2010-01-01

Examination Of The Cognitive Mechanisms Underlying Evaluative And Semantic Priming Effects By Varying Task Instructions: An ERP Study

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Dedication

To my parents and family for always loving me.

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by

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DISSERTATION

Presented to the Faculty of the Graduate School of

The University of Texas at El Paso

in Partial Fulfillment

of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

Department of Psychology

THE UNIVERSITY OF TEXAS AT EL PASO

August 2010

Acknowledgements

This dissertation study is the accumulation of many hours of work and was accomplished with the help of many research assistants, family and friends. I would like to thank Dr. Stephen L. Crites for taking a chance on me and for providing me with the guidance needed to complete the Ph.D. I would also like to thank my lab mates Katherine White, David Herring, Guadalupe Corral and Andrew Mojica for all of their support. My lab mates have become my family; a family I am proud to be a part of.

I would also like to thank the research assistants who spent endless hours running ERPs with me: Thelma Serna, Christine Suarez, Gaby Terrazas, Amanda Munoz, Javier Flores and Julio Estrada. Running over 100 ERP's was physically exhausting but the positive energy and smiles that each of these students brought to the lab, helped carry me to the finish line. They were committed to this project and I will always be grateful for their help.

The dissertation can be a lonely experience but close friends made sure to always be by my side. Thank you so much Larissa Schmersal, Hyoung-Suk Lee, Berenice De La Cruz, Yvette Güerreca, Laura Zambrano and Ivan Torres. These friends were the source of many smiles and hugs throughout the years and I feel so lucky to have made such great friends!

The mentors who I will always look up to are Dr. Donald Moss, Dr. Wendy Francis and Dr. Cohn. These individuals taught me to believe in myself. I am a product of their encouraging words and I hope to inspire other students the way they have inspired me. I would also like to thank Dr. James Wood, Dr. Christina Sobin, and Dr. Samuel Riccillo for their guidance on this project. Thank you so much Yvonne Lopez and Dr. Patricia Witherspoon for giving me the tools necessary to succeed in academia.

My parents laid the framework for my success and with their love, support, and encouragement I was able to reach this fantastic goal. My success is their success and I hope to continue making them proud.

Abstract

This study examined the cognitive processes that underlie stimulus identification and the activation of attitudes by investigating behavioral and psychophysiological effects in a priming paradigm. Cognitive mechanisms were investigated by examining evaluative and semantic priming effects on behavioral response times, the N400, and LPP event-related potential (ERP) components by varying tasks between-subjects. Participants either completed an evaluative task, a semantic task, or a feature-detection task. It was hypothesized that the behavioral evaluative priming effect would occur in the evaluative task and that the behavioral semantic priming effect would occur in the semantic and feature-detection tasks. The N400 was hypothesized to be sensitive only to the semantic priming effect while the LPP was expected to be sensitive to only the evaluative priming effect. Results indicated that the behavioral evaluative priming effect occurred during both the evaluative and semantic tasks, whereas the behavioral semantic priming effect occurred only during the semantic task. The LPP was elicited by evaluative incongruities in the evaluative task and by semantic incongruities in the semantic and feature-detection tasks. The behavioral and ERP findings may suggest that different cognitive mechanisms underlie evaluative and semantic priming effects, which would indicate different cognitive processes occur when a stimulus is identified compared to when an evaluative association for the stimulus is activated.

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Chapter 1: Introduction

The cognitive processes that are activated when a person encounters an attitude object have yet to be fully understood. Knowing the cognitive processes that underlie attitude activation is important because attitudes help guide behavior and act as a "ready aid" when making decisions (Fazio, Ledbetter, & Towles-Schwen, 2000). For instance, when an attitude object is encountered, the evaluative associations tied to that object will automatically activate from memory and influence approach and avoidance behaviors (Chen & Bargh, 1999; Fazio, 2007; Fazio, Ledbetter, & Towles-Schwen, 2000; Jamieson, & Zanna, 1989). Imagine that a person is hiking on a trail and encounters a rattlesnake, which automatically activates a negatively stored evaluation from memory. This would cause a person to find an alternate route immediately, in an attempt to avoid being bitten by the snake. Researchers have used the priming paradigm to examine the cognitive processes that transpire when a stimulus activates evaluative associations in memory (Krosnick, Judd, & Wittenbrink, 2005; Wittenbrink, 2007). This paradigm involves the presentation of a prime stimulus, which then influences the response a person makes to a target stimulus. The aim of this study was to examine the cognitive processes that underlie stimulus identification and the activation of attitudes by investigating behavioral and psychophysiological effects in a priming paradigm.

1.1 Behavioral Semantic and Evaluative Priming

The semantic priming paradigm has been established as a procedure to examine the semantic associations that exist in memory (Hutchison, 2003). The semantic priming effect is found when participants respond faster to a target word preceded by a semantically congruent prime word (e.g., shoe-foot) compared to an incongruent prime word (e.g., tree-foot). Researchers have examined the semantic priming effect by using the lexical decision task, in

which participants indicate whether a target letter string is or is not a word. The effect is observed when response time decreases and accuracy increases to target words preceded by semantically related as opposed to semantically unrelated words (Hutchinson, 2003; Neely, 1977; for a review see Neely, 1991). These findings have also been replicated in studies that examined the semantic priming effect by using masked priming and indirect semantic priming paradigms. Masked priming paradigms consist of presenting a prime word for 50 ms or less and masking it by presenting a random letter string either after the prime, before the prime, or at both time points (Deacon, Hewitt, Yang, & Nagata, 2000; Holcomb, Reder, Misra, & Grainger, 2005; Marcel, 1983). Indirect semantic priming involves presenting a prime that is associated with another word, which in turn is associated with the target (e.g., lion-stripes are associated through the word tiger; Kreher, Holcomb, & Kuperberg, 2006). Although these tasks differ slightly from one another, both demonstrate the automaticity of the semantic priming effect because participants are not instructed to deliberately match the meaning of the prime and target word (Kreher, Holcomb, & Kuperberg, 2006).

The evaluative priming paradigm is a variant of the semantic priming paradigm and has been used to examine the automaticity of attitude activation (for a review see Klauer, & Musch, 2003; Krosnick, Judd, & Wittenbrink, 2007). Evaluative priming was first examined by Fazio, Sanbonmatsu, Powell, and Kardes (1986). This study found that when participants were asked to indicate if the target word was good or bad, they responded quicker to target adjectives (e.g., delightful) that were preceded by evaluatively congruent prime nouns (e.g., gift) than target adjectives preceded by evaluatively incongruent prime nouns (e.g., hell).

1.2 Effect of Task on Evaluative Priming

Unlike the semantic priming effect, which can be elicited in varying tasks, behavioral research has shown that the evaluative priming effect is usually contingent upon completing an evaluative task (i.e., target is “positive” or “negative”) and is eliminated when participants categorize target stimuli along a non-evaluative dimension (i.e., target is a “person” or “animal”; (De Houwer, Hermans, Rothermund, & Wentura, 2002; Klauer & Musch, 2002; Klinger, Burton, & Pitts, 2000). The elimination of the evaluative priming effect during a non-evaluative task was examined by De Houwer, Hermans, Rothermund, and Wentura (2002). This study varied both the valence of animal and person categories (e.g., butterfly-cockroach, friend-snob) and the task instructions (evaluative vs. semantic categorization). When participants completed an evaluative task, the evaluative priming effect was found; however, when participants were asked to categorize targets semantically, the evaluative priming effect was eliminated. Semantic priming effects were not examined in either the evaluative or semantic categorization tasks.

Research conducted by Klauer and Musch (2002) also found that the evaluative priming effect was lost when participants were asked to make non-evaluative decisions concerning the target such as location, color, letter case, and grammar category. When participants were asked to complete an evaluative task, the evaluative priming effect occurred. Based on these results, it has been suggested that evaluative priming effects are dependent upon completing an evaluative task, unlike semantic priming effects, which have been elicited with varying task instructions (semantic categorization and lexical decision). These researchers suggest that the different effects of task on semantic and evaluative priming imply that different cognitive mechanisms may underlie these priming effects (Bargh, Chaiken, Raymond, & Hymes, 1996; De Houwer,

Hermans, Rothermund, & Wentura, 2002; Klauer & Musch, 2003; Klauer, Roβnagel, & Musch, 1997; Wentura, 1999).

Yet, other researchers have elicited the evaluative priming effect during non-evaluative tasks and these researchers argue that a similar mechanism underlies both evaluative and semantic priming. Recent evidence by Spruyt, De Houwer, Hermans, and Eelen (2007) suggests that the allocation of attention to the evaluative dimension must occur in order to elicit the evaluative priming effect during a non-evaluative task. This was demonstrated in a study in which participants were instructed to indicate if the target word was either living or nonliving and to count the number of times the prime was positive or negative. Although this study required the categorization of targets (as living or nonliving) throughout all the trials, the evaluative priming effect was still revealed because participants were attending to the evaluative nature of the prime. These results coalesce with findings from other behavioral studies that have used the naming task (e.g., only naming the target stimuli) to demonstrate that the evaluative priming effect is the result of processes involved at the encoding level and can be obtained without using a direct evaluative task (Bargh, Chaiken, Raymond, & Hymes, 1996; De Houwer, Hermans, & Spruyt, 2001; Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007). These findings dispute prior statements made by researchers who were unable to obtain the evaluative priming effect during non-evaluative tasks and who have argued that different cognitive mechanisms underlie evaluative and semantic priming effects. This study by Spruyt et al. (2007), and recent naming task studies taken as a whole suggest the possibility that similar cognitive mechanisms may underlie both semantic priming and evaluative priming effects.

Behavioral studies thus far have produced mixed conclusions about the cognitive mechanisms underlying the semantic and evaluative priming effects. However, the conclusions

made by each of these studies are limited because only a behavioral measure was examined. Behavioral measures reflect the overall end product of cognitive processes (Bargh & Chartrand, 2000; Luck, 2005). Thus, the ability to ascertain which cognitive/neural process(es) might differ between semantic and evaluative priming is limited. This limitation can be addressed by including a psychophysiological measure such as event-related potentials (ERPs) because they reflect a temporally precise stream of neural activity. The examination of both behavioral measures and event-related potentials can be used to better identify the similarity or differences in the cognitive mechanism(s) responsible for the evaluative and semantic priming effects.

1.3 ADAPTING A PSYCHOPHYSIOLOGICAL MEASURE

In the studies previously discussed, response times and response accuracy were used to explore the cognitive mechanisms that underlie the evaluation of a stimulus and the organization/execution of a response. Coles (1989) proposed the integration of cognitive psychology with the psychophysiological approach as a means to examine psychological processing more fully. Researchers now simultaneously measure psychophysiological effects and response times to investigate the mechanisms responsible for cognitive processes (Coles, 1989). Together, data can be used to examine in detail the brain processes that are associated with changes in response time and response accuracy.

The event related potential is a time-locked measure of electrical brain activity in response to, or in preparation for, specific events (Fabiani, Gratton, & Coles, 2007). When a person first encounters a stimulus, sequences of neural processes allow a person to identify and assess the stimulus and then prepare a response. The electrical activity associated with this sequence of processing is referred to as the ERP. The ERP comprises components, which are positive or negative deflections in the electrical signal. ERP components are defined by their

polarity, positive (P) or negative (N) (e.g., N1, P2), timing or latency, and scalp distribution (Donchin, 1981; Fabiani, Gratton, & Coles, 2007; Kotchoubey, 2006; Kounios, 1996). It is believed that individual ERP components are closely associated with the neural mechanisms that occur in response to the presentation of a stimulus and underlie cognitive processes (Kotchoubey, 2006; Kounios, 1996). ERP components have provided important information on attention, categorization, memory, language processes, error monitoring, and expectancy (Fabiani, Gratton, & Coles, 2007). Thus, the integration of ERPs with behavioral measures may shed light on questions concerning the cognitive mechanisms underlying evaluative and semantic priming effects. The present study focuses on two components that have been explored in previous semantic and evaluative priming paradigms: the N400 and the late positive potential (LPP).

1.4 The N400

The N400 is recorded from the central-parietal scalp and is a negative deflection that occurs approximately 400 ms after a semantically incongruent stimulus is presented. Kutas and Hillyard (1980) were the first to study the N400 and used a sentence verification paradigm to examine semantic incongruities. The results from this seminal study demonstrated that a semantically incongruent final word in a sentence (e.g., "He spread the warm bread with *socks.*") elicited a significantly larger N400 compared to a semantically congruent final word (e.g., "He spread the warm bread with *butter.*"). Thus, the N400 is an ERP component that is thought to reflect the ease with which a stimulus is integrated into a given context based upon access to information in long-term memory (Bentin, McCarthy, & Wood, 1985; Kutas & Federmeier, 2000). This study opened the door for researchers to explore other relevant factors that could

possibly affect the N400, such as the level of meaning associated within word pair priming paradigm (Bentin, McCarthy, & Wood, 1985).

Bentin, McCarthy, and Wood (1985) presented participants with word pairs that were semantically congruent (e.g., bread-butter) or incongruent (e.g., brick-butter) and the results showed that semantically incongruent word pairs elicited a significantly larger N400 peak amplitude than congruent word pairs. These N400 findings have also been replicated by researchers who have used masked priming and indirect priming paradigms (Holcomb, Reder, Misra, & Grainger, 2005; Kreher, Holcomb, & Kuperberg, 2006). As previously discussed, masked priming paradigms have been used to ensure that participants are unable to consciously perceive the prime word; therefore, N400 semantic priming effects are thought to demonstrate automatic processing (Deacon, Hewitt, Yang & Nagata, 2000; Holcomb, Reder, Misra, & Grainger, 2005). Additional support has been provided by studies that have examined the indirect semantic priming paradigm (Kreher, Holcomb, & Kuperberg, 2006). This paradigm involves using a prime that is associated with a mediator word that is in turn associated with the target (e.g., lion-stripes are associated through the word tiger). Results show that the prime activates the mediator word which then activates the target, thus supporting the automaticity of the cognitive mechanism underlying the semantic priming effect.

1.5 N400 - Evaluative Priming

Recently, researchers have begun to explore the usefulness of the N400 to examine if the cognitive mechanisms that underlie evaluative priming effects are similar to those of semantic priming (Morris, Squires, Taber, & Lodge, 2003; Zhang, Lawson, Guo, & Jiang, 2006; Zhang, Li, Gold & Jiang, 2010). Morris and colleagues (2003) examined if attitudes toward political objects (people, ideas, and issues; e.g., Bill Clinton) would spontaneously activate evaluative

associations in memory and then influence responses to valent adjective targets (e.g., honest). Results found a larger N400 effect for incongruent word pairs in comparison to congruent word pairs. This finding was corroborated by Zhang and colleagues (2006, 2010) who examined evaluative priming and elicited larger N400 peak amplitudes to incongruent word pairs. These three studies support the stance that similar cognitive mechanisms underlie evaluative and semantic priming as indicated by the elicitation of the N400 by evaluative incongruities and by previously discussed semantic incongruities. To examine the mechanism underlying these priming effects, researchers have also examined alternative ERP components: the late positive potential.

1.6 THE LATE POSITIVE POTENTIAL (LPP)

The late positive potential (LPP) is thought to reflect evaluative categorization processes and peaks 600 ms after the presentation of a stimulus (Cacioppo, Lorig, Nusbaum, & Berntson, 2004). The LPP has greatest effects over central parietal areas of the scalp (Cacioppo, Crites, Gardner, & Berntson, 1994; Fabiani, Gratton, & Federmeier, 2007; Ito, and Cacioppo, 2000; Picton, 1992) and has been shown to be modulated by a stimulus' subjective probability, relevance to an ongoing task, or inherent appetitive/threatening qualities (see also Fabiani, Gratton, & Federmeier, 2007; Johnson, 1986; Luck, 2005; Nieuwenhuis, Aston-Jones, & Cohen, 2005; Picton, 1992; Rugg & Coles, 1995 for reviews). The LPP has predominantly been examined by using the oddball paradigm, which consists of presenting a series of standard stimuli and then presenting a rare stimulus. For example, a stimulus set could consist of "+ + + + + + --". Studies have demonstrated that when participants are asked to evaluatively categorize stimuli presented in an oddball paradigm, larger LPPs are elicited by evaluatively incongruent stimuli (e.g., a negative stimulus preceded by a string of positive stimuli as depicted in the above example; Cacioppo, Crites, Berntson, & Coles, 1993; Cacioppo, Crites, Gardner, & Berntson, 1994; Crites, Cacioppo, Gardner, & Berntson, 1995; Ito, Larsen, Smith, & Cacioppo, 1998).

1.7 LPP – Affective Priming

Researchers have recently revealed large LPP peak amplitudes in affective (emotional) priming paradigms (Herring, Crites, Taylor, & White, 2010; Hinojosa, Carretié, Méndez-Bértolo, Míguez, & Pozo, 2009; Werheid, Alpau, Jentzch, & Sommer, 2005). For example, Herring and colleagues (2010) used stimuli from the International Affective Picture System (IAPS) to construct congruent and incongruent stimulus trials. Participants were instructed to indicate if the second picture in a picture pair was pleasant (e.g., baby smiling) or unpleasant (e.g., person vomiting). Results demonstrated larger LPP peak amplitudes to emotionally incongruent stimuli compared to congruent stimuli. Other studies that have investigated affective incongruities and the LPP have examined facial expressions (Werheid, Alpay, Jentzxch, & Sommer, 2005) and arousing word pairs (Hinojosa, Carretié, Méndez-Bértolo, Míguez, & Pozo, 2009). Herring et al. (2010) and Hinojosa et al. (2009) reported no N400 effects as a result of affective incongruities and thus are in conflict with N400 results produced by Morris et al. (2003) and Zhang et al. (2006). It is possible that the differences in LPP and N400 effects reported in these studies could be due to differences in the nature of the stimuli (attitudes vs. emotion) examined by affective (emotional) and evaluative (attitudinal) researchers.

1.8 N400 vs. LPP - Evaluative Priming

To further characterize the similarities and differences between the cognitive mechanisms underlying the evaluative and semantic priming effects, Taylor (2008) examined the presence/absence of the N400 and LPP by varying word pairs along both an evaluative and semantic dimension. The previous LPP affective priming findings and the N400 evaluative priming findings only examined stimuli pairs that varied along the affective/evaluative dimension, thus limiting any strong comparisons between mechanisms underlying semantic and evaluative priming effects. Taylor (2008) controlled the influence of semantic relatedness among word pairs by following Storbeck and Robinson’s (2004) paradigm that either paired words from the same semantic category (e.g., animal-animal) or from different semantic categories (e.g.,

animal-person). Word pairs were also systematically varied along an evaluative dimension (congruent vs. incongruent). Stimuli were constructed by using normed words from the Affective Norms for English Words (ANEW) and were presented sequentially. Participants were asked to indicate if the second word was positive (e.g., friend, butterfly) or negative (e.g., trader, scorpion) and results revealed that participants responded quicker to evaluatively congruent word pairs compared to incongruent word pairs. This finding replicates well established evaluative behavioral studies that have previously been discussed (Fazio, Sanbonmatsu, Powell, & Kardes, 1986). No behavioral semantic priming effects were found; participants did not respond any faster to semantically congruent word pairs than to incongruent word pairs. Interestingly, ERP results revealed a significantly larger LPP to evaluatively incongruent word pairs but the N400 was not elicited. In fact, the N400 was only elicited by semantically incongruent person-animal word pairs. As previously discussed, research has shown that the N400 reflects the activation of semantic knowledge from memory in a word pair priming paradigm (Holcomb, Reder, Misra, & Grainger, 2005; Kreher, Holcomb, & Kuperberg, 2006). If the evaluative incongruities in Taylor (2008) elicited the N400, it could indicate similarities in the cognitive mechanism underlying evaluative and semantic priming effects. However, the presence of the LPP component and the absence of the N400 to evaluatively incongruent target words and the presence of the N400 to semantically incongruent person-animal word pairs suggests the possibility that different cognitive mechanisms underlie semantic and evaluative priming effects.

1.9 INCONSISTENCIES – N400 EVALUATIVE PRIMING

As previously mentioned, Taylor (2008) was not the first to examine the N400 to investigate whether evaluative priming relies upon the same cognitive mechanisms as semantic priming. Two other studies used visual stimuli to examine N400 effects in an evaluative priming paradigm but did not directly examine the semantic priming effect (Morris, Squires, Taber, & Lodge, 2003; Zhang, Lawson, Guo, & Jiang, 2006). Morris and colleagues (2003) examined

word pairs consisting of political objects (people, ideas, and issues) and valent adjective targets (e.g., Clinton-honest). Results revealed a larger N400 effect for evaluatively incongruent word pairs in comparison to congruent word pairs. This then raises the question, why was Taylor (2008) unable to replicate the evaluative N400 findings found by Morris and colleagues (2003)? One possible answer to this question is that Morris and colleagues (2003) did not systematically control for the influence of semantic relatedness among word pairs as done by Taylor (2008). The importance of controlling for semantic relatedness among word pairs during an evaluative priming paradigm has been demonstrated by Storbeck and Robinson (2004). These studies demonstrated that, although participants completed an evaluative task, when the word pairs varied systematically along both an evaluative and semantic dimension, response times were only found to be significantly faster for semantically congruent word pairs (e.g., dove-raven). These behavioral results demonstrate the possibility that the evaluative N400 effect, previously reported by Morris et al. (2003), could have been elicited by semantic incongruities among the small set of word pairs examined. For example, one of their primes was "Kennedy," which may have been semantically related to the target words "honest" and "attractive" and semantically incongruent with the target words "cruel" and "vulgar."

Zhang, Lawson, Guo, and Jiang (2006) also examined the N400 in an evaluative priming study but examined a larger set of stimuli that consisted of both pictures and words. A total of 720 prime-target word pairs were presented and 720 prime-target pairs that used pictures as the prime were shown to participants who completed an evaluative task. Zhang et al. (2006) stated that using a large stimulus set would reduce the chances of any semantic relationships among prime and target pairs. These researchers reported a "delayed N400" ERP component to evaluatively incongruent stimuli pairs for both picture prime and word prime pairs. However,

these results are not definitive because the delayed N400 that was reported does not fit the typical characteristics of the N400 ERP component. The delayed N400 was examined using a time window from 480–680ms and was said to peak around 600 ms. The typical N400, reported in existing literature, has been examined using a time window from 300ms–500ms with a peak at 400ms (for review, see Kutas & Federmeier, 2000). The N400 has also been found to be largest over the central parietal region, yet Zhang et al. (2006) examined electrode sites from the entire posterior region of the scalp. These differences should not be overlooked because the "delayed N400" reported by this evaluative research study may not be representative of a true N400 ERP component and thus may not reflect a similar mechanism underlying the evaluative and semantic priming effects.

1.10 N400 Studies – Differences in Stimuli

Discrepancies in research findings that have either reported the presence of the N400 to evaluative incongruities (Morris et al., 2003; Zhang et al., 2006; Zhang et al., 2010) or the absence of N400 and presence of the LPP (Taylor, 2008; affective – Herring et al., 2010; Hinojosa, Carretié, Méndez-Bértolo, Míguez, & Pozo, 2009) could have also resulted from differences in the strength of stimuli examined. The stimulus set used by Taylor (2008) was possibly not as strong as the stimuli used in the Morris et al. (2003) and Zhang et al. (2006) studies, which could have been a reason why the N400 evaluative effect was not found. Fazio and colleagues (1986) demonstrated that the stronger the association between an object and its evaluation, the more accessible the attitude. Morris et al. (2003) used a strong stimulus set that consisted of meaningful political words whereas Taylor (2008) and Zhang et al. (2006) used normed stimuli. The use of politically charged words such as "Kennedy" and "honest" may have resulted in more accessible attitudes compared to normed stimuli. The normed stimulus set used

by Taylor (2008) closely mirrored that of Zhang and colleagues (2006), but differences within the student population could have resulted in poor accessibility to these evaluative associations stored in memory. The student population examined by Zhang et al. (2006) consisted of students from The University of Kentucky while Taylor (2008) examined a predominantly Hispanic population from the University of Texas at El Paso, where many students learned to speak English as their second language. Some participants reported having difficulty with understanding some of the normed words from the stimulus set (e.g., wasp).

The need to strengthen stimuli within the evaluative priming paradigm can be resolved by using pictures, which have been said to have direct access to evaluative associations stored in semantic memory (De Houwer & Hermans, 1994; Glaser, 1992; Glaser, & Glaser, 1989; Paivio, 2007). Although Zhang and colleagues' N400 findings are debatable, their results did find a stronger behavioral evaluative effect when the prime was a picture compared to when it was a word. Behavioral researchers who have used the naming task have also suggested a superiority effect of using pictures to access evaluations (Spruyt, Hermans, De Houwer, & Eelen, 2002; Spruyt, Hermans, De Houwer & Eelen, 2004; Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007). Of the three affective priming studies that have examined the activation of emotion by investigating ERPs, only two used pictures (Herring et al., 2010; Werheid, Alpay, Jentzch, & Sommer, 2005). Out of these two studies only, one examined the presence/absence of the N400 (Herring et al., 2010). The discrepancy in ERP findings between researchers who have used different types of stimuli are evidence for the need to strengthen the stimuli used in evaluative priming studies in order to better characterize the cognitive mechanism underlying evaluative priming effects.

1.11 VARYING TASKS

The existing four ERP studies (Morris et al. 2003; Taylor, 2008; Zhang et al. 2006; Zhang et al. 2010) that have aimed to examine similarities and differences between the cognitive mechanisms that underlie evaluative and semantic priming effects all have one limitation in common. The limitation is that each of these studies only examined evaluative priming effects during an evaluative task. By only instructing participants to determine the valence of the target word, this has restricted researchers from making any concrete conclusions about the cognitive mechanisms underlying the evaluative and semantic priming effects. As previously discussed, mixed results have been reported regarding the absence or presence of the evaluative priming effect during non-evaluative tasks. Several behavioral researchers have reported the elimination of the evaluative priming effect when participants were asked to complete a non-evaluative task (semantic categorization task; De Houwer, Hermans, Rothermund, & Wentura, 2002; Klauer and Musch, 2002; Klinger, Burton, & Pitts, 2000), while other behavioral researchers have reported the evaluative priming effects during non-evaluative tasks (Bargh, Chaiken, Raymond, & Hymes, 1996; De Houwer, Hermans, & Spruyt, 2001; Spruyt, De Houwer, Hermans, & Eelen, 2007; Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007). To examine this inconsistency in behavioral literature, these behavioral studies should be replicated by varying task instructions and by including a psychophysiological measure. By examining the presence or absence of the N400 and LPP during a non-evaluative task versus an evaluative task, the cognitive mechanisms underlying evaluative and semantic priming effects can be more thoroughly characterized.

1.12 PRESENT STUDY

The overall aim of the present study was to examine the cognitive mechanisms that underlie evaluative and semantic priming effects and resolve inconsistencies in the previous behavioral and ERP literature. To examine the mechanisms underlying evaluative and semantic priming effects, the current study had two objectives. The first objective was to manipulate task instructions in order to explore the specific conditions under which the N400 and LPP were elicited by evaluative and semantic priming effects. Prior evaluative research has been limited in conclusions made regarding the cognitive mechanisms that underlie these priming effects because none had systematically examined semantic priming and evaluative priming simultaneously. The discrepancy in conclusions made by behavioral evaluative researchers during non-evaluative tasks was further investigated by examining the N400 and LPP components. This study examined the N400 and LPP during an evaluative task, a semantic task, and a feature-detection task, while also examining evaluative and semantic priming effects simultaneously. Previous researchers have examined the evaluative priming effect during non-evaluative tasks such as semantic categorization and naming tasks but the current study sought to further investigate these findings by examining a task that more closely mirrored the lexical decision task used in semantic priming studies. Thus, the current study also investigated the evaluative priming effect during a task that was completely unrelated to either the semantic or evaluative categorization of the target; a feature-detection task. This task instructed participants to determine the presence or absence of a non-relevant symbol (e.g., red dot) on the target picture, much like a semantic lexical decision task where a person must determine if the target is or is not a word. Asking participants to complete a feature-detection task that was completely

independent of semantic and evaluative categorizations permitted a direct investigation of the presence or absence of the N400 and LPP to evaluative and semantic priming effects.

The second objective of the present study was to strengthen reported priming effects by using picture stimuli. As previously mentioned, discrepancies in prior research could be due to the strength of the stimuli investigated. Thus, the current study sought to reexamine the evaluative priming effect by using idiosyncratic attitudinal picture pairs of well-known public individuals and animals while also systematically varying them along both an evaluative and semantic dimension. Taylor (2008) was the only evaluative priming study that varied stimuli along both dimensions and reported the LPP to evaluative priming effects and not the N400. This could have resulted from the weak normed stimuli that were examined, which is supported by research findings that have shown that people encode words into short-term memory by using an acoustic code rather than a semantic code (Baddeley, 1966). Researchers have also demonstrated that pictures, compared to words, have superior access to the semantic memory system (Glaser, 1992; Glaser, & Glaser, 1989), which contains affective information (De Houwer & Hermans, 1994). The studies that have used pictures in their priming paradigms have examined the activation of emotion and not attitudes. These studies predominantly used pictures obtained from the International Affective Picture System (IAPS; Avero & Calvo, 2006; Hermans, De Houwer, & Eelen, 1994; Herring et al., 2010; Spruyt, Hermans, De Houwer, & Eelen, 2002; Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007). Thus, to understand the mechanism underlying the evaluative priming effect more thoroughly, normed picture stimuli were avoided for the same reasons previously discussed with using normed words. To make this point more clearly, consider the following. Suppose a student majoring in biology, who is naturally fond of reptiles, completes an evaluative task using pictures of animals. This student may indicate a

picture of a snake to be good, which does not fit the norm. Therefore, the current study used idiosyncratic attitude ratings of picture stimuli to strengthen the evaluative priming effect and to avoid any problems with students' attitudes not fitting the norm.

1.13 Study Overview and Hypotheses

The aim of this study was to examine the cognitive mechanisms underlying evaluative and semantic priming effects by investigating the N400 and LPP during an evaluative task, semantic categorization task, and feature-detection task. In addition, evaluative and semantic congruency between prime and target stimuli was factorially manipulated. This study used idiosyncratic pictures of liked and disliked animals and well-known public individuals. Task effects were examined by using a between-subjects design and participants either completed an *evaluative task* (e.g., determined if the second picture was positive or negative), a *semantic task* (e.g., determined if the second picture was a person or animal), or a *feature-detection task* (e.g., determined if a dot was or was not present on the target picture). The relevance of investigating task on evaluative and semantic effects is to further isolate and characterize the LPP and N400 ERP components.

During the *evaluative task*, it was hypothesized that evaluatively incongruent picture pairs (i.e., liked-disliked or disliked-liked) as compared to congruent picture pairs (i.e., liked-liked or disliked-disliked) would reveal slower response times and larger LPP peak amplitudes. The N400 was hypothesized to replicate findings reported by Taylor (2008) by only being elicited by semantically incongruent picture pairs (e.g., male-animal) and not by evaluative incongruities. This finding was hypothesized despite not expecting a behavioral semantic priming effect during the evaluative task because this effect was not found in the study conducted by Taylor (2008).

During the *semantic task*, it was hypothesized that semantically incongruent picture pairs, as compared to semantically congruent picture pairs, would reveal slower response times and larger N400 peak amplitudes. No evaluative priming effects were expected to be demonstrated by slower response times or elicitation of a N400. Affective and evaluative priming studies have only reported the LPP during an evaluative task, thus, the LPP was examined for both semantic and evaluative incongruities during the semantic task.

During the *feature-detection task*, slower response times and larger N400 peak amplitudes were expected to occur as a result of semantic incongruities and not evaluative incongruities. This was expected because previous research studies have elicited the semantic priming effect during lexical decision tasks, masked priming paradigms, and indirect semantic priming paradigms (Deacon, Hewitt, Yang, & Nagata, 2000; Holcomb, Reder, Misra, & Grainger, 2005; Kreher, Holcomb, & Kuperberg, 2006; Marcel, 1983). As previously mentioned, the LPP has only been examined in evaluative tasks, thus, the LPP was examined for both semantic and evaluative incongruities during the feature-detection task.

Chapter 2: Methods

2.1 Participants

The final sample included 99 participants after excluding 5 participants due to technical problems with the EEG recording equipment and 7 for excessive electrical artifacts (feature-detection task – 34, evaluative task – 32 and semantic task – 33). Participants (57 females) were undergraduate students from the Introductory Psychology courses and were recruited through Experimetrix. Participants received three hours of class credit for their participation. The age of participants ranged from 18 to 47 with an average age of 22. A total of 158 participants completed the pre-session, however, 35 participants did not have enough attitudinal stimuli (e.g., very few disliked stimuli) to participate in the ERP session. Of the 123 participants that were asked to return for the second session, 12 did not return.

2.2 Measurement Tools

Attitudinal stimuli. The pre-session stimuli consisted of pictures of white, publicly well-known males (actors, politicians, athletes, musicians, religious figures, etc.) and pictures of animals. A total of 328 pictures of males and 202 pictures of animals were presented in the pre-session. Picture stimuli were found on the internet and were selected based on quality of the image and the presence of few or no background distractions (e.g., logos, odd background colors, etc.). All pictures were sized to 370 X 500 pixels. Only pictures of white males were used to avoid gender and race becoming semantically salient to the participant. If gender and race were not controlled, participants may have unknowingly tried to relate the prime and target based on gender and race. Testing the impact of gender and race upon the N400 and LPP components was not within the scope of the current project, thus gender and race were held constant.

2.3 PROCEDURE

Pre-session. Participants were told about the risks and benefits of the experiment and given a description of the ERP procedure that would take place the following week. If the participant agreed, a time was assigned to return the following week to complete the ERP session. Participants were asked to complete an informed consent form before the pre-session started. Participants rated how much they liked or disliked pictures of white public males and animals by pressing one of seven labeled keyboard keys (---, --, -, Neutral, +, ++, +++) when each picture appeared on the computer screen. Pictures were rated one at a time. If a participant did not know the public male or animal in the picture, they were asked to indicate this by pushing a specified “unknown” key on the keyboard. Pictures were presented via the E-Prime software program and reaction times were recorded when participants rated each picture.

Stimuli set. Based on each participant’s attitude ratings and reaction times, the experimenter selected positive and negative stimuli that were responded to the quickest for the ERP session (e.g., Fazio, 1995; Fazio, 2000). These stimuli had to receive a participant rating of +++ or ++ (positive stimuli) and negative ratings of --- or -- (negative stimuli) to be included in the ERP session. Each participant’s ERP stimuli set consisted of 10 positive and 10 negative white public males and 10 positive and 10 negative animals. Participants then received an appointment card and received a text message to remind them when to return for their scheduled ERP session approximately 7 days later. If a participant could not return on the scheduled day, another appointment time and date was scheduled.

ERP session overview. When the participant arrived, the 40 stimuli pictures that were selected for the ERP session were reviewed with each participant. This was done to ensure that participants did not accidently rate a person or animal picture the opposite of their true attitude

(e.g., Robin Williams as a strong dislike when he is in fact a strong like). During the ERP session, the experimenters prepared the participant for electroencephalograph (EEG) recording by placing an elastic cap containing the EEG electrodes on the participant and attaching an electrode on the mastoid process behind the left and right ear and by attaching the vertical electroculographic (VEOG) electrode under the right eye. Once these preparations were complete, the participant was taken to an isolated room and seated in a comfortable reclining chair approximately 0.5 m in front of a monitor on which the experimental stimuli was displayed.

Task. The experimenter informed participants that the experiment consisted of 5 blocks of picture pairs with a two-minute break between each block. Participants were informed that the picture pairs would be flashed centrally upon the computer monitor. Based on the participant's assigned task, they either received instructions to complete the evaluative task, a semantic task, or a feature-detection task. During the *evaluative task*, participants pushed one of two buttons on a response pad to indicate if the second picture in a picture pair was liked or disliked. During the *semantic task*, participants indicated if the second picture was an animal or person. During the *feature-detection task*, participants indicated if a dot was or was not present on the second picture. Before the participants began the assigned task, the experimenter made sure that the participants clearly understood the instructions and turned on a white noise machine to help mask external noise before leaving the experimental chamber. Participants then initiated the experiment by pressing a button on the response pad (keypad).

Prime pictures were preceded by a 200 ms focus "+" and a 100 ms blank screen. Prime pictures were then presented for 150 ms, with an inter-stimulus interval of 100 ms and the target pictures were presented for 1500 ms followed by an inter-trial interval (blank screen) of 1500

ms. In the event that a participant failed to respond within 1500 ms, the program automatically continued to the next picture pair. Participants were presented with a total of 576 picture pairs. There was a total (not including the practice trials) of 128 picture pairs for each of the following picture pair types: a) semantically matched-evaluatively matched, b) semantically matched-evaluatively mismatched, c) semantically mismatched-evaluatively matched, and d) semantically mismatched-evaluatively mismatched (Table 1). These picture pairs were divided into four experimental blocks of 128 picture pairs. The practice block consisted of 48 pictures pairs (12 per picture pair type) that proceeded the four experimental blocks. In addition, four practice trials were placed at the beginning of each experimental block. During the feature-detection task, participants viewed target pictures that either did or did not have a dot on one of the four corners or center of the target picture. Thus, participants viewed 64 of each of the picture pair types with a dot and the other 64 without a dot (128 total). On average, it took participants 35 minutes to complete the ERP recording.

Table 1.1: Study Design

Study Design

Semantically	**Evaluatively**			
	Matched		**Mismatched**	
Matched	*positive-positive*	*negative-negative*	*positive-negative*	*negative-positive*
male - male	George Clooney-Brad Pitt	Charles Manson-Jeffrey Dahmer	Bill Cosby-Adolf Hitler	Saddam Hussein-Johnny Depp
animal-animal	bunny-kitten	scorpion-snake	puppy-shark	spider-butterfly
Mismatched	*positive-positive*	*negative-negative*	*positive-negative*	*negative-positive*
male-animal	Bill Cosby-puppy	Adolf Hitler-maggot	Sean Connery-cockroach	Ted Bundy-dove
animal-male	pony-Tom Hanks	wasp- Fidel Castro	panda- Richard Nixon	Mel Gibson-swan

Task:

Evaluative	Is the second picture positive or negative?
Semantic	Is the second picture a person or animal?
Feature-Detection	Is a dot present on the second picture?

Design:

3 (Between-Subjects)	Task (evaluative vs. semantic vs. feature-detection)
2	Evaluative (congruent vs. incongruent)
2	Semantic (congruent vs. incongruent)
2	Target (animal vs. person)
2	Target (positive vs. negative)

2.4 DATA ACQUISITION AND REDUCTION

Bioelectrical activity was recorded using Ag/AgCl electrodes. Electroencephalographic (EEG) activity was recorded from 62 scalp locations and referenced to the right mastoid. Electrical activity was also recorded from the left mastoid so a digital linked reference could be computed following data collection. A ground electrode was located between the FPz and Fz electrode locations. Activity from an infraorbital electrode was recorded so (VEOG) artifacts from this channel could be digitally removed from the scalp locations. The electrodes were filled with a high conductivity gel, and electrical impedance at each recording location was reduced to less than 15 Kohms. Neuroscan amplifiers were used to amplify, filter (bandpass of 0.05-30 Hz), and digitize (500 Hz) the bioelectrical signals that were recorded continuously during the experiment.

ERPs. A number of steps were taken to reduce and quantify the bioelectrical data. First, EEG data was re-referenced to a digitally linked-mastoid reference. Second, a digital zero-phase shift, band pass filter (0.15 and 10 Hz, 24 dB/octave) was applied to the continuous data. Third, epochs associated with each target stimulus (0.2 s prestimulus, 0.7 s stimulus, & 0.6 s poststimulus periods) were extracted from the continuous data and each epoch and electrode site were baseline corrected to the mean of its pre-stimulus period. Fourth, epochs containing extreme activity at VEOG were excluded from further analyses. Fifth, a PCA procedure for removing VEOG artifacts from the EEG recordings was applied (Ille, Berg, & Scherg, 2002). Sixth, data was manually reviewed, and electrodes were deleted from further analyses if there is a problem (e.g., if an electrode came loose). Seventh, epochs containing extreme activity at any scalp site were excluded from further analyses. Eighth, the EEG recording for each recording site for each participant was averaged separately within each of the experimental conditions. Ninth,

peak amplitude, latency, and area of the N400 component were recorded from each ERP waveform using a latency window of 275ms to 520 ms from target onset. The latency window for the LPP was from 575ms to 825ms from target onset. These times were used after reviewing the peaks for each component in the averaged ERP files.

2.5 DATA ANALYSES

Behavioral Data. The behavioral data was analyzed with a 2 (task: dot, evaluative, semantic) X 2 (evaluative: congruent vs. incongruent) X 2 (semantic: congruent vs. incongruent) X 2 (target category: person vs. animal) X 2(target valence: liked vs. disliked) mixed ANOVA, where task was a between-subject variable. Arcsine transformations were performed to normalize the distribution of accuracy scores and log transformations were performed to normalize the distribution for the response latencies (Fazio, 1990). Response times that were over 2 *SDs* for each participant's mean were replaced with a score that equaled their mean plus 2 *SDs*. Response times that were faster than 300 ms were coded as wrong and not included in the analyses. [1]

ERP Data. The LPP and N400 ERP components were also analyzed with a 2 (task: dot, evaluative, semantic) X 2 (evaluative: congruent vs. incongruent) X 2 (semantic: congruent vs. incongruent) X 2 (target category: person vs. animal) X 2 (target valence: liked vs. disliked) mixed ANOVA, where task was a between-subject variable. Consistent with previous literature (e.g., Cacioppo, et al., 1993; Ito & Cacioppo, 2000; Ito, et al., 1998), the LPP was largest over parietal sites (P1, Pz, P2, PO3, POz, PO4). Therefore, the LPP analyses were conducted by using

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[1] Analyses within the dot task revealed no significant interactions between the absence or presence of a dot on the target picture with either semantic or evaluative congruency effects for accuracy, response times, the N400, or the LPP (all $p > .05$). Participants were found to respond faster to target pictures with a dot ($M = 96.28$, $SE = 95.04$) compared to not having a dot ($M = 95.04$, $SE = .89$; $F(1, 33) = 7.84$, $p = .008$).

the averaged array of these six sites. The N400 peak has been reported to be largest over frontal electrode sites (F1, FZ, F2, FC1, FCZ, FC2), in past findings using pictures (Federmeier & Kutas, 2001; Ganis, Kutas, & Sereno, 1996). However, no visible N400 peak was found in the averaged wave forms and thus could not be analyzed (details provided in results section).

Chapter 3: Results

3.1 Response Accuracy

Arcsine transformations were performed to normalize the distribution of accuracy scores prior to analysis; however, accuracy scores are reported in percentages for ease of interpretation. The main effect of task and congruency was not reliable, F (2, 96) = 1.64, p = .19. Participants were not found to respond more accurately to semantically congruent (M = 95.6%, SE = .40) than to semantically incongruent picture pairs (M = 95.7%, SE = .45; F (1, 96) = .08, p = .78). A significant interaction between evaluative congruency and task, F (2, 96) = 5.57, p = .005, was revealed. Simple effects for the interaction (Table 1.2) show a significant decrease in accuracy to evaluatively incongruent picture pairs (M = 94.1%, SE = .80) compared to congruent picture pairs (M = 95.4%, SE = .64) during the evaluative task, F (1, 31) = 8.66, p = .006. This evaluative effect did not occur during either the feature-detection task (M_{Evalcong} = 95.6%, SE = .69, $M_{\text{Evalincong}}$ = 95.7%, SE = .76; F(1, 33) = .089, p = .77) or the semantic task (M_{Evalcong} = 96.4%, SE = .70, $M_{\text{Evalincong}}$ = 96.6%, SE = .77; F(1, 32) = 1.59, p = .217).

Although not central to the hypotheses, a significant interaction was also revealed for evaluative congruency and target valence, F (1, 96) = 4.56, p = .037. The simple effects for this interaction (Table 1.3) revealed no significant differences ($M_{\text{EvalcongLiked}}$ = 96.1%, SE = .44, $M_{\text{EvalcongDisiked}}$ = 95.6%, SE = .43; F(1,98) = 2.67, p = .106 and $M_{\text{EvalincongLiked}}$ = 95.4%, SE = .49, $M_{\text{EvalincongDisiked}}$ = 95.4%, SE = .49; F(1,98) = .447, p = .505).

Table 1.2: Evaluative Congruency X Task

		Task		
		Dot	*Evaluative*	*Semantic*
Evaluative	*Congruent*	95.6%	95.4%	96.4%
	Incongruent	95.6%	94.1%	96.6%
	Mdiff	**0.0%**	**1.3%****	**-0.2%**

Note: Significant differences **p < .01

Table 1.3: Evaluative Congruency X Target Valence

		Target Valence		
		Liked	*Disliked*	***Mdiff***
Evaluative	*Congruent*	96.1%	95.6%	**0.5%**
	Incongruent	95.4%	95.4%	**0%**

Note: No significant differences

Additional target effects included a significant interaction between target category and task, F (2, 96) = 4.41, $p < .05$. Simple effects for this interaction (Table 1.4) revealed that participants responded more accurately to animal targets (M = 95.6%, SE = .75) compared to person targets (M = 93.9%, SE = .83) during the evaluative task, F (1, 31) = 5.40, p = .027. This effect was not found during the feature-detection task (M_{animal} = 95.6%, SE = .72; M_{person} = 95.7%, SE = .76; F (1,33) = .447, p = .508) or the semantic task (M_{animal} = 96.4, SE = .74; M_{person} = 96.6%, SE = 7.8; F (1,32) = .317, p = .577). A significant interaction between target category and target valence was also demonstrated, F (1, 96) = 20.93, $p < .01$. Simple effects (Table 1.5)

show that participants responded more accurately to negative-animal targets (*M* = 96.3%, *SE* = .44) than to positive-animal targets (*M* = 95.4%, *SE* = .47) across task, F (1, 98) = 8.02, p = .006, and to positive-person targets (*M* = 96.1%, *SE* = .50) compared to negative-person targets (*M* = 94.7%, *SE* = .56) across task, F (1, 98) = 8.96, p = .004.

Table 1.4: Target Category X Task

Target Category	Task: *Dot*	Task: *Evaluative*	Task: *Semantic*
Person	95.7%	93.9%	96.6%
Animal	95.6%	95.6%	96.4%
Mdiff	**0.10%**	**-1.7%***	**0.2%**

Note: Significant differences, * p <.05

Table 1.5: Target Category X Target Valence

Target Category	Target Valence: *Liked*	Target Valence: *Disliked*	***Mdiff***
Person	96.1%	94.7%	**1.4%****
Animal	95.4%	96.3%	**-.9%****

Note: Significant differences, ** p <.01

3.2 Response Times

Log transformations were performed on the response latencies prior to analysis; however, response times are reported in milliseconds for ease of interpretation. A main effect for condition

was revealed, F (2, 96) = 4.50, p = .003. Contrast comparisons demonstrated that participants responded faster during the semantic task (M = 576 ms, SE = 17.25) than the evaluative task (M = 643, SE = 16.99; t (96) = 3.12, p = .002); however, participants were not found to respond significantly faster in the semantic condition compared to the feature-detection task (M = 587 ms, SE = 16.99; t (96) = .226, p = .822). Participants were found to respond faster during the feature-detection task (M = 587 ms, SE = 17.51) than during the evaluative task, t (96) = -2.91, p = .005. As expected, response times to semantically congruent picture pairs were faster (M = 596 ms, SE = 9.9) than incongruent picture pairs (M = 608 ms, SE = 10; F (1, 96) = 50.17, $p < .001$). This main effect was qualified by a significant interaction between semantic congruency and task, F (2, 96) = 41.44, $p < .001$) (Table 1.6). Further analysis revealed the semantic priming effect only occurred during the semantic task, F (1, 32) = 54.47, $p < .001$. Participants responded more quickly to semantically congruent picture pairs (M = 558 ms, SE = 16.8) than to incongruent picture pairs (M = 594 ms, SE = 16.8). The semantic priming effect was not found during the feature-detection task ($M_{semcong}$ = 588 ms, SE = 17; $M_{semincong}$ = 587 ms, SE = 17.1; F (1, 33) = .012, p = .913) or evaluative task ($M_{semcong}$ = 642 ms, SE = 17.6; $M_{semincong}$ = 645 ms, SE = 17.6; F (1, 31) = 2.93, p = .097).

Table 1.6: Semantic Congruency X Task

		Task		
		Dot	*Evaluative*	*Semantic*
Semantic	*Congruent*	588	642	558
	Incongruent	587	645	594
	Mdiff	**1**	**-3**	**-36*****

Note: Response times are reported in milliseconds, ***p < .001

As hypothesized, response times were also found to be faster to evaluatively congruent picture pairs (*M* = 597 ms, *SE* = 9.9) compared to incongruent picture pairs (*M* = 607 ms, *SE* = 10); *F* (1, 96) = 51.29, *p* < .001). This main effect was qualified by a significant interaction between evaluative congruency and task, *F* (2, 96) = 41.60, *p* < .001 (Table 1.7). The evaluative priming effect was found during the evaluative task, *F* (1, 31) = 59.08, *p* < .001, where participants responded more quickly to evaluatively congruent picture pairs (*M* = 629 ms, *SE* = 12.5) than incongruent picture pairs (*M* = 658 ms, *SE* = 13.1). This effect was also unexpectedly present in the semantic task ($M_{evalcong}$ = 574 ms, *SE* = 16.6; $M_{evalincong}$ = 578 ms, *SE* = 16.6; *F* (1, 32) = 6.12, *p* = .019), albeit to a lesser degree. The evaluative priming effect was only marginally significant during the feature-detection task ($M_{evalcong}$ = 589 ms, *SE* = 17; $M_{evalincong}$ = 586 ms, *SE* = 17; *F* (1, 33) = 3.27, *p* = .08).

Table 1.7: Evaluative Congruency X Task

		Task		
		Dot	*Evaluative*	*Semantic*
Evaluative	*Congruent*	589	629	574
	Incongruent	586	658	578
	Mdiff	**3**	**29*** **	**-4***

Note: Response times are reported in milliseconds, *p < .05, ***p < .001

A significant interaction between semantic congruency and evaluative congruency was also found, F (1, 96) = 6.48, p = .013 (Table 1.8). Simple effects revealed that the semantic congruency effect was larger when picture pairs were also evaluatively congruent (M_{diff} = -15 ms) than evaluatively incongruent (M_{diff} = -10 ms; F (1, 98) = 26.52, p < .001). The evaluative congruency effect was larger for picture pairs that were also semantically congruent (M_{diff} = -13 ms; F (1, 98) = 34.64, p < .001) than if they were semantically incongruent (M_{diff} = -8 ms). This interaction was significantly moderated by target category, F (1, 96) = 17.25, p < .001 (see Appendix Table 1).

Table 1.8: Semantic Congruency X Evaluative Congruency

		Evaluative		
		Congruent	*Incongruent*	***Mdiff***
Semantic	*Congruent*	589	602	**-13*** **
	Incongruent	604	612	**-8*** **
	Mdiff	**-15*** **	**-10*** **	

Note: Response times are reported in milliseconds, ***p < .001

Target category effects were not of primary interest to the current study but significantly revealed a target category by task interaction, *F* (2, 96) = 20.94, *p* < .01 (Table 1.9). During the evaluative task, participants responded more quickly to animal targets (*M* = 632 ms, *SE* = 13.4) than to person targets (*M* = 653 ms, *SE* = 12.2; *F* (1, 31) = 22.94, *p* < .001). During the semantic task, participants responded faster to person targets (*M* = 570 ms, *SE* = 17) than to animal targets (*M* = 581 ms, *SE* = 16.5; *F* (1, 32) = 8.93, *p* = .005). However, no differences were demonstrated between responses made to person or animal targets during the feature-detection task (M_{person} = 587 ms, *SE* = 17; M_{animal} = 588 ms, *SE* = 17.1; *F* (1, 33) = .594, *p* = .446).

Table 1.9: Target Category X Task

Target Category	Task: *Dot*	Task: *Evaluative*	Task: *Semantic*
Person	587	653	570
Animal	588	632	581
Mdiff	**-1**	**21*** **	**-11****

Note: Response times are reported in milliseconds, *p < .05, ***p < .001

Results show that semantic congruency interacted with target category, *F* (1, 96) = 36.80, *p* < .001 (Table 1.10). Participants responded faster to semantically congruent picture pairs when the target was a person (*M* = 594 ms, *SE* = 10.9) compared to an animal (*M* = 598 ms, *SE* = 10.2; *F* (1, 98) = 3.93, *p* < .05). The opposite effect was found when the picture pairs were semantically incongruent; participants responded faster to animal targets (*M* = 603 ms, *SE* = 10.3) than to person targets (*M* = 613 ms, *SE* = 10.4; *F* (1, 98) = 13.3, *p* < .001). Evaluative congruency also interacted with target category, *F* (1, 96) = 8.13, *p* < .01; however, simple

effects were not found to be significant. Further findings show that these two interactions (semantic congruency by target category and evaluative congruency by target category) were moderated by a third variable, task (see Appendix Tables 2 & 3). The evaluative congruency by target category interaction was also found to be moderated by the valence of the target, F (1, 96) = 7.42, p = .008 (see Appendix Table 4).

Table 1.10: Semantic Congruency X Target Category

		Target Category		
		Person	*Animal*	***Mdiff***
Semantic	*Congruent*	594	598	**-4***
	Incongruent	613	603	**10*****

Note: Response times are reported in milliseconds, *p<.05, ***p<.001

Additional target effects demonstrate a significant evaluative congruency by target valence interaction, F (1, 96) = 27.67, p < .001 (Table 1.11). Participants responded faster to evaluatively incongruent picture pairs with a disliked target (M = 602 ms, SE = 10.3) compared to a liked target (M = 612 ms, SE = 11; F (1, 98) = 7.63, p = .007). A marginally significant difference was found between liked and disliked targets when picture pairs were evaluatively congruent, F (1, 98) = 3.87, p = .052. This interaction was found to be significantly moderated by task, F (2, 96) = 8.47, p < .001 (see Appendix Table 5).

Table 1.11: Evaluative Congruency X Target Valence

Evaluative	Target Valence: *Liked*	Target Valence: *Disliked*	***Mdiff***
Congruent	594	600	**-6**
Incongruent	612	602	**10****

Note: Response times are reported in milliseconds, **p < .01

An interaction between target category and target valence was also found to be significant, F (1, 96) = 68.02, $p < .001$ (Table 1.12). Participants responded faster to person targets that were liked (M = 598 ms, SE = 10.6) compared to disliked (M = 610 ms, SE = 10.7; F (1, 98) = 16.1, $p < .001$). Interestingly, the opposite effect was found for animal targets: participants responded faster to disliked-animal targets (M = 592 ms, SE =9.9) than liked animals (M = 608 ms, SE = 10.8; F (1, 98) = 13.68, $p < .001$). This interaction was found to be significantly moderated by task (F (2, 96) = 20.82, $p < .001$) (see Appendix Table 6). A significant four way interaction was also found: semantic congruency by evaluative congruency by target category by target valence (F (2, 96) = 6.59, $p = .008$) (see Appendix Table 7).

Table 1.12: Target Category X Target Valence

Target Category		Target Valence: *Liked*	Target Valence: *Disliked*	***Mdiff***
	Person	598	610	**-12*** **
	Animal	608	592	**16*** **

Note: Response times are reported in milliseconds, ***p < .001

3.3 ERP – N400

The N400 peak was not found to be elicited in the averaged waveforms and thus could not be analyzed. Previous research that has examined the N400 and LPP simultaneously have reported cases in which the LPP waveform has "overlaid" the N400 waveform. It has been suggested that as semantic relatedness increases in a priming paradigm, the LPP latency will peak earlier and superimpose the N400 (Hill, Ott, & Weisbrod, 2005; Hill, Strube, Roesch-Ely, & Weisbrod, 2002).

3.4 ERP – LPP

LPP results revealed a more positive peak amplitude to semantically incongruent picture pairs (M = 7.71 µV; SE = .38) compared to congruent picture pairs (M = 7.15 µV; SE = .34; F (1, 96) = 21.97, $p < .001$). This effect was not hypothesized and is a novel finding. A significant interaction between semantic congruency and task was also found, F (2, 96) = 7.07, $p < .001$ (Figure 1.1). The peak amplitude of the LPP was larger to semantically incongruent picture pairs during both the dot task (M_{cong} = 6.45 µV; SE = .53, M_{incong} = 6.82 µV; SE = .49; F (1, 33) = 6.18, p = .018) (see Appendix Figure 1.4) and the semantic task (see Appendix Figure 1.3) (M_{cong}

= 6.4 μV; *SE* = .65, M_{incong} = 7.56 μV; *SE* = .77; F (1, 32) = 16.3, $p < .001$). This effect was not revealed during the evaluative task (M_{cong} = 8.60 μV; *SE* = .59, M_{incong} = 8.73 μV; *SE* = .66; F (1, 31) = .823, $p = .371$). Furthermore, semantic congruency interacted with target category, F (1, 96) = 6.98, $p < .01$. The LPP was not found to be significantly larger to semantically congruent picture pairs when the target was a person (*M* = 7.26 μV, *SE* = .34) compared to an animal (*M* = 7.05 μV, *SE* = .36; F (1, 98) = 1.49, $p = .23$). Although not significant, the opposite marginal effect was found when the picture pairs were semantically incongruent; the LPP was larger to animal targets (*M* = 7.90 μV, *SE* = .40) than person targets (*M* = 7.5 μV, *SE* = .38; F (1, 98) = 2.96, $p = .09$).

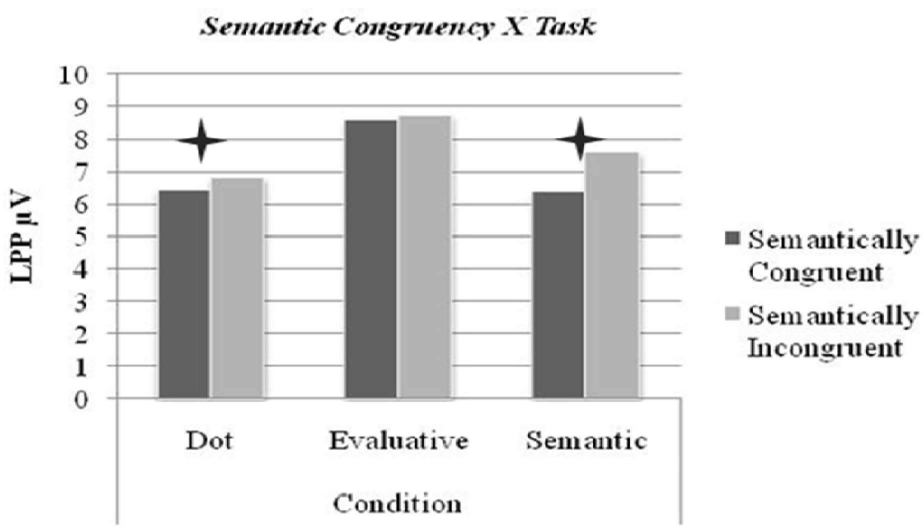

Figure 1.1: Semantic priming was significant in the feature-detection (dot) and semantic tasks but not during the evaluative task.

As hypothesized, the LPP was also more positive to evaluatively incongruent picture pairs (*M* = 7.59 μV; *SE* = .37) than to congruent picture pairs (*M* = 7.27 μV; *SE* = .34; F (1, 96) = 13.92, $p < .001$). A significant interaction between evaluative congruency and task revealed that the LPP was only elicited during the evaluative task, F (1, 31) = 16.29, $p < .001$, larger

peaks were elicited by evaluatively incongruent picture pairs (*M* = 9.04 µV; *SE* = .67) than congruent pairs (*M* = 8.3 µV; *SE* = .58) (Figure 1.2; also see Appendix Figure 1.5). This effect was not found during the semantic task (M_{cong} = 6.99 µV, *SE* = .59; M_{incong} = 7.0 µV, *SE* = .63; *F* (1, 32) = .016, *p* = .902) or feature-detection task (M_{cong} = 6.54 µV, *SE* = .59; M_{incong} = 6.73 µV, *SE* = .62; *F* (1, 33) = 2.42, *p* = .129).

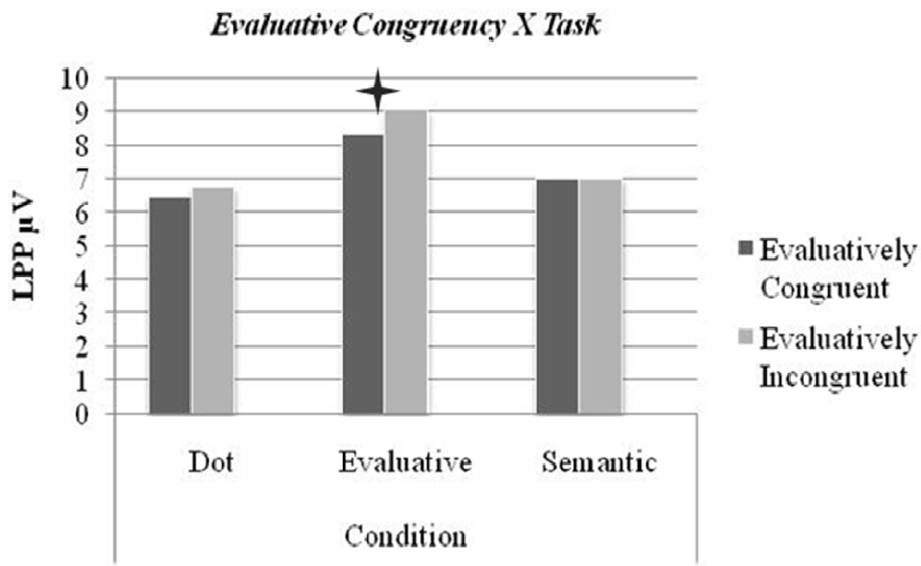

Figure 1.2: Evaluative priming was significant in the evaluative task but not during the feature-detection (dot) or semantic tasks.

Target effects, though not central to any hypotheses, were also revealed: the LPP was larger to liked targets (*M* = 7.73 µV; *SE* = .37) than to disliked targets (*M* = 7.14 µV; *SE* = .35; *F* (1, 96) = 26.35, $p < .001$). Target category interacted with the valence of the target, *F* (1, 96) = 15.02, $p < .001$, (Table 1.13) and simple effects revealed a larger LPP elicited by liked animal targets (*M* = 7.99 µV; *SE* = .38) than by disliked animal targets (*M* = 6.95 µV; *SE* = .38; *F* (1, 98) = 34.39, $p < .001$). A four-way interaction between semantic congruency by evaluative congruency by target valence by condition was also found to be significant; however, since this

interaction is not central to the scope of this study it will not be described in further detail, *F* (2, 96) = 3.53, *p* = .033 (see Appendix Table 8).

Table 1.13: LPP – Target Category X Target Valence

Target Category		**Target Valence**		
		Liked	*Disliked*	***Mdiff***
	Person	7.46	7.32	**0.14**
	Animal	7.99	6.95	**1.04*****

Note: LPP differences reported in μV, ***p < .001

Chapter 4: Discussion

The current study examined the cognitive mechanisms underlying evaluative and semantic priming by investigating behavioral response times, the N400, and LPP ERP components. A between-subject task manipulation was used to isolate and characterize the N400 and LPP to evaluative and semantic priming effects. Consistent with our expectations, participants responded slower to evaluatively incongruent stimuli that elicited larger LPP peak amplitudes during the evaluative task. Unexpectedly, participants also responded slower to evaluative incongruities during the semantic task. Results revealed slower responses to semantically incongruent stimuli pairs and larger LPP peak amplitudes during the semantic task. Larger LPPs were also elicited by semantic incongruities during the feature-detection tasks. The results from this present study will help shed light on inconsistencies found in evaluative priming research and allow for a better understanding of the cognitive mechanisms underlying evaluative and semantic priming.

4.1 Evaluative Priming

The current study demonstrated the hypothesized evaluative priming effect (faster responses and higher accuracy to congruent than incongruent picture pairs) during the evaluative task. However, behavioral response times also revealed the evaluative priming effect during the semantic task, which was not consistent with previous results reported by Taylor (2008). However, as previously discussed, research findings have demonstrated similar results to that of the current study by eliciting the evaluative priming effect during non-evaluative tasks (Spruyt, De Houwer, Hermans, & Eelen, 2007; Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007). The study conducted by Spruyt and colleagues (2007) instructed participants to indicate if

the target was either living or nonliving and to count the number of times the prime was positive or negative. By allocating the attention of participants to the evaluative dimension of the stimuli, the evaluative priming effect was elicited during the non-evaluative task. In the current study, the evaluative task may have become salient to participants prior to completing the semantic task because the experimenter asked participants to look over their stimuli set (selected by the experimenter based on ratings from the pre-session) to ensure that no mistakes were made when rating their attitude toward the stimuli during the pre-session. Yet, the current results are not in line with other studies that have found no behavioral evaluative effect during non-evaluative tasks (Bargh, Chaiken, Raymond, & Hymes, 1996; De Houwer, Hermans, Rothermund, & Wentura, 2002; Klauer, & Musch, 2002; Klauer & Musch, 2003; Klauer, Roβnagel, & Musch, 1997; Klinger, Burton, & Pitts, 2000; Wentura, 1999). Unlike the present study, which used a small number of strong idiosyncratic picture stimuli to examine the evaluative priming effect, these other studies used weaker evaluative stimuli which may have not allowed for efficient evaluative processing to occur during non-evaluative tasks.

The behavioral evaluative priming effect is further qualified by the presence of the LPP to evaluative incongruities during the evaluative task. LPP findings for the current study were consistent with those of affective (emotional) studies and with that of Taylor (2008), which have reveled larger LPP peak amplitudes to evaluatively incongruent stimulus pairs than congruent pairs during an evaluative task (Herring et al., 2010; Hinojosa, Carretié, Méndez-Bértolo, Míguez, & Pozo, 2009; Werheid, Alpay, Jentzsch, & Sommer, 2005; Zhang, Li, Gold, & Jiang, 2010). Examination of the LPP to evaluative priming effects during the semantic and feature-detection tasks revealed no effects. Although the LPP finding to evaluative priming during the evaluative task was hypothesized and mirrored the behavioral data, the LPP did not match the

behavioral evaluative effect that occurred during the semantic task. There is no clear consensus regarding how task manipulations have differentiating effects on cognitive processing at the level of response times and psychophysiology (Nieuwenhuis, Aston-Jones & Cohen, 2005).

4.2 SEMANTIC PRIMING

The behavioral semantic priming effect (faster response times to semantically congruent than to incongruent picture pairs) occurred during the semantic task and not during the evaluative and feature-detection tasks. This finding was expected because researchers have demonstrated the resilience of the semantic priming effect during varied tasks (Deacon, Hewitt, Yang, & Nagata, 2000; Holcomb, Reder, Misra, & Grainger, 2005; Hutchinson, 2003; Kreher, Holcomb, & Kuperberg, 2006; Marcel, 1983; Neely, 1977; for a review see Neely, 1991). The behavioral semantic priming effect was not demonstrated during the evaluative task, which replicates findings reported by Taylor (2008). This may have been caused by the evaluative dimension outweighing the differences in semantic category of the prime and target. In addition to these priming effects, it was also found that participants responded the fastest when picture pairs were congruent along both dimensions. In fact, if participants were presented with a picture pair that was incongruent along one dimension, as long as it was congruent along the other dimension they responded faster than if it was incongruent along both dimensions.

LPP peak amplitudes were revealed to be larger to semantically incongruent picture pairs during the semantic and feature-detection tasks. Based on prior studies that have only examined the LPP to emotional incongruities during an affective task (i.e., pleasant or unpleasant), it was hypothesized that the LPP would only be sensitive to behavioral evaluative priming effects during the evaluative tasks. This interesting and novel finding has not been demonstrated by other affective studies because stimuli have not been systematically controlled along a semantic

dimension. In addition, prior affective studies have not examined tasks effects on the LPP. The LPP effect to semantic incongruities in the semantic and feature-detection tasks is supported by studies that have demonstrated that the LPP may be sensitive to semantic relatedness in a lexical-decision task (Hill, Ott, & Weisbrod, 2005; Hill, Strube, Roeshce-Ely, & Weisbrod; 2002). The findings of the current study may be the first to demonstrate the LPP effect to semantic incongruities while also varying the evaluative congruity of picture pairs. The LPP effect can further be understood by research that has demonstrated the sensitivity of the LPP to task-irrelevant categorizations during an oddball paradigm (Corral, 2009; Ito & Cacioppo, 2000). Researchers have recently shown the LPP to be sensitive to task-irrelevant processes, in which case participants are instructed to categorize along one dimension of the target (e.g., gender) and yet differences along another dimension (e.g., valence) have also been shown to elicit the LPP (Corral, 2009; Ito & Cacioppo, 2000). Thus, it is possible that the LPP was sensitive to semantic incongruities (task irrelevant categorizations) during the feature-detection task.

Analyses of the averaged waveforms revealed no defined N400 peaks throughout the varied tasks, which is unexpected based on robust findings reported in the semantic priming literature. The N400 has well-documented semantic priming effects (Bentin, McCarthy, & Wood, 1985; Deacon, Hewitt, Yang, & Nagata, 2000; Holcomb, Reder, Misra, & Grainger, 2005; Kreher, Holcomb, & Kuperberg, 2006); however, the N400 was not clearly elicited by semantic incongruities in the current study. The N400 could have been superimposed by the large positive LPP effect, which has been reported by other researchers (1989; Hill, Ott, & Weisbrod, 2005; Hill, Strube, Roeshce-Ely, & Weisbrod; 2002; Kutas and Hillyard). The lack of a N400 evaluative priming effect directly disputes findings reported by Morris et al. (2003) and Zhang et al. (2006 & 2010) but coincides with affective priming studies that have also not found

the N400 effect to emotional incongruities (Herring et al., 2010; Hinojosa, Carretié, Méndez-Bértolo, Míguez, & Pozo, 2009).

4.3 Target Effects

Although no hypotheses were generated about target category or target valence effects, results for the target category support those reported by Taylor (2008) and De Houwer et al. (2002), which demonstrated that participants responded faster to animal targets than to person targets during an evaluative task. In addition to these results, it was also demonstrated that participants who completed the semantic task responded faster to person targets than to animal targets. No differences were found in the feature-detection task. Target valence effects reported by Taylor (2008) demonstrated that participants responded significantly faster to positive targets than to negative targets, which has also been demonstrated by Werheid et al. (2005) and supported by theory put forth by Unkelbach et al. (2008). The current study showed a similar finding: participants responded faster to liked-people targets than disliked people. However, results also demonstrated faster responses to disliked-animal targets than liked-animal targets. Similarly, empirical findings and theoretical perspectives from other researchers have demonstrated faster response times to negative stimuli than to positive stimuli (Herring, 2009; Cacioppo & Berntson, 1994; Cacioppo, Gardner, & Berntson, 1997). Accuracy ratings also revealed the same pattern of effects. This possibly indicates that a positive bias exists for people and a negative bias exists for animals.

4.4 Future Directions

Novel findings reported by the present study should be replicated and reexamined by using experimental designs that would allow for a better comparison of N400 and LPP effects.

As previously discussed, the LPP in the present study overlaid the N400 effect, thus eliminating the ability to make direct comparisons of evaluative and semantic priming effects between these two ERP components. Other studies that have examined the N400 have specifically designed experimental manipulations to prevent the overlap of the LPP and have done so by manipulating the length of the SOA and including a task that required participants to identify a probe following the target (e.g., word-word or pseudo word; Hill, Ott, & Weisbrod, 2005; Hill, Strube, Roeshce-Ely, & Weisbrod; 2002; Kutas & Hillyard, 1989). Studies have found the LPP to be sensitive to semantic priming when using short SOA's of 250 ms and not at longer SOA's of 700 ms, which is thought to indicate implicit semantic processing (Hill, Strube, Roeshce-Ely, & Weisbrod; 2002). Studies have also used alternative methods, such as principle component analyses and the ICA to separate ERP component effects (Keyser & Tenke, 2003; Debeber, Makeig, Delorme & Engel, 2004). Therefore, future evaluative and semantic priming studies should try to avoid overlap between these two components to further examine the cognitive mechanisms underlying semantic and evaluative priming effects. In addition, by parsing out these two components, LPP effects to semantically incongruent picture pairs during the semantic and feature-detection tasks can be reexamined.

Behavioral semantic priming effects were examined in the current study by varying prime and target pairs along two semantic categories (person vs. animal), yet this study did not examine the role of semantic associations between prime and target pairs. Studies that have examined the modulation of the N400 by manipulating semantic association (e.g., traffic-jam) and semantic relatedness (lemon-orange) between word pairs have argued that the semantic association is critical for activating meaning in memory, more so than semantic relatedness (Rhodes & Donaldson, 2008). Thus, to better examine the mechanisms underlying evaluative and semantic

priming effects, semantic association between prime pairs should be investigated. It is possible that this variation could influence the degree to which evaluations stored in memory are activated.

Behavioral results demonstrating that participants responded faster to evaluatively congruent picture pairs during both the evaluative and semantic task should be reexamined by systematically varying the complexity of attitudinal stimuli and degree of cognitive load in a priming paradigm. The present study found target effects for accuracy, response time and the LPP, which could have resulted from variation of attitudinal complexity for person targets versus animal targets. It is possible that participants have more complex attitudes for person stimuli (e.g., like Mel Gibson as an actor but dislike his drunken acts) than for animal stimuli. In addition, the present study compared the activation of attitudes for the broad category of animals to the more defined category of males. Future studies should reexamine the present target effects by more systematically varying the degree of attitudinal complexity of prime and target pairs.

The effects of cognitive load on the evaluative and semantic priming effects should also be examined because, as previously discussed, this study used a small set of strong idiosyncratic picture stimuli which may have resulted in a smaller cognitive demand on participants compared to other behavioral evaluative studies that used words. The variation in cognitive load could have played a role in producing differing evaluative priming effects across tasks, where some studies have been able to demonstrate the evaluative priming effect during non-evaluative tasks while others have not. To examine the effects of cognitive load on evaluative priming during non-evaluative tasks, other evaluative stimuli should be examined such as sounds.

4.5 CONCLUSIONS

The behavioral and ERP findings suggest that different cognitive mechanisms underlie evaluative and semantic priming effects. The reported LPP was found to be larger for both evaluative and semantic incongruities but was demonstrated during *different tasks*. In addition, the evaluative N400 effect previously reported by Morris et al. (2003) and Zhang et al. (2006 & 2010) was not replicated. These findings illustrate the demand to continue investigating the cognitive mechanisms that underlie evaluative and semantic priming due to the varying LPP task effects that were revealed. The sensitivity of the LPP to semantic incongruities during the semantic task and the feature-detection task demonstrate possible use of the LPP to investigate implicit semantic processing. In addition to the novel semantic LPP findings, the current results coincide with affective research which demonstrates the usefulness of the LPP to examine evaluative processing. The degree with which the LPP is sensitive to evaluative priming effects should continue to be examined by varying the degree to which participants allocate attention to the evaluative dimension while varying task instructions. The present study suggests that the LPP is elicited by evaluative priming effects only during evaluative tasks and not during non-evaluative tasks, whereas LPP sensitivity to semantic priming effects may occur across tasks. These results illustrate the usefulness of the LPP to examine evaluative and semantic priming effects and the cognitive mechanisms that underlie these processes.

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Appendix A

Semantic Congruency X Evaluative Congruency X Target Category

When participants viewed picture pairs that were semantically congruent and evaluatively incongruent, they responded faster to person targets than to animal targets. However, when picture pairs were semantically incongruent, participants responded faster to animal targets regardless if the pictures were evaluatively congruent or incongruent. Participants responded faster to evaluatively and semantically congruent picture pairs with person targets and animal targets compared to evalutively incongruent picture pairs. Participants responded faster to person and animal targets if presented in semantically incongruent picture pairs that were also evaluatively congruent compared to evalutively incongruent.

Appendix Table 1: Semantic Congruency X Evaluative Congruency X Target Category

			Evaluative	
		Congruent	*Incongruent*	***Mdiff***
Semantic *Congruent*	Person	592	597	**-5***
	Animal	588	608	**-20*****
	Mdiff	**4**	**-11*****	
Incongruent	Person	609	619	**-10*****
	Animal	600	607	**-7***
	Mdiff	**9****	**12*****	

Note: Response times are reported in milliseconds, *$p < .05$, **$p < .01$, ***$p < .001$

Semantic Congruency X Target Category X Task F (2, 96) = 32.97, p < .001

When participants completed a semantic task and were presented with semantically congruent picture pairs, they responded faster to person targets. However, when they were presented with a semantically incongruent picture pairs, they responded faster to animal targets. When participants completed the evaluative task, they responded faster to animal targets regardless of semantic congruency. However, when participants completed a feature-detection task, no differences were found in response times to person and animal targets for either semantically congruent or incongruent picture pairs.

Appendix Table 2: Semantic Congruency X Target Category X Task

Semantic			Task		
			Dot	*Evaluative*	*Semantic*
	Congruent	Person	587	654	542
		Animal	588	631	575
		Mdiff	**-1**	**23*****	**-33*****
	Incongruent	Person	587	654	600
		Animal	587	635	587
		Mdiff	**0**	**19*****	**13 marginally sig**

Note: Response times are reported in milliseconds, ***p < .001

Evaluative Congruency X Target Category X Task F (2, 96) = 4.92, p = .009

When participants completed the evaluative task, they responded faster to animal targets regardless if the picture pairs were evaluatively congruent or incongruent. Participants responded faster to person targets during the semantic task when presented in evaluatively incongruent picture pairs.

Appendix Table 3: Evaluative Congruency X Target Category X Task

Evaluative		Task: *Dot*	Task: *Evaluative*	Task: *Semantic*
Congruent	Person	588	642	571
	Animal	590	615	576
	Mdiff	**-2**	**27*****	**-5**
Incongruent	Person	587	665	571
	Animal	585	651	586
	Mdiff	**2**	**14*****	**-15*****

Note: Response times are reported in milliseconds, ***p < .001

Evaluative Congruency X Target Category X Target Valence

These results show that participants responded more quickly to liked-person targets when presented in either in evaluatively congruent or incongruent picture pair compared to liked animals. On the other hand, participants responded faster to disliked-animal targets compared to disliked persons regardless if they were presented in an evaluatively congruent or incongruent picture pairs. Liked-person targets were responded to faster compared to disliked person targets in evaluatively congruent picture pairs. Disliked-animal targets were responded to faster than to liked animals regardless if they were presented in an evaluatively congruent or incongruent picture pair.

Appendix Table 4: Evaluative Congruency X Target Valence X Task

Evaluative			**Target Valence**		
			Positive	*Negative*	***Mdiff***
	Congruent	Person	589	612	**-23*******
		Animal	599	589	**10***
		Mdiff	**-10*******	**23*******	
	Incongruent	Person	607	609	**-2**
		Animal	617	597	**20*******
		Mdiff	**-10*******	**12****	

Note: Response times are reported in milliseconds, *p < .05, **p < .01, ***p < .001

Evaluative Congruency X Target Valence X Task

When participants completed the evaluative task and were presented with evaluatively congruent picture pairs, they responded faster to liked targets than to disliked targets. However, participants in the semantic task responded faster to disliked targets when presented in evaluatively incongruent picture pairs.

Appendix Table 5: Evaluative Congruency X Target Valence X Task

Evaluative		Task: *Dot*	Task: *Evaluative*	Task: *Semantic*
Congruent	Liked	588	618	576
	Disliked	590	639	570
	Mdiff	**-2**	**-21***	**6**
Incongruent	Liked	588	664	584
	Disliked	584	652	572
	Mdiff	**4**	**12**	**12*** **

Note: Response times are reported in milliseconds, *p < .05, ***p < .001

Target Category X Target Valence X Task

Results show that during the evaluative and semantic tasks participants responded faster to liked-person targets than to disliked-person targets. Participants in the semantic task responded faster to disliked-animal targets than to liked-animal targets.

Appendix Table 6: Target Category X Target Valence X Task

Target Category		Task: *Dot*	Task: *Evaluative*	Task: *Semantic*
Person	Liked	588	640	566
Person	Disliked	586	668	576
	Mdiff	**2**	**-28*** **	**-10** **
Animal	Liked	588	642	595
Animal	Disliked	588	624	567
	Mdiff	**0**	**18**	**28*** **

Note: Response times are reported in milliseconds, **p < .01, ***p < .001

Semantic Congruency X Evaluative Congruency X Target Category X Target Valence

When participants were presented with semantically congruent and evaluatively congruent picture pairs, they responded faster to liked-person targets than to animal targets. In fact this occurred even if the picture pairs were evaluatively incongruent. However, when presented with semantically and evaluatively congruent picture pairs, participants responded faster to disliked-animal targets than to disliked-person targets. When presented with semantically incongruent picture pairs, participants continued to respond faster to disliked-animal targets than to liked animals regardless if the picture pairs were or were not evaluatively congruent.

Appendix Table 7: Semantic Congruency X Evaluative Congruency X Target Category X Target Valence

			Evaluative			
			Congruent		*Incongruent*	
			Liked	Disliked	Liked	Disliked
Semantic	*Congruent*	Person	581	603	597	597
		Animal	593	584	618	597
		Mdiff	**12****	**-19****	**21*****	**0**
	Incongruent	Person	597	621	617	620
		Animal	606	593	616	598
		Mdiff	**9**	**-28*****	**-1**	**-22*****

Note: Response times are reported in milliseconds, **p < .01, ***p < .001

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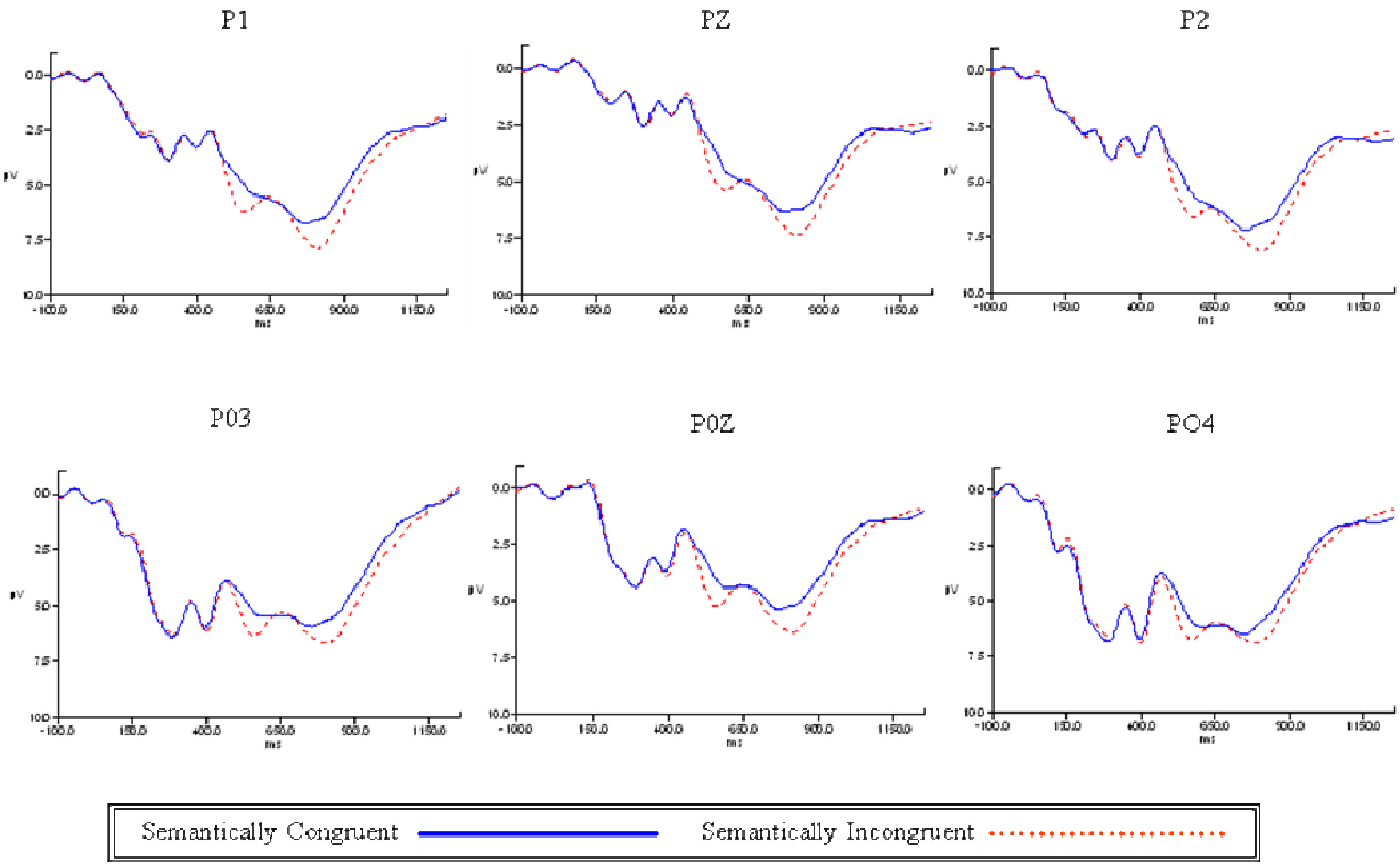
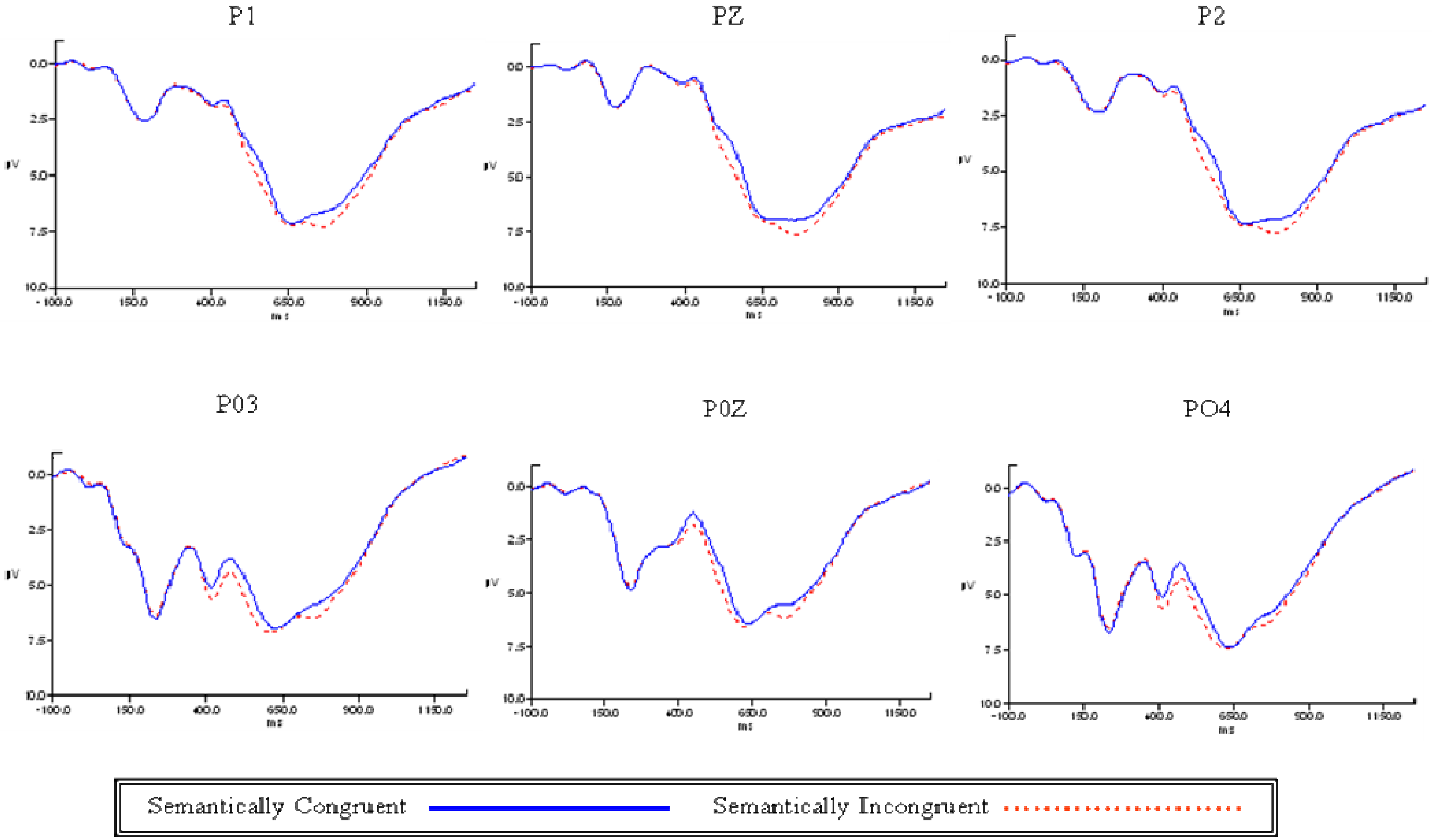
Appendix Table 8: Semantic Congruency X Evaluative Congruency X Target Category X Target Valence

Semantic		Evaluative: *Congruent* Dot	*Congruent* Evaluative	*Congruent* Semantic	*Incongruent* Dot	*Incongruent* Evaluative	*Incongruent* Semantic
Congruent	Liked	6.66	8.43	6.83	6.71	9.27	6.86
Congruent	Disliked	5.95	7.88	5.89	6.48	8.82	6.04
Incongruent	Liked	6.84	8.72	8.19	7.35	9.01	7.85
Incongruent	Disliked	6.7	8.16	7.04	6.39	9.03	7.27



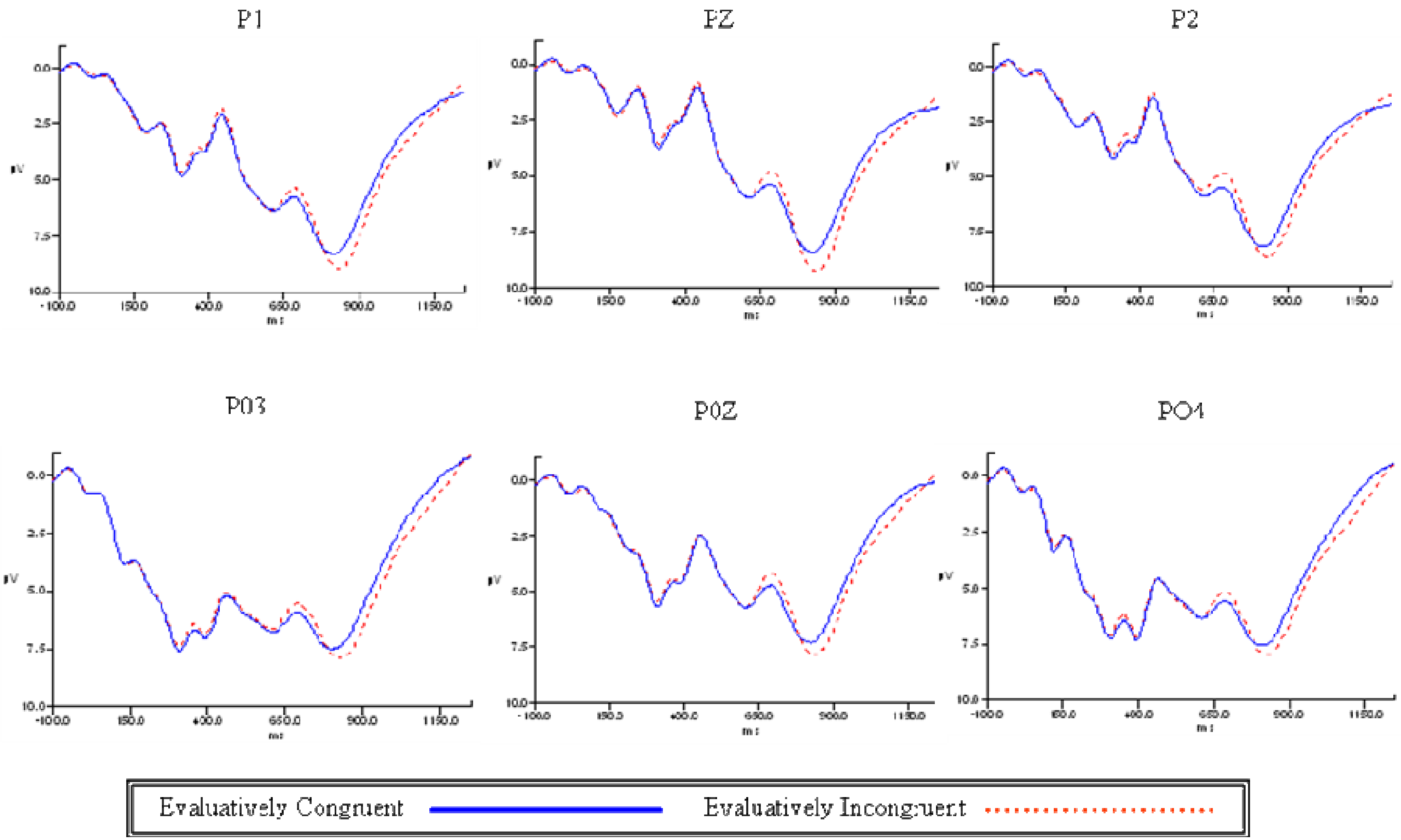
Note: Microvolts are presented on the Y axis, with positives going down, and milliseconds are presented on the X axis.

Figure 1.3: Semantic priming during the semantic task. LPP is larger to semantically incongruent than congruent picture pairs.



Note: Microvolts are presented on the Y axis, with positives going down, and milliseconds are presented on the X axis.

Figure 1.4: Semantic priming during the feature-detection task. LPP is larger to semantically incongruent than congruent picture pairs.



Note: Microvolts are presented on the Y axis, with positives going down, and milliseconds are presented on the X axis.

Figure 1.5: Evaluative priming during the evaluative task. LPP is larger to evaluatively incongruent than congruent picture pairs.

Curriculum Vita

Jennifer Taylor was born in El Paso, Texas on July 20, 1982 to Robert and Hilda Taylor. She graduated from Loretto Academy in El Paso, Texas in May of 2000 and entered the University of Texas at El Paso (UTEP) in the fall of 2000. As a participant in the Research Experience for Undergraduate (REU) Program at UTEP, Jennifer was involved with research in neurobiology and psychobiology laboratories. Jennifer also participated in the (REU) program at Indiana University where she has researched molecular plant biology. She was actively involved in several honor societies such as Psi Chi, National Society of Collegiate Scholars, Alpha Chi Honor Society and the Golden Key Honor Society at UTEP. Jennifer was awarded with the most outstanding senior and Cum Laude honors from the Biology Department when she completed her Bachelors of Science degree at UTEP in May 2004. Jennifer was accepted to the Social Cognitive Neuroscience Doctoral Program in the Department of Psychology at UTEP in fall of 2005 and was a recipient of the Alliance for Graduate Education and the Professoriate (AGEP) Fellowship. In December of 2008, she completed her master's research entitled: The N400 ERP: Semantic vs. Evaluative Incongruities. Jennifer conducted evaluative cognitive research in Dr. Stephen L. Crites' laboratory and attended conferences to present her ongoing research. During this program she worked as a teaching assistant taught six courses at UTEP, which included Introduction to Psychology, Cognitive Psychology and Psychobiology. Jennifer continued to work in Dr. Crites' laboratory until completion of her dissertation research.

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