attitudes through priming. In B. Wittenbrink & N. Schwarz (Eds.), *Implicit measures of attitudes*. (pp. 17-58). New York, NY: Guilford Press.

Wolfe, J. M. (1994). Guided search 2.0 A revised model of visual search. *Psychonomic bulletin & review*, *1*, 202–238. doi:10.3758/BF03200774

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist*, *35*, 151-175. doi:10.1037/0003-066X.35.2.151

Zhang, Q., Li, X., Gold, B. T., & Jiang, Y. (2010). Neural correlates of cross-domain affective priming. *Brain Research*, *1329*, 142-151. doi:10.1016/j.brainres.2010.03.021

Zoccolotti, P., Scabini, D., & Violani, C. (1982). Electrodermal responses in patients with unilateral brain damage. *Journal of Clinical Neuropsychology*, *4*, 143. doi:10.1080/01688638208401124

Footnotes

[1]Previously we have referred to this paradigm as "evaluative" priming. The change to "affect" is intentional to be more specific to the present experiments.

[2]These three studies had a total of 12 experiments. Three of the experiments are not being discussed because two (Calvo & Avero, 2008, experiment 4; Calvo & Nummenmaa, 2007, experiment 5) did not use probe stimuli, while the third (Calvo, Nummenmaa, & Avero, 2010, experiment 1) did not report affective congruity analyses.

[3]The distinction between accessibility and extremity is not made because the two constructs tend to be correlated (Bargh et al., 1992b; Krosnick, Boninger, Chuang, Berent, & Carnot, 1993). The term "prime strength" is used instead more generally, which also encompasses prime arousal.

[4]An original power analysis suggested that 34 participants were needed, however, additional participants were run because the desired lateralized affective priming effect was thought to be underpowered. The sample collected in Experiment 2 was based on the original power analysis.

[5]When prime valence was entered into the design this variable only interacted with prime strength such that response times were quicker to targets when preceded with a pleasant prime low in arousal compared to an unpleasant prime low in arousal. Target arousal was not examined because this variable was beyond the scope of the present analysis.

Table 1

Summary of Relevant Experiments on the Lateralized Affective Priming Effect by Preview Phase, Repeated Exposure, and Findings

Study	Experiment	Preview Phase	Repeated Exposure	LVF (RH) Advantage
Calvo & Nummenmaa (2007)	1	Y	N	Y
	2	N	Y	Y
	3	N	Y	Y
	4	N	Y	Y
	6	N	Y	Y
Calvo & Avero (2008)	1	N	N	N
	2	Y	N	Y
	3	Y	N	Y
Calvo, Nummenmaa, & Avero (2010)	2	N	Y	N

Note. Y = yes; N = no; LVF (RH) = left visual field (right hemisphere).

Table 2

Means (SDs) of valence and arousal ratings as a function of grouping variables and stimulus set

	Valence ratings			
Grouping variables	Set 1 (*n* = 96)	Set 2 (*n* = 96)	*t* (df)	*p*
Valence type				
Pleasant	7.22 (.55)[a]	7.23 (.54)[a]	-.11 (94)	.91
Unpleasant	2.81 (.79)[b]	2.78 (.75)[b]	.16 (94)	.87
Arousal type				
High	4.83 (2.17)[a]	4.90 (2.38)[a]	-.15 (94)	.88
Low	5.20 (2.46)[a]	5.12 (2.29)[a]	.17 (94)	.86
Total	5.01 (2.31)	5.01 (2.33)	.02 (190)	.99

	Arousal ratings			
Grouping variables	Set 1 (*n* = 96)	Set 2 (*n* = 96)	*t* (df)	*p*
Valence type				
Pleasant	5.29 (1.30)[a]	5.45 (1.18)[a]	-.66 (93.10)	.51
Unpleasant	5.59 (.94)[a]	5.63 (.71)[a]	-.23 (88.11)	.82
Arousal type				
High	6.28 (.95)[a]	6.28 (.62)[a]	-.03 (94)	.98
Low	4.60 (.52)[b]	4.80 (.65)[b]	-1.86 (94)	.09
Total	5.44 (1.13)	5.54 (.97)	-.68 (185.68)	.50

Note. Identical superscripts going down between pairs (e.g., high vs. low for by arousal type for valence ratings) indicate no significant difference ($p > .05$).

Table 3

Updated Summary of Relevant Experiments on the Lateralized Affective Priming Effect Including Type of Repeated Exposure

Study	Experiment	Preview Phase	Repeated Exposure	Type of Repeated Exposure	LVF (RH) Advantage
Calvo & Nummenmaa (2007)	1	Y	N		Y
	2	N	Y	Parafoveal + foveal	Y
	3	N	Y	Parafoveal + foveal	Y
	4	N	Y	Parafoveal	Y
	6	N	Y	Parafoveal	Y (RVF)
Calvo & Avero (2008)	1	N	N		N
	2	Y	N		Y
	3	Y	N		Y
Calvo, Nummenmaa, & Avero (2010)	2	N	Y	Parafoveal	N
Herring (2011)	1	Y	Y	Parafoveal	N (RVF)

Note. Y = yes; N = no; (RVF) = right visual field effect also present; LVF (RH) = left visual field (right hemisphere).

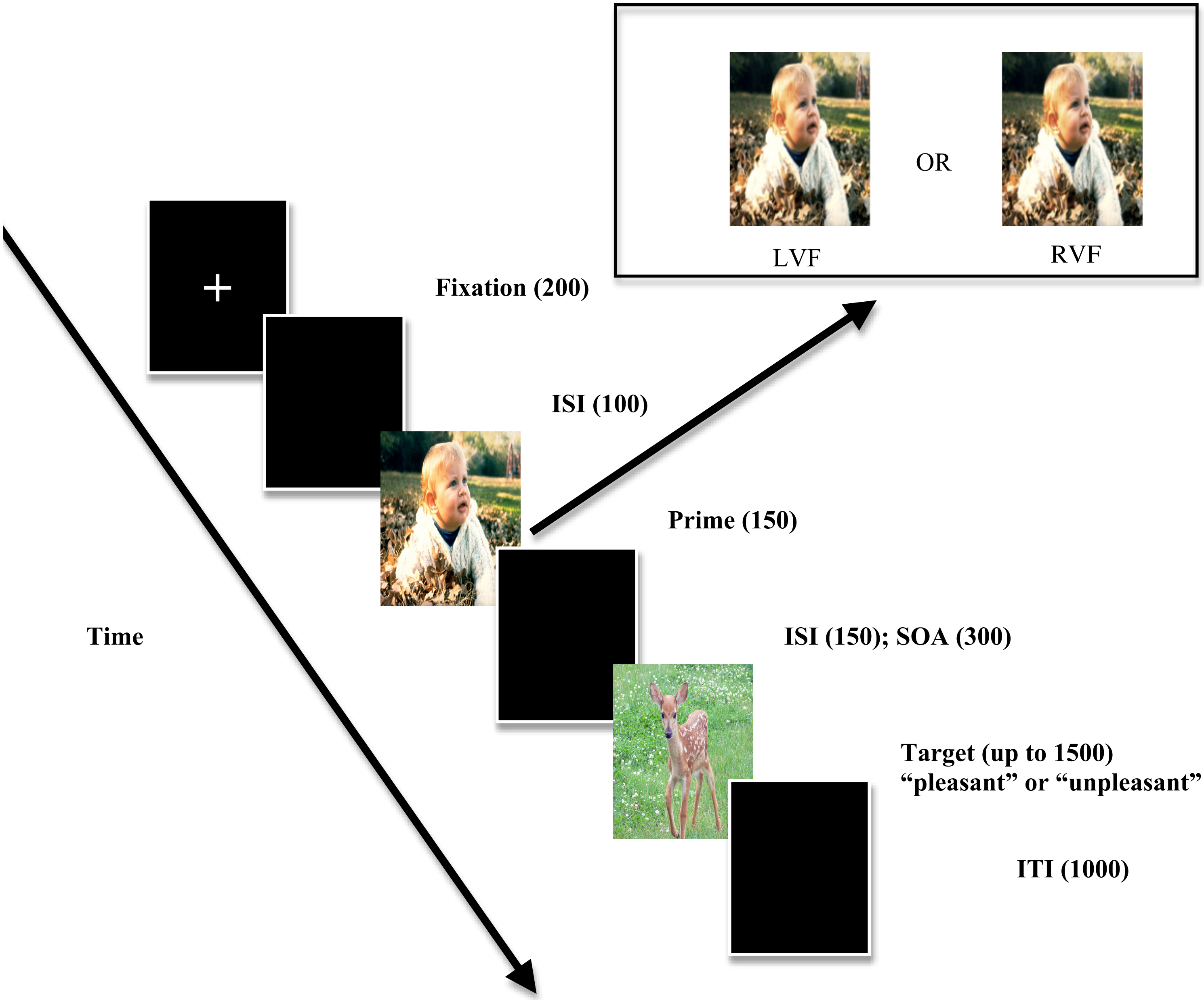


Figure 1. Timing (ms) of the priming sequence. ISI = inter-stimulus interval; SOA = Stimulus-onset asynchrony, and ITI = inter-trial interval; LVF = left visual field; RVF = right visual field.

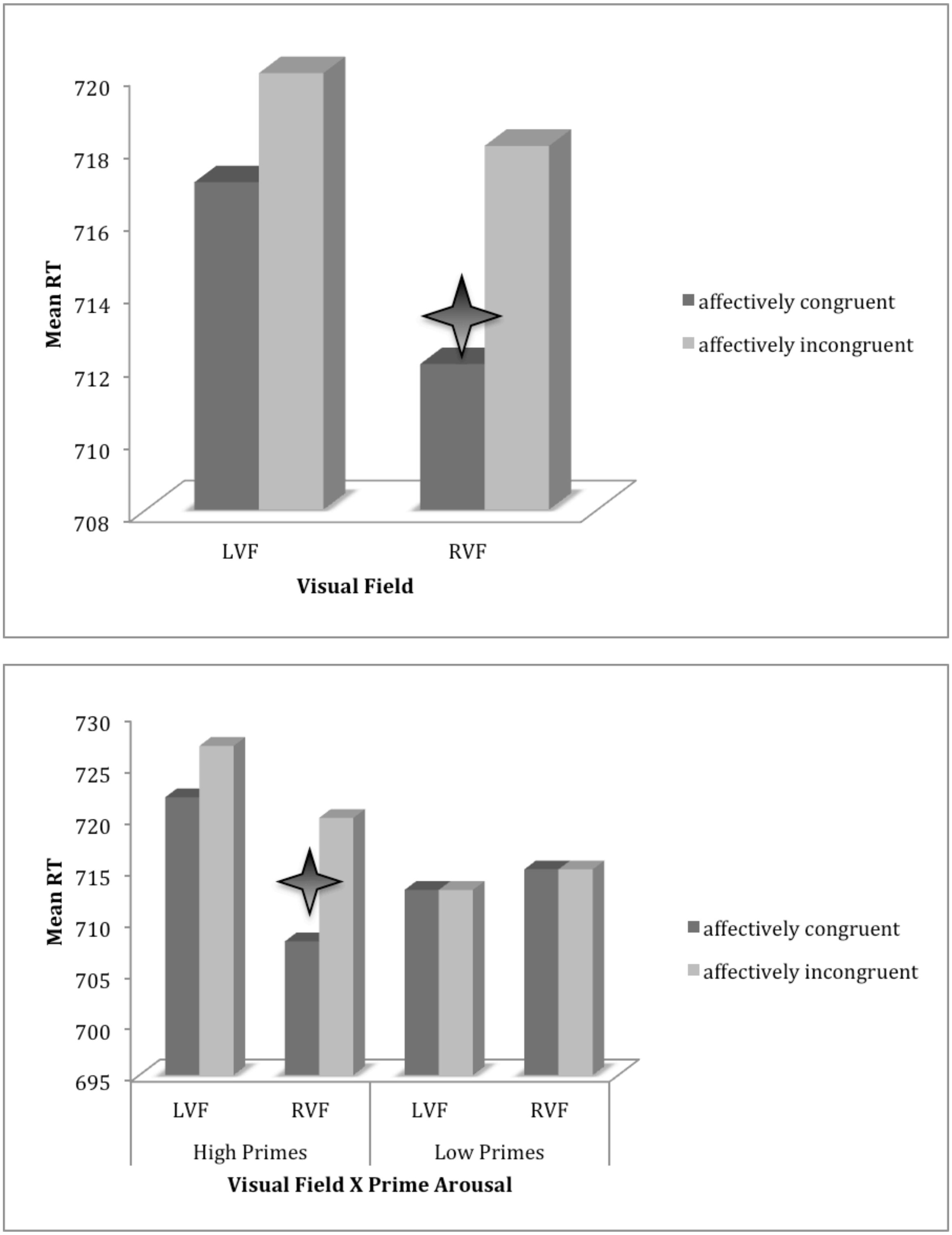
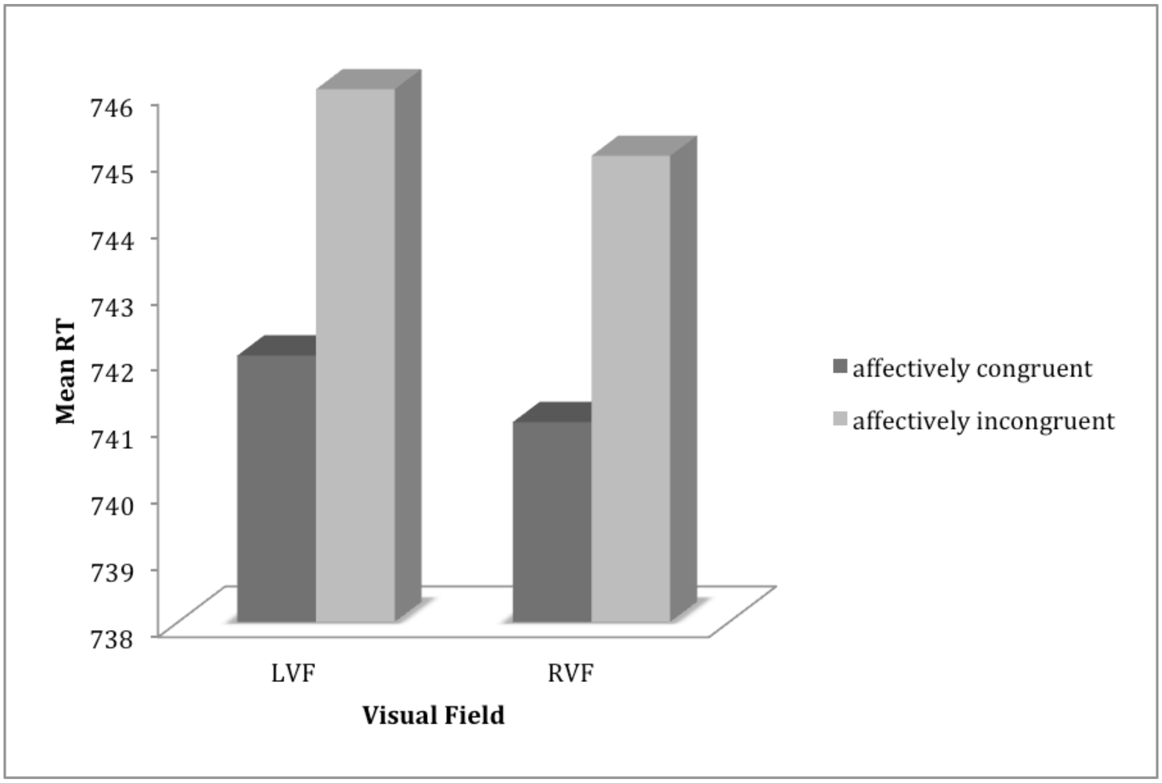


Figure 2. Affective congruity X visual field effect (top panel) and Affective congruity X VF X Prime Strength effect (bottom panel) for Experiment 1. Stars indicate significance (p = .005).



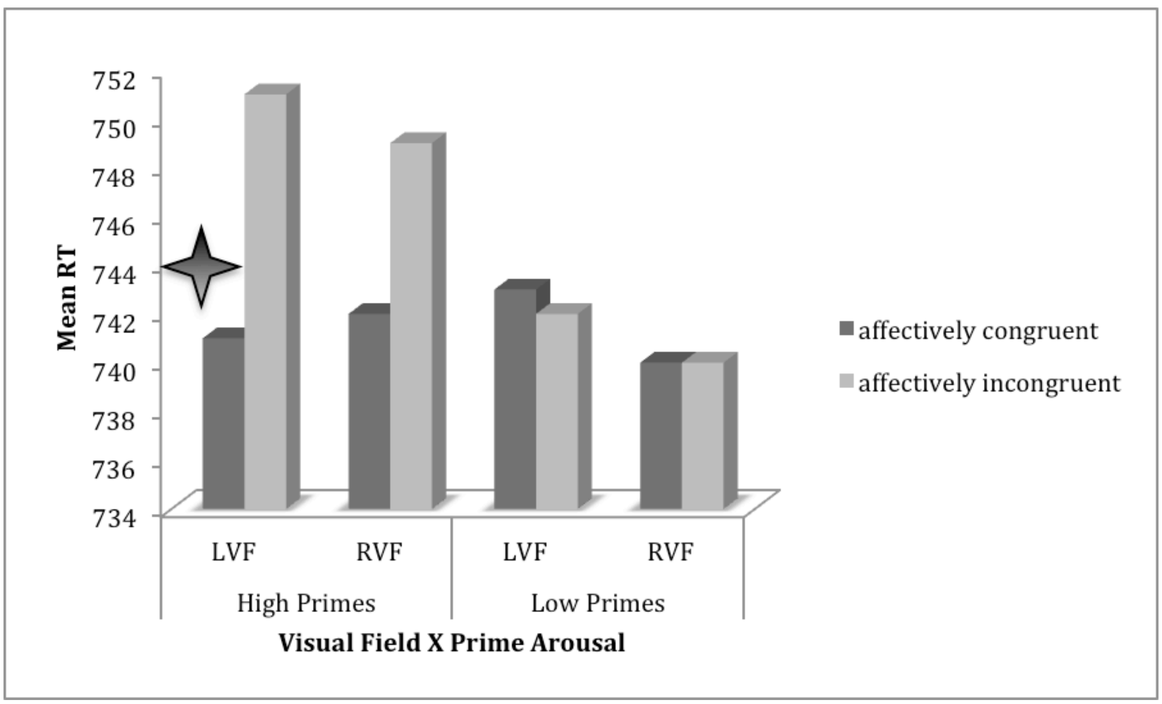


Figure 3. Affective congruity X visual field effect (top panel) and Affective congruity X VF X Prime Strength effect, F (1, 35) = 3.84, p = .058, η_p^2 = .10, (bottom panel) for Experiment 2.

Appendix A

Supplemental Analyses of Experiment 1

Response Accuracy

Response accuracy data were arcsine transformed to normalize the distribution (Howell, 2002) and then analyzed but percentages are reported to ease interpretation. A 2 (affective congruity) X 2 (prime valence) X 2 (prime arousal) X 2 (visual field) Repeated Measures ANOVA revealed a prime valence X congruity interaction, F (1, 56) = 4.16, p = .046, η_p^2 = .07. Simple effects revealed a trend for more accurate responses to targets incongruent with pleasant primes (M = 89.70%, SD = 8.25%) than targets congruent with pleasant primes (M = 86.10%, SD = 11.56%), F (1, 56) = 3.22, p = .078, η_p^2 = .05. However, targets congruent with unpleasant primes were responded to more accurately (M = 90.40%, SD = 8.57%) than targets incongruent with unpleasant primes (M = 85.80%, SD = 11.80%), F (1, 56) = 5.63, p = .021, η_p^2 = .11. A prime valence X affective congruity X visual field interaction was also uncovered, F (1, 56) = 7.43, p = .009, η_p^2 = .11. Simple effects revealed that targets affectively congruent with unpleasant primes presented in the LVF (RH) were responded to more accurately (M = 90.60%, SD = 8.78%) than targets affectively incongruent with unpleasant primes (M = 85.20%, SD = 11.77%) presented in the LVF (RH), F (1, 56) = 8.08, p = .006, η_p^2 = .13. Further, targets affectively incongruent with pleasant primes presented in the LVF (RH) were responded to more accurately (M = 90.30%, SD = 8.69%) than targets affectively congruent with unpleasant primes (M = 85.80%, SD = 11.37%) presented in the LVF (RH), F (1, 56) = 5.12, p = .028, η_p^2 = .08. The affective congruity effects for unpleasant and pleasant primes presented in the right visual filed were not significant, Fs = 2.75 and 1.21, respectively. Finally, a prime arousal X prime valence X visual field interaction was uncovered, F (1, 56) = 5.98, p = .018, η_p^2 = .09, but is not discussed further as it is theoretically irrelevant.

Preview Phase Ratings

Though no hypotheses were generated regarding the preview phase arousal ratings, analyses were conducted as a manipulation check. First, an average rating of the 96 prime pictures was computed

for each participant and all participants were found to be within 2.5 *SD*s of the grand mean ($M = 4.39$). Second, the two stimulus sets were combined as no differences were found between the four prime conditions between sets (*ps* > .05). Next, a Repeated Measures ANOVA revealed a significant effect of prime type, $F\ (3, 59) = 38.61$, $p < .001$, $\eta_p^2 = .66$. All prime types were significantly different from one another (*ps* < .001) with HU primes rated the most arousing followed by LU primes, HP primes, and LP primes. Finally, one-sample *t*-tests were conducted comparing each prime condition to the IAPS ratings. For all but the LU prime condition, prime arousal ratings were significantly lower compared to the IAPS ratings (*ps* < .001). In general, the present sample underrated prime arousal by a little more than one ratings compared to the IAPS (see Table A1).

Table A1

Mean Arousal Ratings During the Preview Phase in Experiment 1

Prime Strength	Experiment 1	IAPS	Mean difference
HU	5.74[a]	6.29	-.55*
LU	4.92[b]	4.93	-.008
HP	4.02[c]	6.27	-2.26**
LP	2.92[d]	4.47	-1.55**
Average	4.39	5.49	-1.09**

Note. HU = high unpleasant; LU = low unpleasant; HP = high pleasant; LP = low pleasant; IAPS = International Affective Picture System ratings. Different superscripts going down indicate significant differences (*ps* < .001).

*$p < .05$. **$p < .001$.

Appendix B

Supplemental Analyses of Experiment 2

Response Accuracy

Response accuracy data were analyzed the same as in Experiment 1 revealing only a prime valence X affective congruity interaction, F (1, 35) = 5.96, p = .02, η_p^2 = .15. As in Experiment 1, responses were more accurate to targets affectively congruent with unpleasant primes (M = 89.60%, SD = 6.83%) than incongruent with unpleasant primes (M = 82.83%, SD = 12.64%), F (1, 35) = 9.63, p = .004, η_p^2 = .21. The simple contrast for affective congruity involving pleasant primes was not significant (F = 2.35).

Preview Phase Ratings

The average of all the stimuli for participants were found to be within 2.5 *SD*s of the grand mean (M = 4.80). Next, the two stimulus sets were compared and differences were found for the HU and HP prime conditions (*ps* < .05). As such, these prime conditions were treated separately while the low arousal conditions were averaged. A repeated measures ANOVA revealed a significant effect of prime type, F (5, 32) = 24.68, p < .001, η_p^2 = .79. All prime types were significantly different from one another (*ps* < .001) with HU2 primes rated the highest followed by HU1 primes, LU primes, HP1 primes, HP2 primes, and LP primes. Finally, one-sample *t*-tests were conducted comparing each prime condition to the IAPS ratings. All positive prime conditions were significantly lower compared to IAPS (*ps* < .001), whereas the negative prime conditions were not (*ps* > .05). In general, the present sample underrated prime arousal by a little more than half a ratings compared to the IAPS (see Table B1).

Table B1

Mean Arousal Ratings During the Preview Phase in Experiment 2

Prime Strength	Experiment 2	IAPS	Mean difference
HU1	5.77[a]	6.39	-.61
HU2	5.95[b]	6.18	-.22
LU	5.15[c]	4.93	.22
HP1	3.98[d]	6.16	-2.17**
HP2	3.61[e]	6.38	-2.76**
LP	2.80[f]	4.47	-1.66**
Average	4.80	5.49	-.68*

Note. Different superscripts going down indicate significant differences (*ps* < .001).

**p* = .01. ***p* < .001.

Vita

David R. Herring was born in Columbus, Georgia. David graduated from Paradise Valley High School in 2001 in Phoenix, Arizona. David also graduated from Arizona State University in 2007, summa cum laude in psychology, as the Outstanding Graduate of the New College of Interdisciplinary Arts and Sciences. David entered graduate school at the University of Texas at El Paso (UTEP) in the fall of 2008 to pursue a doctorate in psychology (social, cognitive, neuroscience). Since entering graduate school, David has made 18 presentations of his research and published two first author papers in the *International Journal of Psychophysiology* and *Emotion*. David is a Department of Homeland Security (DHS) fellow and was recently awarded the Outstanding Graduate in psychology for the College of Liberal Arts at UTEP.

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