9-2014

# Examination of Psychopathic Traits and Attention Using the Image Based Parity Task

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# Examination of Psychopathic Traits and Attention Using the Image Based Parity Task

by

Veronica Claudia Llamas

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A Dissertation submitted in partial satisfaction of
the requirements for the degree
Doctor of Philosophy in Clinical Psychology

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September 2014

Each person whose signature appears below certifies that this dissertation in his/her opinion is adequate, in scope and quality, as a dissertation for the degree Doctor of Philosophy.

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# ACKNOWLEDGEMENTS

As I reflect back on my time in graduate school and all the hard, long hours put into my education, it is hard to imagine getting through it without the awesome support I have received from family, friends, and mentors. I would like to express my sincerest thanks to Dr. Haerich, who has provided me with endless guidance, mentorship, and support throughout these many years. I am thankful for his continuous patience and enthusiasm, without which this project would not have been possible. I would also like to thank my committee members for their much appreciated advice and perspective, which has served to direct and refine the trajectory of this dissertation.

To my family, who has seen me at my worst and at my best, your patience, humor, and understanding have been integral in my battle with graduate school. You have stood by me despite my limited time to devote to you all. I am especially thankful for my father's faith in me and delicious food that has sustained me throughout desperate weekends. And to my mother, who is no longer here on Earth, I would like to express my deepest love and gratitude for her sacrifices, optimism and never-ending encouragement. I would also like to express a special thank you to my husband, who has never stopped believing I could accomplish anything, and who has provided me daily support through the trials and tribulations of graduate school colliding with life.

Lastly, but certainly not least, I would like to thank all my closest friends, some of whom were beside me during late night study sessions, and others who have patiently listened to my struggles. I could not ask for a better collection of partners in crime.

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ABBREVIATIONS

| | |
|---|---|
| PPI-R | Psychopathic Personality Inventory – Revised |
| ME | Machiavellian Egocentricity |
| RN | Rebellious Nonconformity |
| BE | Blame Externalization |
| CN | Carefree Nonplanfulness |
| SOI | Social Influence |
| F | Fearlessness |
| STI | Stress Immunity |
| C | Coldheartedness |
| PCL-R | Psychopathy Checklist – Revised |
| RMH | Response Modulation Hypothesis |
| SIL | Superimposed Low |
| SIH | Superimposed High |

ABSTRACT OF THE DISSERTATION

Examination of Psychopathic Traits and Attention Using the Image Based Parity Task

by

Veronica Claudia Llamas

Doctor of Philosophy, Graduate Program in Clinical Psychology
Loma Linda University, September 2014
Dr. Paul E. Haerich, Chairperson

Psychopathy has been defined as including deficits in affective, cognitive, and behavioral functioning. Due to the severity of these deficits, several etiological theories have emerged in an attempt to better understand the personality construct. The response modulation hypothesis (RMH; Patterson & Newman, 1993) is a theory growing in popularity among researchers and posits that an inability to reallocate attentional resources to peripheral information moderates the affective and behavioral deficits commonly documented within individuals with psychopathy. Thus, the present study attempted to examine to test the validity of the RMH in a non-incarcerated population. The results somewhat support the theory that subcortical-cortical circuitry is at least partly involved in how individuals with psychopathic traits process all information. As Coldheartedness increased interference from positively and negatively arousing distractors was similar. Likewise, increasing levels of Self-Centered Impulsivity were found to be associated with better accuracy. However, some traits of psychopathy were associated with more distraction. Future studies should consider determining which traits of psychopathy tend to moderate attentional focus and resultant affective processing.

# CHAPTER ONE

# INTRODUCTION

## Specific Aims

The study of psychopathy has become a growing field of investigation due to its affective, cognitive, and behavioral implications. Psychopathic individuals are characterized as lacking empathy, being impulsive, manipulative, and displaying superficial charm (Cleckley, 1988). Several etiological theories have emerged in an attempt to better understand the common deficits found with psychopathy. Prominent theories focus on neuroanatomical structures, fear conditioning, and cognitive deficits. Some researchers argue that the deficits associated with psychopathy may be a consequence of an inability to adequately process emotion or fear (e.g. Lykken, 1995, Patrick, Cuthbert, Lang, 1994). The idea of a basic fear dysfunction is based primarily on Gray's behavioral inhibition system model (Gray, 1987) and associations with amygdala functioning (Patrick, 1994). According to these theories, the amygdala plays a central role in sensory networks, learning, and behavioral expression. Another well documented theory in the field of psychopathy is the response modulation hypothesis (RMH; Patterson & Newman, 1993), which posits that an inability to reallocate attentional resources to peripheral information moderates the affective and behavioral deficits associated with psychopathy. This theory has been particularly useful in delineating the role of attention in processing fear and emotional information that was previously thought to be a primary contributor to psychopathy associated abnormalities.

Although many studies have investigated individuals assessed with psychopathy in the penal system, few have focused on the non-incarcerated population of psychopaths, and even fewer have studied individuals with psychopathic traits. Despite psychopaths being more prevalent in incarcerated samples (Hare, 2006; Salekin, Rogers, Ustad, & Sewell, 1998), emerging research suggests that individuals who have not committed violent crimes and are living among the general population, have some level of psychopathic traits. Therefore, the construct of psychopathy is considered to be dimensional in nature as opposed to categorical. Essentially, psychopathy can be viewed as a continuum on which individuals will express varying degrees of the personality construct (Edens, Marcus, Lilienfeld, & Poythress, 2006). This is in support of the shift to explore expression of psychopathic correlates in the non-incarcerated population.

The aim of the present study was to examine the relationship of attention and psychopathic personality traits in a non-incarcerated population. In order to thoroughly examine this relationship, a task which measures attentional focus and interference from peripheral stimuli was used. Moreover, this specific task should offer the possibility of using emotional distractors in a controlled design in order to examine how attention may moderate emotional processing. One such task, which meets these requirements, is the image-based parity task. The image-based parity task is also open to manipulations of the attentional focus providing for additional opportunities to examine the validity of the RMH. To date, no other studies have implemented the image-based parity task to explore the RMH; therefore, unique characteristics of this specific task may also further elucidate the role of attention and psychopathic traits. Experimental manipulations to the task was conducted in order to explore how the focus of attention may contribute to changes in response. The current study is also unique in that its sample will be a majority of non-Caucasian, (e.g., Hispanic, Asian American, African American) mixed gender participants. The current study contains a significant exploratory component as this specific task, experimental manipulations, and sample have never been examined together. However, based on the RMH it is expected that higher levels of psychopathic traits will be associated with reduced interference by peripheral information (i.e. images).

## Background

### *Introduction to Psychopathy*

The construct of psychopathy has been a central topic of research since Cleckley's (1988) seminal work and description of the personality disorder. Before moving on, it is essential to define the terminology that will be used to describe psychopathy throughout this paper. The term "psychopathy" is used to describe the general construct of psychopathy, "psychopathic individuals" or "psychopaths" will represent those individuals identified as meeting a clinical cut-off score defined by a specific study, and lastly "psychopathic traits" will refer to specific characteristics associated with psychopathy and existing on a continuum. The current understanding of psychopathy has been largely based on his observations of psychiatric inpatients. His description characterizes psychopathy as demonstrating significant emotional deficits such as lacking empathy, guilt, remorse, and shame. Experiencing low stress reactivity and having general poverty of affect are also psychopathy trademarks. He noted that individuals he identified as psychopaths often had poor interpersonal relationships which are characterized by superficial charm, deceitfulness, manipulation, unreliability, and egocentricity. Furthermore, Cleckley's description included traits which reflected poor abilities to plan, a general lack of insight and judgment, failure to learn by experience, and antisocial tendencies.

The development of the most widely used assessment for psychopathy – The Psychopathy Checklist-Revised (PCL-R; Hare, 2003) – has significantly impacted the conceptualization and examination of psychopathy. The PCL-R (like its predecessor the PCL) was created to capture the core interpersonal, affective, and antisocial tendencies associated with psychopathy. As a result, the construct of psychopathy was originally conceptualized as having two underlying facets described as the Interpersonal/Affective (Factor 1) and Social Deviance (Factor 2) factors. To this day, many researchers continue to conceptualize psychopathy with these factors in mind and often attempt to examine differential correlates associated with the two distinct, yet correlated factors. However, more recent analyses of the PCL-R have identified slightly different underlying constructs of psychopathy. Cooke and Michie (2001) found a 3-factor hierarchical model of psychopathy, which included facets of interpersonal style (manipulativeness, grandiosity), emotional deficiencies (lack of remorse and empathy), and impulsive lifestyle (lack of planning, irresponsibility). The results of their factor structure have fine-tuned the overarching core concepts of psychopathy by clarifying its distinct features. Moreover, they decided to exclude items associated with pure behavior as they argue that antisocial tendencies are a possible consequence of psychopathy and not necessarily a core diagnostic feature. Debate regarding this issue has continued as Hare (2003) proposed a four-factor construct to psychopathy including: an Interpersonal factor, Affective factor, Lifestyle factor, and Antisocial factor. He argued that the criminal items excluded from Cooke and Michie are clinically relevant and should not be excluded based on core features of the construct versus correlates. This evolution of how psychopathy has been conceptualized since the creation of a way to measure it has facilitated the etiological understanding, correlates, and possible “protective factors” associated with various psychopathic traits. Moreover, it leads to questions regarding the benefit of measuring traits of psychopathy, as opposed to clinical levels of psychopathy.

The use of empirical research to examine the proposed characteristics of psychopathy has proven to be extensive and useful. Individuals with high levels of psychopathy demonstrate diminished physiological responses to aversive shocks (Hare, 1982) and emotional stimuli (Patrick, Cuthbert, & Lang, 1994). Psychopathy has been linked to difficulty with processing parts of affective speech (Blair, Jones, Clark, Smith, 1997), attenuated fear potentiated startle (Levenston, Patrick, Bradley, Lang, 2000; Patrick, Bradley, & Lang, 1993; Vaidyanathan, Hall, Patrick, & Bernat, 2011), poor passive avoidance (Newman, & Kosson, 1986; Newman, & Schmitt, 1998), and impairments in identification of fear inducing behaviors and moral acceptance of such behaviors (Marsh, & Cardinale, 2012). Associations between psychopathy and the use of instrumental and indirect aggression have also been supported (Glenn, & Raine, 2009; Vaillancourt, & Sunderani, 2011). Notably, higher levels of psychopathy are predictive of general and violent crimes, likelihood to violate conditional release, and recidivism (Hart, 1998; Hart, Kropp, & Hare, 1988; Hemphill, Hare, &Wong, 1998; Salekin, Rogers, & Sewell, 1996; Salekin, Rogers, Ustad, & Sewell, 1998). Individuals identified as psychopaths have also evidenced poor to moderate success in treatment (Rice, Harris, & Cormier, 1992; Salekin, Worley, & Grimes, 2010).

### ***Continuous Distribution of Psychopathy***

As a result of the associated criminal impact, psychopathy has been largely studied within samples of criminal offenders. In fact, base rates of clinical psychopathy within prisons have been estimated to be from 15-30% for male offenders (Hare, 1995; Hare, 2003; Salekin, et al., 1998), with similar estimates (12-27%) reported for psychiatric hospitals (Cleckley, 1988). Such high base rates not only created ideal settings for the study of the construct, but also established a focus on the relationship between psychopathy and crime. However, emerging research has begun to support a dimensional, as opposed to taxonic, underlying construct of psychopathy, wherein traits of psychopathy, similar to any other pathology, exist at varying degrees along a continuum (Bishopp & Hare, 2008; Edens, Marcus, Lilienfeld, & Poythress, 2006). Additional support of a dimensional construct of psychopathy is also demonstrated by similar laboratory results for individuals with psychopathic traits as seen with individuals identified as meeting clinical criteria for psychopathy. For example, Fearless Dominance (which correlates to Factor 1 of the PCL-R) has been found to moderate the relationship between attention and fear potentiated startle, such that higher Fearless Dominance scores are associated with reduced fear potentiated startle when attention is drawn away from the threat (Dvorak-Bertsch, Curtin, Rubenstein, & Newman, 2009). Similarly, higher scores on psychopathy measures have been associated with reduced startle responses when viewing aversive pictures (Justus & Finn, 2007). In addition, undergraduates demonstrated reduced processing of distractors during an attentional demand task that varied by perceptual load (Sadeh & Verona, 2008). Furthermore, Masui, & Nomura

(2011) found that response inhibition was not affected by high punishment or reward for a sample of undergraduates with high psychopathy scores.

### ***Neuroanatomy of Psychopathy***

Prior to brain imaging studies, speculation regarding neurobiological abnormalities of psychopathy was based on cognitive and behavioral research. With advances in techniques, and the combination of previous laboratory studies, these speculations can now be explored further. Despite these advances and developments in knowledge, relatively few structural and functional brain imaging studies have been conducted specifically to examine abnormalities related to psychopathy. It should be noted, however, that no one structure has been linked with psychopathy, and instead the phenotypic traits may be better accounted for by a combination of abnormalities or neural pathways (Raine, & Yang, 2007). Since theories regarding the etiology of psychopathy usually focus on the amygdala and its neural connectivity with other areas of the brain, it will be the focus of this section.

The amygdala has garnered much attention for being dysfunctional in psychopathy. Because of the amygdala's role in emotional learning and fear-conditioning, it has long been hypothesized that psychopathy was associated with functional or structural abnormalities of the amygdala. Studies have demonstrated reduced amygdala activation for psychopathy when engaged in a moral-decision making task (Glenn, Raine, & Schug, 2009). Likewise, reduced amygdala volumes have also been shown in psychopaths (Yang, Raine, Narr, Colletti, Toga, 2009). However, in Boccardi, et al.'s (2011) sample of psychopathic offenders, increased global amygdala volumes were found for offenders with psychopathy when compared to controls. The increased global volumes were qualified by enlargements in the lateral nucleus and central nucleus (which are connected to other systems which can affect impulsivity, motivation, and stress). Decreases in tissue volume were also seen within the basolateral nucleus of the amygdala, which may account for the break down in reinforcement due to its connection with other brain regions and pathways. Related to the amygdala is the hippocampus, which has also been shown to have reduced posterior volumes in alcoholics with high psychopathy scores (Laakso, et al., 2001). Furthermore, psychopathic individuals have demonstrated reduced activation of the amygdala-hippocampal complex (Kiehl, et al., 2001).

With regard to pathways, evidence suggests there is reduced connectivity between the ventromedial prefrontal cortex and amygdala, as well as between the ventromedial prefrontal cortex and medial parietal cortex by way of the right uncinate fasciculus (Motzkin, Newman, Kiehl, & Koenigs, 2011). Due to the relationship between subcortical and cortical structures, it is important to also highlight differences in structure and activation found to be associated with psychopathy. Within a non-incarcerated population, reduced activation in the right inferior frontal cortex and medial prefrontal cortex during an affect recognition task has been associated with interpersonal/affective traits of psychopathy (Gordon, Baird, & End, 2004). Lastly, reductions in prefrontal gray matter volume in individuals with psychopathy have also been found, and may contribute to the cognitive and affective deficiencies often demonstrated with higher levels of psychopathy (Yang, et al., 2005). Taken as a whole, the abnormalities evident in psychopathic individuals may contribute to the emotional and behavioral deficits commonly documented. Furthermore, dysfunctions in the subcortical—cortical neural pathways provide greater support for the interaction between emotional and cognitive processing deficits.

### *Low-fear Hypothesis*

Given deficits that include: poor fear conditioning (Lykken, 1957), abnormal responses to aversive shocks (Hare, 1982), poor passive avoidance (Newman, & Kosson, 1986; Newman, & Schmitt, 1998), and attenuated fear potentiated startle (Levenston, Patrick, Bradley, Lang, 2000; Patrick, Bradley, & Lang, 1993), theorists attempted to establish an explanation that would encompass such behaviors. It was recognized that at the core of these deficits, emotion, or fear processing was interrupted in some manner. Combined with findings of reduced amygdala activation (Birbaumer, et al. 2005) it was posited that a bidimensional mechanism of aversive and appetitive reactions was underlying these common deficits.

More specifically, Gray's theory (1987) of the behavioral inhibition system (BIS) and its counter, the behavioral activation system (BAS), were used to explain the low fear conditioning of psychopathic individuals. The BAS promotes approach behavior to stimuli that will lead to reward, whereas the BIS inhibits the BAS-activated behavior in the context of punishment stimuli (avoidance). This model is representative of the conditioning networks which govern adaptive learning. With regard to psychopathy, Gray suggested that psychopaths have no fear of punishment due to a weak BIS. Thus, the poor passive avoidance and fear conditioning often demonstrated in laboratory studies.

Along similar lines, the fear and amygdala research has inspired the exploration of the appetitive/avoidance theory to fear potentiated startle in psychopaths. Lang (1979, 1995) describes emotion as being organized in a biphasic manner, with an appetitive or aversive motivational system. Therefore, the current emotional response and feeling of pleasant or unpleasantness is driven by appetitive or aversive motivation. Avoidance is the behavioral result of an aversive reaction and approach is the behavioral result of an appetitive reaction. Included in Lang's theory is the association of varying degrees of valence and arousal to behavioral motivation. Lang, Bradley, and Cuthbert (1990) suggested the similarity of valence between picture stimulus and probe in a startle paradigm modulates the startle reflex. In other words, approach or withdrawal behavior correlated with picture valence will either inhibit a startle reflex or produce a startle reflex (potentiation) upon activation of a startle probe which utilizes the current behavioral state.

Based on the low-fear hypothesis psychopaths lack the ability to emotionally process and recognize emotional stimuli or objects. Thus, the stimuli do not effectively engage the appropriate motivational behavior that is generally seen in an emotion circuit. Therefore, during startle reflex probing the linear effect of the picture valence on startle potentiation will not be seen. Instead, the quadratic effect of startle reaction will demonstrate similar startle reactions for unpleasant and pleasant picture stimuli. This lack of startle modulation was demonstrated in Levenston, Patrick, Bradley, and Lang (2000) and Patrick, Bradley, and Lang (1993). Although non-psychopaths are influenced by emotionally relevant stimuli, psychopaths have no ability for connecting emotionally salient stimuli with behavior and hence treat pleasant stimuli no differently from the unpleasant stimuli. The low-fear hypothesis, however, does not account for other cognitive processes outside of emotion.

### *Response Modulation Hypothesis*

Other models of psychopathy have developed since the low-fear hypothesis; one of which is Newman's response modulation hypothesis (RMH; Newman & Lorenz, 2003; Patterson & Newman, 1993). According to Patterson and Newman (1993) response modulation is the "temporary suspension of a dominant response set and a brief concurrent shift of attention from the organization and implementation of goal-directed responding to its evaluation" (p. 717). In comparison to the low-fear hypothesis, the RMH is a more specific and more general explanation of psychopathic deficits as it describes the role of attention in emotion processing, in addition to attention's impact on general behavior. In other words, RMH is able to explain situation specific fear deficits as well as attention moderated deficits that do not necessarily include fear conditioning.

Gorenstein and Newman (1980) described the abnormal behaviors commonly observed in both animals with septohippocampal lesions and behaviors of people with different psychopathologies, including psychopathy. They noted that animals with lesions would often continue with goal-directed behavior (e.g. eating) in spite of punishment (e.g. shocks), a result that is not unlike that found in psychopaths. In contrast, normal response modulation involves an adaptive network of associative steps (Newman & Lorenz, 2003). The first step involves evaluation of novelty and unexpectedness of the stimuli (setting up the scene for possible attentional capture). The second step in the network is evaluating the appetitive (pleasantness) or aversive (unpleasantness) pull of the stimuli. This step is followed by evaluating the relevance of the stimuli to current goals (bringing in a motivational component). The last steps require evaluation of the ability to complete a goal given the new information and consolidating it with current social norms, consequences, and self-concepts. With increasing cognitive evaluation an individual is able to alter their attentional resources based on their controlled processing abilities. This described process is used to support generally automatic activation of networks for emotion processing. However, this automatic process can turn into a controlled process based on motivational factors. To further elucidate, an example will be used. Imagine a student is in class listening to a lecture (primary goal/activity). The professor mentions a word that is personally relevant for the student because of a joke he had recently heard (secondary stimulus). The student's first reaction would be to begin laughing, but because they are in class it would be socially inappropriate to laugh out loud (evaluation of secondary information goal relevance). Therefore, the student would redirect his attention back to the lecture (controlled process). Thus, normal response modulation allows an individual to actively participate in stimulus appraisal given the relevance of contextual information, thereby reinforcing associations between appropriate behavior and irrelevant secondary information. Abnormal response modulation would not enable the ability to capitalize on contextual information due to a lack of controlled processing or shifting of attention.

Response modulation, as applied to psychopathy, represents a core deficit in the ability to orient attention to normally relevant peripheral stimuli (Newman & Lorenz, 2003). In other words, once psychopaths are engaged in goal-oriented tasks, they are unable to allocate attention to contextual cues outside of the primary task. In addition, psychopaths demonstrate the same response modulation deficit for emotional and neutral information when they are deemed peripheral information. As a result, the previous expectation that psychopaths are unable to process emotional information is considered less valid as psychopaths are not necessarily less sensitive to emotion. Instead their association networks are weaker due to poor orientation of attention to salient information, which in turn reinforces the lack of appropriate associations and schemas.

Many studies have examined and supported the validity of the RMH with regard to psychopathy. One of the first to examine the scope of attention and psychopathy was Jutai and Hare (1983). They found reduced amplitudes for the N100 evoked auditory potential to random tone pips for psychopaths compared to nonpsychopaths when engaged in a primary task (playing a video game). However, when no primary task was required, psychopaths and nonpsychopaths demonstrated similar N100 amplitudes for tone pips.

Newman, Schmitt, and Voss (1997) were able to examine the RMH in the context of neutral peripheral cues. They required criminal psychopaths and nonpsychopaths to determine the semantic relevance of a context display in relation to the test display. They used a picture-word stroop task, in which a test stimulus, a picture or a word, is superimposed over the other stimulus which serves as a to-be-ignored distractor. The participants were required to determine whether a subsequent context display contained a stimulus which is semantically related to the test stimulus. On some trials, the context display stimuli were semantically related to the to-be-ignored distractor rather than the test stimulus. Results revealed that psychopaths demonstrated significantly reduced interference compared to nonpsychopaths when context displays were semantically related to distractors.

Replication of the above findings has been reported by Hiatt, Schmitt, and Newman (2004). These authors attempted to reconcile discrepancies regarding psychopathy, attention, and the stroop paradigm. In addition to replicating the reduced interference experienced by psychopaths in the picture-word stroop task, Hiatt and colleagues also found no significant difference in the interference experienced between psychopaths and nonpsychopaths on a traditional color-word stroop (counter to the RMH); results which are consistent with Smith, Arnett, and Newman (1992). These authors hypothesized that the difference between studies is a result of spatial separation between test stimulus and distractor. In order to examine the driving force between these inconsistent results the authors created a third stroop-like paradigm in which the task is to name the color of a rectangular box (e.g. green) that surrounds a color word (e.g. red). With this paradigm they were able to demonstrate the RMH deficit for psychopaths as they demonstrated less interference from the color word when naming the box color compared to nonpsychopaths. Furthermore, they were able to explain the fundamental difference in results between traditional color-word stroop and picture-word stroop tasks; essentially supporting their hypothesis that spatial separation of target and peripheral information reduces the conflict between stimuli and hence, reduces interference for psychopaths. However, it should be noted that the authors' description of spatial separation is more consistent with object separation wherein two distinct objects may appear within the same spatial area, in addition to being superimposed, and yet are processed separately. Overall, these results, along with Newman, Schmitt, and Voss

(1997), support the hypothesis that psychopaths are unable to incorporate peripheral information when engaged in a dominant response set. The significance of these particular studies is that they were able to demonstrate minimal processing of peripheral neutral cues, challenging the low-fear hypothesis' stance that psychopaths' behavior is driven by an inability to process emotional or fearful information. Similar results have also been supported in female offenders (Vitale, Brinkley, Hiatt, & Newman, 2007). This suggests that the salience of the peripheral information/stimuli should not significantly impact the capture of attention as both neutral and arousing contextual stimuli demonstrate reduced capture of attention for psychopaths.

An alternative explanation for the lack of support for the RMH in traditional stroop tasks is elucidated by Zeier, Maxwell, and Newman (2009). They proposed that because the RMH assumes a predetermined focus of attention, which makes psychopaths less susceptible to peripheral information, the converse is true when no primary focus of attention is established, and psychopaths perform the same as nonpsychopaths. To test their proposal with a population of psychopaths and nonpsychopaths, they employed a modified flanker task in which the target was either cued or not cued. In support of their hypothesis, results indicated that when no predetermined (i.e. exogenous cue) focus of attention was presented, psychopaths and nonpsychopaths experienced similar interference by a distractor. However, when cues were present to highlight the target of attention, psychopaths capitalized on it more and experienced significantly less interference from distractors than nonpsychopaths. Their results shed some light on the inconsistent results from stroop tasks and emphasize the importance of ruling out experiment specific effects that may help determine the generalizablity of the theory. In other words, they were able to give a possible explanation as to why psychopaths demonstrated similar interference on the traditional color-word stroop task, yet displayed reduced interference on other tasks when compared to nonpsychopaths; findings which are a direct result of the task being used and limiting applicability of the RMH to situations in which a predetermined focus of attention is present.

More recent studies of the RMH have examined the role of attention in moderating emotional processing for psychopathic individuals. In a task requiring memory recall for an emotional word (primary task) and recall of the source location (contextual information), incarcerated psychopaths demonstrated reduced memory bias for source location as compared with nonpsychopaths. However, psychopaths, like nonpsychopaths, maintained significant memory bias for emotional over neutral words (Glass & Newman, 2009). Researchers have also examined attention's role in the well established attenuation of the fear potentiated startle for psychopaths (Newman, Curtin, Bertsch, & Baskin-Sommers, 2010). Previously, it was thought that poor fear conditioning accounted for the lack of startle in these paradigms. In contrast, evidence driven by the RMH has revealed that when attention is purposefully focused on the threat (i.e. stimuli which represent a possible electric shock), incarcerated psychopaths display normal fear potentiated startle in response to noise probes. On the other hand, when the focus of attention is on alternative aspects of the paradigm (i.e. stimuli which are not associated with a shock), psychopaths demonstrate the classic lack of fear potentiated startle to the noise probes. A follow up to this particular study found that the deficit in fear potentiated startle displayed by psychopaths is only present when threat cues appeared after the alternative focus of attention was established. In conditions where focus of attention was on the threat cue, fear potentiated startles were elicited from psychopaths (Baskin-Sommers, Curtin, Newman, 2011). This is in line with the prediction of Zeier, Maxwell, and Newman (2009) that a pre-established target of attention, also known as an early attention bottleneck, is the underlying mechanism associated with the deficit in incorporating peripheral information related to psychopathy.

Only two studies have been conducted on non-incarcerated samples of individuals with psychopathic traits to examine the RMH. Both studies support the RMH and show similar results to incarcerated psychopaths. University students high on the Fearless Dominance factor of the Psychopathic Personality Inventory demonstrated the same fear potentiated startle when attention was focused on the threat, and lack of fear potentiated startle when attention was focused away from the threat as was observed with incarcerated psychopathic men (Dvorak-Bertsch, Curtin, Rubinstein, & Newman, 2009). Sadeh and Verona (2008) found that non-incarcerated men scoring high on primary psychopathy, as measured by the Psychopathic Personality Inventory, demonstrated reduced interference from distractors on a task of perceptual load. Furthermore, individuals high on primary psychopathy were less distracted by irrelevant stimuli on trials with a moderate perceptual load (load 4) than were individuals low on primary psychopathy at a high perceptual load (load 6). In other words, individuals low on primary psychopathy were less distracted by irrelevant stimuli at a load of 6, but not before, whereas those high on primary psychopathy demonstrated the same lack of distraction at load 4. With regard to RMH, these results support that individuals with high levels of psychopathy are less distracted by peripheral stimuli than those with lower levels of psychopathy. More specifically, they are able to demonstrate reduce interference by distractors on a lower perceptual load, which generally causes increased interference for those lower on psychopathy.

In summary, the RMH was developed to highlight the role of attention in an effort to explain the deficits commonly seen in psychopaths (e.g., poor passive avoidance, low fear conditioning, lack of empathy, impulsiveness). The RMH states that these deficits are a reflection of the failure to process affective, inhibitory, and other potentially important information when it is peripheral to their ongoing goal-directed behavior. The RMH is more specific than previous theories of low-fear conditioning because it predicts situation specific fear deficits and is also more comprehensive because it describes the role of attention in moderating deficits in fear responses. The majority of studies examining the validity of the RMH have supported its assumptions using various experimental paradigms (e.g., stroop, picture-word stroop, flanker tasks, perceptual load tasks, fear potentiated startle, and memory bias). These studies have also helped refine the hypothesis to include the underlying mechanism of an early attentional bottleneck which accounts for the inability to incorporate contextual information, whether salient or not, when engaged in a dominant task, and allows for normal processing of contextual information when no prepotent focus of attention is created.

### ***Current Study***

The primary aim of this study is to explore the validity of the response modulation hypothesis in a non-incarcerated university sample with varying degrees of psychopathic traits. In particular, the role of attention within different manipulations of the image-based parity task will be examined. The primary psychopathic traits which will be examined include those that fall under the two overarching factors of Self-Centered Impulsivity and Fearless Dominance, in addition to Coldheartedness. Factor analyses for the PPI-R have demonstrated that the subscale Coldhearteness does not load onto either factor, however, because it is a central component to the construct of psychopathy and has been used in previous literature, it will be included as an essential trait to be examined in this study as well.

The image-based parity task is a modified version of the word-based parity task that was originally created by Wolford and Morrison (1980). The parity task was used to examine how the presence of irrelevant stimuli affects performance during a primary task. Wolford and Morrison found that when using the participant's name as the irrelevant stimulus or distractor, response times significantly increased (i.e. interference) when deciding whether two numbers were considered the same or different parity (primary task). Furthermore, research using the parity task has demonstrated attentional capture by irrelevant emotional words as measured by significant increases in response times when compared to neutral words (Aquino & Arnell, 2007; Harris & Pashler, 2004). With regard to the image-based parity task, the primary task of deciding digit parity remains the same and emotional words in the display are replaced by pictures from the International Affective Picture System (IAPS). Similar to the word-based parity task, the image-based parity task elicits unintended attentional capture by irrelevant emotional pictures while deciding digit parity. In addition, the image-based parity task demonstrated persistent interference across 100 trials, whereas results for word-based parity tasks have reported habituation by the 50$^{th}$ trial (Haerich, Alberty, & Da Silva, 2008). This task was chosen to examine the RMH within a community sample because:

1) it has been established as a primary attention task that creates a situation in which peripheral information has the potential of competing with a goal-directed task, 2) and will test the generalizability of the RMH by ruling out test-specific effects, 3) it allows for the use of IAPS pictures which are commonly used in fear potentiated startle paradigms, 4) it provides for manipulations of the task which could possibly affect how psychopathic traits and attention interact, and 4) it includes both emotional and attentional aspects which may contribute to the exploration of how attention moderates the processing of emotional information within non-incarcerated individuals with psychopathic traits.

### *Hypotheses*

It should be noted that despite this study being driven by the response modulation hypothesis and its relevance for psychopathy, it is largely exploratory as limited research has been conducted with either this attention task or the population being used. Furthermore, different versions of the parity task were created based on previous research to examine the affects of spatial arrangement and perceptual load on interference for individuals with psychopathic traits. It is hypothesized that:

1) Emotional images will produce more interference (longer response times) than neutral images on the parity task.

 a. More specifically, it is expected that negatively arousing images will produce the most interference followed by positively arousing and neutral images.

2) Emotional images will produce less accurate responses than neutral images, with negatively arousing images producing the least accurate responses.

3)  Based on the RMH, individuals higher on psychopathic traits will demonstrate less interference by distractors (images) presented during the task than those lower on psychopathic traits.

c. More specifically, an interaction is expected such that the effect of arousal will decrease as psychopathic trait scores increase.  In other words, as psychopathy scores increase, interference by highly arousing images will decrease, whereas individuals with lower scores on psychopathy will demonstrate significantly more interference from high arousal distractor images.

4)  With regard to the different versions of the parity task (Control, Basic, Superimposed Low Load, and Superimposed High Load), it is expected that response times for the control task will be significantly faster than response times for the other three versions. Furthermore, the Superimposed High Load task will require the most cognitive resources and thus be associated with the slowest response times.

5)  Because the response modulation mechanism employs early bottleneck attentional capture, it would stand to reason that psychopathy trait scores should demonstrate a negative relationship between response times on all versions of the task.  In other words, the relationship hypothesized in hypothesis 3 should remain the same across the version type.

6)  Lastly, image arousal and valence ratings are expected to be similar to standard IAPS ratings

# CHAPTER TWO

# METHODS

## Participants

Participants included 23 (32 %) male (*M* = 20.17 years of age, *SD* = 2.17, range = 18-25) and 50 (68%) female (*M* = 20.26 years of age, *SD* = 3.60, range = 17-37) students enrolled in an introductory psychology or statistics course at private Christian universities in Southern California. The mean age of the present sample is younger than the mean age of the normative college/community sample for the PPI-R (*M* = 27.73, *SD* = 13.41). Data was collected as part of a larger study to examine attentional correlates of psychopathic traits. A total of 85 subjects participated in this current study, which included four different versions of the parity task. However, four were dropped from the analyses as they did not complete the questionnaire, five were removed for incomplete data, and three were removed due to low accuracy rates, resulting in a sample size of 73. The sample reflects the predominantly minority population of the university (9.5% Caucasian, 31.5% Hispanic, 31.5% Asian American, 11% African American, 16.5% Other). All students were given course credit for their participation in the study.

## Measure

Psychopathic personality traits were assessed by the Psychopathic Personality Inventory – Revised (PPI-R; Lilienfeld and Widows, 2005). The PPI-R is a 154-item measure based on a 4-point Likert-type scale (1 = false, 2 = mostly false, 3 = mostly true, 4 = true). The PPI-R yields an overall psychopathy score, eight content (subscale) scales, and four validity scales. The eight subscales are: Machiavellian Egocentricity (ME), Rebellious Nonconformity (RN), Blame Externalization (BE), Carefree Nonplanfulness (CN), Social Influence (SOI), Fearlessness (F), Stress Immunity (STI), and Coldheartedness (C). The four validity scales include: Virtuous Responding (detection of positive impression management), Deviant Responding (detection of bizarre symptoms not consistent with a known psychopathology), Inconsistent Responding 15, and Inconsistent Responding 40 (detection of inconsistency of responses). Samples of test items include: "I am easily flustered in pressured situations", "I'm not good at getting people to do favors for me", "I've been the victim of a lot of bad luck", and "I enjoy seeing someone I don't like get into trouble". For a college/community sample, the PPI-R has demonstrated adequate internal consistency and test-retest reliabilities for total ($\alpha$ = .92, $\alpha$ = .93) and subscale scores ($\alpha$ = .78-.87, $\alpha$ = .82-.95), respectively (Lilienfeld & Widows, 2005).

## Apparatus and Stimuli

The image-based parity task was presented on a PC with a 17-in. color monitor and programmed in E-Prime Professional (version 2.0). Participants viewed the display from an unfixed distance of approximately 55 cm. Displays appeared differently for each version of the task. For the control version, displays contained two single digits flanking a color block; the basic version had a similar display to the control version with the exception that single digits flanked an IAPS image; the superimposed low load version (SLL) had two single digits superimposed on the lower center of the IAPS image and were displayed with a white rectangular background; and the superimposed high load version (SHL) was similar to the SLL version with the exception that in addition to two single digits displayed with a white background, two upper case letters appeared superimposed on the lower center of the image also displayed with a white background.

The digits and letters were presented in 40-point bold Arial Black font for the control and basic versions; 28-point bold Arial Black font was used for the two superimposed versions. The color blocks and images were approximately 13.5 cm in width and height (≈14.0° visual angle) and the digits for the control and basic task were approximately 16.0 cm apart (≈16.2° visual angle). For the two superimposed tasks, digits were not farther apart than approximately 11.0 cm (~11.3° visual angle). The only digits used were 2, 3, 5, 6, 8, and 9. The digits were randomly paired, however constrained so that half the digit pairs demonstrated parity.

**Procedure and Design**

Each participant completed the PPI-R questionnaire and parity task; the order of which was counterbalanced across participants. For the parity task, each trial began with a fixation cross in the center of the computer screen appearing for 700-1500 msec, followed by the image or color block and two digits (or two digits and two uppercase letters for the SIH version). The image/color blocks and digits/letters remained on the screen until a response was made or up to 2000 msec. The participants were instructed to press the “Z” key if the digits were both even or both odd (parity), and press the “M” key if one was even and the other was odd (non-parity). The participants were asked to respond as quickly as possible and as accurately as possible while ignoring the center image/color block.

The task portion of the experiment began with four practice blocks (one of each version) of 12 trials each with equal numbers of parity and non-parity trials appearing randomly. The image in the practice blocks for the Basic, SLL, and SHL task versions was the same neutral image in each practice trial. Following the practice blocks, participants received two blocks for each version of the task. Each block contained 56 trials. There were four positive and four negative blocks with 28 high arousal (emotional image) trials and 28 low arousal (neutral image) trials. For the Control task some colored boxes were arbitrarily designated as "high arousal" and others as "low arousal". As in the practice blocks, there were equal numbers of parity and non-parity trials presented in random order with the constraint that every eight trials include 2 parity trials with even digits, 2 parity trials with odd digits, and 4 non-parity trials. In sum, each block was devoted to a specific valence (positive or negative) and version (control, basic, SLL, SHL) with randomly high or low arousing images appearing for each trial. The presentation order of the eight blocks was random.

After the parity tasks, participants rated each image as to the level of arousal (low to high) and valence (negative to positive) on 7-point likert scales. They were instructed that valence represents the degree to which they consider an image to be negative (unpleasant) or positive (pleasant), with 1 being the most negative and 7 being the most positive, and 4 being neutral. Similarly, they were instructed that arousal represents the degree to which they consider an image to be shocking, surprising, exciting, etc., with 1 representing something that is not arousing at all (i.e., boring, uninteresting, etc.) and 7 representing something that is highly arousing.

# CHAPTER THREE

# RESULTS

## Data Analytic Strategy

Task performance, as measured by response time (for correct trials) and accuracy, were analyzed separately in 2 (arousal) X 2 (valence) X 4 (task version) repeated measures ANCOVAs, with psychopathic traits as between-subjects continuous variables, or covariates. To visually examine any interactions between categorical independent variables and continuous psychopathic traits, psychopathy scores were split into a three-level categorical independent variable and graphed as low, average, and high scores (+/- 1SD above the mean and including the mean). However, no statistical tests were interpreted for the split psychopathy scores as the primary hypotheses of this study focus on the relationships between psychopathic traits and attention (as measured by response time and accuracy), as opposed to comparing groups of those with high and low psychopathy. Tests of homogeneity were examined and Greenhouse-Geisser corrections were used in interpretation of the results when violations to homogeneity were demonstrated. In addition, interference scores were calculated by taking the difference in reaction time between highly arousing image trials and neutral image trials for each task version. Correlations were conducted between interference scores and traits of psychopathy.

## Descriptive Statistics for PPI-R

Means, standard deviations, and ranges for the PPI-R total, factor, and subscale scores are listed in Table 1 for males, females, and the full sample. Descriptives were separated by gender in order to better compare to the Lilienfeld and Widows (2005) normative sample, which is also separated by gender. The current sample did not significantly differ in total mean scores or trait scores of psychopathy, with the exception of females in the current sample expressing significantly higher scores on Coldheartedness than the female normative sample (*M* = 29.37, *SD* = 5.83). Means for factor scores in the normative sample were not reported and therefore could not be compared to the present sample.

Table 1

*Descriptive Statistics for Males and Females*

| | Male | | Female | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| Coldheartedness | 32.09 | 7.13 | 31.56** | 6.40 |
| Machiavellian Egocentricity | 42.39 | 7.51 | 39.10 | 8.46 |
| Rebellious Nonconformity | 31.43 | 6.86 | 32.58 | 7.20 |
| Blame Externalization | 30.61 | 6.37 | 30.76 | 6.34 |
| Carefree Nonplanfulness | 34.65 | 7.38 | 33.98 | 7.04 |
| Social Influence | 47.83 | 7.69 | 46.22 | 9.30 |
| Fearlessness | 35.39 | 7.64 | 31.94 | 8.51 |
| Stress Immunity | 33.48 | 6.51 | 30.76 | 6.54 |
| Self-Centered Impulsivity | 139.09 | 17.35 | 136.42 | 18.78 |
| Fearless Domination | 116.70 | 15.78 | 108.92 | 18.36 |

Note: *M* = mean; *SD* = standard deviation. **$p < .01$.

## Response Time

The omnibus repeated measures ANCOVA with total psychopathy score as the covariate revealed a main effect of task, $F(3, 207) = 2.71$, $p = .04$, partial $\eta^2 = .04$. Follow-up contrasts demonstrated a linear trend across tasks, such that response times on the control task were the fastest, followed by the basic and SIL tasks, and with the SIH task evidencing the slowest response times ($F$s (1,69) > 3.40, $p$s < .05, partial $\eta^2 > .01$). However, no significant difference in response time was found between the basic and SIL task $F(1, 69) = 2.60$, $p = 0.11$, partial $\eta^2 = .04$. Mean response times across task version can be found in Table 2. No other main effects were significant. A significant arousal (high, low) X PPI-R total score interaction was found, $F(1, 69) = 4.79$, $p = 0.03$, partial $\eta^2 = .07$, such that as total psychopathy scores increased, there was more distraction (slower response times) from highly arousing images than neutral images (Figure 1).

Table 2

*Mean response times and accuracy rates for task version*

| | Response Times | | Accuracy | |
|---|---|---|---|---|
| | *M* | SE | *M* | SE |
| Control | 876.10 | 19.44 | 0.88 | 0.01 |
| Basic | 982.00 | 21.54 | 0.85 | 0.02 |
| Superimposed Low | 971.74 | 23.23 | 0.85 | 0.01 |
| Superimposed High | 1076.42 | 21.48 | 0.86 | 0.01 |

Note: *M* = mean; SE = standard error.

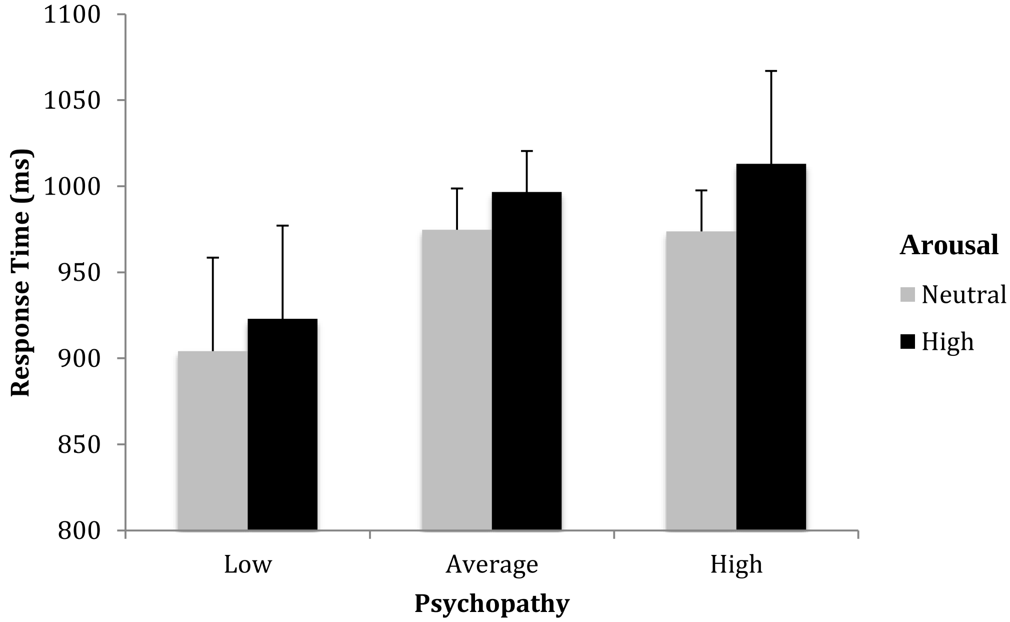


*Figure* 1. PPI-R and Arousal Interaction for Response Time.

When using Coldheartedness as a covariate within the 2 (valence) X 2 (arousal) X 4 (task) repeated measures ANCOVA significant main effects for valence, $F(1, 69) = 4.20$, $p = .04$, partial $\eta^2 = .06$, and task, $F(3, 207) = 8.24$, $p < .001$, partial $\eta^2 = .11$, were found. The same linear trend across task was revealed. Negative images ($M = 987.17$, $SD = 20.59$) were found to elicit slower reaction times than positive images ($M = 965.96$, $SD = 20.57$). In addition, an arousal X valence interaction, $F(1, 69) = 5.22$, $p = 0.03$, partial $\eta^2 = .07$, demonstrated that response times for negatively arousing images ($M$ =1002.00) were significantly slower when compared to positively arousing images ($M$ = 975.08), however there was no significant difference between negative ($M = 972.34$) and positive ($M = 956.84$) low arousing images (Figure 2). However, when traits of Coldheartedness are introduced, the significant difference seen between response times for negatively compared to positively arousing images decreases with increasing Coldheartedness scores, arousal X valence X Coldheartedness interaction, $F(1, 69) = 4.02$, $p = 0.49$, partial $\eta^2 = .06$ (Figure 3). A significant arousal X valence X task interaction was also found, $F(3, 207) = 3.28$, $p = 0.03$, partial $\eta^2 = .05$. Planned follow-up contrasts revealed that when individuals are shown highly arousing images, there is a greater difference between response times for positive ($M = 979.10$) and negative ($M = 1019.42$) images for the basic version compared to control, (positive [$M = 863.79$], negative [$M = 886.12$]), $F(1, 69) = 5.049$, $p = .028$, partial $\eta^2 = .07$. However, this difference is not seen within the SIL (positive [$M = 981.59$], negative [$M = 1007.49$]) and SIH (positive [$M = 1075.85$], negative [$M = 1094.96$]) versions when compared to control, $Fs\ (1, 69) < 1.28$, $ps > .05$, partial $\eta^2 < .02$ (Figure 4).

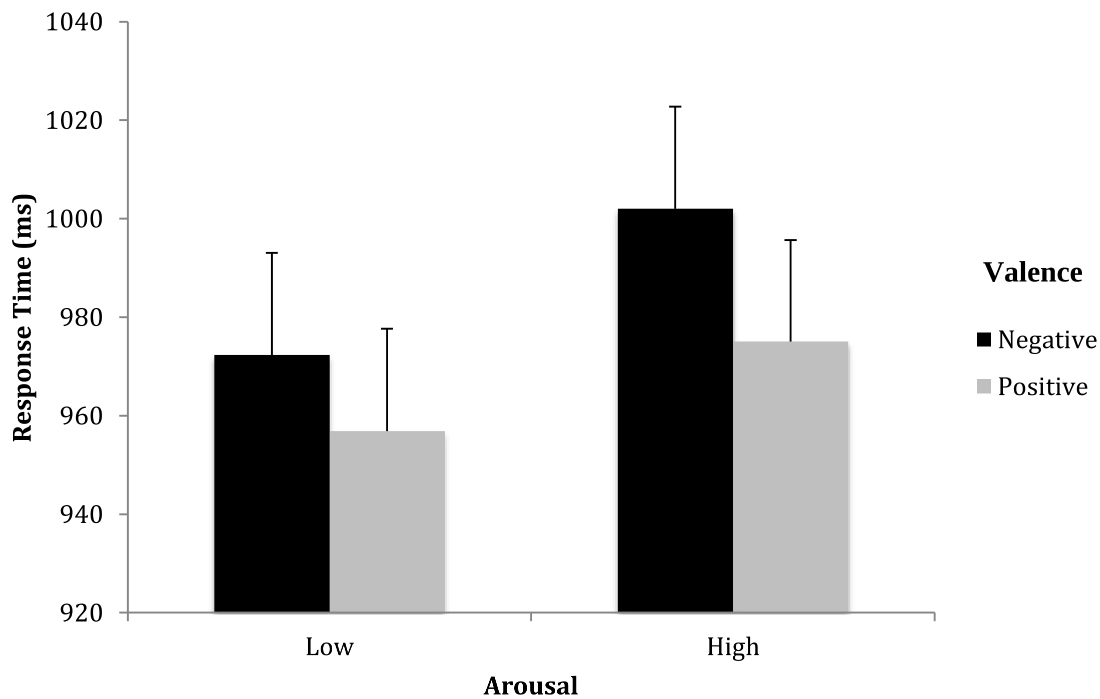


*Figure* 2. Interaction between arousal and valence for ANCOVA with Coldheartedness.

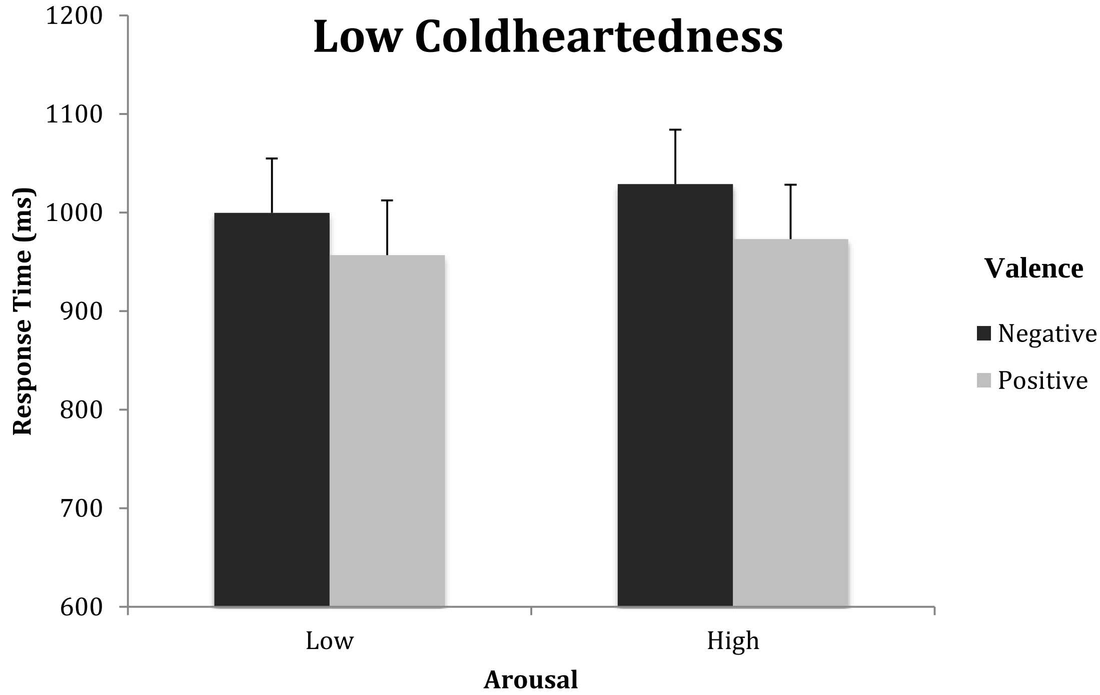


*Figure 3*.  3-way interaction between arousal X valence X Coldheartedness (Low).

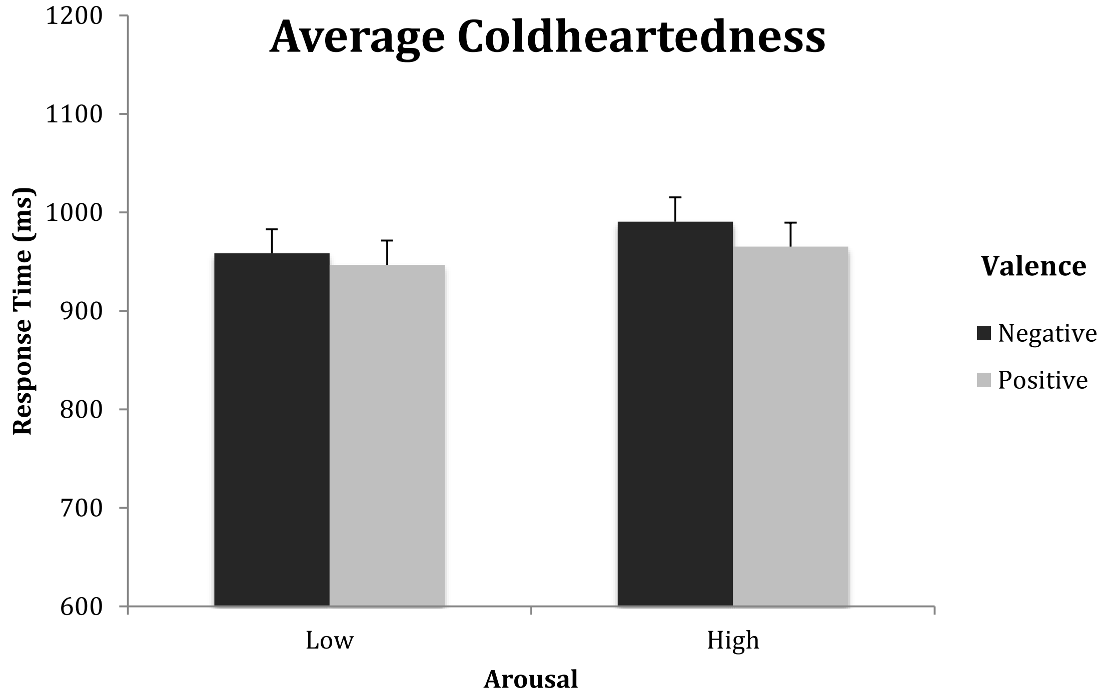


*Figure 3*. 3-way interaction between arousal X valence X Coldheartedness (Average).

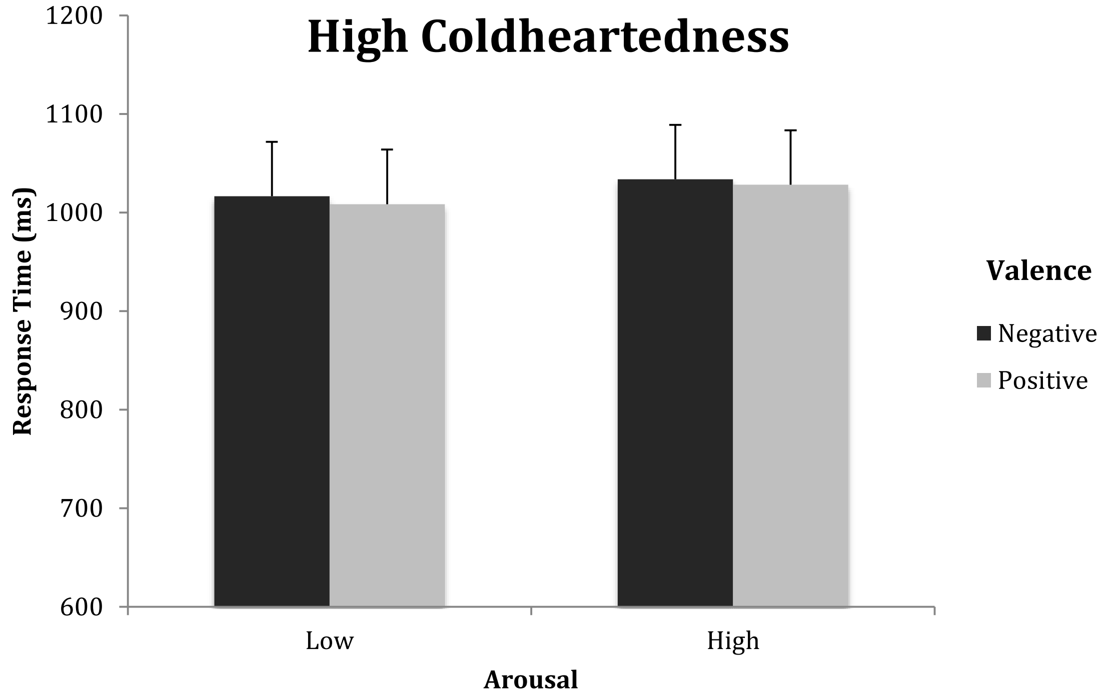


*Figure 3*. 3-way interaction between arousal X valence X Coldheartedness (High).

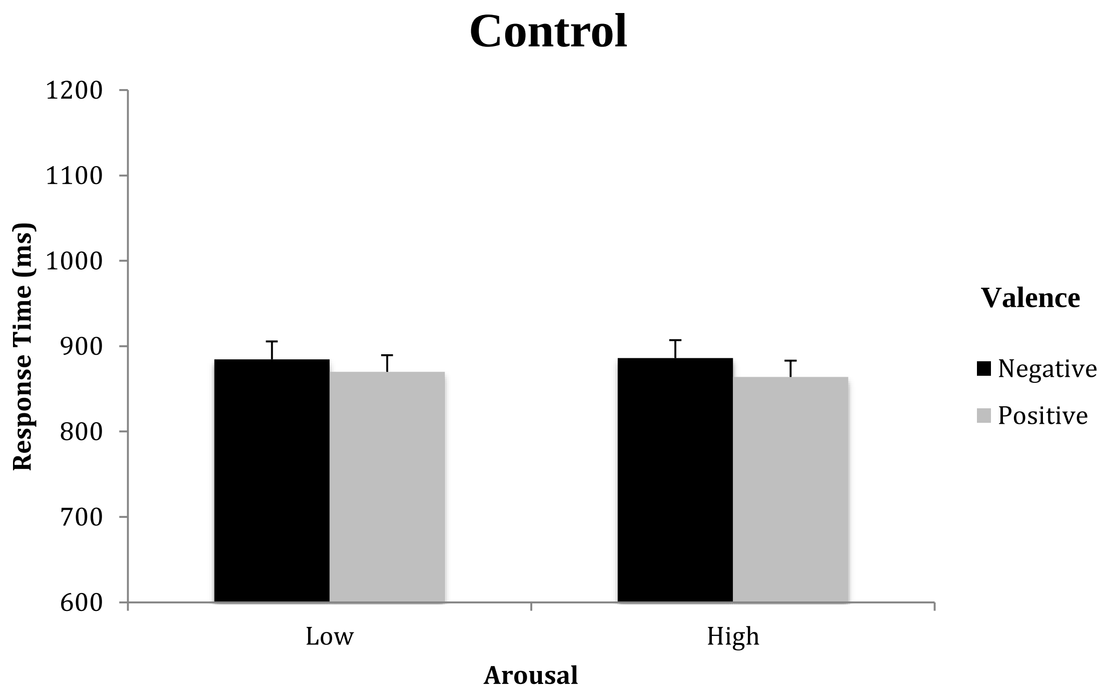


*Figure 4.* Arousal X valence X task (control) interaction for ANCOVA with Coldheartedness.

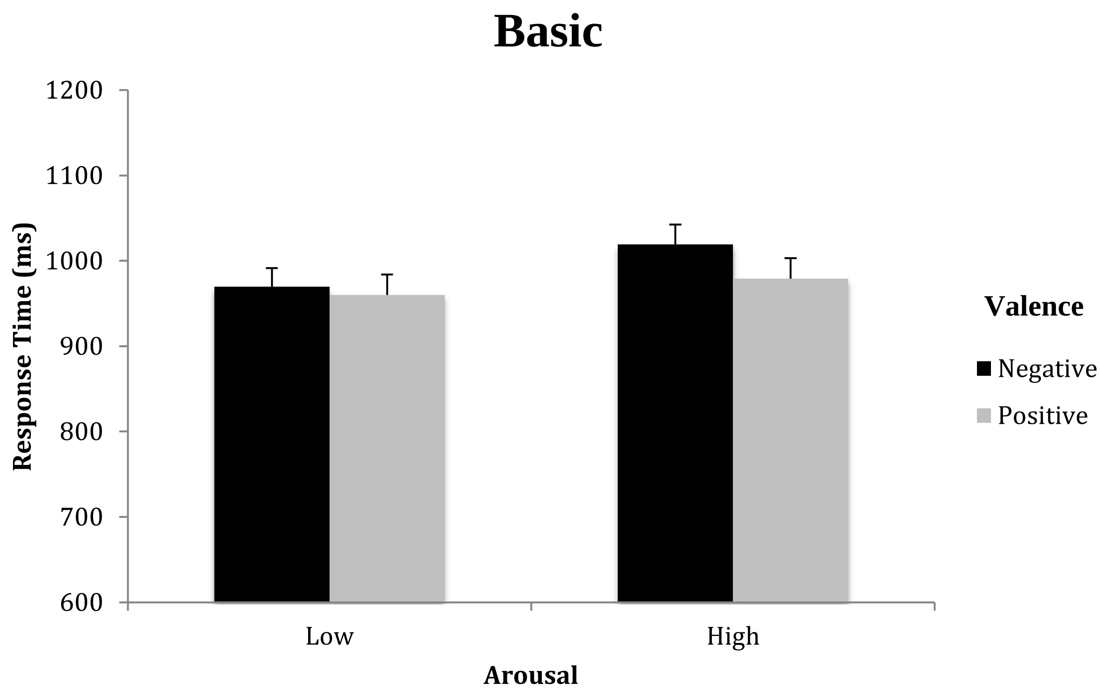


*Figure* 4. Arousal X valence X task (basic) interaction for ANCOVA with Coldheartedness.

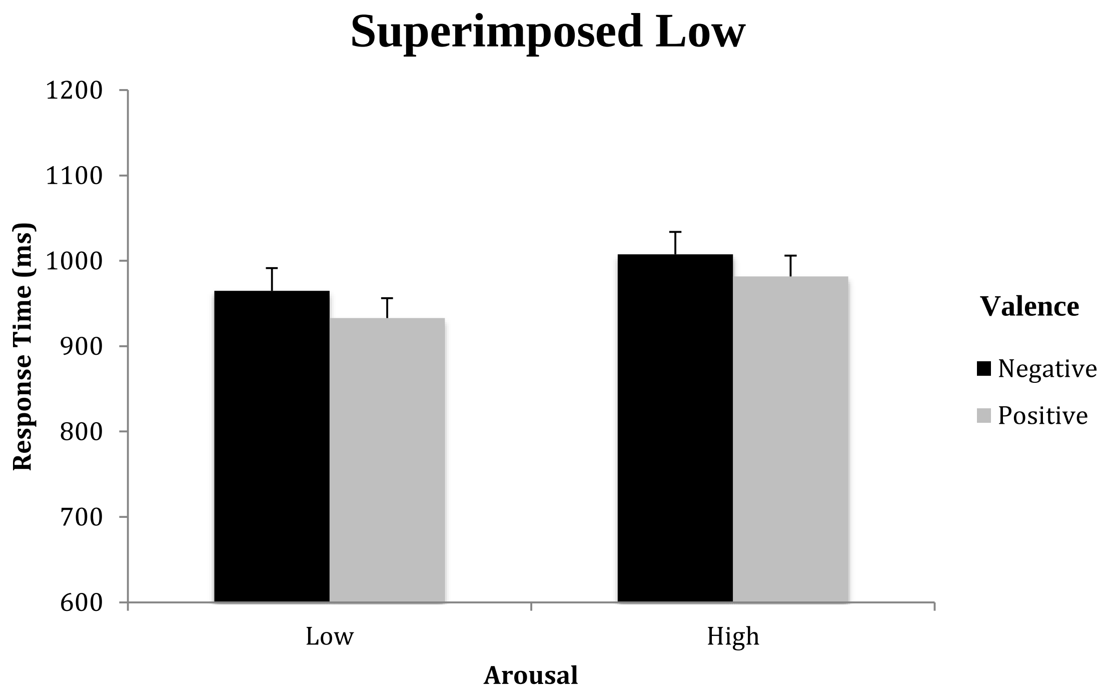


*Figure* 4. Arousal X valence X task (superimposed low) interaction for ANCOVA with Coldheartedness.

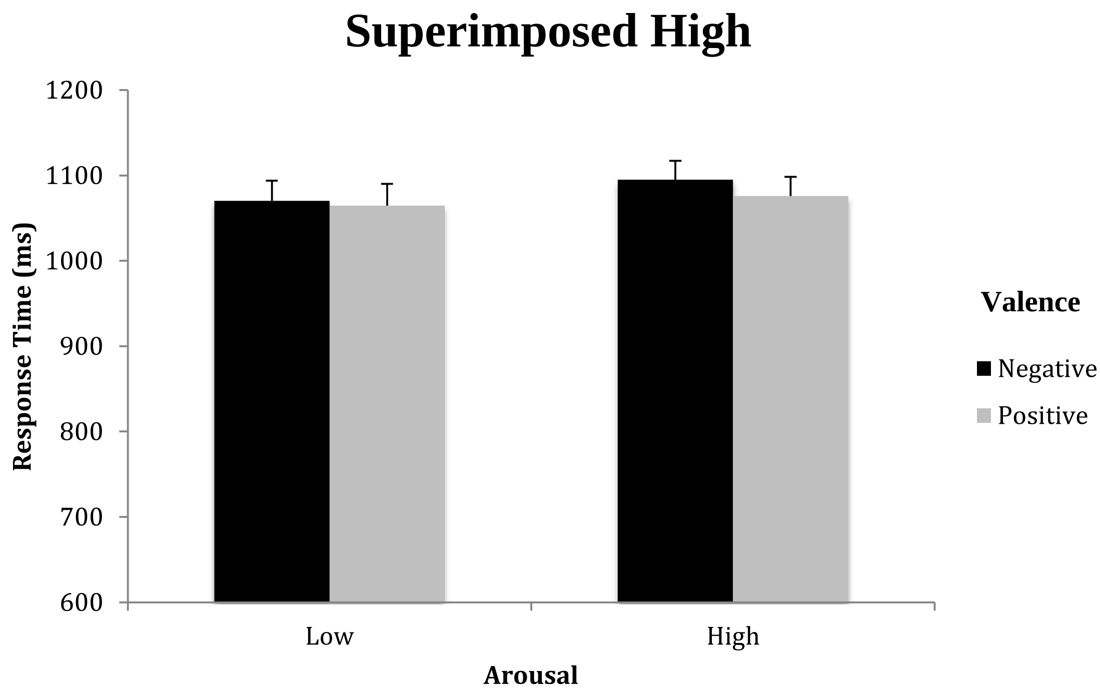


*Figure* 4. Arousal X valence X task (superimposed high) interaction for ANCOVA with Coldheartedness.

An Omnibus ANCOVA with Fearless Dominance as the covariate revealed the main effect of task as was previously found, $F(3, 207) = 3.98$, $p = .01$, partial $\eta^2 = .05$. No other main effects or interactions were significant. An ANCOVA with Self-Centered Impulsivity did not revealed any significant main effects or interactions.

Correlations between calculated interference scores and traits of psychopathy are listed in Table 3. Significant relationships were found between total psychopathy, Self-Centered Impulsivity scores, and interference from positively arousing images for the SIH version; as psychopathy and Self-Centered Impulsivity scores increased, the interference from positively arousing images also increased ($r = .27$, $p < .05$; $r = .24$, $p < .05$, respectively). Unexpectedly, there was a positive correlation between interference scores for the control task and Carefree Nonplanfulness, $r = .30$, $p < .01$.

Table 3

Correlations Between Psychopathy Trait Scores and Response Time Interference (ms) Across Task

| | BE | C | CN | F | ME | RN | SOI | STI | PPI-R Total | FD | SCI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Negative Control | 0.07 | 0.01 | 0.01 | 0.12 | -0.08 | 0.07 | 0.13 | 0.00 | 0.09 | 0.12 | 0.02 |
| Positive Control | -0.07 | 0.23 | 0.30** | -0.06 | 0.10 | -0.10 | -0.17 | 0.05 | 0.06 | -0.09 | 0.10 |
| Negative Basic | 0.04 | -0.22 | -0.01 | -0.04 | 0.02 | 0.08 | 0.00 | -0.10 | -0.05 | -0.06 | 0.05 |
| Positive Basic | -0.07 | 0.18 | 0.15 | 0.20 | 0.04 | 0.13 | 0.10 | 0.09 | 0.21 | 0.18 | 0.10 |
| Negative SIL | -0.18 | 0.09 | 0.06 | 0.00 | -0.02 | -0.08 | 0.09 | 0.04 | 0.01 | 0.06 | -0.08 |
| Positive SIL | 0.06 | -0.03 | 0.06 | 0.00 | 0.07 | 0.14 | -0.04 | 0.07 | 0.08 | 0.01 | 0.13 |
| Negative SIH | 0.02 | -0.14 | 0.01 | 0.19 | -0.09 | 0.01 | 0.03 | 0.07 | 0.03 | 0.12 | -0.03 |
| Positive SIH | 0.11 | 0.10 | 0.15 | 0.08 | 0.18 | 0.16 | 0.09 | 0.19 | 0.27* | 0.15 | 0.24* |

Note: *M* = mean; *SD* = standard deviation. *$p < .05$. **$p < .01$. C = Coldheartedness, ME = Machiavellian Egocentricity, RN = Rebellious Nonconformity, BE = Blame Externalization, CN = Carefree Nonplanfulness, SOI = Social Influence, F = Fearlessness, STI = Stress Immunity, PPI-R Total = Total Psychopathy Score, FD = Fearless Dominance, SCI = Self-Centered Impulsivity.

## Accuracy

Results for accuracy with Self-Centered Impulsivity as the covariate revealed a main effect of task, $F(3, 213) = 3.81$, $p = 0.02$, partial $\eta^2 = .05$. Table 2 displays mean accuracy rates for each version. The control version demonstrated the highest accuracy rates, followed by the SIH version, and with the basic and SIL versions evidencing the lowest accuracy rates. Furthermore, Bonferroni post-hoc tests revealed that the control version had significantly higher accuracy rates when compared to the basic and SIL versions $p$s < .05, but not when compared to the SIH version, $p > .05$. No significant difference was found between the basic and SIL version with regard to accuracy rates, $p > .05$. A task X Self-Centered Impulsivity interaction suggests that for the basic version, when Self-Centered Impulsivity traits increase, accuracy rates also increase, $F(3, 213) = 3.58$, $p = 0.02$, partial $\eta^2 = .14$. However, this relationship is not as defined within the other versions (Figure 5). No significant main effects or interactions were found with total psychopathy scores, Coldheartedness, or Fearless Dominance.

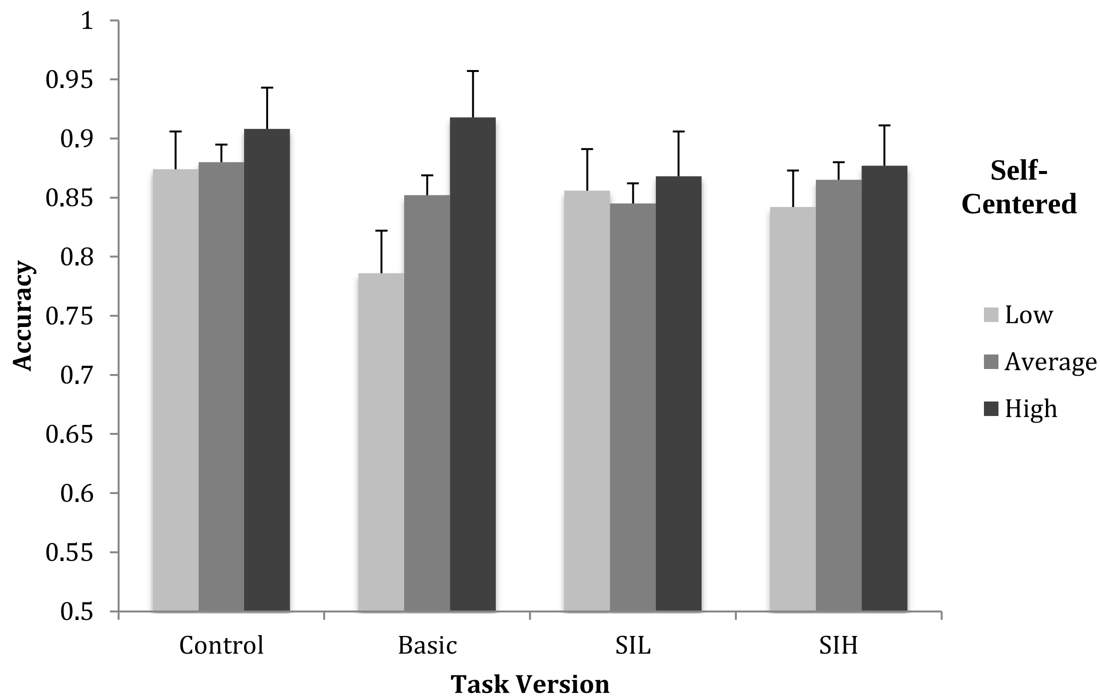


*Figure* 5. Interaction between task X Self-Centered Impulsivity for accuracy.

Image parity ratings for valence and arousal are listed in Appendix A. Average valence and arousal ratings for each individual image were generally similar to the normed valence ratings. No individual image ratings were more than two standard deviations away from the normed value. However, for the few valence ratings which were at least one standard deviation away from the normed mean values, it appeared that the participants in the current sample generally rated positive images more neutral than the normed data.

# CHAPTER FOUR

## DISCUSSION

There have been several theories proposed to explain the etiology of psychopathic traits (e.g. fearlessness, impulsivity, lack of empathy, social charm, and egocentricity), including differences in neuroanatomy, low fear conditioning, and attentional deficits. The Response Modulation Hypothesis (RMH) posits that attention moderates the processing of emotional information for individuals with psychopathic traits (Newman & Lorenz, 2003; Patterson & Newman, 1993). According to this theory, individuals with psychopathic traits experience difficulty re-orienting attention to salient peripheral information when engaged in a goal-directed task. Therefore, the present study attempted to examine the RMH utilizing the image-based parity task and sampling from a pool of undergraduates with varying degrees of psychopathic traits. This study is largely exploratory as the majority of studies testing the RMH have primarily focused on "clinical psychopaths," or those identified as psychopaths using a clinical cut-off score. In addition, no other studies have included the image-based parity task as the primary attention task, which includes neutral and arousing (salient) images, essentially testing the RMH's proposal that psychopaths respond similarly to emotional as well as neutral information when it is peripheral to the primary goal.

Though the primary aim of this study was to examine the interaction of psychopathy and attention when processing emotional stimuli, it was also expected that main effects of arousal and valence from the parity task would replicate previous findings (Haerich, Alberty, & Da Silva, 2008; Llamas, & Haerich, 2011). However, unlike previous results, which demonstrated linear trends in arousal levels from neutral to positively arousing to negatively arousing, the current results largely supported main effects of task version. Only the ANCOVA which included Coldheartedness as a covariate demonstrated a main effect for valence, with negatively valenced images producing slower response times than positively valenced images.

It is likely that main effects for arousal or valence were not found in the current study because the addition of psychopathic variables as covariates may have accounted for more statistical variance than either arousal or valence when psychopathy is not included. Though these results were counter to expectations, they provide useful information about the Response Modulation Hypothesis as the inclusion of psychopathy demonstrated that there may actually be a relationship between psychopathy and attention. However, the design of the current experiment makes it difficult to determine the amount of variance which psychopathy accounts for compared to the variance of the remaining independent variables. What can be interpreted from these results is that without the inclusion of psychopathy, arousal and valence are sufficient enough to elicit distraction from the primary task, however, once psychopathy is included in the model, the relationship between arousal, valence, and interference is no longer significant. This suggests that continued testing of the RMH may yield additional interesting results, but more sophisticated statistical methods may be helpful in elucidating the relationships present.

Results are inconsistent with regard to the primary hypotheses that psychopathy would moderate the relationship between attention and emotional processing. The factors of Fearless Dominance and Self-Centered Impulsivity did not yield any significant relationships with interference as measured by response time. However, total psychopathy score was found to interact with arousal such that as total psychopathic trait scores increased, the interference by arousing images also increased. This result runs counter to what was expected, as the Response Modulation Hypothesis would argue that as psychopathy increases there should be less interference by peripheral information, regardless of the arousal level. Notably, the competing low-fear hypothesis was also not supported in these results as a relationship between higher psychopathic trait scores and reduced interference was not found for negatively arousing images when compared to positively arousing and neutral images.

However, it is notable that when Coldheartedness was used as an independent covariate, the hypothesized results were supported. Coldheartedness evidenced an interaction with arousal and valence such that as Coldheartedness scores increased the interference from negatively and positively arousing images did not differ. This result supports the theory that the salience of the peripheral information for individuals with high psychopathic traits is secondary to the primary task goal because when Coldheartedness is low, negatively arousing images tend to capture more attention than positively arousing images. A similar result has been found in startle modulation studies, wherein individuals identified as “clinical” psychopaths tend to demonstrate a similar attenuation of startle for positively as well as negatively arousing images, however individuals identified as “non-psychopaths” evidence a linear trend in startle from neutral to positive to negatively arousing images (Patrick, Bradley, & Lang, 1993). In addition, there were trends to suggest that as Coldheartedness increased the magnitude of interference from neutral and arousing images also decreased.

To examine how varying attentional focus and perceptual load affects the relationship between psychopathy and emotion, four different versions of the parity task were created. In all analyses for response time, with the exception of SCI as the covariate, task version demonstrated a main effect. As expected, the control version elicited the fastest response times and the SIH version elicited the slowest. However, there was no significant difference found between the basic version of the task and SIL version. These results suggest that though the SIL version of the task manipulates the focus of attention, it is not significantly more distracting to have the digits of the task superimposed on the distractor. Subjective reports from participants following the experiment were that the SIL version assisted in narrowing the focus of attention on the primary task of identifying parity, despite the distractor being immediately behind the digits. In addition, by bringing the digits visually closer, the participants would not have to take additional time to scan across the screen and image before making their decision regarding parity of the digits. The inclusion of additional distractors (i.e. letters) during the SIH version elicited the expected slower response times due to the increased perceptual and cognitive load of the stimuli.

The only significant interaction with task version was found within the Coldheartedness ANCOVA, and included arousal and valence. This interaction demonstrated that the basic version of the task elicited a significant difference between response times to positively and negatively arousing images when compared to the control version of the task, however this same difference was not found across the SIL and SIH versions when also compared to the control version. This result is interesting and unexpected as it appears as though the basic version of the task is most useful when attempting to capture attention utilizing emotional distractors. It is possible that the SIL version of the task narrows attentional focus too much to distinguish distractions from images, whereas the SIH version's primary task may be too difficult and hence requires more cognitive resources in order to complete the objective, essentially taking away resources from any peripherally salient information. Though the Sadeh and Verona (2008) study, which included variations of perceptual and cognitive load, found that incarcerated men with psychopathy were able to demonstrate less distraction at a lower perceptual load than controls, the present study may not have been successful at increasing the degree of perceptual load enough to test a similar response. Furthermore, Sadeh and Verona did not include any images in their study, and instead displayed a series of letters as the load stimuli and distractors. The added complexity of an image present, with numbers and letters, may have contributed to the lack of support for finding that individuals high on traits of psychopathy be less distracted at a lower perceptual load than would be expected from controls.

Analyses of accuracy with psychopathic traits, valence, and arousal did not yield many significant results. Only Self-Centered Impulsivity was found to interact with task version, such that for the basic version only, as Self-Centered Impulsivity increased, so too did accuracy. This result is consistent with expectations and is quite interesting as Self-Centered Impulsivity is representative of risky behaviors and, as the name suggests, impulsivity. Despite increased tendencies to react quickly, individuals with high degrees of SCI, were able to be less distracted by images and perform more accurately on the primary task. It is important to note that this result cannot simply be explained by an accuracy-response time trade-off since a significant positive relationship between SCI and response time interference was also not found.

The current study was also unable to find substantial support for correlations between psychopathic traits and calculated interference scores between neutral and arousing images for the four different task versions. However, it was found that as SCI and PPI-R total scores increased the interference from positively arousing images in the SIH version also increased. Unexpectedly, Carefree Nonplanfulness was found to also be associated with increased interference from positively arousing distractors in the control task. This finding is unexpected as the control version of the task does not contain and images, and only contains blocks of color as distractors. In addition, the blocks of color were randomly assigned as positive or negative distractors and placed within an arbitrarily assigned arousing or neutral block for statistical analyses purposes. One explanation for why correlations between psychopathic trait scores and calculated interference scores did not match expectations is that there may be a lack of sufficient variance in psychopathic trait scores in a sample size of 73 in order to detect a significant relationship. In addition, the nature of repeated measures makes it difficult to interpret scores that have been averaged over several trials and then collapsed across additional variables in order to create a calculated score of interference. However, it is also possible that within the current sample, and using the current experimental design, there is no relationship between psychopathic trait scores and interference by distractors when engaged in a primary task.

It is unclear as to why interference by emotional distractors varied across the different traits of psychopathy. In fact, the current results evidenced that total psychopathic traits were actually associated with increased distraction from negatively arousing images, whereas Coldheartedness demonstrated no difference in distraction from positively arousing compared to negatively arousing images. Furthermore, the two factor scores of Fearless Dominance and Self-Centered Impulsivity failed to yield any significant relationships with arousal or valence. One explanation may be provided by previous results of Llamas (2013; thesis). This thesis found that the proposed factor structure of the PPI-R with two separate lower order factors was not well supported in the current population. Moreover, an exploratory factor analysis was unable to recover all eight subscales of the PPI-R, which make up the factor structure of the construct. Given these previous results, it may be possible that the FD and SCI factors do not fully capture their intended underlying constructs within the current sample, and therefore may not impact interference as expected. Unfortunately, the current sample was not large enough to maintain enough statistical power to run separate analyses on the eight subscales of the PPI-R in order to test this hypothesis. However, it is also possible that only specific traits of psychopathy, such as Coldheartedness, drive the moderation between attention and emotional processing. No other studies to date have examined the relationship between specific psychopathic traits, attention, and emotion; all previous studies conducted analyses on total psychopathy scores, lower order factor scores, and separate Coldheartedness scores (specific to PPI-R use). Future directions within this field should possibly include examining specific traits which drive the relationships found between psychopathy and cognitive and emotional deficits.

Another limitation of the current study, which may have contributed to inconsistent results, is the lack of control for trait anxiety. Whether anxiety has a significant relationship with psychopathy or not has been a source of controversy within the study of psychopathy. Cleckley's original description of psychopaths included characteristics of low anxiousness, and in fact, some empirical studies have found a negative correlation between the callous-unemotional traits of psychopathy and anxiety (see Widiger, 2006). However, Widiger also warns that it is not unlikely to find no association between psychopathy and anxiety after other traits of psychopathy have accounted for the majority of variance. Nonetheless, Hiatt and Newman (2006) highlight the importance that trait anxiety can play in moderating performance on behavioral inhibition tests for individuals with psychopathy, and that a similar expectation is supported by some empirical literature examining attentional deficits. Thus, the current results may be a reflection of individuals with high trait anxiety and future studies should control for such a variable in order to test this possibility.

Lastly, the current study was underpowered due to limited sample size. The difficulty with conducting analyses of individual differences lies in gathering a sufficient sample size to obtain a statistical power of at least .80. Unfortunately, this study was unable to meet the required sample size of 158 subjects for a power of .80, or even 103 subjects for a power of .60. It would be informative to conduct the same study with additional participants in order to determine whether results can be replicated, essentially giving greater support for a lack of association between psychopathy, attention, and emotion processing, or whether expected relationships can be found.

In summary, these results somewhat support the theory that subcortical-cortical circuitry is at least partly involved in how individuals with psychopathic traits process all information. The ability to attend to information will impact how individuals with certain psychopathic traits respond to information which is not central to their primary focus of attention. For the current study, Coldheartedness and Self-Centered Impulsivity demonstrated expected moderation effects between attention and emotion processing. Individuals with higher degrees of Coldheartedness evidenced similar interference from positively and negatively arousing distractors; a result which would be counter to expectations for individuals with lower degrees of Coldheartedness. Similarly, increasing levels of Self-Centered Impulsivity were found to be associated with better accuracy, and hence, less distraction from emotional images during the basic parity task. However, the current results also evidenced that higher total psychopathy scores are actually associated with more distraction from arousing images. It is important to also note that though the RMH was not fully supported with the current findings, the low-fear hypothesis was also not supported. It would have been expected that for negatively arousing images response times would have been faster and accuracy rates would have been higher for individuals with higher psychopathic traits; this was not found to be the case in the current study. Thus, future studies should consider controlling for trait anxiety, use of appropriate and more sophisticated statistical methods for testing, and examination of moderation by specific psychopathic traits.

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# APPENDIX A

# INFORMED CONSENT FORM



LOMA LINDA
UNIVERSITY

*Paul Haerich, Ph.D*
*Professor*
*(909) 558 8707*
*phaerich@llu.edu*

*Department of Psychology*
*School of Behavioral Health*
*Loma Linda University*
*Loma Linda, CA 92350*

**Informed Consent Document**
**For**
**Attentional Control and the Impact of Distractors During Matching Tasks**
Principal Investigator: Paul Haerich, Ph.D.

**Purpose and Procedures**

We conduct research studies, such as this one, in order to further our knowledge of human behavior, the capabilities of the human mind, and the way humans perceive and respond to stimuli in the environment. We also are concerned that you find your experience to be rewarding and educational. Therefore, we wish to keep you fully informed of the procedures and stimuli involved. One way we do this is by describing the procedures to you and answering any questions you may have. The other way we do this is by using this document.

You are invited to participate in this research study as an adult member of society to help us better understand how people maintain attention to complete a task and how distractions are able to capture attention.

During this study you will be asked to indicate whether two letters or two numbers are the same or are different. The basis of the match will change from one sets of items to the next. For example, you may indicate if, two numbers match because both numbers are even or both numbers are odd. Or, the numbers might match because they are either greater than 5, or both less than 5. Or, the numbers might match because they are the same number, that is, both are the number 2.

On each trial you will first see an X in the center of the screen. This X will be replaced by an image, patch of color, or a word in the center of the screen with the two letters (or numbers) on either side. Your task is to ignore the image, patch of color, or word, and indicate as quickly as possible (while still being accurate) if the two letters (or numbers) match. The trials will be presented in sets of 60. After a set of 60 trials, you will have a short break and the experimenter will let you know what a "match" will be for the next set of trials. The experimenter will also let you know how many sets of trials there are.

The series of images presented on trials will include pictures of animals, guns, household objects, human nudes, nature scenes, mutilations, plants, rocks, snakes, spiders, sports scenes, etc. After the matching task, you will be given the opportunity to rate each image you saw using a computer-based rating-questionnaire. The experimenter will provide you with the specific instructions for these ratings.

*Loma Linda University*
*Adventist Health Sciences* ***Center***
**Institutional Review Board**
**Approved** 3/14/14 **Void after** 3/13/2015
**#** 5110071 **Chair** R L Ragsdale

You will also be asked to complete a computerized series of questions regarding your personality, experiences, and opinions.

The brain is connected to the rest of the body. While this may seem like an obvious statement, it means that we can monitor physiological responses like your pulse and slight changes in the amount of sweat produced at your finger tips to get additional information on how the brain responds to and processes information while you are participating. In this study, you will have two small, button-like sensors taped to the tips of the first and third fingers of your non-dominant hand to measure changes in sweat production (also called skin conductance). A pulse monitor will be clipped over the middle finger.

In addition to monitoring pulse and skin conductance, we may also wish to measure the electrical activity of your brain as you view the images and perform the recognition task. We will ask you to wear a net of up to 256 sensors that measure the electroencephalogram (or EEG) commonly referred to as brain waves. Each sensor acts like a microphone which picks up the small electrical signals produced by the brain cells. The entire sensor net has been soaked in a salt-water solution to improve the electrical connection from the scalp to each sensor. After the net has been applied, we may take a picture with a special camera that will let the computer know exactly where each of the sensors is in 3-D space.

The experimenter will explain the specific parts of this study in which we are asking you to participate, including the instructions for the matching task and which of the physiological measures will be included.

We encourage you to ask questions of the experimenter about the instructions or any aspect of the task(s) or recording methods.

You are free to discontinue your participation without negative consequences at any time simply by letting the experimenter know that you wish to do so. That is, you will receive participation credit whether or not you complete the session today.

When you signed up for the timeslot to participate in this study, you received information on the duration for your participation. The total time for your participation will be either 60 or 90 minutes; the experimenter will confirm the duration with you before you begin.

**Risks**

The images described above that are used in this research study have been selected to produce a wide range of responses. Although the content is similar to what might be seen on some television channels (for example, the Discovery Channel), you may feel uncomfortable while viewing these images.

None of the stimuli or procedures used in this research poses a risk which is greater than that expected in everyday life. Therefore, the committees at Loma Linda University (Institutional Review Board), and La Sierra University (Institutional Review Board) that review human studies have determined that participating in this study exposes you to minimal risk. The official stamp appearing on this form indicates this approval.

*Loma Linda University*
*Adventist Health Sciences Center*
**Institutional Review Board**
**Approved** 3/14/14 **Void after** 3/13/2015
**#** 5110071 **Chair** R L Ringleymd

**Benefits**

As is typical of basic research studies such as this, there are no direct benefits to you which will result from your participation in the study other than the educational experience of participating in a scientific psychological research project.

We anticipate that the results of this study will be of use in advancing the understanding of how the human mind works. Specifically, we expect the results will help us understand how the brain processes information, attends to targets and how attention may be captured by distracting information of various types in the environment and the cognitive mechanisms involved. Eventually, we anticipate that this information will aid in the understanding and treatment of disorders of mood and personality.

**Compensation**

Although not a benefit from the research study itself, you may receive extra credit for a course. The amount of extra credit points depends on whether you signed up for a 60- or 90-minute research study. If you are a student at LLU, you may receive 12 or 18 credit points for your class. If you are a student at LSU, you will receive 1 or 2 credits for your class. You will receive your credit via the SONA system which you used to sign up for this research study.

**Confidentiality**

All of the information gathered during your participation in this research study is both anonymous and confidential. No public presentation or any publication resulting from this study will disclose your identity. Your name will not be reported with your responses. All data will be reported in group form only.

If you have any questions regarding this study, we will be happy to answer them.

**Participant's Rights and Third-Party Contacts**

Because we wish to ensure that your participation is voluntary, we want to assure you that you may terminate at any time merely by telling the experimenter that you wish to do so. You will receive credit even if you decide to discontinue your participation before the test session is over.

Please feel free to ask any questions that you may have about this experiment at any time. Any questions that you may have at a later date may be directed to Paul Haerich, Ph.D., Department of Psychology, Loma Linda, CA 92354 (phone: 909-558-4707; email: participation@pehclab.org).

If you wish to contact an impartial third party not associated with this study regarding any complaint or questions about the study, you may contact the Office of Patient Relations, Loma Linda University Medical Center, Loma Linda, CA, 92354 (phone: 909 558 4647; email: patientrelations@llu.edu).

*Loma Linda University*
*Adventist Health Sciences Center*
**Institutional Review Board**
**Approved** 3/14/14 **Void after** 3/13/2015
**#** 5110071 **Chair** R L Rigsby

**Consent Statement**

***I have read the contents of the consent form and have been given the opportunity to ask questions concerning the study. I have been offered a copy of this form. I acknowledge that I am at least 18 years of age. I hereby give my voluntary consent to participate in this study. Participating in this research study does not waive my rights nor does it release the investigators or institution(s) from their responsibilities. I may call Paul Haerich, Ph.D at (909) 558-4770 if I have any additional questions or concerns.***

______________________________________________

Research ID Number as Signature / Date

I have reviewed this consent document with the person signing above. An opportunity has been provided to ask any questions regarding this document and the research described in it.

______________________________________________

Investigator Signature / Date

*Loma Linda University*
*Adventist Health Sciences Center*
**Institutional Review Board**
**Approved** 3/14/14 **Void after** 3/13/2015
**#** 5110071 **Chair** R L Ringleymnd

## APPENDIX B

## IAPS SAMPLE AND NORMED RATINGS OF VALENCE AND AROUSAL

| Image # | Valence Sample Ratings | | Valence Normed Ratings | | Arousal Sample Ratings | | Arousal Normed Ratings | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| 1019 | 3.42 | 1.86 | 3.95 | 1.96 | 5.11 | 2.35 | 5.77 | 1.83 |
| 1040 | 3.64 | 1.87 | 3.99 | 2.24 | 4.23 | 2.35 | 6.25 | 2.13 |
| 1050 | 3.88 | 2.17 | 3.46 | 2.15 | 5.40 | 2.44 | 6.87 | 1.68 |
| 1051 | 3.71 | 2.03 | 3.80 | 1.75 | 4.89 | 2.44 | 5.95 | 1.98 |
| 1052 | 3.70 | 1.89 | 3.50 | 1.87 | 5.29 | 2.38 | 6.52 | 2.23 |
| 1070 | 3.82 | 1.73 | 3.96 | 2.30 | 4.58 | 2.01 | 6.16 | 2.08 |
| 1090 | 3.74 | 1.86 | 3.70 | 1.90 | 4.51 | 2.13 | 5.88 | 2.15 |
| 1110 | 4.01 | 2.09 | 3.84 | 1.89 | 4.99 | 2.28 | 5.96 | 2.16 |
| 1200 | 2.92 | 2.07 | 3.95 | 2.22 | 5.00 | 2.37 | 6.03 | 2.38 |
| 1205 | 2.63 | 1.65 | 3.65 | 1.76 | 5.60 | 2.37 | 5.79 | 2.18 |
| 1220 | 3.03 | 2.02 | 3.47 | 1.82 | 4.75 | 2.48 | 5.57 | 2.34 |
| 1274 | 2.40 | 1.79 | 3.17 | 1.53 | 5.21 | 2.57 | 5.39 | 2.39 |
| 1300 | 3.45 | 2.21 | 3.55 | 1.78 | 5.34 | 2.26 | 6.79 | 1.84 |
| 1301 | 3.77 | 1.93 | 3.70 | 1.66 | 5.22 | 2.32 | 5.77 | 2.18 |
| 1303 | 3.75 | 2.01 | 4.68 | 2.11 | 5.05 | 2.08 | 5.70 | 2.04 |
| 1313 | 4.53 | 1.79 | 5.65 | 1.47 | 4.62 | 2.06 | 4.39 | 2.03 |
| 1390 | 4.00 | 2.06 | 4.50 | 1.56 | 4.55 | 2.18 | 4.50 | 1.56 |
| 1525 | 3.32 | 1.94 | 3.09 | 1.72 | 5.67 | 2.16 | 6.51 | 2.25 |
| 1616 | 3.92 | 1.71 | 5.21 | 1.12 | 4.77 | 2.51 | 3.95 | 1.95 |
| 1640 | 5.01 | 1.62 | 6.16 | 1.88 | 4.66 | 1.97 | 5.13 | 2.20 |
| 1650 | 5.63 | 1.88 | 6.65 | 2.25 | 5.44 | 2.21 | 6.23 | 1.99 |
| 1675 | 4.68 | 1.64 | 5.24 | 1.48 | 4.30 | 2.07 | 4.37 | 2.15 |
| 1710 | 7.48 | 1.63 | 8.34 | 1.12 | 6.38 | 2.50 | 5.41 | 2.34 |
| 1720 | 5.56 | 1.83 | 6.79 | 1.56 | 5.04 | 2.29 | 5.32 | 1.82 |
| 1722 | 6.58 | 2.01 | 7.04 | 2.02 | 5.49 | 2.38 | 5.22 | 2.49 |
| 1811 | 5.36 | 1.87 | 7.62 | 1.59 | 5.00 | 2.19 | 5.12 | 2.25 |
| 1930 | 3.75 | 2.01 | 3.79 | 1.92 | 5.74 | 2.08 | 6.42 | 2.07 |
| 1932 | 3.78 | 1.79 | 3.85 | 2.11 | 5.42 | 2.22 | 6.47 | 2.20 |
| 1935 | 3.70 | 1.60 | 4.88 | 1.44 | 4.38 | 2.09 | 4.29 | 1.95 |
| 1945 | 3.03 | 2.03 | 4.59 | 1.68 | 5.04 | 2.54 | 4.42 | 2.03 |
| 2102 | 4.08 | 1.69 | 5.16 | 0.96 | 3.27 | 1.69 | 3.03 | 1.87 |
| 2200 | 4.29 | 1.98 | 4.79 | 1.38 | 4.01 | 2.20 | 3.18 | 2.17 |
| 2210 | 4.12 | 1.83 | 4.38 | 1.64 | 3.88 | 1.91 | 3.56 | 2.21 |
| 2214 | 4.34 | 1.43 | 5.01 | 1.12 | 3.71 | 1.86 | 3.46 | 1.97 |
| 2220 | 3.62 | 1.78 | 5.03 | 1.39 | 3.95 | 2.24 | 4.93 | 1.65 |
| 2230 | 3.60 | 1.77 | 4.53 | 1.22 | 3.90 | 2.10 | 4.13 | 1.68 |

IAPS Sample and Normed Ratings of Valence and Arousal

| Image # | Valence Sample Ratings | | Valence Normed Ratings | | Arousal Sample Ratings | | Arousal Normed Ratings | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| 2351 | 4.23 | 2.04 | 5.49 | 2.00 | 4.58 | 2.19 | 4.74 | 2.05 |
| 2372 | 4.26 | 1.47 | 5.48 | 1.63 | 3.79 | 1.71 | 4.09 | 1.99 |
| 2383 | 4.08 | 1.52 | 4.72 | 1.36 | 3.47 | 1.92 | 3.41 | 1.83 |
| 2410 | 3.81 | 1.57 | 4.62 | 1.72 | 3.77 | 1.69 | 4.13 | 2.29 |
| 2487 | 4.58 | 1.87 | 5.20 | 1.80 | 4.03 | 1.94 | 4.05 | 1.92 |
| 2575 | 4.30 | 1.53 | 5.46 | 1.15 | 4.04 | 1.87 | 4.16 | 2.10 |
| 2635 | 4.64 | 1.64 | 5.22 | 1.65 | 3.95 | 2.02 | 4.42 | 1.98 |
| 2704 | 4.77 | 2.01 | 4.85 | 1.89 | 5.12 | 2.27 | 5.30 | 2.16 |
| 2730 | 2.34 | 1.85 | 2.45 | 2.25 | 5.44 | 2.67 | 6.80 | 2.21 |
| 2780 | 3.52 | 1.87 | 4.77 | 1.76 | 5.11 | 2.16 | 4.86 | 2.05 |
| 2810 | 3.55 | 1.76 | 4.31 | 1.65 | 4.49 | 2.25 | 4.47 | 1.92 |
| 2811 | 3.29 | 2.01 | 2.17 | 1.38 | 5.37 | 2.45 | 6.90 | 2.22 |
| 3000 | 2.08 | 1.83 | 1.59 | 1.35 | 5.67 | 2.52 | 7.26 | 2.10 |
| 3010 | 1.93 | 1.60 | 1.71 | 1.19 | 5.77 | 2.84 | 7.16 | 2.24 |
| 3030 | 2.29 | 1.79 | 1.91 | 1.56 | 5.60 | 2.38 | 6.76 | 2.10 |
| 3053 | 1.64 | 1.55 | 1.31 | 0.97 | 6.18 | 2.65 | 6.91 | 2.57 |
| 3060 | 1.84 | 1.66 | 1.79 | 1.56 | 5.99 | 2.67 | 7.12 | 2.09 |
| 3068 | 1.58 | 1.13 | 1.80 | 1.56 | 6.00 | 2.69 | 6.77 | 2.49 |
| 3069 | 1.71 | 1.57 | 1.70 | 1.41 | 6.16 | 2.49 | 7.03 | 2.41 |
| 3071 | 2.38 | 1.94 | 1.88 | 1.39 | 5.92 | 2.58 | 6.86 | 2.05 |
| 3080 | 1.82 | 1.62 | 1.48 | 0.95 | 6.22 | 2.63 | 7.22 | 1.97 |
| 3102 | 1.77 | 1.65 | 1.40 | 1.14 | 6.32 | 2.71 | 6.58 | 2.69 |
| 3110 | 2.07 | 1.58 | 1.79 | 1.30 | 5.63 | 2.72 | 6.70 | 2.16 |
| 3120 | 2.11 | 1.85 | 1.56 | 1.09 | 5.74 | 2.51 | 6.84 | 2.36 |
| 3130 | 1.96 | 1.87 | 1.58 | 1.24 | 5.71 | 2.61 | 6.97 | 2.07 |
| 3170 | 1.77 | 1.41 | 1.46 | 1.01 | 5.77 | 2.74 | 7.21 | 1.99 |
| 3210 | 4.01 | 1.90 | 4.49 | 1.91 | 4.40 | 2.14 | 5.39 | 1.91 |
| 3266 | 1.67 | 1.31 | 1.56 | 0.98 | 5.86 | 2.67 | 6.79 | 2.09 |
| 3302 | 4.25 | 2.41 | 4.50 | 2.40 | 5.56 | 2.32 | 5.70 | 2.27 |
| 3500 | 2.75 | 1.98 | 2.21 | 1.34 | 5.33 | 2.53 | 6.99 | 2.19 |
| 3530 | 2.27 | 1.72 | 1.80 | 1.32 | 5.41 | 2.59 | 6.82 | 2.09 |
| 4004 | 4.01 | 1.85 | 5.14 | 1.85 | 4.34 | 2.05 | 4.44 | 2.14 |
| 4005 | 4.18 | 2.14 | 5.43 | 2.08 | 4.74 | 2.33 | 5.02 | 2.00 |
| 4220 | 4.38 | 2.20 | 6.60 | 1.72 | 4.85 | 2.20 | 5.18 | 2.33 |
| 4275 | 4.67 | 1.97 | 5.70 | 2.01 | 4.63 | 2.06 | 4.41 | 2.45 |
| 4279 | 3.99 | 2.29 | 5.47 | 2.04 | 4.58 | 2.34 | 4.38 | 2.61 |
| 4537 | 4.73 | 1.96 | 5.64 | 1.78 | 4.47 | 2.31 | 4.49 | 2.44 |
| 4559 | 4.67 | 2.10 | 5.53 | 1.80 | 4.81 | 2.30 | 4.83 | 2.29 |

IAPS Sample and Normed Ratings of Valence and Arousal

| Image # | Valence Sample Ratings | | Valence Normed Ratings | | Arousal Sample Ratings | | Arousal Normed Ratings | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| 4607 | 5.21 | 2.19 | 7.03 | 1.84 | 5.62 | 2.22 | 6.34 | 2.16 |
| 4608 | 4.89 | 2.35 | 7.07 | 1.66 | 5.19 | 2.31 | 6.47 | 1.96 |
| 4652 | 4.92 | 2.61 | 6.79 | 2.02 | 5.95 | 2.62 | 6.62 | 2.04 |
| 4656 | 4.86 | 2.33 | 6.73 | 1.94 | 5.37 | 2.37 | 6.41 | 2.19 |
| 4658 | 4.88 | 2.30 | 6.62 | 1.89 | 5.68 | 2.29 | 6.47 | 2.14 |
| 4659 | 4.79 | 2.54 | 6.87 | 1.99 | 5.82 | 2.30 | 6.93 | 2.07 |
| 4660 | 5.10 | 1.97 | 7.40 | 1.36 | 5.47 | 2.17 | 6.58 | 1.88 |
| 4664 | 4.78 | 2.45 | 6.61 | 2.23 | 5.55 | 2.54 | 6.72 | 2.08 |
| 4670 | 4.62 | 2.33 | 6.99 | 1.73 | 5.48 | 2.37 | 6.74 | 2.03 |
| 4676 | 5.18 | 2.29 | 6.81 | 1.67 | 5.63 | 2.40 | 6.07 | 2.22 |
| 4677 | 4.34 | 2.32 | 6.58 | 1.65 | 4.99 | 2.51 | 6.19 | 2.08 |
| 4681 | 4.68 | 2.27 | 6.69 | 1.82 | 5.42 | 2.26 | 6.68 | 1.70 |
| 4687 | 4.82 | 2.16 | 6.87 | 1.51 | 5.26 | 2.39 | 6.51 | 2.10 |
| 4689 | 5.04 | 2.08 | 6.90 | 1.55 | 5.30 | 2.21 | 6.21 | 1.74 |
| 4694 | 4.56 | 2.40 | 6.69 | 1.70 | 5.51 | 2.31 | 6.42 | 2.08 |
| 4695 | 4.78 | 2.34 | 6.84 | 1.53 | 5.74 | 2.33 | 6.61 | 1.88 |
| 4750 | 4.16 | 2.16 | 5.57 | 1.92 | 5.00 | 2.23 | 4.90 | 2.15 |
| 4810 | 4.51 | 2.42 | 6.56 | 2.09 | 5.60 | 2.53 | 6.66 | 2.14 |
| 5120 | 3.85 | 1.54 | 4.39 | 1.34 | 4.15 | 2.11 | 3.07 | 2.12 |
| 5130 | 3.64 | 1.64 | 4.45 | 1.13 | 3.55 | 1.68 | 2.51 | 1.72 |
| 5260 | 5.88 | 1.98 | 7.34 | 1.74 | 4.89 | 2.28 | 5.71 | 2.53 |
| 5270 | 5.71 | 2.02 | 7.26 | 1.57 | 4.81 | 2.37 | 5.49 | 2.54 |
| 5390 | 5.14 | 1.71 | 5.59 | 1.54 | 4.05 | 2.13 | 2.88 | 1.97 |
| 5480 | 6.47 | 1.92 | 7.53 | 1.63 | 6.04 | 2.47 | 5.48 | 2.35 |
| 5500 | 3.93 | 1.53 | 5.40 | 1.58 | 3.36 | 1.74 | 3.00 | 2.42 |
| 5510 | 4.00 | 1.70 | 5.15 | 1.43 | 3.36 | 1.80 | 2.82 | 2.18 |
| 5520 | 4.21 | 1.69 | 5.33 | 1.49 | 3.77 | 1.82 | 2.95 | 2.42 |
| 5530 | 3.92 | 1.56 | 5.38 | 1.60 | 3.33 | 1.66 | 2.87 | 2.29 |
| 5531 | 3.66 | 1.81 | 5.15 | 1.45 | 3.53 | 1.94 | 3.69 | 2.11 |
| 5532 | 3.74 | 1.56 | 5.19 | 1.69 | 3.58 | 1.68 | 3.79 | 2.20 |
| 5533 | 4.16 | 1.66 | 5.31 | 1.17 | 3.77 | 2.26 | 3.12 | 1.92 |
| 5534 | 4.05 | 1.66 | 4.84 | 1.44 | 3.32 | 1.90 | 3.14 | 2.03 |
| 5535 | 4.18 | 1.80 | 4.81 | 1.52 | 3.63 | 2.04 | 4.11 | 2.31 |
| 5600 | 5.97 | 1.88 | 7.57 | 1.48 | 4.89 | 2.41 | 5.19 | 2.70 |
| 5660 | 5.64 | 1.85 | 7.27 | 1.59 | 4.26 | 2.35 | 5.07 | 2.62 |
| 5700 | 5.30 | 2.04 | 7.61 | 1.46 | 4.88 | 2.21 | 5.68 | 2.33 |
| 5731 | 4.73 | 1.71 | 5.39 | 1.58 | 3.60 | 2.06 | 2.74 | 1.95 |
| 5740 | 4.51 | 1.60 | 5.21 | 1.38 | 3.45 | 1.85 | 2.59 | 1.99 |

IAPS Sample and Normed Ratings of Valence and Arousal

| Image # | Valence Sample Ratings | | Valence Normed Ratings | | Arousal Sample Ratings | | Arousal Normed Ratings | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| 5814 | 5.63 | 1.92 | 7.15 | 1.54 | 5.15 | 2.55 | 4.82 | 2.40 |
| 5849 | 5.66 | 2.21 | 6.65 | 1.93 | 4.78 | 2.48 | 4.89 | 2.43 |
| 5910 | 6.67 | 1.93 | 7.80 | 1.23 | 6.29 | 2.44 | 5.59 | 2.55 |
| 5961 | 3.75 | 1.83 | 3.52 | 1.86 | 4.97 | 2.33 | 5.80 | 2.37 |
| 5971 | 3.89 | 1.93 | 3.49 | 1.87 | 5.12 | 2.21 | 6.65 | 2.02 |
| 5972 | 3.70 | 1.78 | 3.85 | 2.33 | 4.88 | 2.43 | 6.34 | 2.20 |
| 5973 | 3.66 | 1.72 | 3.51 | 1.83 | 4.95 | 2.15 | 5.78 | 2.27 |
| 6150 | 4.26 | 1.53 | 5.08 | 1.17 | 3.44 | 1.79 | 3.22 | 2.02 |
| 6250 | 3.25 | 2.02 | 2.83 | 1.79 | 5.59 | 2.38 | 6.54 | 2.61 |
| 6313 | 2.51 | 1.99 | 1.98 | 1.38 | 5.41 | 2.59 | 6.94 | 2.23 |
| 6350 | 2.53 | 1.85 | 1.90 | 1.29 | 5.58 | 2.65 | 7.29 | 1.87 |
| 6370 | 2.74 | 1.75 | 2.70 | 1.52 | 5.52 | 2.51 | 6.44 | 2.19 |
| 6510 | 2.64 | 1.69 | 2.46 | 1.58 | 5.34 | 2.45 | 6.96 | 2.09 |
| 6540 | 2.42 | 1.67 | 2.19 | 1.56 | 5.26 | 2.43 | 6.83 | 2.14 |
| 6550 | 2.71 | 2.18 | 2.73 | 2.38 | 5.84 | 2.46 | 7.09 | 1.98 |
| 6560 | 2.59 | 2.02 | 2.16 | 1.41 | 5.60 | 2.69 | 6.53 | 2.42 |
| 6610 | 3.66 | 1.95 | 3.60 | 1.79 | 4.47 | 2.13 | 5.06 | 2.39 |
| 6900 | 4.66 | 1.87 | 4.76 | 2.06 | 4.41 | 1.97 | 5.64 | 2.22 |
| 6910 | 4.84 | 1.75 | 5.31 | 2.28 | 5.01 | 1.93 | 5.62 | 2.46 |
| 6940 | 3.89 | 1.93 | 3.53 | 2.07 | 4.89 | 2.10 | 5.35 | 2.02 |
| 7002 | 4.51 | 1.73 | 4.97 | 0.97 | 3.56 | 1.92 | 3.16 | 2.00 |
| 7004 | 4.21 | 1.79 | 5.04 | 0.60 | 3.42 | 2.04 | 2.00 | 1.66 |
| 7006 | 4.08 | 1.82 | 4.88 | 0.99 | 3.26 | 1.83 | 2.33 | 1.67 |
| 7009 | 4.44 | 1.65 | 4.93 | 1.00 | 3.47 | 1.78 | 3.01 | 1.97 |
| 7010 | 4.14 | 1.56 | 4.94 | 1.07 | 3.00 | 1.75 | 1.76 | 1.48 |
| 7020 | 4.11 | 1.70 | 4.97 | 1.04 | 3.45 | 1.94 | 2.17 | 1.71 |
| 7025 | 4.10 | 1.63 | 4.63 | 1.17 | 3.22 | 1.78 | 2.71 | 2.20 |
| 7030 | 4.08 | 1.74 | 4.69 | 1.04 | 3.36 | 2.00 | 2.99 | 2.09 |
| 7031 | 3.90 | 1.69 | 4.52 | 1.11 | 3.44 | 1.84 | 2.03 | 1.51 |
| 7034 | 4.04 | 1.47 | 4.95 | 0.87 | 3.27 | 1.73 | 3.06 | 1.95 |
| 7035 | 4.33 | 1.76 | 4.98 | 0.96 | 3.21 | 1.79 | 2.66 | 1.82 |
| 7037 | 4.27 | 1.64 | 4.81 | 1.12 | 3.86 | 1.89 | 3.71 | 2.08 |
| 7038 | 4.15 | 1.77 | 4.82 | 1.20 | 3.64 | 1.89 | 3.01 | 1.96 |
| 7040 | 3.85 | 1.81 | 4.69 | 1.09 | 3.19 | 1.95 | 2.69 | 1.93 |
| 7041 | 4.19 | 1.66 | 4.99 | 1.12 | 3.19 | 1.73 | 2.60 | 1.78 |
| 7043 | 3.99 | 1.42 | 5.17 | 1.26 | 3.59 | 1.83 | 3.68 | 2.09 |
| 7050 | 4.19 | 1.63 | 4.93 | 0.81 | 3.45 | 1.75 | 2.75 | 1.80 |
| 7052 | 4.30 | 1.67 | 5.33 | 1.32 | 3.42 | 1.84 | 3.01 | 2.02 |

IAPS Sample and Normed Ratings of Valence and Arousal

| Image # | Valence Sample Ratings | | Valence Normed Ratings | | Arousal Sample Ratings | | Arousal Normed Ratings | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| 7053 | 4.51 | 1.84 | 5.22 | 0.75 | 3.68 | 2.11 | 2.95 | 1.91 |
| 7055 | 3.93 | 1.69 | 4.90 | 0.64 | 3.33 | 1.75 | 3.02 | 1.83 |
| 7056 | 4.01 | 1.71 | 5.07 | 1.02 | 3.41 | 1.85 | 3.07 | 1.92 |
| 7058 | 4.26 | 1.56 | 5.29 | 1.38 | 3.96 | 2.00 | 3.98 | 2.17 |
| 7059 | 4.42 | 1.76 | 4.93 | 0.81 | 3.74 | 1.99 | 2.73 | 1.88 |
| 7060 | 3.75 | 1.73 | 4.43 | 1.16 | 3.29 | 1.85 | 2.55 | 1.77 |
| 7080 | 4.10 | 1.77 | 5.27 | 1.09 | 3.40 | 1.95 | 2.32 | 1.84 |
| 7090 | 4.52 | 1.98 | 5.19 | 1.46 | 3.75 | 2.04 | 2.61 | 2.03 |
| 7096 | 4.25 | 1.49 | 5.54 | 1.26 | 3.49 | 1.87 | 3.98 | 1.87 |
| 7100 | 4.40 | 1.83 | 5.24 | 1.20 | 3.30 | 1.98 | 2.89 | 1.70 |
| 7110 | 3.90 | 1.56 | 4.55 | 0.93 | 3.38 | 1.82 | 2.27 | 1.70 |
| 7140 | 4.14 | 1.58 | 5.50 | 1.42 | 3.42 | 1.68 | 2.92 | 2.38 |
| 7150 | 4.42 | 1.67 | 4.72 | 1.00 | 3.48 | 1.94 | 2.61 | 1.76 |
| 7160 | 4.51 | 1.53 | 5.02 | 1.10 | 4.10 | 1.91 | 3.07 | 2.07 |
| 7161 | 4.10 | 1.62 | 4.98 | 1.02 | 3.49 | 1.76 | 2.98 | 1.99 |
| 7170 | 4.42 | 1.75 | 5.14 | 1.28 | 3.79 | 2.03 | 3.21 | 2.05 |
| 7175 | 4.18 | 1.80 | 4.87 | 1.00 | 3.40 | 2.05 | 1.72 | 1.26 |
| 7179 | 4.64 | 1.92 | 5.06 | 1.05 | 3.66 | 1.98 | 2.88 | 1.97 |
| 7183 | 4.62 | 1.96 | 5.58 | 1.39 | 4.55 | 2.48 | 3.78 | 2.19 |
| 7184 | 4.18 | 1.64 | 4.84 | 1.02 | 3.89 | 1.99 | 3.66 | 1.89 |
| 7185 | 3.79 | 1.69 | 4.97 | 0.87 | 3.22 | 1.95 | 2.64 | 2.04 |
| 7186 | 4.19 | 1.71 | 4.63 | 1.60 | 3.38 | 1.93 | 3.60 | 2.36 |
| 7188 | 4.73 | 1.51 | 5.50 | 1.12 | 4.37 | 1.93 | 4.28 | 2.16 |
| 7190 | 4.63 | 1.49 | 5.55 | 1.34 | 3.77 | 1.98 | 3.84 | 2.06 |
| 7200 | 6.21 | 1.99 | 7.63 | 1.74 | 5.95 | 2.27 | 4.87 | 2.59 |
| 7205 | 4.49 | 1.63 | 5.56 | 1.39 | 3.73 | 1.87 | 2.93 | 2.16 |
| 7217 | 4.03 | 1.76 | 4.82 | 0.99 | 3.44 | 1.94 | 2.43 | 1.64 |
| 7220 | 6.56 | 1.89 | 6.91 | 1.74 | 6.07 | 2.21 | 5.30 | 2.35 |
| 7224 | 3.84 | 1.75 | 4.45 | 1.36 | 2.88 | 1.77 | 2.81 | 1.94 |
| 7230 | 6.07 | 2.04 | 7.38 | 1.65 | 5.45 | 2.39 | 5.52 | 2.32 |
| 7233 | 4.22 | 1.89 | 5.09 | 1.46 | 3.30 | 1.97 | 2.77 | 1.92 |
| 7235 | 3.97 | 1.74 | 4.96 | 1.18 | 3.14 | 1.77 | 2.83 | 2.00 |
| 7260 | 6.07 | 1.88 | 7.21 | 1.66 | 5.45 | 2.42 | 5.11 | 2.19 |
| 7270 | 5.73 | 2.16 | 7.53 | 1.73 | 4.96 | 2.57 | 5.76 | 2.21 |
| 7289 | 5.82 | 2.33 | 6.32 | 2.00 | 5.38 | 2.46 | 5.14 | 2.51 |
| 7330 | 6.64 | 1.97 | 7.69 | 1.84 | 6.55 | 2.32 | 5.14 | 2.58 |
| 7350 | 5.99 | 2.11 | 7.10 | 1.98 | 5.74 | 2.33 | 4.97 | 2.44 |
| 7359 | 3.14 | 2.05 | 2.92 | 1.70 | 4.82 | 2.61 | 5.36 | 2.19 |

IAPS Sample and Normed Ratings of Valence and Arousal

| Image # | Valence Sample Ratings | | Valence Normed Ratings | | Arousal Sample Ratings | | Arousal Normed Ratings | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| 7361 | 2.97 | 1.83 | 3.10 | 1.73 | 4.93 | 2.50 | 5.09 | 2.48 |
| 7380 | 2.26 | 1.43 | 2.46 | 1.42 | 4.73 | 2.46 | 5.88 | 2.44 |
| 7400 | 6.52 | 1.93 | 7.00 | 1.64 | 6.08 | 2.36 | 5.06 | 2.23 |
| 7450 | 5.52 | 2.27 | 6.40 | 2.01 | 5.34 | 2.47 | 5.05 | 2.22 |
| 7460 | 5.56 | 2.43 | 6.81 | 2.08 | 5.38 | 2.40 | 5.12 | 2.49 |
| 7481 | 5.68 | 2.01 | 6.53 | 1.78 | 5.03 | 2.36 | 4.92 | 2.13 |
| 7482 | 5.81 | 2.09 | 6.36 | 1.77 | 5.19 | 2.45 | 4.81 | 2.24 |
| 7490 | 4.26 | 1.89 | 5.52 | 1.41 | 3.70 | 2.03 | 2.42 | 2.23 |
| 7501 | 5.55 | 2.05 | 6.85 | 1.70 | 5.49 | 2.25 | 5.63 | 2.27 |
| 7508 | 5.93 | 2.12 | 7.02 | 1.46 | 5.22 | 2.47 | 5.09 | 2.11 |
| 7547 | 4.45 | 1.75 | 5.21 | 0.96 | 3.47 | 1.97 | 3.18 | 2.01 |
| 7705 | 3.99 | 1.52 | 4.77 | 1.02 | 3.12 | 1.72 | 2.65 | 1.88 |
| 7950 | 4.04 | 1.62 | 4.94 | 1.21 | 3.10 | 1.70 | 2.28 | 1.81 |
| 8030 | 6.03 | 2.05 | 7.33 | 1.76 | 5.82 | 2.18 | 7.35 | 2.02 |
| 8034 | 5.23 | 1.87 | 7.06 | 1.53 | 4.78 | 2.02 | 6.30 | 2.16 |
| 8060 | 5.10 | 2.03 | 5.36 | 2.23 | 5.22 | 2.16 | 5.31 | 1.99 |
| 8080 | 5.11 | 1.90 | 7.73 | 1.34 | 4.85 | 2.10 | 6.65 | 2.20 |
| 8185 | 6.11 | 1.91 | 7.57 | 1.52 | 6.22 | 1.85 | 7.27 | 2.08 |
| 8186 | 5.99 | 2.00 | 7.01 | 1.57 | 5.86 | 2.20 | 6.84 | 2.01 |
| 8190 | 6.14 | 1.97 | 8.10 | 1.39 | 5.25 | 2.49 | 6.28 | 2.57 |
| 8200 | 5.23 | 1.92 | 7.54 | 1.37 | 5.22 | 2.23 | 6.35 | 1.98 |
| 8232 | 4.95 | 1.98 | 5.07 | 1.80 | 5.07 | 2.00 | 5.10 | 2.21 |
| 8300 | 5.63 | 1.95 | 7.02 | 1.60 | 4.99 | 2.14 | 6.14 | 2.21 |
| 8370 | 5.95 | 1.96 | 7.77 | 1.29 | 5.36 | 2.38 | 6.73 | 2.24 |
| 8400 | 5.73 | 1.82 | 7.09 | 1.52 | 5.15 | 2.40 | 6.61 | 1.86 |
| 8466 | 3.22 | 2.06 | 4.86 | 1.77 | 4.73 | 2.49 | 4.92 | 2.09 |
| 8470 | 5.34 | 2.06 | 7.74 | 1.53 | 4.75 | 2.19 | 6.14 | 2.19 |
| 8485 | 3.37 | 2.10 | 2.73 | 1.62 | 6.22 | 2.20 | 6.46 | 2.10 |
| 8490 | 6.00 | 2.20 | 7.20 | 2.35 | 5.92 | 2.25 | 6.68 | 1.97 |
| 9300 | 1.77 | 1.32 | 2.26 | 1.76 | 5.47 | 2.73 | 6.00 | 2.41 |
| 9301 | 1.73 | 1.35 | 2.26 | 1.56 | 5.34 | 2.74 | 5.28 | 2.46 |
| 9402 | 3.26 | 2.00 | 4.48 | 2.12 | 4.82 | 2.18 | 5.07 | 2.15 |
| 9410 | 1.75 | 1.21 | 1.51 | 1.15 | 5.86 | 2.67 | 7.07 | 2.06 |
| 9411 | 4.16 | 1.83 | 4.63 | 1.58 | 4.58 | 2.03 | 5.37 | 1.97 |
| 9470 | 3.23 | 1.59 | 3.05 | 1.51 | 5.04 | 2.19 | 5.05 | 1.98 |
| 9495 | 3.47 | 1.84 | 3.34 | 1.75 | 5.12 | 2.26 | 5.57 | 2.00 |
| 9810 | 2.47 | 2.01 | 2.09 | 1.78 | 5.33 | 2.52 | 6.62 | 2.26 |