Do You See What Eye See: The Effect of Psychopathic Traits on Memory and Attention to
Emotional Images

by

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Abstract

Numerous studies have found a central/peripheral trade-off in memory for negative stimuli. This pattern has been supported by eye-tracking studies showing that participants fixate more often on central rather than peripheral details. Only one study to date has examined this in relation to psychopathy and found that psychopaths equally remembered central and peripheral details for negative stimuli (Christianson et al., 1996). The present study investigated the relationship between psychopathic traits, the central/peripheral trade-off, and eye-tracking patterns upon viewing emotional images. Eye movements of 68 undergraduates scoring high or low on the Self-Report Psychopathy Scale were tracked while viewing a negative, positive, and neutral image. Memory for these images was subsequently tested. A central/peripheral trade-off was found only for the positive and neutral image. Eye-tracking patterns did not support the attentional narrowing hypothesis and were unrelated to memory. There was no effect of psychopathy on emotional memory, however differences in eye fixation count and duration were found between those high versus low in psychopathy when viewing the positive image. The results suggest that the relationship between attention and memory is much more complicated than previously believed.

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Do You See What Eye See: The Effect of Psychopathic Traits on Memory and Attention to Emotional Images

The construct of psychopathy has been documented for decades (Hare & Neumann, 2009). From representations of psychopathy in mainstream media (e.g., Dexter Morgan, Hannibal Lector, Patrick Bateman) to countless academic studies, psychopaths have consistently captivated the interest of a diverse audience. Psychopathy can be defined as a personality disorder characterized by a set of affective, interpersonal, and behavioural features (Cleckley, 1941, 1976; Hare, 2003). In terms of affective features, psychopaths exhibit remorselessness, a lack of empathy, callousness, and shallow affect (DeLisi, 2009). Interpersonally, psychopaths are typically manipulative, grandiose, superficially charming individuals who often engage in excessive lying (DeLisi, 2009). Behaviourally, psychopaths also tend to display a number of features, such as impulsivity, a lack of anger control, and socially deviant behaviour (DeLisi, 2009; Hare, Hart, & Harpur, 1991). Overall, psychopaths are egocentric individuals who act in order to comply with their own self-interests, disregarding the effect that these actions may have on others (DeLisi, 2009). Research using community samples has found that psychopathy is present in roughly 1% of the general population (Coid, Yang, Ullrich, Roberts, & Hare, 2009; Forth, Brown, Hart, & Hare, 1996; Neumann & Hare, 2008), however the disorder is more prevalent in offender populations, with approximately 20% of offenders displaying substantial psychopathic traits (Hare, 2003).

A lack of emotional responding is considered to be one of the most prominent traits of psychopathy (Patrick, Bradley, & Lang, 1993). Indeed, psychopaths demonstrate a myriad of affective features, including a lack of remorse or guilt, fearlessness, callousness, and egocentricity (Cleckley, 1941, 1976). A growing body of research has examined this lack of

emotional responding in psychopaths, and has provided support for the notion that psychopaths demonstrate affective deficits in a wide variety of tasks, such as emotional face recognition (e.g., Iria & Barbosa, 2009), emotional language recognition (e.g., Bagley, Abramowitz, & Kosson, 2009), and emotional memory (e.g., Christianson et al., 1996).

The current study investigated differences in emotional memory between undergraduate students who were high versus low in psychopathic traits. In particular, memory for central and peripheral details of emotional images was tested among these groups. While emotional images were viewed, the eye movements of participants were tracked using an eye tracking device in order to determine where attention was allocated as images were viewed. This was the first study to implement eye tracking to examine emotional memory for central and peripheral details in conjunction with psychopathic traits. A secondary purpose of the current study was to examine the relationship between two measures of psychopathy: the Triarchic Psychopathy Measure (TriPM; Patrick, 2010) and the Self Report Psychopathy Scale-Short Form (SRP-SF; Paulhus, Neumann, & Hare, in press).

This thesis will begin with a discussion of several methods that have been developed to measure psychopathy. This will be followed by a discussion of the literature examining emotional processing deficits in those with a high degree of psychopathic traits, including differences in emotional memory. Emotional memory among non-psychopathic individuals will then be discussed, including an overview of the central/peripheral trade-off in memory in addition to studies that have utilized an eye tracking device while examining emotional memory. Studies that have examined the central/peripheral trade-off in conjunction with psychopathy will then be reviewed. Following this, the methods and results of the current study will be outlined, along with a discussion of these results and how they relate to the existing literature.

Assessment of Psychopathy

A wide range of tools has been developed in order to measure the construct of psychopathy. These measures include expert ratings, observer ratings, and self-report ratings. Measures such as expert ratings are typically used in clinical practice and with research using offender samples, whereas self-report measures are favoured when conducting research using community samples.

Clinical ratings. Currently, the most widely used clinical measure of psychopathy is the Hare Psychopathy Checklist-Revised (PCL-R; Hare, 1991, 2003). The PCL-R contains 20 items that are assessed using both file review and semi-structured interviews (Hare, 2003). These 20 items assess characteristics associated with a psychopathic personality, including affective (e.g., callousness, remorselessness), interpersonal (e.g., manipulativeness, glibness) and behavioural features (e.g., impulsivity, lack of behavioural control). In the scoring process, each item is rated as a '0' (definitely not present or does not apply), a '1' (possibly present), or a '2' (definitely present), allowing for a maximum score of 40. Thus, higher scores on this scale indicate a higher degree of psychopathy. Generally, a score of 30 has been used as the cut-off for psychopathic personality (Hare, 2003; Hare & Neumann, 2009).

Factor analysis of the PCL-R has revealed two correlated factors (Hare et al., 1990). Factor 1 consists of the affective and interpersonal features of psychopathy, whereas Factor 2 consists of the antisocial and socially deviant features of the disorder (Hare et al., 1990; Neumann, Kosson, Forth, & Hare, 2006). A number of studies have been conducted examining the correlates of these two factors of psychopathy. According to these studies, Factor 1 is most strongly correlated with deficits in emotional processing (Patrick et al., 1993; Verona, Patrick, Curtin, Bradley, & Lang, 2004; Vaidyanathan, Hall, Patrick, & Bernat, 2011), while Factor 2 is

most strongly associated with general and violent recidivism (Hemphill, Hare, & Wong, 1998; Walters, 2003a, 2003b; Kennealy, Skeem, Walters, & Camp, 2010; Yang, Wong, & Coid, 2010).

Cooke and Michie (2001) have proposed a three-factor model of psychopathy. These three factors include Arrogant and Deceitful Interpersonal Style, Deficient Affective Experience, and Impulsive and Irresponsible Behavioural Style. Cooke and Michie's (2001) three-factor model divided the original Factor 1 into two separate factors, and altered the original Factor 2 by removing the antisocial aspects to create their third factor (Salekin, Brannen, Zalot, Leistico, & Neumann, 2006). More recently, Hare (2003) has put forward a four-factor model of psychopathy, which retains Cooke and Michie's (2001) three factors, but adds a fourth factor measuring the early onset and antisocial features of psychopathy. Recent studies have provided support for the four-factor model of psychopathy (e.g., Amato, Cornell, & Fan, 2008; Hare & Neumann, 2006; Hill, Neumann, & Rogers, 2004; Jones, Cauffman, Miller, & Mulvey, 2006).

Two adaptations of the PCL-R have been created: the Psychopathy Checklist: Youth Version (PCL-YV; Forth, Kosson, & Hare, 2003) and the Psychopathy Checklist: Screening Version (PCL:SV; Hart, Cox, & Hare, 1995). The PCL-YV resembles the PCL-R in that it is a multi-item measure assessing affective, interpersonal, and behavioural characteristics of psychopathy from both file and interview information (Forth et al., 2003). However, the PCL-YV is specified for use with adolescent populations. Originally, the PCL-R was created for use in criminal settings, therefore the PCL:SV was created in order to assess for psychopathy in non-offender samples as well as to screen for psychopathy in criminal settings with a shortened measure (Hart et al., 1995). The PCL:SV contains 12 items derived from the PCL-R and assesses a similar factor structure (Hart et al., 1995). The PCL:SV has been shown to be a reliable and valid tool in non-forensic samples (Forth et al., 1996), and is moderately correlated with other

measures of psychopathy such as the Psychopathic Personality Inventory (PPI; Lilienfeld & Andrews, 1996; Malterer, Lilienfeld, Neumann, & Newman, 2010).

Self-report measures of psychopathy. The PCL-R, the PCL-YV, and the PCL:SV all require the rater to perform a file review of the participant's history as well as conduct a semi-structured interview in order to score each item. Even in the case of the PCL:SV, this can be a lengthy process when large samples of participants are involved. Furthermore, the need for access to file information poses an issue when community samples are used (Uzieblo, Verschuere, Van den Bussche, & Crombez, 2010). Additionally, in order to obtain inter-rater reliability, an additional rater must complete the assessment. Thus, researchers often use self-report psychopathy scales in non-institutionalized samples in order to measure the construct (Uzieblo et al., 2010). Another benefit of self-report psychopathy scales is that the assessment can be completed free of rater bias (Blais, Solodukhin, & Forth, 2014). However, concern has been expressed regarding the potential for dishonest responding when using self-report measures, particularly with a construct such as psychopathy (Lilienfeld & Fowler, 2006). This concern has been addressed by a recent meta-analysis, which found a negative correlation between self-report psychopathy scores and socially desirable responding (Ray et al., 2013). Overall, self-report psychopathy scales appear to be useful tools for researchers.

One popular self-report psychopathy scale used in research is the Psychopathic Personality Inventory-Revised (PPI-R; Lilienfeld & Widows, 2005). The PPI-R is a 154-item scale that can be used in both offender and community samples (Lilienfeld & Widows, 2005). This scale measures three factors and eight subscales. The factors measured by the PPI-R include Fearless Dominance, Self-Centered Impulsivity, and Coldheartedness. The Fearless Dominance factor contains three subscales, titled Social Influence, Fearlessness, and Stress Immunity. The

Self-Centered Impulsivity factor contains four subscales, titled Machiavellian Egocentricity, Rebellious Nonconformity, Blame Externalization, and Carefree Nonplanfulness. Finally, the Coldheartedness factor consists of only one subscale, which is also titled Coldheartedness. This third factor is often excluded from statistical analyses as the validity of this factor has been questioned (Uzieblo et al., 2010), thus many view the PPI-R as a two-factor measure. The PPI-R has generally been shown to have good convergent validity, as demonstrated by its associations with the PCL-R (Berardino, Meloy, Sherman, & Jacobs, 2005) as well as with other self-report psychopathy measures, such as the Levenson's Self-Report of Psychopathy (LSRP; Levenson, Kiehl, & Fitzpatrick, 1995; Uzieblo et al., 2010). Additionally, the measure has been shown to have good external validity, as demonstrated by its relationship to several theoretically significant traits of psychopathy (e.g., Benning, Patrick, Hicks, Blonigen, & Krueger, 2003; Uzieblo et al., 2010). However, some researchers have questioned the robustness of the factor structure of the PPI-R (e.g., Siebert, Miller, Few, Zeichner, & Lynam, 2011; Uzieblo et al., 2010). For example, Siebert et al. (2011) note that the PPI-R's Factor 1, Fearless Dominance, has produced non-significant correlations with theoretically relevant variables, such as aggression and engagement in crime.

Another popular self-report psychopathy measure is the Self-Report Psychopathy Scale (SRP; Hare, 1985). Since its creation, the SRP has undergone two revisions. The most recent version of the scale is referred to as the Self-Report Psychopathy Scale-III (SRP-III; Paulhus et al., in press). Several studies have supported the use of this measure as a valid tool for assessing psychopathy (e.g., Mahmut, Menictas, Stevenson, & Homewood, 2011; Williams, Paulhus, & Hare, 2007). Additionally, factor analyses have revealed that a four-factor structure is the best fit for the SRP-III (Mahmut et al., 2011; Williams et al., 2007). These four factors consist of

Interpersonal Manipulation, Criminal Tendencies, Erratic Lifestyle, and Callous Affect (Williams et al., 2007). A shortened version of the SRP-III, entitled the Self-Report Psychopathy Scale-Short Form (SRP-SF; Paulhus et al., in press), has been created as well. Factor analysis of the SRP-SF has also revealed that a four-factor structure is the best fit for this measure (Neumann, Hare, & Pardini, in press).

More recently, Patrick (2010) created a self-report psychopathy measure referred to as the Triarchic Psychopathy Measure (TriPM). The TriPM was created following the formulation of the triarchic model of psychopathy; a framework intended to integrate differing theoretical notions of psychopathy and results of existing assessments of the disorder (Patrick, 2010; Patrick, Fowles, & Krueger, 2009). According to the triarchic model, psychopathy can be conceptualized using three domains: Boldness (e.g., fearlessness, dominance), Meanness (e.g., callousness, lack of empathy), and Disinhibition (e.g., impulsivity, irresponsibility; Drislane, Patrick, & Arsal, 2014; Patrick et al., 2009). The TriPM includes 58 self-report items pertaining to these three domains of psychopathy. Items on the Boldness domain were intended to expand upon the Fearless Dominance factor of the PPI-R (Patrick, 2010). Items on the Meanness and Disinhibition domains were adapted from the Externalizing Spectrum Inventory (Krueger, Markon, Patrick, Benning, & Kramer, 2007; Patrick 2010), a scale designed to measure externalizing problem behaviours in line with the Diagnostic and Statistical Manual of Mental Disorders (4th ed., DSM-IV; American Psychiatric Association, 1994). As the triarchic model is the most recent framework of psychopathy, it is important to determine its validity in the measurement of psychopathy in addition to the convergent validity between this measure and other psychopathy measures. TriPM scores have been found to correlate with variables theoretically relevant to psychopathy, such as impulsivity and lack of empathy (e.g., Stanley,

Wygant, & Sellbom, 2013). Additionally, some research has been conducted examining the relationship between scores on the TriPM and scores on other psychopathy measures (e.g., PCL-R, SRP-III) and have found correlations between the two (Patrick, 2010; Sellbom & Philips, 2013). However, no published research to date has examined the relationship between scores on the TriPM and the SRP-SF. The present study involved the administration of two self-report psychopathy measures: the TriPM and the SRP-SF, and the relationship between these two measures was examined in order to extend the literature regarding the convergent validity of both the TriPM and the SRP-SF.

In sum, a wide range of assessment tools is available for clinicians and researchers in order to measure psychopathy. While most demonstrate acceptable psychometric properties, some are more suited for research purposes with community samples because they are brief, easy to administer, and do not require inter-rater reliability (e.g., self-report measures; Lilienfeld & Fowler, 2006), while others are preferable for clinical purposes as well as for research with offender populations (e.g., expert ratings such as the PCL-R).

Psychopathy and Emotional Processing

As mentioned above, individuals with a high degree of psychopathic traits present with a series of affective features, such as callousness, lack of empathy, and lack of remorse. As such, researchers have hypothesized that psychopaths are inhibited in terms of emotional processing (Brook, Brieman, & Kosson, 2013). A number of studies have been conducted examining potential deficits in emotional responding exhibited by psychopaths. In order to study these effects, researchers have often used autonomic nervous system measures, such as the startle response, as an indication of maladaptive emotional response (Berkout, Gross, & Kellum, 2013).

Psychopathy and autonomic reactions to emotional stimuli. In a study conducted by Patrick et al. (1993), startle response was used as a proxy for emotional responding. As explained by Patrick et al. (1993), in nonpsychopathic individuals, the eyeblink reflex is larger when unpleasant stimuli are viewed. Conversely, startle response magnitude tends to decrease with positive emotional stimuli. This linear relationship between emotional valence and startle response has been termed the affect-startle effect (Lang, Bradley, & Cuthbert, 1990). The explanation behind this effect appears to have an evolutionary basis. According to Lang (1995), this effect may be a product of motivational priming. This theory posits that the magnitude of defensive reflexes, such as the startle response, increases with aversive motivation, that is, when the individual is in a negative affective state and the aversive motivational system is activated (i.e., the system linked to avoidance behaviour in order to evade a negative outcome). On the other hand, the magnitude of the startle response decreases with positive motivation, that is, when the individual is in a positive affective state and the appetitive motivational system is activated (i.e., the system linked to engagement behaviour in order to promote a positive outcome).

Patrick et al. (1993) tested the startle response of 54 incarcerated male sex offenders. Offenders were assessed for psychopathy using the PCL-R. Offenders were shown pleasant (e.g., food, sports scenes), neutral (e.g., household objects, neutral faces), and unpleasant slides (e.g., mutilations, aimed guns). Upon viewing these slides, offenders were exposed to a burst of white noise, which acted as the startle probe. When differences in startle reflex were analyzed between groups, it was found that nonpsychopathic offenders responded in accordance with the affect-startle effect. Psychopaths, on the other hand, did not show this typical response. There was no difference in startle reflex magnitude for negative and positive images among the psychopathic

offenders. In other words, psychopathic offenders had the same blink magnitude regardless of whether a negative or positive image was shown. Interestingly, psychopathic offenders demonstrated the greatest startle response when viewing neutral slides. Patrick et al. (1993) suggest that this pattern of responding may indicate a general lack of emotional response among psychopathic offenders. The differences in startle response between psychopaths and nonpsychopaths further support the notion that psychopaths are deficient in processing emotional stimuli. Participants were also asked to rate the emotional valence and arousal of each slide, and results revealed that psychopaths and nonpsychopaths rated the slides equally in terms of emotional valence and arousal. Although this finding may initially seem to contradict the notion that psychopaths demonstrate deficits in emotional response, Patrick et al. (1993) note that this result may provide support for Cleckley's (1941, 1976) notion of psychopaths embodying a 'mask of sanity'. Cleckley (1941, 1976) believed that psychopaths experience a disconnect between the linguistic properties and experiential components of emotional stimuli, and termed this disconnect 'semantic dementia'. This concept suggests that psychopaths may be able to understand and describe emotional stimuli, however they do not appear to *experience* these emotions in the same ways as nonpsychopathic individuals (Christianson et al., 1996).

In order to replicate and expand the work of Patrick et al. (1993), Levenston, Patrick, Bradley, and Lang (2000) conducted a study examining the startle response of 36 male offenders in reaction to pleasurable (e.g., erotic scenes, thrill scenes), neutral (e.g., kitchen utensils, appliances), and aversive (e.g., mutilation scenes, assault scenes) images. Participants were split into psychopaths and nonpsychopaths (as measured by the PCL-R) and underwent the typical startle response procedure. Similar to Patrick et al. (1993), Levenston et al. (2000) found that nonpsychopathic offenders showed an increase in startle response magnitude for aversive

images, whereas psychopathic offenders demonstrated an inhibition in startle response for positive and aversive images as compared to neutral scenes. Levenston et al. (2000) note that the most robust differences between psychopathic and nonpsychopathic offenders occurred when victim scenes were viewed, such as mutilation or assault scenes. These scenes elicited a particularly increased startle response among nonpsychopathic offenders, whereas the startle response of psychopaths remained inhibited for these scenes. Levenston et al. (2000) explain that this difference between groups may suggest a particular deficit in empathy in psychopathic individuals. Further, Levenston et al. (2000) note that the lack of startle response to aversive stimuli among psychopaths may reflect the hypothesis that psychopaths are low in fearfulness. As mentioned previously, the typical heightened startle response to aversive stimuli may reflect an evolutionary reaction, as the system linked to avoidance behaviour in order to evade a negative outcome is activated with potential threats. If psychopaths are in fact low in fearfulness, it might follow that aversive stimuli are not necessarily perceived as potential threats, thus the system linked to avoidance behaviour may not be activated in the same way as with nonpsychopaths.

Vanman, Mejia, Dawson, Schell, and Raine (2003) examined the association between startle reflex modulation and psychopathic traits in a community sample consisting of adult males and females. The researchers used interviews and other supplemental sources (e.g., criminal records, self reported offending) to score the PCL-R to measure psychopathic traits, and created high and low psychopathy groups based on these scores. During the experiment, community members viewed a slide show containing positive and negative images, and were exposed to the startle probe at varying intervals. Vanman et al. (2003) found that participants who had higher Factor 1 scores (i.e., higher interpersonal and affective traits) displayed a

decrease in emotional modification of the startle reflex. Alternatively, high Factor 2 scorers (i.e., more impulsive and antisocial traits) displayed an increase in emotional modification of the startle reflex. This pattern of results suggests that affective and interpersonal traits are the most important factors when considering startle reflex modulation in psychopaths, and may be most important to consider when examining emotional processing deficits in these individuals.

The startle reflex of female psychopathic offenders was tested by Sutton, Vitale, and Newman (2002). Sutton et al. (2002) measured psychopathy using the PCL-R, and divided offenders into psychopaths and nonpsychopaths based on their scores. Negative, neutral, and positive images were shown to the offenders while startle eyeblink magnitude was recorded following an acoustic startle probe. The acoustic startle probe was presented either 2 seconds or 4.5 seconds after image onset, or in between the presentation of two images. When the acoustic startle probe was presented 2 seconds after image onset, Sutton et al. (2002) found that nonpsychopaths had greater eyeblink startle magnitudes while looking at negative as opposed to positive pictures. Psychopaths showed this same pattern, however the difference was only marginally significant. Additionally, nonpsychopaths had greater eyeblink startle magnitudes when shown negative pictures as opposed to neutral pictures. There was no difference in eyeblink startle magnitude between negative and neutral pictures for psychopaths. When the acoustic startle probe was presented 4.5 seconds after image onset, no differences emerged between psychopaths and nonpsychopaths. Both groups had increased eyeblink startle magnitudes for negative images compared to neutral and positive images. Sutton et al. (2002) hypothesized that rather than a complete lack of emotional response to negative stimuli, perhaps the response of psychopaths is delayed, potentially explaining why they responded in the same

way as nonpsychopaths when the startle probe was presented 4.5 seconds after image onset rather than after 2 seconds.

Patrick, Cuthbert, and Lang (1994) tested the hypothesis that highly psychopathic individuals would show a decreased autonomic response as compared to those low in psychopathy while imagining negative and neutral scenes. Based on scores measured by the PCL-R, 54 male sex offenders were divided into high and low psychopathy groups. The researchers used descriptive sentences in order to cue offenders to imagine fearful and neutral scenes. While these scenes were imagined, participants' heart rate, skin conductance, and facial muscle activity were recorded. These autonomic measures have been found to increase when emotional stimuli are involved as opposed to neutral stimuli, perhaps due (much like startle response) to a reaction to a perceived threat (e.g., Levenston et al., 2000). Thus, it was hypothesized that due to their difficulty processing emotional stimuli, those high in psychopathy would not show the typical increase in these measures. Participants also rated the pleasantness and arousal of each imagined scene. Patrick et al. (1994) found that participants in the high psychopathy group showed lower physiological responses than the low psychopathy group when imagining fearful scenes. This finding was particularly robust for participants' heart rate and skin conductance response, and further supports the idea that psychopaths do not respond to fear in the same ways as nonpsychopaths. In line with the findings of Patrick et al. (1993), participants in this study did not differ in terms of self-reported ratings of pleasantness and arousal of the imagined scenes, providing further support for Cleckley's (1941, 1976) notion of 'the mask of sanity'.

In a study examining skin conductance response in reaction to signaled and unsignaled aversive noises, Fung et al. (2005) found that adolescents high in psychopathic traits (as

measured by the Child Psychopathy Scale; Lynam, 1997) failed to respond to anticipated as well as unanticipated bursts of noise. This same impairment was not found in adolescents who were low in psychopathic traits. Other researchers have also found that individuals high in psychopathic traits show an impaired skin conductance response to aversive stimuli. For example, Tharp, Maltzman, Syndulko, and Ziskind (1980) found that individuals with a high degree of psychopathic traits (e.g., impulsivity, irresponsibility, shallow affect) showed a delayed and reduced skin conductance response in anticipation of an aversive noise as compared to control subjects. Heart rate, however, did not differ between groups. This study produced findings similar to earlier research, such as the study conducted by Hare (1965), in which psychopathic offenders (as measured using a 12-item checklist defined by Cleckley, 1959) displayed a delayed and reduced skin conductance response while awaiting an electric shock as compared to nonpsychopathic offenders. Taken together, these studies suggest that individuals high in psychopathy show a reduced autonomic response even when anticipating an aversive stimulus. This reduced response may imply that psychopathic individuals lack anticipatory fear to punishment, threat, and other aversive stimuli (Fung et al., 2005).

These studies evaluating autonomic responses to aversive and emotional stimuli consistently demonstrate that psychopathic individuals display deficits in autonomic arousal when compared to controls, and in particular a lack of fearfulness. These deficits suggest that psychopaths do not respond in a normative manner when emotional or threatening stimuli are presented or anticipated.

Psychopathy and emotional recognition deficits. As opposed to autonomic responses, some researchers have examined emotional recognition deficits in psychopaths to infer their difficulty with emotional processing. For example, Blair et al. (2002) examined the ability of

psychopathic and nonpsychopathic (as measured by the PCL-R) male offenders to recognize and process emotion in vocalized words. The offenders were presented with vocalizations of neutral words, but the emotional intonation of each word differed (e.g., happiness, sadness, disgust, fear, anger). Offenders were asked to identify the emotion that was conveyed in the vocalization of each word. The results revealed that psychopaths made more emotional recognition errors than nonpsychopaths. When the results were broken down by emotion, Blair et al. (2002) found that psychopaths were particularly impaired in the recognition of fear. This impairment remained even after controlling for offender intelligence. This finding supports the notion that psychopaths are impaired in recognizing the distress or fearfulness of others. This deficit in response to others' distress has been said by Blair (2001) to be a mediator of the socially deviant behaviour displayed by psychopaths.

In a similar study of vocal affect recognition, Bagley et al. (2009) compared the ability of psychopathic and nonpsychopathic (as measured by the PCL-R) male offenders to recognize vocalizations of emotion in two conditions. In the first condition, offenders were asked to differentiate semantic components of speech. Psychopaths performed more poorly than nonpsychopaths in this condition, and had particular trouble with the recognition of happiness and sadness. In the second condition, offenders were asked to differentiate prosodic components of speech. Again, psychopaths tended to perform less accurately than nonpsychopaths on the vocal affect recognition task in this condition, and had particular trouble recognizing surprise. These results further support the notion that psychopaths have difficulty recognizing emotional cues.

Several studies have also examined the ability of psychopaths to recognize emotions in the faces of other individuals. The results of these studies have been somewhat mixed. Glass and

Newman (2006) had psychopathic and nonpsychopathic (as measured by the PCL-R) male offenders perform a facial affect recognition task while viewing photos of emotional faces. The results revealed that psychopaths did not differ from nonpsychopaths in the performance of this task. The idea that perhaps emotional processing deficits within psychopaths are context dependent has been raised in order to explain this divergent result (Glass & Newman, 2006). Book, Quinsey, and Langford (2007) also failed to find an effect of psychopathy on facial affect recognition performance. On the other hand, Iria and Barbosa (2009) found significant differences in performance between psychopaths and nonpsychopaths when completing an emotional recognition task. Iria and Barbosa (2009) asked psychopathic and nonpsychopathic (as assessed by the PCL:SV) criminals and non-criminals to react by pressing a key on a keyboard when a fearful face was presented. The results demonstrated that psychopaths (regardless of criminal status) failed to react to fearful faces significantly more often than did nonpsychopaths. Similarly, Blair et al. (2004) found that psychopathic offenders were significantly more deficient at recognizing fearful faces than their nonpsychopathic counterparts. The results of these studies further support the notion that psychopathic individuals may have a selective deficiency in the processing of fear (Blair et al., 2004). Habel, Kühn, Salloum, Devos, and Schneider (2002) also found an effect of psychopathy on emotional processing with facial stimuli. Habel et al. (2002) reported that psychopathic offenders (as measured by the PCL-R) made more errors than nonpsychopathic offenders when attempting to distinguish happy faces from sad faces.

Overall, the results of studies examining the ability of psychopaths to recognize emotions have pointed towards a deficit in this skill. In particular, psychopaths appear to have trouble distinguishing happiness from sadness (e.g., Bagley et al., 2009; Habel et al., 2002), and

consistently demonstrate difficulty in the recognition of fear and distress (e.g., Blair et al., 2002; Blair et al., 2004; Iria & Barbosa, 2009).

Psychopathy and cognitive performance with emotional stimuli. In addition to deficits in emotional recognition tasks, research has also found that psychopaths display abnormalities in cognitive performance compared to controls. For example, Williamson, Harpur, and Hare (1991) examined the processing of emotional and neutral words among psychopathic and nonpsychopathic male offenders. Psychopathy was assessed using the Psychopathy Checklist (PCL; Hare, 1980). Williamson et al. (1991) presented the male offenders with positive words, negative words, neutral words, and pronounceable non-words. Offenders were asked to perform a lexical decision task, which consisted of deciding whether the letter strings presented were real words or non-words, while reaction time and several different waveforms of event-related brain potentials were recorded. Williamson et al. (1991) found that nonpsychopaths made lexical decisions faster and with larger event-related brain potentials when words were emotional as opposed to neutral. Psychopaths failed to show this pattern of responding. The reaction time of psychopaths was not improved with emotional as opposed to neutral words, nor was there an increase in event-related brain potentials for emotional words. Williamson et al. (1991) hypothesized that perhaps emotional words do not hold any more information or emotional significance than neutral words for psychopaths, thus they respond to the two types of words in similar ways.

In another emotional language processing task, Hervé, Hayes, and Hare (2003) used PCL-R ratings to divide 35 male offenders into low, medium, and high psychopathy groups. Offenders were presented with a number of metaphorical statements that ranged in emotional valence from highly negative to highly positive. Hervé et al. (2003) asked the offenders to sort

these emotional metaphors in terms of their strength and direction of emotional valence. The groups were equally able to understand the literal meaning of the metaphors, but those in the high psychopathy group made the most valence errors when sorting the metaphors. Additionally, those in the high psychopathy group had the highest number of large valence errors, which were defined by Hervé et al. (2003) as the incorrect sorting of a metaphor to its most intense opposite valence (e.g., sorting a negative metaphor as highly positive). Hervé et al. (2003) explain these results by suggesting that perhaps psychopaths attempted to process and make decisions regarding the metaphors based on their literal meaning as opposed to their connotative or emotional meaning. Thus, psychopaths appear to understand the literal components of language, but perhaps the emotional components remain unrecognized.

Verona, Sprague, and Sadeh (2012) also examined performance on an emotional-linguistic task in a community sample consisting of individuals with a criminal history. These individuals were recruited via parole and probation board agencies. The researchers administered the PCL:SV in order to screen for psychopathy, and used portions of the Diagnostic and Statistical Manual of Mental Disorders (4th ed., text-revised; DSM-IV-TR; American Psychiatric Association, 2000) in order to screen for Antisocial Personality Disorder (APD). Based on the results of these measures, participants were assigned to one of three groups: psychopathy, APD, or a control group. During the study, participants were shown neutral (e.g., umbrella), negative (e.g., poison), and offender-relevant negative (e.g., jail) words and asked to press a button when words were presented in a normal font. When words were presented in an italicized font, participants were instructed not to press the button (i.e., to inhibit the button-pressing response). Thus, participants were meant to focus on this inhibitory control and not on the emotional content of the words. This paradigm has also been referred to as a Go/No-Go task (Verona et al.,

2012). As participants were completing this emotional-linguistic task, P300 event-related brain potentials were measured. Verona et al. (2012) found that participants in the control group demonstrated larger event-related brain potentials with negative words during the Go trials (trials in which the words were presented in normal font, eliciting a button-press from participants), but smaller event-related brain potentials with negative words during the No-Go trials (trials in which the words were presented in italicized font, thus prompting participants to inhibit the button-press response). According to Verona et al. (2012), this pattern of results indicates that control participants were focused on inhibitory control as opposed to processing the emotional valence of each word. Alternatively, participants in the psychopath group demonstrated a lack of emotional processing regardless of whether or not the trial required inhibitory control. This finding suggests that across the Go and No-Go trials, psychopathic participants did not discriminate between negative and neutral words, supporting the notion that psychopaths have difficulty with emotional processing. Finally, participants in the APD group showed increased processing for negative words as opposed to neutral words across both Go and No-Go trials, suggesting that these individuals had difficulty ignoring the emotional context when engaging in inhibitory control. Verona et al. (2012) explain this finding by stating that perhaps individuals with APD prioritize negative emotional processing even in situations when this is not adaptive.

In addition to deficits in language processing for emotional stimuli, researchers have examined the effects of psychopathy and emotional stimuli on memory. Dolan and Fullam (2005) presented male offenders with emotional stimuli and subsequently assessed their recall and recognition memory for these images. Offenders were assessed for psychopathy using the PCL:SV and were grouped into low, moderate, or high in psychopathy. Offenders were shown a slide show containing images coupled with one-sentence narratives. This slide show was

organized into three phases: the first non-emotional phase, an emotional phase, and the second non-emotional phase. Free recall and recognition memory were assessed for the details of the images shown in the slide show. Dolan and Fullam (2005) found that those in the high psychopathy group were more impaired than the other groups in their recall memory for the emotional phase of the slide show. Additionally, the high and medium psychopathy groups demonstrated the most impairment in recognition memory for the emotional phase. Dolan and Fullam (2005) suggest that perhaps this impairment in emotional memory for psychopaths is due to a lack of arousal when viewing emotional scenes, thus emotional details may not have been encoded into memory as powerfully as it may have for nonpsychopaths.

Glass and Newman (2009) have also found differences between those high and low on psychopathic traits (as assessed by the PCL-R) in terms of emotional memory. Male offenders were presented with positive, negative, and neutral words, and memory for these words was subsequently tested. These words acted as the primary focus. Each word also had different contextual features, such as a different coloured box surrounding the text. These contextual features served as the secondary focus. While recall for the primary focus did not differ between groups, offenders who were classified as low-anxious psychopathic individuals (often thought to be the 'prototypical' psychopath) tended to be influenced less by emotion than nonpsychopaths when recalling the secondary focus.

The above literature supports the conclusion that psychopaths perform differently than controls on cognitive tasks involving emotional stimuli. These differences have been demonstrated with both emotional language processing tasks (e.g., Hervé et al., 2003; Verona et al., 2012; Williamson et al., 1991) and emotional memory tasks (e.g., Dolan & Fullam, 2005;

Glass & Newman, 2009), providing further evidence for the notion that psychopaths are impaired in emotional processing.

Perspectives accounting for psychopaths' emotional processing deficits. The above literature consistently demonstrates that psychopaths have difficulty processing emotional stimuli. This is evidenced by the results of a variety of studies, including autonomic response differences, emotional recognition differences, and cognitive functioning differences between psychopathic and nonpsychopathic individuals when emotional stimuli are involved. A number of perspectives have been put forth in order to explain these emotional processing deficits exhibited by psychopaths (Brook et al., 2013). Brook et al. (2013) have outlined several of these perspectives in a review article summarizing research examining emotional processing deficits in psychopaths. One of these perspectives has been termed by Brook et al. (2013) as the *general emotional deficit perspective*. Originally proposed by Cleckley (1941, 1976), this perspective posits that psychopaths are cognitively intact, but have a general lack of ability to experience emotion. Consequently, they are unable to appreciate the emotional reactions that others may have to their actions (Brook et al., 2013; Cleckley, 1941, 1976). A second perspective has been termed by Brook et al. (2013) as the *specific emotional deficit perspective*, which proclaims that psychopaths do not have an inability to experience and process emotions in general, but rather these deficiencies are limited to specific emotions. In particular, researchers have focused on the inability of psychopaths to experience and process fear. This specific emotional deficit with regard to fearful stimuli has been found in several studies (e.g., Blair et al., 2002; Blair et al., 2004; Hare, 1965; Iria & Barbosa, 2009). Termed the *low fear hypothesis* (Lykken, 1957), this hypothesis holds that because of their difficulty experiencing fear, psychopaths are not motivated to avoid socially deviant behaviour that may result in punishment. On a similar note, the *violence*

inhibition mechanism hypothesis (VIM; Blair, 1995) posits that psychopaths are selectively impaired in their ability to recognize the distress of others. Therefore, psychopaths have difficulty realizing when to change their potentially violent behaviour in response to others' distress, since they demonstrate deficits in understanding and recognizing non-verbal distress cues (Blair, 1995).

A perspective known as the *response modulation hypothesis* has also been put forward in order to explain the emotional processing deficits associated with psychopathy (Newman, Schmitt, & Voss, 1997). Response modulation has been explained as the ability of individuals to involuntarily shift attention to peripheral cues in the midst of a task (Heritage & Benning, 2013; Newman et al., 1997). The response modulation hypothesis holds that psychopaths are impaired in this regard, and thus, emotional processing deficits may be explained as an inability for the psychopathic individual to process cues that are peripheral to their focus of attention (Lorenz & Newman, 2002).

Many of these perspectives go hand in hand with a biological explanation to account for emotional processing deficits found in psychopaths (Brook et al., 2013). In a review of the neuropsychological literature relating to psychopathy, Blair (2008) notes that the amygdala and the ventromedial prefrontal cortex (vmPFC) seem to be consistently affected in psychopaths. Those high in psychopathic traits have been shown to have reduced activity in both the amygdala and the vmPFC when viewing emotional facial expressions compared to those low in psychopathic traits (Gordon, Baird, & End, 2004). Adolescents who display psychopathic traits have also demonstrated reductions in activity in these same brain regions when viewing emotional facial expressions (Marsh et al., 2008). The amygdala has been implicated in the production of stimulus-reinforcement learning, allowing individuals to learn which stimuli are

associated with aversive outcomes, such as fear and sadness (Blair, 2008). The lack of response in psychopaths to fearful stimuli may be explained by this lack of activity in the amygdala.

Overall, the lack of activity in these brain regions has been used to help explain the emotional processing deficits that psychopaths consistently demonstrate (Blair, 1995; Dolan & Fullam, 2005).

Memory for Emotional Stimuli

As discussed previously, psychopaths have been found to display abnormalities in memory performance in the presence of emotional stimuli. The following section will outline the ways in which normal participants (i.e., participants without psychopathy) perform with regard to memory for emotional stimuli.

Several studies have documented enhanced memory for emotional as opposed to neutral information (e.g., Choi, Kensinger, & Rajaram, 2013; Doerksen & Shimamura, 2001; Kensinger & Corkin, 2003). Neuroimaging studies have also provided support for the enhanced memory of emotional information, demonstrating that different neural and cognitive mechanisms are employed with emotional stimuli (Hamann, 2001). In order to further dissect the effect of memory enhancement for emotional stimuli, researchers have questioned whether the emotional valence of the stimuli plays a role. The results of studies have been mixed. Some studies have found that positive information is better remembered than negative or neutral information (e.g., Levine & Bluck, 2004; Walker, Vogl, & Thompson, 1997). For example, Levine and Bluck (2004) conducted a study in which participants recalled events associated with the televised verdict announcement of the O.J. Simpson trial in 1995. During this trial, O.J. Simpson was acquitted of the murders of Nicole Brown Simpson and Ron Goldman. Participants who viewed the verdict as positive recalled events associated with the trial more clearly than participants who

viewed the verdict as negative. However, participants who viewed the verdict as positive were also more likely to endorse false events than participants who felt negatively about the trial.

In a similar study of emotional autobiographical memory, Walker et al. (1997) asked undergraduate participants to keep a diary of unique events that had occurred over a three-month period. While recording these events, participants also rated the pleasantness of each event. Following the three-month period, participants' memory for the recorded events was tested. Walker et al. (1997) found that events that had been rated as pleasant by the participants were remembered better than events that had been rated as unpleasant. Additionally, the pleasantness rating of the events predicted participant's self-reported memory clarity ratings.

Alternatively, the results of other studies have suggested that memory seems to be particularly improved for negative events and stimuli as opposed to positive or neutral information (Kensinger, 2007). In a longitudinal study conducted by Porter and Peace (2007), participants recruited from the community had memories that were more factually consistent, more vivid, and contained more sensory components when recalling a traumatic event as opposed to a positive one. These results contradict the notion that traumatic memories are especially susceptible to repression and dissociation (Kihlstrom, 1996; Loftus, 1993). Similarly, East and West Germans who considered the falling of the Berlin wall as a highly negative event recalled facts of the event more accurately than participants who viewed the event as highly positive (Bohn & Berntsen, 2007).

In addition to this enhanced memory for autobiographical negative events, numerous studies have shown that participants' memory for negative stimuli is superior when compared to memory for neutral or positive stimuli (e.g., Kensinger, Garoff-Eaton, & Schacter, 2006; Kensinger & Schacter, 2006). For example, Kensinger et al. (2006) found that university

students remembered specific visual details more often for negative objects than for neutral objects. This difference was enhanced when participants viewed the objects for longer periods of time. Similarly, in a pair of studies, Kensinger and Schacter (2006) presented university students with negatively arousing words and neutral non-arousing words (study 1), and negatively arousing images and neutral non-arousing images (study 2). Participants viewed these stimuli while completing a cognitive processing task, and were subsequently given a surprise recognition test regarding their memory for the stimuli they had been shown. During this test, participants were shown the same negative and neutral stimuli they had previously viewed, but new stimuli were intertwined into the presentation. Kensinger and Schacter (2006) asked participants to indicate which stimuli they had previously viewed. The results indicated that although participants made some misattribution errors regarding negatively arousing stimuli (i.e., indicating that they had previously viewed a word or image when they had in fact not seen it before), these errors occurred much more frequently when neutral stimuli were concerned. Kensinger and Schacter (2006) explain that these results suggest a reduced susceptibility to memory distortion for negative stimuli.

Although the results of the aforementioned studies are somewhat mixed, they support the notion that memory is affected by emotion.

Memory for central and peripheral details: The central/peripheral trade-off. In order to further examine the association between memory and emotional stimuli, researchers have focused on participants' memory for specific details of emotional images. Some researchers have shown that overall memory is facilitated for negative events (e.g., Kensinger & Schacter, 2006; Porter & Peace, 2007), however other researchers have found that this enhancement of memory for negative stimuli occurs only for specific details (e.g., Brown, 2003; Christianson &

Loftus, 1991; Kensinger, Garoff-Eaton, & Schacter, 2007). In particular, researchers have consistently found that with negative stimuli, memory is facilitated for central details and inferior for peripheral details (Chipchase & Chapman, 2013). In other words, there is a trade-off in memory between central and peripheral details for negative stimuli that does not exist when neutral stimuli are concerned. Central details are typically defined as the details associated with the central, emotionally provocative item(s), while peripheral details are the details that are not of relevance to the central detail (i.e., details that are on the periphery; Kensinger et al., 2007).

In order to examine this central/peripheral trade-off in memory, Christianson and Loftus (1991) conducted a series of five studies examining memory for details of images ranging in emotional valence. Christianson and Loftus (1991) created a series of 15 slides, the eighth of which was considered the 'critical slide'. Across the different emotional conditions, the contents of this critical slide varied. The researchers included both a negative and a neutral emotional condition, and the contents of the critical slide corresponded with these valences (a woman cycling across the street in the neutral condition, and a woman who had fallen off her bike in the negative condition). Christianson and Loftus (1991) note that details of a scene may be remembered better if they are particularly distinctive or unusual, as they may act to attract attention of the viewer, even if they are not emotional. As such, the researchers also included an unusual version of the critical slide across their five studies to test this theory (this critical slide consisted of a woman carrying a bike upside down). Across all five studies, Christianson and Loftus (1991) found that when compared to the neutral condition, memory in the negative condition was consistently enhanced for central details of the scene, and constantly impaired for peripheral details of the scene. In terms of the unusual condition, memory for peripheral details was as poor as in the negative condition, suggesting that like emotional aspects of a scene, the

unusual aspects were drawing participants' attention away from peripheral details. However for central details, memory in the unusual condition did not show the same patterns as the negative condition. Central detail memory was enhanced in the negative condition when compared to the neutral condition, whereas central detail memory in the unusual condition did not show this same enhancement. The researchers speculate that perhaps this difference is due to the fact that the central detail of the negative slide was simply more attention-catching than the central detail of the unusual slide. Christianson and Loftus (1991) note that participant ratings of the slides support this hypothesis. Alternatively, the researchers suggest that perhaps participants in the unusual condition focused on the central event as a whole (i.e., participants thought about a bike being carried upside down instead of focusing on the details of the bike and the woman carrying it), while participants in the negative condition were more concerned with the woman in distress who had fallen off her bike, and thus remembered more details associated with her.

Brown (2003) also examined memory for central and peripheral details of emotionally arousing images and how this interacted with contextual reinstatement (CR) procedures. These CR procedures are used in order to enhance memory, typically in eyewitnesses of crimes. CR procedures use peripheral information in order to cue memory, thus, Brown (2003) predicted that these procedures would not be effective when participants view negatively arousing stimuli, as the central/peripheral trade-off posits that peripheral information is largely ignored. In this study, participants viewed one of three sets of slides, each depicting a different 'critical slide'. These slides were based on the stimuli used by Christianson and Loftus (1991). The critical slide contained either a neutral image, an unusual image, or a negatively arousing image, thus creating three groups of participants: neutral, unusual, and negative. Each version of the critical slide contained a central detail as well as a peripheral detail. The participants viewed these slides, and

were subsequently given a memory test regarding the central and peripheral information from the critical slide. Prior to this memory test, half the participants underwent a CR manipulation, which involved using peripheral information to improve participants' memory. The results demonstrated that participants in the negative condition correctly remembered the central detail significantly more often than participants in the neutral and unusual conditions. Additionally, participants in the negative condition remembered the peripheral detail significantly less often than participants in the neutral and unusual conditions. These results are consistent with the central/peripheral trade-off. That is, after viewing a negatively arousing event, peripheral memory tends to worsen while central memory is enhanced. Additionally, Brown (2003) found results similar to Christianson and Loftus (1991) regarding memory in the unusual condition. That is, the enhanced central detail memory exhibited in the negative condition did not exist in the unusual condition, suggesting that perhaps emotional aspects of a scene capture attention in different ways than unusual or distinctive aspects that are not particularly emotional. Upon examining the effects of CR procedures, Brown (2003) found that while these procedures enhanced memory for participants in the neutral and unusual conditions, the same enhancements were not found for participants in the negative condition. In fact, participants in the negative condition who underwent CR procedures had worse memory for peripheral details.

In order to further test the notion of the central/peripheral trade-off in memory, Kensinger et al. (2007) had participants view negatively arousing objects and neutral objects on neutral backgrounds (e.g., a snake by a river, a monkey in a jungle). Participants were then tested on their ability to remember the central objects and the peripheral backgrounds. Kensinger et al. (2007) found that participants had better memory for the negatively arousing objects than for the neutral objects. Additionally, participants had poorer memory for the peripheral background

when paired with negatively arousing objects as opposed to neutral objects, consistent with the notion of a central/peripheral trade-off.

Evidence supporting the notion of a central/peripheral trade-off is also found in the literature examining the phenomenon known as the *weapons focus effect* (Christianson & Loftus, 1991; Christianson, Loftus, Hoffman, & Loftus, 1991). This effect refers to the tendency for eyewitnesses of a crime to have better recall for the weapon held by the perpetrator than for the peripheral details involved in the scene (e.g., features of the crime scene, correct identification of the perpetrator in a lineup; Steblay, 2002). Thus, in a situation involving negative affect (i.e., the commission of a crime), attention tends to focus on the weapon involved, thus enhancing memory for the weapon and decreasing memory for the remaining details (e.g., Kramer, Buckhout, & Eugenio, 1990; Maass & Kohnken, 1989).

This central/peripheral trade-off has also been replicated in negative autobiographical memories. Berntsen (2002) completed a series of three experiments in which undergraduate students recorded the central and peripheral details associated with their emotional memories. In this series of experiments, students recorded central and peripheral details of highly negative, shocking events (e.g., death of a loved one, accidents) as well as highly positive, happy events (e.g., falling in love, birth of a child). In all three studies, Berntsen (2002) found that students consistently recorded central details more often than peripheral details, but only for negative memories; this same effect was not elicited with positive memories. In a similar pair of studies, Christianson and Loftus (1990) asked university students to recall their most traumatic memory (e.g., death of a loved one, divorce of parents). Students were subsequently asked if there was a particular detail about this event that seemed particularly salient, and if so, whether this detail was central or peripheral to the event itself. It was found that in study one, students reported

remembering more central details than peripheral details. However, in study two, almost half of the students reported a peripheral detail as being the salient detail. There are a number of limitations associated with this study. First, Christianson and Loftus (1990) did not compare the remembered details of the traumatic events with a positive event. Second, Berntsen (2002) has commented that asking participants if one detail was particularly well remembered, and subsequently whether this detail was central or peripheral, may be problematic; if participants remember a detail particularly well, it is likely that it will be deemed central by participants for this reason, thus inviting a degree of circular inference.

Theories accounting for the central/peripheral trade-off. In order to explain this trade-off in memory between central and peripheral details for negative information, many researchers have cited Easterbrook's (1959) cue utilization hypothesis, which posits that emotional events can lead to an attentional narrowing due to the experience of arousal. That is, the experience of emotion and arousal influence attention, which have an effect on the components of a stimulus or scene that are encoded into memory (Christianson, 1992; Easterbrook, 1959). According to Easterbrook (1959), experiencing a high degree of arousal limits the number of details one is able to attend to at a time, and thus individuals tend to focus on the central details of a scene at the expense of the peripheral details. In other words, attention is narrowed to the central aspect of the stimuli. Similar to Easterbrook (1959), Kensinger (2009) posits that emotional arousal (negative emotional arousal in particular) allows memory for intrinsic features of an emotional stimulus to be enhanced, while memory for extrinsic features (i.e., features that are conceptually and/or spatially separate from the emotional item) remains unenhanced.

In addition to the experience of emotional arousal, this narrowing of attention to the central, emotionally-provocative features of negative stimuli may also have an evolutionary

explanation. When an organism feels threatened by a negative stimulus, it is adaptive to respond to the potentially threatening aspect of that stimulus (Lacreuse, Schatz, Strazzullo, King, & Ready, 2013). Thus, throughout evolution, it is possible that attention has been moulded to focus on negative, potentially threatening stimuli so that a response can be formed as quickly as possible, therefore avoiding the potential threat (Cacioppo & Gardner, 1999). This seems to be especially applicable to fear-inducing stimuli (e.g., Öhman, Flykt, & Esteves, 2001; Wessel & Merckelbach, 1998), and is exemplified by the weapons focus effect mentioned above (Flowe, Hope, & Hillstrom, 2013).

Overall, the hypothesis that attention narrows to central aspects of negative stimuli has been used to explain why these central details are better remembered than the non-significant peripheral details. In further support of this hypothesis, Nobata, Hakoda, and Ninose (2010) asked participants to discriminate a digit presented in the periphery of negative, positive, and neutral emotional images. The researchers found that performance was poorer when participants viewed negative emotional images, suggesting that participants' functional field of view narrowed when a negative stimulus was viewed while remaining unchanged with positive and neutral stimuli. Similar results were reported by Oue, Hakoda, Onuma, and Morikawa (2001). The results of these studies demonstrate that attention tends to narrow when viewing negative stimuli. Additionally, Rowe, Hirsh, and Anderson (2007) found that attentional space widens when participants are in a positive mood as opposed to a negative mood.

The central/peripheral trade-off and eye tracking studies. To further examine the influence of attention on memory for central and peripheral details, some researchers have tracked the eye movements of participants as they view emotional stimuli (e.g., Chipchase & Chapman, 2013; Christianson et al., 1991). Christianson et al. (1991) conducted a series of three

studies in which undergraduate students viewed a slideshow containing a number of images. Students were presented with one critical slide in the middle of this slideshow, which depicted either a negative, neutral, or unusual scene. Each version of the critical slide had a corresponding central detail and peripheral detail. In the first of the three experiments, students' eye movements were not tracked, however they were directed to a fixation cross that overlaid the central detail. Students only viewed each slide for 180 milliseconds, thus limiting their exposure to the stimulus and restricting their eye fixations to one per slide. This allowed the researchers to ensure that all students were viewing the same detail(s) for the same amount of time. Following a filler task, students were given cued-recall and recognition memory tests regarding the details of the critical slide. The results demonstrated that students in the negative condition had significantly better recall memory for the central detail of the critical slide than those in the neutral and unusual conditions. The recall for the peripheral detail did not differ between groups. Analyses regarding the recognition memory for the central and peripheral details revealed a similar pattern of results. In experiment two, Christianson et al. (1991) followed the same procedure as experiment one, however the unusual condition was dropped, and students viewed each slide for 150 milliseconds (as opposed to 180 milliseconds). Students in the negative condition correctly recalled and recognized the central detail more often than those in the neutral condition. Christianson et al. (1991) note that since the number of eye fixations per slide was limited, the enhancement of memory for central details with negative images cannot be explained by the distribution of attention alone. To explore this phenomenon further, Christianson et al. (1991) conducted a third experiment in which the eye movements of students were tracked as they viewed the stimuli. As in experiment one, students were randomly assigned to view either a negative, neutral, or unusual critical slide during the slide show of images. While these images were viewed, eye

movements were tracked using a corneal reflection technique. 2.70 seconds were allotted to view each slide. Identical to experiments one and two, recall and recognition memory tests for the central and peripheral details were given following a neutral filler task. Memory for both the recall and recognition tests followed the same pattern of results: students in the negative condition recalled and recognized the central detail significantly more often than those in the neutral or unusual conditions. When the eye tracking data were analyzed, Christianson et al. (1991) discovered that students in the negative condition had a significantly greater number of eye fixations on the central detail than did students in the neutral or unusual conditions, however they fixated on the central detail for shorter durations. The researchers note that this pattern of results is similar to other eye tracking studies (e.g., Loftus 1972), and suggests that the number of eye fixations rather than the duration of these fixations is a better predictor of performance on memory tests.

Chipchase and Chapman (2013) also used an eye tracking device while examining memory for central and peripheral details of emotional images. University students viewed negative, positive, and neutral objects that had been placed onto neutral backgrounds. As these stimuli were viewed, students wore an eye tracking device that recorded their eye movements. Memory for the objects and peripheral backgrounds were then tested. The results were consistent with a central/peripheral trade-off; when objects were negative, students had enhanced recognition memory for the objects while memory for the peripheral background was impaired. This same central/peripheral trade-off was not found when objects were positive or neutral. Although students had better memory for objects when the object was positive as opposed to neutral, there were no impairments in memory for the peripheral backgrounds in these conditions. The researchers also found that students fixated more frequently on and had longer

gaze durations for negative objects than for positive or neutral objects. Additionally, students had shorter eye gaze durations on the peripheral background in the negative condition as compared to the positive and neutral conditions.

The above discussion summarizes the occurrence of the central/peripheral trade-off; a typical response to emotionally negative stimuli. This phenomenon is hypothesized to occur because attention is narrowed to the central emotionally provocative portion of negative stimuli. This attentional narrowing may occur due to the experience of arousal, which in turn restricts attentional capabilities, or due to the presentation of a potentially threatening stimulus. Thus, central details that are associated with an emotionally provocative item are remembered well, while memory for peripheral details is poor (Kensinger, 2009).

Psychopathy, Emotion, and Memory

As mentioned previously, individuals with a high degree of psychopathic traits have difficulty processing and responding to emotional stimuli. Thus, has been called into question whether psychopathic individuals would demonstrate the same heightened memory for central details (at the expense of peripheral details) when viewing negative stimuli that is exhibited by nonpsychopathic individuals. To date, only two studies have examined this phenomenon in relation to psychopathic traits; one conducted with adults (Christianson et al., 1996), and one with children (Thijssen, Otgaar, Meijer, Smeets, & de Ruiter, 2012). In the study with children, Thijssen et al. (2012) had parents of children ranging from 8 to 12 years of age complete the Antisocial Process Screening Device (APSD; Frick & Hare, 2001) in order to assess the degree of psychopathic traits in their child. The children were divided into two groups based on their APSD scores: the high callous-unemotional (CU) traits group, and the low CU traits group. Children who display a high degree of CU traits tend to lack empathy for others, lack feelings of

guilt when they have misbehaved, and demonstrate a low level of anxiety, mirroring descriptions of psychopathic affective traits exhibited in adults. The children viewed negative (e.g., shark, black eye) and neutral (e.g., green traffic light, tree) pictures, each with a small red symbol displayed in the corner of the image. This symbol served as the peripheral detail, while the picture itself constituted the central details. The children then had to identify the central and peripheral details they had seen within each image through a forced-choice recognition memory task. The results revealed that with the neutral images, the peripheral detail was better remembered than the central details. Alternatively, with the negative images, the central details were better remembered than the peripheral detail. Interestingly, no other differences were found. That is, emotional memory did not differ between the high CU and the low CU children. Thijssen et al. (2012) hypothesize that perhaps emotional memory deficits have not yet developed in children of such a young age. Additionally, the researchers note that the children used in their sample were from a non-clinical population, potentially providing an alternative explanation for the lack of emotional memory differences between high and low CU children.

In the study with adults, Christianson et al. (1996) divided 62 male offenders into psychopathic and nonpsychopathic groups based on their scores on the PCL-R. Within these groups, offenders were randomly assigned to a neutral or emotional condition. All offenders viewed a slide show containing a series of images, however one critical slide was either neutral or emotional. In the neutral condition, offenders viewed an image that was emotionally neutral, whereas in the emotional condition, offenders viewed an emotionally negative image. Christianson et al. (1996) had offenders rate each image in terms of how pleasant it was immediately after the slide show had finished. Following a neutral filler task, offenders were asked to recall central and peripheral details of the critical slide. Additionally, offenders were

given multiple-choice questions regarding the critical slide in order to test recognition memory. Christianson et al. (1996) predicted that nonpsychopaths would demonstrate the attentional narrowing that has been found within other studies examining memory for central and peripheral details of negative scenes. On the other hand, Christianson et al. (1996) predicted that due to their difficulty in processing emotional stimuli, psychopaths would not exhibit this attentional narrowing and thus would not demonstrate a decrease in peripheral memory for negative scenes. Both of these predictions were supported. In the neutral condition, psychopaths and nonpsychopaths did not differ in the number of correct responses when recalling central and peripheral details of the scene; central and peripheral details were recalled equally well among psychopaths and nonpsychopaths. However, in the emotional condition, nonpsychopaths recalled significantly less peripheral details than did psychopaths, while recall for central details remained equal across both groups. In other words, the recall memory of nonpsychopaths was consistent with the attentional narrowing hypothesis, whereas psychopaths did not demonstrate this same pattern of responding. The results of the recognition memory test indicated similar findings. These results suggest that psychopathic offenders were not affected by the emotionality of the images in the emotional condition, and thus their memory for peripheral details was not impaired. When analyzing the ratings of pleasantness for the critical slide, Christianson et al. (1996) found that psychopaths and nonpsychopaths in the emotional condition rated the critical slide as equally unpleasant. Therefore, psychopaths did not differ from nonpsychopaths in their self-reported rating of the emotionality of the slide, however, they did demonstrate differences in recall that suggest a deficit in emotional processing. Like other researchers, Christianson et al. (1996) explained this finding in terms of Cleckley's (1941, 1976) perspective on psychopathy,

noting that perhaps psychopaths have the ability to describe emotions that they themselves do not experience.

The Current Study

The purpose of the current study was to examine the relationship between psychopathic traits, emotional memory, and attention to emotional images. Specifically, memory for the central and peripheral details of emotional images was evaluated. Additionally, in order to test the patterns of attentional narrowing in individuals with high and low degrees of psychopathic traits, eye movements were tracked while images were viewed. No research to date has examined the central/peripheral trade-off in individuals with psychopathic traits while also employing the use of an eye tracking device. Additionally, the majority of studies that have examined the central/peripheral trade-off did not include a positive image condition in their research paradigm (Talarico, Berntsen, & Rubin, 2009). Thus, questions still remain regarding how central and peripheral details are recalled in the presence of positive events and/or stimuli, although one study found that being in a positive mood enhances recall of peripheral details (Talarico et al., 2009), and another found that while central detail memory was enhanced with a positive image, there was no accompanying decrease in peripheral detail memory (Chipchase & Chapman, 2013). Furthermore, Christianson et al. (1996) note that much of the literature examining emotional processing deficits in psychopaths has focused on negative stimuli. The researchers suggest that perhaps psychopaths' emotional memory would mimic that of non-psychopaths in the presence of positive stimuli. The current study included a positive condition in order to examine the central/peripheral trade-off in this condition in addition to whether psychopaths' memory for central and peripheral details will mirror that of nonpsychopaths when viewing positive images.

A secondary purpose of the current study was to examine the relationship between two measures of psychopathy: the TriPM and the SRP-SF. The triarchic model is the most recent conception of psychopathy, and as such, it is important to determine how scores on the TriPM relate to scores on other measures of psychopathy. No published research to date has examined the relationship between the TriPM and the SRF-SF, therefore these two measures of psychopathy were included in the current study in order to further support the convergent validity of both the TriPM and the SRP-SF. Below are the hypotheses made regarding the current study.

Hypothesis 1: In the negative image condition, relative to the neutral condition, I predicted that participants who are low in psychopathic traits will demonstrate enhanced memory for central details and poor memory for peripheral details (i.e., the central/peripheral trade-off).

Hypothesis 2: Conversely, due to the difficulty with emotional processing exhibited by psychopaths, I predicted that in the negative image condition, relative to the neutral condition, participants high in psychopathic traits will not show this enhanced central detail memory. Instead, memory for central and peripheral details will be equal.

Hypothesis 3: There is a lack of literature examining how the central/peripheral trade-off functions with positive emotional images. Thus, the current study was exploratory in nature with respect to participant memory for central and peripheral details of the positive image. However, given the emotional processing deficits within psychopathic individuals, I hypothesized that memory for central and peripheral details will be similar across all conditions (i.e., negative, neutral, and positive) for participants high in psychopathic traits.

Hypothesis 4: Participants in the low psychopathy group will have a significantly larger number of eye fixations on the central details of the negative image than on the peripheral details, and more fixations on the central details than participants in the high psychopathy group.

Hypothesis 5: For neutral images, low psychopathy participants will have an equal number of eye fixations on both the central and peripheral details.

Hypothesis 6: High psychopathy participants will have an equal number of eye fixations for the central and peripheral details across all emotional valence conditions.

Hypothesis 7: High and low psychopathy participants will not differ in ratings of valence or arousal for the positive image, the neutral image, or the negative image. Similar results for valence and arousal ratings were found by Christianson et al. (1996), Patrick et al. (1993), and Patrick et al. (1994).

Hypothesis 8: Participant scores on the SRP-SF and the TriPM will be positively correlated.

Method

Participants

Participants included 68 male ($n = 16$; 23.5%) and female ($n = 52$; 76.5%) undergraduate students enrolled in introductory psychology and neuroscience courses at Carleton University. Participants received course credit for their involvement. Participants who wore hard contact lenses or bifocal eyeglasses were not eligible to participate, as the EyeLink II eye tracker does not effectively track eye movements if these are worn. Participants ranged from 17 to 43 years of age ($M = 20.07$, $SD = 4.6$). The majority of participants identified as White/Caucasian ($n = 49$; 72.1%). The remaining participants identified as Black/African-Canadian ($n = 5$; 7.4%), Other ($n = 4$; 5.9%), Middle Eastern ($n = 3$; 4.4%), East Indian ($n = 3$; 4.4%), Asian ($n = 3$; 4.4%), and Aboriginal/First Nations/Native Canadian ($n = 1$; 1.5%).

Materials

International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008)¹.

All emotional photographic images used were selected from the International Affective Picture System (IAPS; Lang et al., 2008). IAPS is a database which includes over 700 emotional colour photographs depicting a wide range of content. The database includes normative data from a large sample of university students who provided ratings of emotional valence and emotional arousal for each photograph. Emotional valence and emotional arousal were rated using a 9-point scale, with high ratings representing high pleasure and high arousal, and low ratings representing low pleasure and low arousal. Three images were chosen for the present study: one negative, one neutral, and one positive. These images were chosen using a procedure outlined by Porter, Spencer, and Birt (2003); in order to be included in the study, photos had to include people as well as a visible background. The negative image chosen (image number 9433) had a high arousal rating (5.89) and a low valence rating (1.84), indicating that the photo was highly negative and highly arousing. This photo depicted a fatally wounded man lying on the street surrounded by several onlookers as well as two dogs. There were two people walking together in the background of the image. The positive image (image number 4617) had an arousal rating similar to the negative image (5.19), as well as a high valence rating (6.6), indicating that this photo is highly positive and highly arousing. This photo depicted a waiter and a female patron happily conversing in front of a street side café. Finally, the neutral image chosen (image number 2579) had a low arousal rating (3.85) and a mid-range valence rating (5.53), indicating that the photo is not highly arousing and is emotionally neutral. This photo depicted two chefs preparing dumplings in the middle of a busy street market. Central details of the images were defined as

¹ Images chosen from the IAPS database are not included in this document due to ethical constraints put forth by Lang et al. (2008).

the central emotionally provocative feature, whereas peripheral details were defined as the details that were not centrally relevant, and were on the periphery of the central detail. In order to locate the central and peripheral details of each image, three independent raters were asked to identify which portions of the images were central, consistent with the definition provided above. These raters drew circles around the portion they believed to be the central area of each image. The average area from these three raters was considered to be the central area for each image. The remaining portions of each photo were considered to be the peripheral area. This same procedure was utilized by Porter et al. (2003) to physically define central and peripheral areas. Images were presented to participants on a PC display monitor using the stimuli presentation software associated with the eye tracking device (Experiment Builder).

Valence and Arousal Ratings of IAPS Images. Similar to the normative data included in the IAPS database, participants rated each photograph used in the study in terms of valence and arousal immediately after it was viewed (see Appendix A). These ratings were provided via pencil and paper. Participants rated each image on a separate rating sheet to ensure comparisons to previous images could not be made. In line with the IAPS normative data, ratings were made on a 9-point Likert scale. Higher ratings of valence indicated a higher degree of pleasantness, while lower ratings of valence indicated a higher degree of unpleasantness. Higher ratings of arousal indicated that the photo is emotionally arousing, whereas lower ratings of arousal indicated that the photo is emotionally un-arousing.

Demographic Questionnaire. Participants provided their age, gender, and ethnicity on this questionnaire completed online via the survey software Qualtrics (see Appendix B).

Self-Report Psychopathy Scale – Short Form (SRP-SF; Paulhus et al., in press). The SRP-SF is a 29-item self-report scale used to measure psychopathic traits in community samples.

Participants rated the degree to which each item applies to them on a 5-point Likert scale (1 = *Disagree Strongly*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, 5 = *Agree Strongly*). The SRP-SF measures four facets of psychopathy: interpersonal (e.g., “It’s fun to see how far you can push people before they get upset”), affective (e.g., “I don’t bother to keep in touch with my family anymore”), lifestyle (e.g., “I’m a rebellious person”), and antisocial (e.g., “I was convicted of a serious crime”). Participants received a score on each of these facets plus a total score.

In order to create the SRP-SF, the 64-item SRP-III was shortened (Paulhus et al., in press). The SRP-III has demonstrated good reliability and validity in non-forensic samples (e.g., Mahmut et al., 2011; Williams et al., 2007). Additionally, the SRP-SF itself has been found to be moderately to strongly correlated with the PCL-R (Neumann et al., in press). Participants of the present study completed the SRP-SF online during the mass testing portion of the experiment.

Triarchic Psychopathy Measure (TriPM; Patrick, 2010). The TriPM is a 58-item self-report psychopathy measure designed to assess the three domains of psychopathy consistent with the triarchic model: boldness (e.g., “I’m afraid of far fewer things than most people”), meanness (e.g., “It doesn’t bother me to see someone else in pain”), and disinhibition (e.g., “I often act on immediate needs”). The boldness and meanness domains consist of 19 items, while the disinhibition domain consists of 20 items. Participants rated the degree to which they believe each item applies to them using a 4-point Likert scale (3 = *False*, 2 = *Somewhat False*, 1 = *Somewhat True*, 0 = *True*). The scoring process provides a score for each domain of psychopathy measured by the scale. The TriPM was completed online via the survey software Qualtrics.

Each of these three domains was found to correlate significantly with total scores on the PCL-R in a sample of male offenders (Patrick, 2010). Undergraduate students’ scores on all three domains of the TriPM have also demonstrated a moderate relationship with several other self-

report psychopathy measures, including the PPI, the SRP-III, and the Youth Psychopathic Traits Inventory (YPI; Andershed, Kerr, Stattin, & Levander, 2002; Patrick, 2010). When compared to scores on the LSRP, only scores on the meanness and disinhibition domains were significantly correlated (Patrick, 2010). The three domains of the TriPM have also been found to significantly correlate to variables that are theoretically relevant to psychopathy in both undergraduate and offender samples (Sellbom & Phillips, 2013). Stanley et al. (2013) also found evidence that the TriPM is a valid measure of psychopathy with a sample of male offenders in that TriPM scores were related to theoretically relevant variables such as a lack of empathy and egocentricity.

NEO-Five-Factor Inventory (NEO-FFI; Costa & McCrae, 1992). Participants completed the NEO-FFI online via the survey software Qualtrics, however data from the NEO-FFI was not analyzed as part of the current project. The NEO-FFI was included in order to collect data for the purposes of a separate study.

Memory Questionnaires. Participants answered two sets of memory questions for each of the three images viewed via paper and pencil (see Appendix C). The first question set pertained to recall memory, while the second assessed recognition memory. Each question set contained three questions regarding central details and three questions regarding peripheral details. Thus, a maximum score of 3 was possible for each type of detail on each question set.

The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Several studies have shown that attentional space widens when an individual is in a positive mood (e.g., Rowe et al., 2007; Talarico et al., 2009). Thus, participants in a positive mood may be more likely to attend to peripheral details of stimuli, regardless of other variables. In order to determine whether current mood affects attention to emotional images, participants completed the PANAS at the beginning of the study. The PANAS is a 20-item self-report

measure of current affective state. 10 items correspond to positive affect and 10 items correspond to negative affect. Participants rated the degree to which each item corresponds to their current mood on a 5-point Likert scale (1 = *Very Slightly or Not at All*, 2 = *A Little*, 3 = *Moderately*, 4 = *Quite a Bit*, 5 = *Extremely*). The PANAS was completed online via the survey software Qualtrics. Scoring the PANAS yields a positive affect score in addition to a negative affect score. The PANAS has been shown to be a highly reliable and valid measure with good internal consistency (Crawford & Henry, 2004; Watson et al., 1988).

EyeLink II. The EyeLink II system developed by SR Research was used to track and record participants' eye movements. The EyeLink II is a head-mounted eye tracking device that uses two cameras to record pupil reflection. Pupil reflection of participants was tracked and recorded at a sample rate of 500 hertz (Hz). The EyeLink II system is highly accurate, with an average gaze position error of less than 0.5°. When calibrating and validating the system with each participant, it is recommended by the manufacturer that cut-offs of 0.5° or less of average error and less than 1.0° of maximum error be implemented. These calibration/validation error cut-offs were implemented in the current study. In the event that participant exceeded these cut-offs during the calibration and validation phase of the experiment, calibration/validation was repeated in order to comply with the recommended error cut-offs.

Procedure

Undergraduate students were recruited from Carleton University's mass testing system. During mass testing, prospective participants completed the SRP-SF. As the SRP-SF does not provide any formal cut-off scores indicative of psychopathy, males scoring within the top 20%, females scoring within the top 20%, males scoring within the bottom 20%, and females scoring within the bottom 20% on this measure were recruited to participate in the study. A similar cut-

off procedure was used by Fung et al. (2005) and Dadds et al. (2009), who divided participants into high and low psychopathy groups using the top and bottom 20% or 25% of psychopathy scores, respectively. The purpose of this recruitment procedure was to ensure that given the non-offender sample, participants could be split into high and low scoring groups based on SRP-SF scores. This procedure was also followed in an attempt to create a relatively equal number of males and females within both the top and bottom ranges of scores on the SRP-SF, thus helping to control for any potential effects of gender. Despite this attempt, the majority of participants were female ($n = 52$; 76.5%). Prospective participants falling within the aforementioned ranges were recruited via email to participate (see Appendix D). Prospective participants were told that they would be presented with emotional images, and that their eye movements would be monitored with an eye tracker as these images were viewed. Upon recruitment, participants were informed that the study involved examining how emotional images are processed, and how this processing interacts with personality traits such as psychopathic traits.

All participants were tested individually in a laboratory room located at Carleton University. Participants began by reading the informed consent form (see Appendix E). Once informed consent was obtained, participants completed the PANAS scale in order to measure their mood at the time of participation. Participants were then set up in the EyeLink II eye tracker system by the experimenter. This process involved placing the device on the participant's head and making the appropriate adjustments to the device in order to ensure that the eye tracking cameras were in the optimal position. Once the eye tracking device had been properly adjusted, each participant underwent a calibration and validation process. This process involved the participant viewing a series of nine dots on a PC display monitor while their eye movements were tracked. This process ensured that participants' eye movements were tracked with the least

amount of error possible. If the error rate exceeded 0.5° of average error and/or 1.0° of maximum error, the calibration and validation process was repeated until the error fell within these cut-offs.

Following the set-up and calibration/validation of the eye tracker, each participant viewed a series of three IAPS images on a PC display monitor. One of these images was emotionally negative, one was neutral, and one was positive. At this point, participants were not informed that their memory for these images would be tested later in the experiment. Rather, participants were informed that the study will examine how emotional images are processed. The order in which these images were shown to participants was randomized in order to counterbalance any order effects of image presentation. Each image was shown to participants for 10 seconds².

Immediately after each image was shown, participants completed the corresponding Valence and Arousal Ratings scale to obtain the participant's rating of the emotional valence and arousal of each image. Additionally, in between the presentation of each emotional image participants completed a drift correct procedure. This procedure involved participants focusing on a fixation point in the centre of the display screen while eye movement was tracked. This procedure corrected for any potential shifts of the eye tracking device and helped to minimize eye gaze error. Following each drift correct, participants proceeded to the next emotional image.

After all three images had been viewed, the EyeLink II was removed. Participants then engaged in a filler task for 5 minutes. This filler task consisted of a neutrally themed word search (see Appendix F). Following this, participants were informed that their memory for the details of each image would be tested. Participants had not been informed at the beginning of the study that

² Pilot testing was conducted with 20 participants in order to determine whether viewing images for 5 versus 10 seconds would impact memory. Half ($n = 10$) were randomly assigned to the 5 second time duration condition, while the remainder ($n = 10$) were assigned to the 10 second condition. An independent samples t-test indicated no significant difference in memory between the 5 second ($M = 15.3$, $SD = 2.79$) and 10 second ($M = 16.2$, $SD = 3.08$) conditions, $t(18) = -0.68$, $p = .50$, $d = -0.31$, thus the 10 second time duration was chosen.

their memory would be assessed, therefore the researcher explained the need for this deception and directed participants to a second informed consent form (see Appendix G) if they wished to continue with the remainder of the study. Following the completion of this second consent form, participants completed the Memory Questionnaires corresponding to each emotional image.

Once participants' memory had been tested, they were directed to a computer where they completed the Demographic Questionnaire, the TriPM, and the NEO-FFI. Participants were then debriefed in both written and verbal format (see Appendix H) and thanked for their participation.

Results

Data Treatment

Data from a total of 79 participants were collected. All cases that were assigned to the 5 second time duration condition during pilot testing were removed ($n = 10$). An additional case was removed due to ineligibility³, leaving a total of 68 cases to be included in the final analyses.

Data screening. All variables were screened for entries that fell outside of the possible range of values in order to ensure no entry errors had been made. No impossible values were found.

Missing values. The TriPM was the only questionnaire that contained missing values. One participant was missing the entire TriPM questionnaire, while three participants were each missing one item score. In order to determine whether the data were missing at random, Little's MCAR test was performed. All variables associated with the TriPM were included in the analysis. Results were non-significant, $\chi^2(114) = 106.52, p = .68$, indicating that there was no pattern to the missing data and the data were missing at random.

³ This ineligible participant signed up for the study via SONA without recruitment from the researchers. Upon scoring the SRP-SF scale, it was found that this participant did not fall within the top or bottom scoring 20% and thus was ineligible for the study.

Listwise deletion is an appropriate way in which to deal with missing values if the total loss of data is less than 5% (Tabachnick & Fidell, 2007). In the current data set, listwise deletion would have resulted in a 5.9% loss of participants ($n = 4$). Therefore, this method was deemed unsuitable. Given the small amount of missing data and the finding that the data were missing at random, it was decided to leave the missing data as collected. TriPM scores were computed for the three participants missing one item by summing the available item scores and omitting the missing item. Pairwise deletion for analyses utilizing TriPM scores was then used for the participant missing the entire TriPM scale in order to maximize sample size.

Evaluation of normality. All variables were screened for normality by observing histogram plots in addition to skewness and kurtosis values.

TriPM Meanness, TriPM Disinhibition, SRP-SF Antisocial, and PANAS Negative scores were positively skewed. A square root transformation was applied to each of these variables. This transformation corrected skewness values for all variables except PANAS Negative scores. A log transformation was then applied to this variable, which corrected the skewness. Despite these corrections of skewness, the results of analyses using these variables did not differ with or without transformations, thus the analyses were conducted using the variables in their original state. The eye fixation duration variables for all image valences (i.e., positive, negative, and neutral) were negatively skewed. Additionally, the eye fixation count variable for the neutral image was positively skewed. Attempts were made to transform these variables to correct skewness (reverse square root transformation to correct negative skew, and square root transformation to correct positive skew), however no improvement in normality was achieved. Thus, these variables remained in their original state for analyses.

Valence ratings for the negative image in addition to arousal ratings for the neutral image were positively skewed and leptokurtic. Originally, two 2 (High vs. Low psychopathy) X 3 (Positive vs. Negative vs. Neutral valence) mixed analysis of variance (ANOVA) tests were to be conducted with valence and arousal ratings serving as dependent variables in order to determine whether ratings differed as a function of degree of psychopathy and image valence. Due to the departure from normality for several of these variables in addition to the desire to avoid transformation due to the associated interpretation issues, a different analytic approach was taken. An average valence score and an average arousal score were created across all three images for each participant. Instead of representing the actual valence and arousal ratings of the image, these average scores represent how close that participant was to scoring the valence and arousal of the image with regard to its ‘true’ valence and ‘true’ arousal score (i.e., was the positive image rated positively, was an arousing image rated as arousing, etc.). Higher scores indicated that the participant scored the image closer to its true valence and arousal ratings, while lower scores indicated that the image was not rated in accordance to its true ratings (e.g., a negative image was scored positively, an arousing image was rated as un-arousing, etc.). In other words, these new variables represent how accurate participants were at rating valence and arousal across all three emotional images. The scoring manual used to create these new variables can be found in Appendix I. There were no issues with skewness or kurtosis for these new variables.

Sphericity and homogeneity of variance. Sphericity was examined for all mixed design ANOVAs using Mauchly’s test of sphericity. No violations of sphericity were found. Mauchly’s test statistics are reported below along with the results of each mixed design ANOVA. Violations of homogeneity of variance were examined using Levene’s test. This assumption was not

violated for any of the mixed design ANOVAs run, however violations were found when conducting one-way between subjects ANOVAs examining the difference in SRP-SF facet and total scores as well as TriPM scores for participants high versus low in psychopathy. Due to the violation of homogeneity of variance for these tests, Kruskal-Wallis tests were run in lieu of one-way between subjects ANOVAs when examining the difference in psychopathy scores between participants high versus low in psychopathy. The Kruskal-Wallis test is a non-parametric test and can be used when assumptions of ANOVA are violated (Field, 2009).

Identification of outliers and correlation diagnostics. Variable z scores were examined in order to screen for extreme values. Any z score values exceeding ± 3.29 were considered extreme scores (Field, 2009). Three univariate outliers were identified. All outlier values were transformed to one unit higher than the next most extreme score on that variable.

All variables to be included in correlational analyses (TriPM scales, SRP-SF scales, PANAS scales, memory scores, and eye fixation count and duration) were screened for linear relationships via inspection of scatterplots. The TriPM and SRP-SF scales were linearly related. Additionally, eye fixation count and eye fixation duration were linearly related, however the relationships between the PANAS scales and eye fixation count and duration variables did not fulfill the linearity assumption. The relationships between memory scores and eye fixation count and duration variables also violated the assumption of linearity. In order to address these violations, the relationship between these variables were assessed using Spearman's correlations as opposed to Pearson's correlations, which tests linear relationships between variables. Additionally, PANAS Negative scores in addition to several eye fixation count and duration scores were non-normally distributed. As Spearman's correlation coefficient is a nonparametric test, it can be utilized when parametric assumptions such as non-normality or lack of a linear

relationship have been violated (Field, 2009). Furthermore, it can be argued that scores on the PANAS are ordinal, as higher scores on the scale represent higher levels of affect, however the difference between scores cannot be assigned a meaningful value. In addition to being a nonparametric alternative when parametric assumptions are violated, Spearman's correlation coefficient is useful when variables can be considered ordinal (Field, 2009).

Valence and Arousal Ratings

A one-way between subjects ANOVA was conducted in order to examine the effect of psychopathy level on overall image valence ratings. There were two levels of the independent variable; high psychopathy ($n = 42$) and low psychopathy ($n = 26$). The ANOVA was significant, $F(1, 66) = 5.71, p = .02$. Participants in the low psychopathy condition were significantly more accurate when rating valence ($M = 7.86, SD = 0.61$) than those in the high psychopathy condition ($M = 7.48, SD = 0.64$). In other words, low psychopathy participants scored the valence of the images significantly more closely to their 'true' valence ratings than high psychopathy participants.

A one-way between subjects ANOVA was conducted in order to examine the effect of psychopathy level on overall image arousal ratings. There were two levels of the independent variable; high ($n = 42$) and low ($n = 26$) psychopathy. The ANOVA was significant, $F(1, 66) = 5.33, p = .02$. Participants in the low psychopathy condition were significantly more accurate when rating arousal ($M = 6.35, SD = 1.01$) than those in the high psychopathy condition ($M = 5.77, SD = 0.99$). In other words, low psychopathy participants scored the arousal of the images more closely to their 'true' arousal ratings than high psychopathy participants.

Relationship Between Mood and Attention

In order to determine the relationship between participant mood and attention to emotional images, Spearman's correlations were run between scores on the PANAS and eye tracker fixation count/duration values. There were no significant correlations between PANAS Positive or Negative scores and eye fixation count or eye fixation duration for any of the images. Spearman's correlations between PANAS Positive and Negative scores with eye fixation count and eye fixation duration variables are presented in Table 1. These results suggest that participant mood at the time of the study was unrelated to attention. Thus, the use of PANAS scores as a covariate when examining the effects of psychopathy, valence, and type of detail on emotional memory was not necessary.

Psychopathy, Image Valence, Type of Detail, and Memory

Recall memory. A 2 (High vs. Low psychopathy) X 2 (Central vs. Peripheral detail) X 3 (Negative vs. Positive vs. Neutral valence) mixed ANOVA was run in order to examine the effects of psychopathy, type of detail, and image valence on recall memory scores. Mauchly's test of sphericity was not significant for valence, $W = 0.99$, $\chi^2(2) = 0.94$, $p = .63$, or the interaction between type of detail and valence, $W = 0.98$, $\chi^2(2) = 1.23$, $p = .54$, thus no corrections were applied. Additionally, Levene's tests of homogeneity of variance were non-significant, indicating that there were no violations of this assumption.

There was a significant main effect of type of detail, $F(1, 66) = 83.39$, $p < .01$. Overall, participants recalled significantly more central details ($M = 1.48$, $SE = 0.05$) than peripheral details ($M = 0.82$, $SE = 0.06$). However, this main effect is qualified by a significant two-way interaction between type of detail and valence, $F(2, 132) = 31.74$, $p < .01$.

Table 1

Correlation coefficients (Spearman's rho) between PANAS scores and eye fixation count/duration

	PANAS Positive	PANAS Negative
Negative Image		
Eye Fixation Count		
Central Details	- .12	.07
Peripheral Details	- .11	- .15
Eye Fixation Duration		
Central Details	- .03	.05
Peripheral Details	.08	- .13
Positive Image		
Eye Fixation Count		
Central Details	.02	.13
Peripheral Details	- .08	- .22
Eye Fixation Duration		
Central Details	.05	.21
Peripheral Details	- .01	- .21
Neutral Image		
Eye Fixation Count		
Central Details	- .12	- .10
Peripheral Details	.03	- .10
Eye Fixation Duration		
Central Details	- .03	.02
Peripheral Details	.04	- .01

Simple contrasts using the neutral image as a reference category were run in order to further examine this significant interaction. Additionally, paired-samples t-tests utilizing a Bonferroni correction were run in order to further break down simple contrasts. Since three post-hoc t-tests were run, Bonferroni corrected t-tests were evaluated at a rate of $\alpha = .05/3 = .02$ to control for inflated family-wise error. The results revealed a significant simple contrast between central and peripheral recall memory for negative versus neutral images, $F(1, 66) = 31.42, p < .01$. When the image was negative, central and peripheral details were recalled equally, $t(67) = -.49, p = .63$. However when the image was neutral, significantly more central details were recalled than peripheral details, $t(67) = 7.59, p < .01$. A second significant simple contrast was found between

central and peripheral recall memory for positive versus neutral images, $F(1, 66) = 6.45, p = .01$. For both the positive, $t(67) = 9.23, p < .01$, and neutral, $t(67) = 7.59, p < .01$, images, recall memory significantly decreased when recalling peripheral as opposed to central details, however this decrease in memory was much more pronounced for the positive image compared to the neutral image. Table 2 depicts the mean recall memory scores for central and peripheral details for all three image valences. Figure 1 depicts the interaction between type of detail and valence for recall memory.

Table 2

Mean recall memory scores (M) and standard errors (SE) for each image valence and type of detail

	<i>M</i>	<i>SE</i>
Negative Image		
Central Details	0.99	0.09
Peripheral Details	1.06	0.10
Positive Image		
Central Details	1.81	0.10
Peripheral Details	0.56	0.09
Neutral Image		
Central Details	1.64	0.08
Peripheral Details	0.83	0.07

Note. Recall memory scores for each cell had a possible range from 0 – 3

There were no main effects of valence, $F(2, 132) = 2.97, p = .06$, or psychopathy, $F(1, 66) = 0.11, p = .75$. Additionally, the two-way interactions between type of detail and psychopathy, $F(1, 66) = 1.62, p = .21$, valence and psychopathy, $F(2, 132) = 1.01, p = .37$, and the three-way interaction between type of detail, valence, and psychopathy, $F(2, 132) = 1.06, p = .35$, were not significant.

Figure 1. Mean recall memory scores for central and peripheral details for each image valence

Recognition memory. A 2 (High vs. Low psychopathy) X 2 (Central vs. Peripheral detail) X 3 (Negative vs. Positive vs. Neutral valence) mixed ANOVA was run in order to examine the effects of psychopathy, type of detail, and image valence on recognition memory scores. Mauchly's test of sphericity was not significant for valence, $W = 0.97$, $\chi^2(2) = 1.84$, $p = .40$, or the interaction between type of detail and valence, $W = 0.99$, $\chi^2(2) = 0.66$, $p = .72$, thus no corrections were applied. Additionally, Levene's tests of homogeneity of variance were non-significant, indicating that there were no violations of this assumption.

There was a significant main effect of type of detail, $F(1, 66) = 46.53$, $p < .01$, $\eta^2 = .11$. Overall, participants recognized significantly more central details ($M = 1.81$, $SE = 0.05$) than peripheral details ($M = 1.30$, $SE = 0.05$). There was also a significant main effect of valence, $F(2, 132) = 5.06$, $p < .01$, $\eta^2 = .02$. Pairwise comparisons using a Bonferroni adjustment were conducted in order to further examine this main effect. The results revealed that recognition memory was significantly higher for the positive image ($M = 1.71$, $SE = 0.06$) than for the

negative image ($M = 1.42$, $SE = 0.07$), $p = .01$. Recognition memory did not differ for the negative image ($M = 1.42$, $SE = 0.07$) compared to the neutral image ($M = 1.54$, $SE = 0.06$), $p = .51$, nor did it differ for the positive image ($M = 1.71$, $SE = 0.06$) compared to the neutral image ($M = 1.54$, $SE = 0.06$), $p = .17$.

These main effects were qualified by a significant two-way interaction between type of detail and valence, $F(2, 132) = 8.82$, $p < .01$, $\eta^2 = .05$. Simple contrasts using the neutral image as a reference category were run in order to further examine this significant interaction. Additionally, paired-samples t-tests utilizing a Bonferroni correction were run in order to further break down simple contrasts. Since three post-hoc t-tests were run, the Bonferroni corrected t-tests were evaluated at a rate of $\alpha = .05/3 = .02$ to control for inflated family-wise error. The results revealed a significant simple contrast between central and peripheral recognition memory for negative versus neutral images, $F(1, 66) = 16.98$, $p < .01$. Similar to recall memory, recognition memory scores were equal for central and peripheral details when the image was negative, $t(67) = 0.29$, $p = .77$. However, when the image was neutral, significantly more central details were recognized than peripheral details, $t(67) = 7.68$, $p < .01$. A second simple contrast between central and peripheral recognition memory for positive versus neutral images revealed no significant difference, $F(1, 66) = 1.07$, $p = .31$. In other words, the difference between central and peripheral recognition memory was the same for both the positive and neutral images. For both the positive, $t(67) = 5.04$, $p < .01$, and neutral, $t(67) = 7.68$, $p < .01$, images, recognition memory was better for central details than for peripheral details. Table 3 depicts the mean recognition memory scores for central and peripheral details for all three image valences. The interaction between type of detail and valence for recognition memory is depicted in Figure 2.

Table 3

Mean recognition memory scores (M) and standard errors (SE) for each image valence and type of detail

	<i>M</i>	<i>SE</i>
Negative Image		
Central Details	1.45	0.11
Peripheral Details	1.40	0.10
Positive Image		
Central Details	2.02	0.08
Peripheral Details	1.39	0.10
Neutral Image		
Central Details	1.96	0.07
Peripheral Details	1.13	0.08

Note. Recognition memory scores for each cell had a possible range from 0 – 3

Figure 2. Mean recognition memory scores for central and peripheral details for each image valence

There was no main effect of psychopathy, $F(1, 66) = 0.001, p = .98$. Additionally, the two-way interactions between type of detail and psychopathy, $F(1, 66) = 0.38, p = .54$, valence

and psychopathy, $F(2, 132) = 0.26, p = .77$, and the three-way interaction between type of detail, valence, and psychopathy, $F(2, 132) = 0.09, p = .91$, were not significant.

Psychopathy, Image Valence, Type of Detail, and Attention

Eye fixation count. A 2 (High vs. Low psychopathy) X 2 (Central vs. Peripheral detail) X 3 (Negative vs. Positive vs. Neutral valence) mixed ANOVA was run in order to examine the effects of psychopathy, type of detail, and image valence on eye fixation count. Mauchly's test of sphericity was not significant for valence, $W = 0.99, \chi^2(2) = 0.49, p = .78$, or the interaction between type of detail and valence, $W = 0.99, \chi^2(2) = 0.58, p = .75$, thus no corrections were applied. Additionally, Levene's tests of homogeneity of variance were non-significant, indicating that there were no violations of this assumption.

There was a significant main effect of type of detail, $F(1, 66) = 28.51, p < .01, \eta^2 = .12$. Overall, participants fixated significantly more often on peripheral details ($M = 19.73, SE = 0.62$) than on central details ($M = 14.33, SE = 0.55$). There was also a significant main effect of valence, $F(2, 132) = 6.72, p < .01, \eta^2 = .003$. Pairwise comparisons using a Bonferroni adjustment were conducted in order to further examine this main effect. The results revealed that significantly more eye fixations were made on the negative image ($M = 17.46, SE = 0.36$) than on the positive image ($M = 16.42, SE = 0.32$), $p < .01$. Additionally, significantly more eye fixations were made on the neutral image ($M = 17.21, SE = 0.35$) than on the positive image ($M = 16.42, SE = 0.32$), $p = .03$. There were no significant differences in eye fixation count between the negative ($M = 17.46, SE = 0.36$) and the neutral ($M = 17.21, SE = 0.35$) image, $p = 1.00$.

These main effects are qualified by two significant interactions. A significant two-way interaction was found between type of detail and valence, $F(2, 132) = 25.28, p < .01, \eta^2 = .16$. However, this two-way interaction is qualified by a significant three-way interaction between

type of detail, valence, and psychopathy, $F(2, 132) = 3.75, p = .03, \eta^2 = .02$. Given the presence of this significant higher-order interaction, only the three-way interaction was further examined using post-hoc tests. Simple contrasts using the neutral image as a reference category were run in order to further examine the three-way interaction. Additionally, paired-samples t-tests utilizing a Bonferroni correction were run in order to further break down simple contrasts. Following the Bonferroni correction, t-tests were evaluated at a rate of $\alpha = .05/6 = .008$ to control for inflated family-wise error. The results revealed a non-significant simple contrast between central and peripheral eye fixation count for negative versus neutral images when participants were high versus low in psychopathy, $F(1, 66) = 0.02, p = .89$. When viewing the negative image, participants both high, $t(41) = -7.87, p < .008$ and low, $t(25) = -4.65, p < .008$, in psychopathy fixated significantly more often on peripheral than on central details. Alternatively, when viewing the neutral image, participants both high, $t(41) = 0.29, p = .78$, and low, $t(25) = 1.90, p = .07$, in psychopathy had an equal number of eye fixations on central and peripheral details.

A second simple contrast revealed a significant difference when comparing central and peripheral eye fixation count for positive versus neutral images when participants were high versus low in psychopathy, $F(1, 66) = 5.72, p = .02$. When participants were high in psychopathy, eye fixation counts were equal for central and peripheral details of both the positive, $t(41) = -1.69, p = .10$, and neutral images, $t(41) = 0.29, p = .78$. When participants were low in psychopathy, eye fixation counts were also equal for central and peripheral details of the neutral image, $t(25) = 1.90, p = .07$, however when viewing the positive image, peripheral details were fixated on significantly more often than central details, $t(25) = -3.37, p < .008$. Table 4 provides the mean number of eye fixations made on central and peripheral details for each

emotional image for participants who were high versus low in psychopathy. Figure 3 depicts the three-way interaction between type of detail, valence, and psychopathy for eye fixation count.

Table 4

Mean number of eye fixations (M) and standard errors (SE) for each image valence and type of detail for participants high versus low in psychopathy

	Low Psychopathy (<i>n</i> = 26)		High Psychopathy (<i>n</i> = 42)	
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
Negative Image				
Central Details	12.62	1.28	9.64	1.00
Peripheral Details	23.00	1.27	24.57	1.04
Positive Image				
Central Details	12.00	1.27	14.71	1.00
Peripheral Details	21.12	1.42	17.86	1.12
Neutral Image				
Central Details	20.19	1.46	16.83	1.15
Peripheral Details	15.62	1.46	16.19	1.15

There was no main effect of psychopathy, $F(1, 66) = 1.77, p = .19$. Additionally, the two-way interactions between type of detail and psychopathy, $F(1, 66) = 0.17, p = .68$, and valence and psychopathy, $F(2, 132) = 1.83, p = .16$, were not significant.

Eye fixation duration. A 2 (High vs. Low psychopathy) X 2 (Central vs. Peripheral detail) X 3 (Negative vs. Positive vs. Neutral valence) mixed ANOVA was run in order to examine the effects of psychopathy, type of detail, and image valence on eye fixation duration (measured in milliseconds). Mauchly's test of sphericity was not significant for valence, $W = 0.97, \chi^2(2) = 2.28, p = .32$, or the interaction between type of detail and valence, $W = 0.99, \chi^2(2) = 0.86, p = .65$, thus no corrections were applied. Additionally, Levene's tests of homogeneity of variance were non-significant, indicating that there were no violations of this assumption.

Figure 3. Mean eye fixation count scores for each image valence and type of detail for participants high versus low in psychopathy

There was a significant main effect of type of detail, $F(1, 66) = 18.72, p < .01$. Overall, participants spent significantly more time attending to peripheral details ($M = 4876.29, SE = 137.57$) than to central details ($M = 3704.78, SE = 141.22$). There was also a significant main effect of valence, $F(2, 132) = 3.89, p = .02$. Pairwise comparisons using a Bonferroni adjustment were conducted in order to further examine this main effect. The results revealed that significantly more time was spent viewing the positive image ($M = 4339.79, SE = 26.91$) than the negative image ($M = 4227.39, SE = 49.89$), $p = .04$. There were no significant differences in eye fixation duration between the positive ($M = 4339.79, SE = 26.91$) and neutral ($M = 4304.43, SE = 42.46$) image, $p = 1.00$, nor between the negative ($M = 4227.39, SE = 49.89$) and neutral image ($M = 4304.43, SE = 42.46$), $p = .16$.

These main effects are qualified by two significant interactions. A significant two-way interaction was found between type of detail and valence, $F(2, 132) = 20.97, p < .01$. However,

this two-way interaction is qualified by a significant three-way interaction between type of detail, valence, and psychopathy, $F(2, 132) = 4.31, p = .02$. Given the presence of this significant higher-order interaction, only the three-way interaction was further examined using post-hoc tests. Simple contrasts using the neutral image as a reference category were run in order to further examine the three-way interaction. Additionally, paired-samples t-tests utilizing a Bonferroni correction were run in order to further break down simple contrasts. Following the Bonferroni correction, t-tests were evaluated at a rate of $\alpha = .05/6 = .008$ to control for inflated family-wise error. The results revealed a non-significant simple contrast between central and peripheral eye fixation duration for negative versus neutral images when participants were high versus low in psychopathy, $F(1, 66) = 0.03, p = .87$. When viewing the negative image, participants both high, $t(41) = -6.32, p < .008$, and low, $t(25) = -3.67, p < .008$, in psychopathy fixated for a significantly longer period of time on peripheral than on central details. Alternatively, when viewing the neutral image, participants both high, $t(41) = 0.71, p = .48$, and low, $t(25) = 2.07, p = .05$, in psychopathy spent an equal amount of time fixating on central and peripheral details.

A second simple contrast revealed a significant difference when comparing central and peripheral eye fixation duration for positive versus neutral images when participants were high versus low in psychopathy, $F(1, 66) = 6.65, p = .01$. When participants were high in psychopathy, eye fixation durations were equal for central and peripheral details of both the positive, $t(41) = -1.23, p = .23$, and neutral images, $t(41) = 0.71, p = .48$. When participants were low in psychopathy, eye fixation durations were also equal for central and peripheral details of the neutral image, $t(25) = 2.07, p = .05$, however when viewing the positive image, significantly more time was spent fixating on peripheral than on central details, $t(25) = -3.70, p < .008$. Table

5 provides the mean eye fixation duration for central and peripheral details for each emotional image for participants who were high versus low in psychopathy. Figure 4 depicts the three-way interaction between type of detail, valence, and psychopathy for eye fixation duration.

Table 5

Mean eye fixation duration (M) and standard errors (SE) for each image valence and type of detail for participants high versus low in psychopathy

	Low Psychopathy (n = 26)		High Psychopathy (n = 42)	
	M	SE	M	SE
Negative Image				
Central Details	3170.00	329.73	2511.91	259.43
Peripheral Details	5416.31	333.82	5811.33	262.65
Positive Image				
Central Details	3061.08	338.14	4031.24	266.05
Peripheral Details	5617.85	327.54	4649.00	257.71
Neutral Image				
Central Details	4942.92	364.39	4511.52	286.70
Peripheral Details	3671.85	350.48	4091.43	275.76

There was no main effect of psychopathy, $F(1, 66) = 0.47, p = .49$. Additionally, the two-way interactions between type of detail and psychopathy, $F(1, 66) = 0.00, p = .98$, and valence and psychopathy, $F(2, 132) = 1.63, p = .19$, were not significant.

ANOVA results were largely the same for both eye fixation count and eye fixation duration. Due to the identical patterns found, it was considered that perhaps these variables are conveying identical information. Correlation analyses were run between these two variables and significant positive relationships were found (see Appendix J), however both sets of results were included since past studies have found different patterns for eye fixation count and fixation duration (e.g., Christianson et al., 1991; Loftus, 1972), thus it is possible that these two variables could portray different information with a new sample even though that was not the case in the present study.

Figure 4. Mean eye fixation duration scores for each image valence and type of detail for participants high versus low in psychopathy

Relationship Between Memory and Attention

Numerous studies examining the central/peripheral trade-off have noted that participant attention to these images may be related to subsequent memory patterns (e.g., Chipchase & Chapman, 2013; Christianson & Loftus, 1991). In order to determine the relationship between participant memory scores and attention to the emotional images viewed, Spearman's correlations were run between scores on the memory questionnaires and eye tracker fixation count/duration values for each image. There were no significant correlations found between eye tracker data and recall memory for neither central nor peripheral details for any of the three emotional images. The same pattern of results was found for recognition memory. Table 6

depicts this relationship for the negative image, and Tables 7 and 8 depict this relationship for the positive and neutral images, respectively.

Table 6

Correlation coefficients (Spearman's rho) between memory scores and eye fixation count/duration scores for the negative image

	Recall Memory		Recognition Memory	
	Central	Peripheral	Central	Peripheral
Central				
Eye Fixation Count	.01	.02	-.07	-.02
Eye Fixation Duration	-.07	.07	-.16	.07
Peripheral				
Eye Fixation Count	-.01	-.21	.15	-.09
Eye Fixation Duration	.01	-.10	.23	-.12

Table 7

Correlation coefficients (Spearman's rho) between memory scores and eye fixation count/duration scores for the positive image

	Recall Memory		Recognition Memory	
	Central	Peripheral	Central	Peripheral
Central				
Eye Fixation Count	.03	-.04	-.05	-.02
Eye Fixation Duration	.12	-.12	-.01	-.07
Peripheral				
Eye Fixation Count	-.12	.18	.02	.07
Eye Fixation Duration	-.10	.09	-.01	.05

Table 8

Correlation coefficients (Spearman's rho) between memory scores and eye fixation count/duration scores for the neutral image

	Recall Memory		Recognition Memory	
	Central	Peripheral	Central	Peripheral
Central				
Eye Fixation Count	.08	.01	.05	-.02
Eye Fixation Duration	.02	.05	-.03	-.01
Peripheral				
Eye Fixation Count	.02	-.06	.02	-.01
Eye Fixation Duration	-.03	-.11	-.02	-.03

Participant Psychopathy Scores

Descriptive statistics for the overall sample on the SRP-SF and the TriPM are presented in Table 9. Also presented in Table 9 are the ranges of scores possible on each measure in addition to results of reliability analyses (reliability was assessed using Cronbach's α).

Table 9

Descriptive statistics and reliability analyses for the SRP-SF and the TriPM

Scale	Overall Sample (<i>n</i> = 68)		Range of Scores	Cronbach's α
	<i>M</i>	<i>SD</i>		
SRP-SF				
Interpersonal	15.15	7.12	7 – 35	.91
Affective	14.94	6.32	7 – 35	.86
Lifestyle	15.93	6.04	7 – 35	.87
Antisocial	11.85	4.08	8 – 40	.75
Total	58.01	21.47	29 – 145	.95
TriPM				
Boldness	30.73	9.73	0 – 57	.88
Meanness	14.03	11.27	0 – 57	.67
Disinhibition	16.37	10.05	0 – 60	.83

Note. Range of scores indicates the range of scores possible on each scale.

SRP-SF and TriPM scores for participants high versus low in psychopathy. Kruskal-Wallis tests were conducted in order to determine whether participants who were high versus low

in psychopathy differed in SRP-SF facet and total scores. The results revealed a significant difference in SRP-SF total scores between participants high and low in psychopathy, $H(1) = 47.56, p < .01$. High psychopathy participants had significantly higher SRP-SF total scores than low psychopathy participants. Participants high in psychopathy also had significantly higher SRP-SF Interpersonal, $H(1) = 48.30, p < .01$, Affective, $H(1) = 44.05, p < .01$, Lifestyle, $H(1) = 44.84, p < .01$, and Antisocial scores, $H(1) = 37.45, p < .01$, than those low in psychopathy.

Kruskal-Wallis tests were also run in order to determine whether participants who were high versus low in psychopathy differed in TriPM Boldness, Meanness, and Disinhibition scores. The results revealed that participants high in psychopathy had significantly higher Meanness, $H(1) = 40.07, p < .01$, and Disinhibition scores, $H(1) = 28.70, p < .01$, than participants low in psychopathy, however Boldness scores did not differ between participants high versus low in psychopathy, $H(1) = 2.43, p = .12$. Descriptive statistics for the SRP-SF and TriPM in addition to the results of Kruskal-Wallis tests are presented in Table 10.

Table 10

Descriptive statistics for the SRP-SF and TriPM for high versus low psychopathy groups and results of Kruskal-Wallis tests

Scale	Low Psychopathy ($n = 26$)		High Psychopathy ($n = 42$)		H
	M	SD	M	SD	
SRP-SF					
Interpersonal	7.65	1.02	19.79	5.03	48.30**
Affective	8.85	1.93	18.71	4.99	44.05**
Lifestyle	9.65	2.38	19.81	3.96	44.84**
Antisocial	8.58	1.42	13.88	3.87	37.45**
Total	34.73	3.62	72.43	13.75	47.56**
TriPM					
Boldness	28.08	10.65	32.41	8.82	2.43
Meanness	4.46	3.97	20.10	10.12	40.07**
Disinhibition	8.77	4.99	21.20	9.46	28.70**

Note. ** $p < .01$

Relationship between the SRP-SF and the TriPM. Pearson's correlations were run in order to examine the relationship between scores on the SRP-SF and the TriPM. Table 11 displays the correlation coefficients between total and facet scores on these two measures.

Table 11

Correlation coefficients (Pearson's r) between scores on the SRP-SF and scores on the TriPM

	TriPM Boldness	TriPM Meanness	TriPM Disinhibition
SRP-SF Total	.27*	.84**	.66**
Interpersonal	.26*	.81**	.57**
Affective	.27*	.84**	.57**
Lifestyle	.24	.67**	.63**
Antisocial	.18	.62**	.59**

Note. * $p < .05$, ** $p < .01$

SRP-SF total and facet scores were moderately to strongly correlated with TriPM Meanness and Disinhibition scores. However, correlations between SRP-SF Total, Interpersonal, and Affective scores and scores on the TriPM Boldness scale were low. Scores between the SRP-SF Lifestyle and Antisocial factors and TriPM Boldness scores were not significantly correlated.

Discussion

The purpose of the present study was to examine memory for central and peripheral details of emotional images in individuals with varying degrees of psychopathic traits. Specifically, the current study sought to determine whether the central/peripheral trade-off in memory would exist for participants with a higher degree of psychopathic traits in the same way that it has been found to exist in other participants in a multitude of previous studies (e.g., Chipchase & Chapman, 2013; Christianson & Loftus, 1991; Kensinger et al., 2006). Additionally, the present study incorporated the use of an eye tracking device in order to examine attention to central and peripheral details of emotional images. Notably, this is the first study to implement the use of such a device in a study examining the relationship between the

central/peripheral trade-off and psychopathy. A secondary purpose of the present study was to examine the relationship between scores on the SRP-SF and the TriPM, a measure stemming from the triarchic model of psychopathy, the most recent conceptualization of the disorder.

Summary and Explanation of Findings

Valence and arousal ratings. The original intent of examining participant valence and arousal ratings of each emotional image was to determine whether participants who were high versus low in psychopathy would provide significantly different ratings of these images. It was hypothesized that like the findings of Christianson et al. (1996), Patrick et al. (1993), and Patrick et al. (1994), participants would provide the same valence and arousal ratings of each image regardless of psychopathy. However, due to non-normality of the data, a different research question regarding valence and arousal ratings was examined in lieu of the original. Rather than examining the difference in raw valence and arousal scores between individuals high and low in psychopathy, the overall accuracy of valence and arousal ratings across all three emotional images were examined between these groups. The results revealed that participants who were high in psychopathy were significantly less accurate than those low in psychopathy at rating both the emotional valence and emotional arousal of the images. In other words, the low psychopathy participants performed better at rating the images' valence and arousal in line with their 'true' valence and arousal ratings. Perhaps participants who were higher in psychopathic traits found the negative image to be less negative, the positive image to be less positive, etc. than participants low in psychopathy, thus their ratings of valence were overall not as accurate. The same might be true for arousal; perhaps high psychopathy participants were not as emotionally aroused by the images and thus their ratings of arousal appear to be less accurate.

These results mirror the findings of Hervé et al. (2003), who reported that inmates who were high in psychopathy made significantly more errors than those who were in the mid to low psychopathy range when matching emotional valence to various metaphorical statements. In other words, high psychopathy participants were less accurate when making decisions regarding valence of emotional stimuli. The results of the present study provide additional support to suggest that individuals with a higher degree of psychopathic traits may be impaired in the ability to assign appropriate emotional valence labels to various emotional stimuli. Hervé et al. (2003) explain this impairment by suggesting that psychopaths rate emotional stimuli using a feature other than valence, such as the arousal invoked by the image. These researchers explain that perhaps psychopaths associate low arousal with negativity and high arousal with positivity, thus allowing for valence matching errors if arousal was used as the sorting criteria. The present study examined accuracy of arousal ratings in addition to valence ratings, and found that students higher in psychopathic traits were less accurate when rating how arousing images were in addition to valence, suggesting that they are also impaired in this regard. In order to further understand these impairments, future research could examine participants' reasoning for each valence and arousal rating in addition to the rating itself. Additionally, future research could examine the accuracy of psychopaths' versus nonpsychopaths' valence and arousal ratings to a range of affective stimuli.

Mood and attention. A number of studies have demonstrated that when an individual is in a positive mood, attentional space widens (e.g., Rowe et al., 2007; Talarico et al., 2009). Thus, in the present study, it was possible that participants who were in a positive mood at the time of testing may have widened their attentional gaze, and as a consequence may have spent more time viewing peripheral details of the emotional images shown regardless of other variables, such as

psychopathy or the valence of the images. Analyses examining the relationship between participant mood and attention were not consistent with previous studies. Neither positive mood nor negative mood was related to eye fixation count or eye fixation duration, suggesting that participants did not tend to focus on particular aspects of the images based on their mood at the time of testing. Due to these results, there was no need to control for participant mood in subsequent analyses.

The central/peripheral trade-off and attention to emotional images. I predicted that for participants low in psychopathic traits, a central/peripheral trade-off in memory would be seen for the negative image. In other words, participants would have better memory for the central details than the peripheral details of the negative image. Conversely, I predicted that memory in the neutral condition would be relatively equal for both types of details (i.e., no central/peripheral trade-off would be seen). Memory patterns for the positive image were exploratory, as minimal research has included a positive stimuli condition when examining the central/peripheral trade-off. For participants higher in psychopathic traits, it was hypothesized that no central/peripheral trade-off in memory would be seen in any of the emotional valence conditions (i.e., memory for each type of detail would be relatively equal across all three images). These hypotheses were not supported by the results of the present study. First, there was no effect of psychopathy on recall or recognition memory. In other words, memory patterns did not differ for individuals who were low versus high in psychopathic traits. In their study of the central/peripheral trade-off in children with a high or low degree of CU traits, Thijssen et al. (2012) also failed to find a difference in memory between these two groups. However, given that Thijssen et al. (2012) used a sample of children and the present study utilized a sample of adults, comparisons are difficult to make.

The lack of an effect of psychopathy could be due to the fact that a student sample was used. Research has consistently found that the prevalence of psychopathic traits is much lower in student and community populations as opposed to offender populations (e.g., Coid et al., 2009; Hare, 2003). Even though participants in the high psychopathy group were in fact higher in psychopathic traits than those in the low psychopathy group, high psychopathy participants in the current study would likely score lower on psychopathy measures than an offender population, as mean psychopathy scores for offenders tend to be higher than mean psychopathy scores in the community (Forth, Bo, & Kongerslev, 2012). In other words, even though significant differences in psychopathy scores were found between these groups, perhaps they simply were not different enough to produce differences in memory. Additionally, the majority of participants in the present study were female. Past research has found that females tend to have lower scores on measures of psychopathy than males (e.g., Borroni, Somma, Andershed, Maffei, & Fossati, 2014). Furthermore, some studies examining affective deficits in females with psychopathic traits have reported that the results did not support the same emotional processing deficits that have been found in male psychopaths (e.g., Isen et al., 2010; Justus & Finn, 2007; Vitale, Maccoun, & Newman, 2011). Given this information, it is possible the large number of female participants in the present study may aid in explaining why no effects of psychopathy on emotional memory were found.

Contrary to my predictions, the results of the present study revealed a central/peripheral trade-off in recall memory for both the positive and the neutral image, but no such trade-off was found for the negative image. In other words, participants better recalled central details than peripheral details for the positive and neutral image, and had equal memory for central and peripheral details for the negative image. Although both the positive and neutral images were

associated with a central/peripheral trade-off in recall memory, this trade-off was much more pronounced for the positive image. The results of the recognition memory tests revealed a similar pattern, the only difference being that the central/peripheral trade-off was not more pronounced for the positive image than for the neutral image. Interestingly, this pattern of results appears to be the opposite of what was hypothesized, since the only image expected to have an associated central/peripheral trade-off was the negative image. Additionally, memory for central and peripheral details of the neutral image was expected to be equal, however a central/peripheral trade-off was found in this condition. It is interesting that a central/peripheral trade-off was found for the positive condition given that like the negative condition, this image was meant to be emotional. Although most studies examining the central/peripheral trade-off in memory have focused only on negative and neutral stimuli, Chipchase and Chapman (2013) included a positive stimulus and found that memory for central details in this condition compared to a neutral condition was enhanced, however there was no subsequent decrease in peripheral memory. Alternatively, in the present study, the central/peripheral trade-off in recall memory was in fact the most pronounced for the positive image.

In order to explain these patterns in memory, the results of analyses using eye tracker data were examined. Originally, it was hypothesized that the eye tracker data would follow the same pattern as the hypothesized memory effects. In other words, participants in the low psychopathy group would fixate more often and for a longer period of time on the central details than on the peripheral details in the negative condition, and would attend equally to central and peripheral details in the neutral condition, whereas participants in the high psychopathy group would have an equal number of eye fixations and spend an equal amount of time on the central and peripheral details across all image valences. However, given that memory was equal for

central and peripheral details of the negative image, it would be reasonable to suggest that attention to central and peripheral details would also be equal. Similarly, since a central/peripheral trade-off in memory was found for the positive and neutral images, it would be reasonable to suggest that attention would follow a similar pattern for these conditions (i.e., more attention devoted to central as opposed to peripheral details). In large part, the results of the eye fixation count and the eye fixation duration analyses did not support either of these proposed patterns. First, while there was no main effect of psychopathy on eye fixation count or eye fixation duration, there was a three-way interaction between type of detail being viewed, image valence, and psychopathy for both eye tracking variables. For participants both high and low in psychopathy, peripheral details of the negative image were fixated on significantly more often and for a significantly longer period of time than central details. These results suggest that participants were looking away from the central portion of the negative image, which depicted a fatally injured man. When taken together with the results of the memory tests, an interesting pattern emerges. Despite spending significantly less time attending to the central portion of the negative image, participants remembered the central details of this image equally as well as the peripheral details. This suggests that perhaps something about the central portion of the negative image was particularly salient for participants, thus they were able to remember details about this part of the image just as well as they did the background details. Some support for this theory can be found in the literature examining evolutionary perspectives to explain responses to negative stimuli. Evolutionarily speaking, it is adaptive for individuals to respond to negative stimuli that are potentially threatening, thus allowing them to attempt to avoid similar threats in the future (Lacreuse et al., 2013). Additionally, individuals need to be able to respond to negative stimuli even when the presentation of these stimuli is brief in order to promote evolutionary

success (Carretié, Hinojosa, Mercado, & Tapia, 2005). Some research has found that responses to negative stimuli occur even when the stimuli were processed unconsciously (e.g., Carretié, et al., 2005; Esteves & Öhman, 1993). For example, Carretié et al. (2005) found that neural responses from regions in the brain associated with danger processing were more likely to occur when participants unconsciously viewed negative stimuli as opposed to non-negative stimuli. The results of the present study may provide additional support for this phenomenon; even though participants did not seem to attend to the emotionally provocative aspect of the negative image, they were able to remember details regarding the emotional aspect just as well as details regarding the background. Perhaps this finding was due in part to evolutionary processes that encourage responding to negative stimuli.

As mentioned above, the pattern of eye tracking for the negative image was the same for participants both high and low in psychopathy. Participants in both psychopathy groups also had the same pattern of eye tracking for the neutral image; participants made an equal number of eye fixations and spent an equal amount of time viewing both the central and peripheral details, suggesting that they were not focusing on any particular aspect of the neutral image. These results support the hypotheses made regarding eye tracking patterns in the neutral condition, however they become somewhat puzzling when taken together with the results of the memory tests. Even though participants did not seem to devote their attention to any particular area of the neutral image, they remembered central details of the image much better than peripheral details.

The difference between participants high versus low in psychopathy emerged when analyzing eye tracking data for the positive image. Participants low in psychopathy fixated more often on and spent more time viewing peripheral details of the positive image as opposed to central details, suggesting that like the negative image, these participants were looking away

from the central, emotionally provocative aspect. On the other hand, participants high in psychopathy made an equal number of fixations and spent an equal amount of time viewing each type of detail for the positive image, suggesting that these participants did not focus their attention on any particular area. Despite these differences in attention between those high and low in psychopathy, all participants had better memory for the central details of the positive image than for the peripheral details. Even more interesting is that neither group attended to the central details more than the peripheral details, yet memory for these details was enhanced.

Memory and attention. As mentioned above, eye tracker patterns and memory patterns for each emotional image did not seem to be in sync. This lack of relationship was confirmed when correlational analyses between memory scores and eye tracker data for each image yielded non-significant results. These results suggest that where participants were looking as they viewed each emotional image was unrelated to their subsequent memory for details of those images. In large part, these findings contradict much of the evidence presented in the existing literature. A number of past studies that examined the central/peripheral trade-off in memory have noted that participant attention to certain details of the stimuli seemed to explain memory patterns (e.g., Chipchase & Chapman, 2013; Christianson & Loftus, 1991). For example, Chipchase and Chapman (2013) found that in addition to remembering more central details and less peripheral details of negative stimuli, participants also tended to fixate more often and for a longer duration on central details than on peripheral details. They note that this pattern of results supports the attentional narrowing hypothesis; the finding that central details were remembered better than peripheral details when viewing a negative stimulus may be explained by the fact that attention was in fact narrowed to these central details. The same cannot be said for the current study; attention to details did not map on to memory patterns for these details, and upon further

investigation it was found that they were in fact unrelated. This suggests that perhaps a factor other than attention must be used in order to explain memory patterns for emotional images.

Indeed, Christianson et al. (1991) note that perhaps the central/peripheral trade-off cannot be explained solely by attention. In a pair of studies, they found that memory for central details was enhanced when viewing a negative stimulus compared to a neutral stimulus, despite limiting the distribution of attention in both these conditions by directing participants to a fixation cross and showing the stimuli for less than one second. When attention was not restricted and participants were free to fixate on any aspect of the stimuli, it was found that more eye fixations were made on central as opposed to negative details with a negative stimulus, and that memory for these central details was in fact enhanced. This seems to suggest that attention to detail plays an important role in subsequent memory for those details, however taken together with the results when attention was restricted, it appears as though attention may not entirely explain patterns in memory. However, Christianson et al. (1991) raise an important consideration regarding studies that have used eye tracking as a proxy for attention. They note that critics have stated that perhaps eye movements are not fully representative of attention. These critics argue that just because the eyes are fixating on certain details does not necessarily mean that attention is being devoted to them (e.g., Posner, 1980). In later work, Posner, Cohen, Choate, Hockey, and Maylor (1984) note that within real world contexts, attention typically redirects itself with each eye movement so that the two are in sync, however the possibility that attention may not be entirely captured by eye tracking can still be noted as a potential limitation in the current study.

Measures of psychopathy. Two different measures of psychopathy were used in the current study: the SRP-SF and the TriPM. Incorporating the use of two psychopathy measures

provided the opportunity to examine the relationship between scores on both these measures, as data regarding this relationship is lacking in the current literature.

Since participant total scores on the SRP-SF were used in order to create a high and a low psychopathy group, a manipulation check of these groups was conducted by running Kruskal-Wallis tests in order to determine whether participants who were high versus low in psychopathy differed in SRP-SF total and facet scores. Participants who were high in psychopathy consistently scored significantly higher than those low in psychopathy across SRP-SF total and facet scores. Thus, it appears that the procedure for recruiting participants for these high and low psychopathy groups was successful since participants in the high psychopathy group were in fact higher in psychopathic traits than those in the low psychopathy group. For TriPM scores, participants high in psychopathy had significantly higher scores than those low in psychopathy for the Meanness and Disinhibition scales, however the two groups did not differ in Boldness scores.

Correlation analyses were also run in order to examine the relationship between scores on the SRP-SF and the TriPM. Since both these scales measure the construct of psychopathy, it was hypothesized that participant scores on each of these measures would be positively correlated. In large part, the results were consistent with this hypothesis. SRP-SF total and facet scores were moderately to strongly correlated in a positive direction with TriPM Meanness and Disinhibition scores. TriPM Boldness scores, however, were positively but weakly correlated with SRP-SF total scores and the Interpersonal and Affective facets. Furthermore, the Lifestyle and Antisocial facets of the SRP-SF were not significantly related to TriPM Boldness scores. While no published studies to date have examined the relationship between the SRP-SF and the TriPM, some studies have examined the relationship between the TriPM and other measures of

psychopathy. Patrick (2010) reported moderate positive correlations between SRP-III total scores (the measure from which the SRP-SF was derived) and all three triarchic domains. The relationship between the SRP-III and the Boldness scale was the weakest, with a correlation coefficient of $r = .31$. These results mirror the findings of the present study, except that correlations between the SRP-SF total scores and the Meanness and Disinhibition scales were much stronger than Patrick's (2010) reported correlations between these domains and the SRP-III. Like the present study, Patrick (2010) used a mixed-gender university sample in order to analyze these correlations.

In a study of male offenders, Patrick (2010) found weak to moderate positive correlations between PCL-R total scores and TriPM Boldness, Meanness, and Disinhibition scores. The Interpersonal and Antisocial facets of the PCL-R correlated weakly to moderately with each TriPM domain. The Affective facet was moderately correlated with the Meanness domain; all other correlations were non-significant. Additionally, the Lifestyle facet was moderately correlated only with the Disinhibition domain. These results are relatively similar to the correlations between the SRP-SF and the TriPM reported in the present study, the exception again being that Meanness and Disinhibition scores were much more strongly related to scores on the SRP-SF than to the PCL-R scores reported by Patrick (2010). However, it must be noted that the strong correlations between scores on the SRP-SF and the TriPM reported in the present study may be due, in part, to the fact that an extreme groups design was used. Prospective participants scoring within the top or bottom 20% of a mass testing pool on the SRP-SF were recruited, thus creating two extreme groups for analyses. The use of extreme groups tends to inflate standardized effect size, thus the correlation coefficients presented may be reflective of this (Preacher, Rucker, MacCallum, & Nicewander, 2005). Therefore the relationship between

scores on the SRP-SF and the TriPM found in the current study may not be generalizable to other populations. As Feldt (1961) notes, analyses of extreme groups can demonstrate that a linear relationship between two variables exists, however it is difficult to make conclusions regarding the strength of this relationship (Preacher et al., 2005).

Patrick et al. (2009) note that when comparing the TriPM to other measures of psychopathy, the PCL-R seems to best represent the Meanness and Disinhibition domains, whereas Boldness is better represented by the PPI. Since the SRP-SF shares a similar factor structure to the PCL-R, these relationships may explain the weak correlations found between the Boldness scale of the TriPM and SRP-SF total and facet scores in the present study. Additionally, the notion that Boldness may not be completely captured by the PCL-R (and subsequently, measures created that follow a similar factor structure) may aid in explaining why participants who were high versus low in psychopathy did not differ on Boldness scores, since psychopathy categories were created using scores on the SRP-SF.

Strengths, Limitations, and Future Directions

There were a number of notable strengths associated with the current study. First, this was the first study to examine the relationship between the central/peripheral trade-off and psychopathy in conjunction with the use of an eye tracking device. Incorporating the use of the eye tracking device allowed for the examination of participant attention to central and peripheral details of each emotional image shown, and thus was able to aid in the explanation of participant memory patterns for these details. Additionally, the use of the eye tracker made it possible to examine the attentional narrowing hypothesis (i.e., were participants focusing attention on certain details when viewing certain images, thus potentially explaining memory patterns for those details). Some of the past studies that examined the central/peripheral trade-off have

hypothesized that perhaps memory patterns could be explained by participant attention to certain details, but did not actually measure attention as part of the study (e.g., Christianson et al., 1996; Kensinger et al., 2006; Thijssen et al., 2012). Including eye tracking data in order to represent participant attention allowed for more concrete evidence regarding the relationship between attention on memory. Additionally, the present study utilized a mixed gender student sample (although the majority of the sample was female), a sample that has been highly neglected in the current literature. To date, much of the research examining emotional processing deficits in those with psychopathic traits has focused on male offender samples.

The use of a student sample, however, also presented a possible limitation of the current study. Given that the prevalence of psychopathic traits is low in the community (Hare, 2003), a student sample may not have been the ideal sample on which to test effects of psychopathy. Had this study been conducted with an offender sample, where rates of psychopathy are much higher (Hare, 2003), more effects of psychopathy may have been revealed. Furthermore, had the sample included more male participants, it is possible that additional effects of psychopathy may have been found since males typically receive higher scores on psychopathy measures than females (e.g., Borriani et al., 2014). Additionally, the sample size was relatively small, which could have lead to a lack of power to detect differences between those high versus low in psychopathic traits.

Another potential limitation is the possibility that eye tracking may not entirely represent attention. Although it has been said that one's attention typically reorients to sync with eye movements (Posner et al., 1984), it is possible that the eye tracking data collected may not be fully representative of participant's attention as they viewed each image. In line with this, it is also possible that the eye tracking device did not capture participant eye movements with

complete accuracy. Although several steps were taken in order to minimize eye gaze error as much as possible (e.g., calibrating the machine for each participant to fall within recommended error cut-offs, completing a drift correct procedure in between each image presentation to correct for potential shifts in the device), technology has the potential to malfunction, and if a malfunction did occur it could have interfered with eye tracking results.

The image chosen as the negative condition may also have presented a possible limitation of the present study. As mentioned previously, the negative image depicted a fatally injured man, and a large amount of blood could be seen. While this image is most certainly negative in valence, it is also relatively gory. The eye tracking data demonstrated that participants focused their attention on the peripheral aspects of the image, thus it appears that they were looking away from the central, gruesome scene. It is possible that if the image were negative in valence, but not gory, participants may have devoted more attention to the central part of the image. Future research examining the central/peripheral trade-off, psychopathy, and eye tracking patterns may benefit from choosing a negative image that does not contain blood or other potentially gory details. Alternatively, future research may choose to include both a gory and a non-gory negative image as stimuli and determine whether any differences in memory or attention emerge between the two.

The effects examined in the present study should be observed using an offender sample in future research. As mentioned above, the use of a student sample presented a limitation to the current study. It is possible that different effects may be found within an offender sample, where the prevalence of psychopathic traits is much higher (Hare, 2003). Additionally, future research investigating the central/peripheral trade-off, psychopathy, and attention to emotional images would also benefit from including a positive stimulus condition within the research paradigm. As

mentioned previously, the use of positive stimuli has been relatively rare within the literature examining the central/peripheral trade-off. Thus, hypotheses made regarding the positive image condition were exploratory in nature. The results regarding the positive image did not mirror results reported by Chipchase and Chapman (2013), who also incorporated a positive stimulus. Therefore, more research involving positive stimuli is needed in order to clarify existing inconsistencies.

Conclusion

Overall, the findings of the current study did not support results found in the existing literature. Unlike Christianson et al. (1996), no differences in emotional memory were found between individuals high versus low in psychopathic traits. Additionally, unlike other studies examining the central/peripheral trade-off (e.g., Chipchase & Chapman, 2013; Christianson & Loftus, 1991), no trade-off was found for the negative stimulus. Instead, a central/peripheral trade-off in memory existed for the positive and neutral image. Eye tracking patterns were not able to account for this pattern in memory, as attention to the emotional images did not sync with memory for the images. Furthermore, attention and memory proved to be unrelated following a series of correlational analyses. Due to the inconsistencies between the current study and past research, more research is needed regarding the central/peripheral trade-off in memory and attention to emotional images among individuals with varying degrees of psychopathic traits.

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Valence and Arousal Ratings

Image # 1

On a scale of 1 to 9, how emotionally arousing did you find this image? Please circle your answer.

Image # 2

On a scale of 1 to 9, what did you find the emotional valence of the image to be? Emotional valence refers to how positive or negative you feel the image is. Please circle your answer.

1 2 3 4 5 6 7 8 9
(Very negative) (Very positive)

On a scale of 1 to 9, how emotionally arousing did you find this image? Please circle your answer.

[illegible]

Image # 3

On a scale of 1 to 9, what did you find the emotional valence of the image to be? Emotional valence refers to how positive or negative you feel the image is. Please circle your answer.

1 2 3 4 5 6 7 8 9
(Very negative) (Very positive)

On a scale of 1 to 9, how emotionally arousing did you find this image? Please circle your answer.

[illegible]

Appendix B**Demographic Questionnaire**

Please provide the following information:

Note: You may skip any questions you do not wish to answer.

1. Age: _____
2. Are you:
 - a. Male
 - b. Female
 - c. Other: _____
3. What is your racial/ethnic background?
 - a. Aboriginal Canadian/Native Canadian/First Nations
 - b. Asian
 - c. Black/African-Canadian
 - d. East Indian
 - e. Hispanic/Latino
 - f. Middle Eastern
 - g. White/Caucasian
 - h. Other: _____

Appendix C

Memory Questionnaires

Recall

Negative Image Question Set

1. What colour was the shirt of the man lying on the ground? (Central)
2. In what position were the arms of the woman right behind the man lying on the ground? (Peripheral)
3. What colour was the dog sniffing the blood in the picture? (Central)
4. How many people were walking together in the background? (Peripheral)
5. What shape was on the shirt of the man lying on the ground? (Central)
6. What colour was the shirt of the woman on the right in the background? (Peripheral)

Neutral Image Question Set

1. What type of food was being cooked? (Central)
2. How many flags were in the background behind the people preparing the food? (Peripheral)
3. How many people were cooking the food? (Central)
4. How many people were watching the food being prepared? (Peripheral)
5. On which side of the table was the man wearing the chef's hat? (Central)
6. How many barrels were to the right of the people preparing the food? (Peripheral)

Positive Image Question Set

1. What type of shoes was the woman in the front wearing? (Central)
2. What colour was the tablecloth in the background? (Peripheral)
3. What colour dress was the woman in the front wearing? (Central)
4. What colour was the dog in the background? (Peripheral)
5. What object was the man in the front holding? (Central)
6. What was the name of the café the people were standing in front of? (Peripheral)

Recognition

Negative Image Question Set

1. What colour was the shirt of the man lying on the ground? (Central)
 - a) Blue
 - b) Green
 - c) Red
 - d) Yellow
2. In what position were the arms of the woman right behind the man lying on the ground? (Peripheral)
 - a) Crossed
 - b) One hand on her hip
 - c) Both hands on her hips
 - d) By her side

3. What colour was the dog sniffing the blood in the picture? (Central)
 - a) White
 - b) Brown
 - c) Grey
 - d) Black and white
4. How many people were walking together in the background? (Peripheral)
 - a) One
 - b) Two
 - c) Three
 - d) Four
5. What shape was on the shirt of the man lying on the ground? (Central)
 - a) Circle
 - b) Heart
 - c) Square
 - d) Star
6. What colour was the shirt of the woman on the right in the far background? (Peripheral)
 - a) Blue
 - b) Yellow
 - c) White
 - d) Pink

Neutral Image Question Set

1. What type of food was being cooked? (Central)
 - a) Bread
 - b) Pasta
 - c) Dumplings
 - d) Stir Fry
2. How many flags were in the background behind the people preparing the food? (Peripheral)
 - a) Two
 - b) Three
 - c) Four
 - d) Five
3. How many people were cooking the food? (Central)
 - a) One
 - b) Two
 - c) Three
 - d) Four
4. How many people were watching the food being prepared? (Peripheral)
 - a) One

- b) Two
- c) Three
- d) Four

5. On which side of the table was the man wearing the chef's hat? (Central)

- a) The right side of the table
- b) The left side of the table
- c) At the head of the table
- d) He was sitting on top of the table

6. What type of vehicle could be seen in the background by the flags? (Peripheral)

- a) Car
- b) Truck
- c) Bike
- d) Minivan

Positive Image Question Set

1. What type of shoes was the woman in the front wearing? (Central)

- a) Flip flops
- b) High heels
- c) Sneakers
- d) Flats

2. What colour was the tablecloth in the background? (Peripheral)

- a) Yellow
- b) Blue
- c) White
- d) Black

3. What colour dress was the woman in the front wearing? (Central)

- a) Red
- b) Yellow
- c) Blue
- d) Black

4. What colour was the dog in the background? (Peripheral)

- a) Brown
- b) White
- c) Black
- d) Grey

5. What object was the man in the front holding? (Central)

- a) Mug
- b) Wine glass
- c) Napkin
- d) Tray

6. What was the name of the café the people were standing in front of? (Peripheral)
- a) Café Torino
 - b) Café Italia
 - c) Café Dulce
 - d) Café Trattoria

Appendix D

Recruitment Email to Prospective Participants

Dear Prospective Participant,

We are recruiting participants for our study titled “Processing of emotional images: The role of psychopathic and personality traits” based on information yielded from the 2014 mass testing package. We would like to invite you to participate in this study.

In this study you will be asked to wear an eye-tracking device as you view three images that range in emotionally provocative content, from negative to positive. You will also be asked to rate these images in terms of their pleasantness and arousal. You will also be asked to complete a series of demographic, mood, and personality questionnaires. The viewing of emotionally upsetting images may cause some discomfort or emotional distress. More specifically, the graphic nature of one image (involving a fatally injured man) that you will be asked to view may cause emotional upset. Additionally, some of the questions regarding your personality traits may cause some mild discomfort or emotional distress. Please be reminded that your participation is entirely voluntary, that you may choose not to answer any question, and that you may withdraw from the study at any time without penalty.

The study will require approximately 75 minutes of your time and will be completed at Loeb A509 at Carleton University. You will receive 1.5% towards your grade for your participation. This study has been approved by the Carleton Ethics Committee for Psychological Research (Approval # 14-65). If you wear hard contact lenses or bifocal eyeglasses, you are ineligible to participate, as the eye tracker does not effectively track eye movements if these are worn. Additionally, you are asked to refrain from wearing heavy eye-makeup on the day you participate in the study, as this interferes with the effectiveness of the eye-tracker.

If you would like to participate, please sign up for a time slot on Carleton University’s SONA system for the study titled “Processing of emotional images: The role of psychopathic and personality traits”.

Regards,

Ellen Tansony

Ellen Tansony, B.A.
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Appendix E

Consent Form # 1

This informed consent form is designed to explain to you the study's purpose, the required tasks and additional information to allow you to decide whether or not you wish to participate in the study. Please take the time to read this information carefully.

Project Title: Processing of emotional images: The role of psychopathic and personality traits

Research personnel:

Ellen Tansony
Principal Investigator
Department of Psychology Graduate Student, Carleton University
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Lauren Thompson
Secondary Investigator
Department of Psychology Undergraduate Student, Carleton University
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Adelle Forth
Faculty Supervisor
Department of Psychology Faculty, Carleton University
adelle.forth@carleton.ca

Purpose: In conducting this study, we hope to gain an understanding of how emotional images are processed, and how this emotional processing interacts with personality traits, such as psychopathic traits. We also hope to examine the allocation of attention as emotional images are viewed by using an eye-tracking device.

Task requirements: You will be asked to wear an eye-tracking device as you view three images that range in emotionally provocative content, from negative to positive. You will also be asked to rate these images in terms of their pleasantness and arousal. Additionally, you will be asked to complete a cognitive processing task, a demographic questionnaire, and three self-report questionnaires. These questionnaires will measure your current mood, various personality traits, and psychopathic traits. Please note that individual scores on questionnaires will not be shared. Rather, aggregate test results can be shared with participants should this information be requested.

This study involves the use of an eye-tracking device. The EyeLink II system developed by SR Research is the device that will be used to track and record your eye movements. The EyeLink II is a head-mounted eye-tracking device. The EyeLink II does not require the use of a bite bar or a head rest. You will simply wear the eye-tracking device on your head as if it were a helmet. Two

small cameras attached to the device will point towards your eyes and will allow us to track your eye movements as you proceed through the study.

Time required: This study will take approximately 75 minutes to complete and will be completed in room Loeb A509 Carleton University.

Remuneration: You will receive 1.5% credit towards your PSYC 1001, 1002, 2001, or 2002 grade for your participation.

Right to withdraw: You have the right to withdraw from this study at any point, without penalty. If you choose to withdraw before the end of the study, simply inform the researcher and the study will be stopped. You will then be debriefed. You will still receive your 1.5% toward your psychology course.

Potential risk and discomfort: The viewing of emotionally upsetting images may cause some discomfort or emotional distress. More specifically, the graphic nature of one image (involving a fatally injured man) that you will be asked to view may cause emotional upset. Additionally, some of the questions regarding your personality traits may cause some mild discomfort or emotional distress. If you should feel discomfort at any point during this study, please be reminded that your participation is entirely voluntary, that you may choose not to answer any question, and that you may withdraw from the study at any time without penalty.

Anonymity/confidentiality: All responses will be strictly confidential. This data will be used for research publications, conference presentations and/or teaching material. All answers will be coded in such a way that participants cannot be identified. Files will be stored in a locked cabinet in a laboratory at Carleton University, to which only members of the lab have access.

We will collect data through the software Qualtrics, which uses servers with multiple layers of security to protect the privacy of the data (e.g., encrypted websites and password protected storage). Please note that Qualtrics is hosted by a server located in the USA. The United States Patriot Act permits U.S. law enforcement officials, for the purpose of an anti-terrorism investigation, to seek a court order that allows access to the personal records of any person without that person's knowledge. In view of this we cannot absolutely guarantee the full confidentiality and anonymity of your data. With your consent to participate in this study you acknowledge this.

This study has received clearance by the Carleton University Ethics Committee for Psychological Research (Approval # 14-65).

If you have any concerns, ethical or otherwise, regarding this study, please contact:

Psychology Departmental Chair: Dr. Joanna Pozzulo
613-520-2600 ext. 1412
psychchair@carleton.ca

Carleton University Ethics Committee for Psychological Research Chair: Dr. Shelley Brown

(613) 520-2600 ext. 1505
shelley.brown@carleton.ca

Consent. I have read the above form and hereby consent to continue participating in this study. The data in this study will be used for research publications and/or teaching purposes. I am aware that the data collected in this study will be kept strictly confidential and anonymous. By clicking on the box I consent to participate in this study.

☐

By checking this box I indicate that I have read the above informed consent and that I am fully aware of any possible risks or consequences of participating in this study.

Appendix F**Filler Task****NHL Teams Word Search**

“Find the NHL Hockey team names words listed at the bottom in the NHL Hockey Teams Word Search grid. The words can be forwards or backwards, vertical, horizontal, or diagonal. Circle each letter separately, but keep in mind that letters in each NHL Hockey Team name may be used in more than one team name

http://www.printactivities.com/Word_Search_Puzzles/Hockey-Teams-Word-Search.html

NHL Hockey Teams Word Search Puzzle

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T H S R O T A N E S E S P B R
S R E D N A L S I T R U E C I
N E S H A R K S R E H T N A P
S D R T D L I W G K A D G N N
S W O S A D T N H C E E U A C
F I T K S R A A P A I V I D T
A N A C K R S A T J S I N I G
E G D U W L S A H E R L S E N
L S E N A C I R R U H S E N I
E E R A H T H B A L K S T S N
L E P C K T A W S B I K O R T
P O H O C S C K H E N C Y E H
A V A L A N C H E Y G U O Y G
M T O I L E R S R E S D C L I
S E U L B A M S S E M A L F L

```

AVALANCHE	FLYERS	PREDATORS
BLACKHAWKS	HURRICANES	RANGERS
BLUE JACKETS	ISLANDERS	RED WINGS
BLUES	KINGS	SABRES
CANADIENS	LIGHTNING	SENATORS
CANUCKS	MAPLE LEAFS	SHARKS
COYOTES	OILERS	STARS
DEVILS	PANTHERS	THRASHERS
DUCKS	PENGUINS	WILD
FLAMES		

Appendix G

Consent Form # 2 (Post Deception)

This informed consent form is designed to explain to you the study's true purpose and the true nature of your involvement. This informed consent form provides information to allow you to decide whether or not you wish to continue your participation in the study. Please take the time to read this information carefully.

Project Title: Memory for central and peripheral details in emotional images: The role of psychopathy

Research personnel:

Ellen Tansony
Principal Investigator
Department of Psychology Graduate Student, Carleton University
ellen.tansony@carleton.ca

Lauren Thompson
Secondary Investigator
Department of Psychology Undergraduate Student, Carleton University
laurene.thompson@carleton.ca

Adelle Forth
Faculty Supervisor
Department of Psychology Faculty, Carleton University
adelle.forth@carleton.ca

Purpose: In conducting this study, we hope to gain an understanding of how psychopathic and personality traits relate to memory for central and peripheral details of emotional images. We also hope to examine the allocation of attention as emotional images are viewed by using an eye-tracking device.

Task requirements: You will be asked to wear an eye-tracking device as you view three images ranging in emotional valence. You will also be asked to rate these emotional images in terms of their valence and arousal. Additionally, you will be asked to complete a cognitive processing task, a demographic questionnaire, and three self-report questionnaires. These questionnaires will measure your current mood, various personality traits, and psychopathic traits. Your memory for the three images you view will also be tested. Please note that individual scores on questionnaires will not be shared. Rather, aggregate test results can be shared with participants should this information be requested.

This study involves the use of an eye-tracking device. The EyeLink II system developed by SR Research is the device that will be used to track and record your eye movements. The EyeLink II

is a head-mounted eye-tracking device. The EyeLink II does not require the use of a bite bar or a head rest. You will simply wear the eye-tracking device on your head as if it were a helmet. Two small cameras attached to the device will point towards your eyes and will allow us to track your eye movements as you proceed through the study.

Time required: This study will take approximately 75 minutes to complete and will be completed in room Loeb A509 Carleton University.

Remuneration: You will receive 1.5% credit towards your PSYC 1001, 1002, 2001, or 2002 grade for your participation.

Right to withdraw: You have the right to withdraw from this study at any point without penalty. If you choose to withdraw before the end of the study, simply inform the researcher and the study will be stopped. You will then be debriefed. You will still receive your 1.5% toward your psychology course.

Potential risk and discomfort: The viewing of emotionally upsetting images may cause some discomfort or emotional distress. More specifically, the graphic nature of one image (involving a fatally injured man) that you will be asked to view may cause emotional upset. Additionally, some of the questions regarding your personality traits may cause some mild discomfort or emotional distress. If you should feel discomfort at any point during this study, please be reminded that your participation is entirely voluntary, that you may choose not to answer any question, and that you may withdraw from the study at any time without penalty.

Anonymity/confidentiality: All responses will be strictly confidential. This data will be used for research publications, conference presentations and/or teaching material. All answers will be coded in such a way that participants cannot be identified. Files will be stored in a locked cabinet in a laboratory at Carleton University, to which only members of the lab have access.

We will collect data through the software Qualtrics, which uses servers with multiple layers of security to protect the privacy of the data (e.g., encrypted websites and password protected storage). Please note that Qualtrics is hosted by a server located in the USA. The United States Patriot Act permits U.S. law enforcement officials, for the purpose of an anti-terrorism investigation, to seek a court order that allows access to the personal records of any person without that person's knowledge. In view of this we cannot absolutely guarantee the full confidentiality and anonymity of your data. With your consent to participate in this study you acknowledge this.

This study has received clearance by the Carleton University Ethics Committee for Psychological Research (Approval # 14-65).

If you have any concerns, ethical or otherwise, regarding this study, please contact:

Psychology Departmental Chair: Dr. Joanna Pozzulo

613-520-2600 ext. 1412
psychchair@carleton.ca

Carleton University Ethics Committee for Psychological Research Chair: Dr. Shelley Brown
(613) 520-2600 ext. 1505
shelley.brown@carleton.ca

Consent. I have read the above form and hereby consent to continue participating in this study, which examines the relationship between psychopathic and personality traits and memory for central and peripheral details of emotional images. The data in this study will be used for research publications and/or teaching purposes. I am aware that the data collected in this study will be kept strictly confidential and anonymous. By clicking on the box I consent to continue to participate in this study.

☐

By checking this box I indicate that I have read the above informed consent and that I am fully aware of any possible risks or consequences of participating in this study.

Appendix H

Debriefing Form

What are we trying to learn in this research?

The purpose of this study is to investigate whether memory for central and peripheral details of emotional images differs based on psychopathic and personality traits. Past research has suggested that typically, individuals have enhanced memory for central details and inhibited memory for peripheral details of a negative image. However, research conducted by Christianson et al. (1996) has suggested that individuals high in psychopathic traits do not display this same pattern of results. This is likely due to the finding that those high in psychopathic traits have difficulty processing emotional information.

In this study we measured a range of characteristics including personality traits (i.e., extraversion, agreeableness, conscientiousness, and openness to experience) and psychopathic traits (i.e., impulsivity, manipulation, lack of remorse, irresponsibility). We also asked you to complete a scale regarding your mood at the beginning of the study, which will allow us to examine whether mood affects attention to and memory for emotional images. We asked you to wear the eye tracker as you viewed the images in order for us to examine where you were looking and for how long. We also tested your memory for the images you saw in order to examine the relationship between psychopathic and personality traits and memory for emotional images.

Why is this important to psychologists or the general public?

There is a lack of research examining the relationship between psychopathic/personality traits and memory for central and peripheral details of emotional images. Additionally, no research examining these variables has concurrently tracked participant eye movements. This study aims to further understand the relationship between these variables.

What are our hypothesis and predictions?

We predict that individuals with less psychopathic traits will have enhanced memory for central details of the negative image (relative to the neutral image), and inhibited memory for peripheral details. On the other hand, we predict that individuals with more psychopathic traits will have relatively equal memory for central and peripheral details across all emotional image conditions. We also predict that those with less psychopathic traits will have more eye fixations on the central details of the negative image than on the peripheral details, while those with more psychopathic traits will have a relatively equal number of eye fixations on both types of details. Our predictions for how the big five personality traits will relate to central and peripheral memory are exploratory in nature.

Why did we use deception?

It was necessary not to inform you that your memory for the images would be tested so that we could collect eye gaze patterns that were as natural as possible. Had you been aware of the memory test it may have interfered with where you looked as you viewed the images, and you may have attempted to anticipate what types of memory questions would be asked of you. This would have prevented us from being able to examine the true relationship between emotional memory and psychopathic and personality traits. You may choose to withdraw your data in light of this information. Lastly, it is very important that you do not tell others about the true nature of this study because it may influence their responses and in turn invalidate our data.

How can I learn more?

If you are interested in learning more about the relationship between psychopathic traits and memory for emotional images, please refer to the following sources:

- Christianson, S.-Å., Forth, A. E., Hare, R. D., Strachan, C., Lidberg, L., & Thorell, L-H. (1996). Remembering details of emotional events: A comparison between psychopathic and nonpsychopathic offenders. *Personality and Individual Differences*, 20, 437-443.
- Thijssen, J., Otgaar, H., Meijer, E. H., Smeets, T., & de Ruiter, C. (2012). Emotional memory for central and peripheral details in children with callous-unemotional traits. *Behavioral Sciences and the Law*, 30, 506-512. doi: 10.1002/bsl.2021

What if I have questions later?

If you wish to discuss this research further feel free to contact:

Ellen Tansony
Principal Investigator
ellen.tansony@carleton.ca

Lauren Thompson
Secondary Investigator
laurene.thompson@carleton.ca

and/or

Adelle Forth
Faculty Supervisor
adelle.forth@carleton.ca

If you have any ethical concerns about this study please contact Dr. Shelley Brown (Chair, Carleton University Ethics Committee for Psychological Research) by phone: (613) 520-2600 ext. 1505 or by email: shelley.brown@carleton.ca

Should you have any other concerns please contact Dr. Joanna Pozzulo (Chair, Department of Psychology) by phone: 613-520-2600, ext. 1412; or by email: psychchair@carleton.ca.

This study has received clearance by the Carleton University Ethics Committee for Psychological Research (Approval # 14-65). Please refer to this number when contacting the Chair of the Department or the Chair of Carleton University Ethics Committee for Psychological Research.

What can I do if I experience discomfort or distress after participating in this study?

If you find that after participating in this study you feel any sort of emotional, mental, or physical stress or anxiety, please contact Carleton University Health and Counseling Services at 613-520-6674. If you live in the Ottawa area you can also contact the Distress Center of Ottawa and Region at 613-238-3311. If you are not located in the Ottawa area the telephone number for your local Crisis Line can be found at the front of most phone books.

Thank you for taking the time to participate in this study! Your participation is greatly appreciated!

Appendix I

Scoring Manual for Overall Valence and Overall Arousal Scores

Overall Valence

An overall valence score was created across all three images for each participant. Instead of representing the raw valence score of the image, this score now represents how close that participant was to scoring the valence of the image with regard to its true valence score (i.e., did they score the positive image positively, did they score the negative image negatively, did they score the neutral image “neutrally”). Valence scores were recoded in order to comply with this new variable. Positive image valence scores remained the same (because for this image, a higher score meant the image was as positive as possible, which corresponds to higher scores indicating higher accuracy when rating valence). Negative image valence scores were reverse coded such that:

1 = 9, 2 = 8, 3 = 7, 4 = 6, 5 = 5, 6 = 4, 7 = 3, 8 = 2, 9 = 1

A score of 9 would now indicate that the participant rated the negative image as negatively as possible, whereas a score of 1 now indicates that the participant rated the negative image as positively as possible.

For neutral images, the optimal score was a 5 (a rating of 5 indicates that the participant rated the image as “neutrally” as possible). Thus, a score of 5 was recoded to a score of 9 (because a score of 9 on this new variable indicates the image was rated as accurately as possible). A score of 1 and a score of 9 were equally inaccurate ways to score this image, so raw scores of both 1 and 9 were recoded to a score of 1 (because a score of 1 on this new variable indicates the image was rated as inaccurately as possible). Thus, neutral image valence scores were coded such that:

1 = 1, 2 = 3, 3 = 5, 4 = 7, 5 = 9, 6 = 7, 7 = 5, 8 = 3, 9 = 1

To create an overall valence score, the newly created positive, negative, and neutral scores were averaged, providing an overall valence score out of 9 indicating how accurate the participant was at rating image valence. Higher scores indicated higher accuracy.

Overall Arousal

An overall arousal score was created across all three images for each participant. Instead of representing the raw arousal score of the image, this score now represents how close the participant was to scoring the arousal of the image with regard to its true arousal score (i.e., did they score the positive and negative images as arousing, and the neutral image as non-arousing). Arousal scores were recoded in order to comply with this new variable. The positive and negative image scales were not recoded (because for both of these images, a higher score meant the image was more arousing, which corresponds to higher scores indicating higher accuracy when rating arousal). The neutral image was reverse coded such that:

1 = 9, 2 = 8, 3 = 7, 4 = 6, 5 = 5, 6 = 4, 7 = 3, 8 = 2, 9 = 1

A score of 9 would now indicate that the participant rated the neutral image as unarousing as possible, whereas a score of 1 now indicates that the participant rated the neutral image as arousing as possible.

To create an overall arousal score, the newly created positive, negative, and neutral scores were averaged, providing an overall arousal score out of 9 indicating how accurate the participant was at rating image arousal. Higher scores indicated higher accuracy.

Appendix J

Correlation Coefficients Between Eye Tracker Variables

Correlation coefficients (Pearson's r) between eye fixation count and eye fixation duration scores for the negative image

	Eye Fixation Duration	
	Central	Peripheral
Eye Fixation Count		
Central	.89**	-.81**
Peripheral	-.77**	.75**

Note. ** $p < .01$

Correlation coefficients (Pearson's r) between eye fixation count and eye fixation duration scores for the positive image

	Eye Fixation Duration	
	Central	Peripheral
Eye Fixation Count		
Central	.86**	-.86**
Peripheral	-.92**	.86**

Note. ** $p < .01$

Correlation coefficients (Pearson's r) between eye fixation count and eye fixation duration scores for the neutral image

	Eye Fixation Duration	
	Central	Peripheral
Eye Fixation Count		
Central	.81**	-.82**
Peripheral	-.91**	.92**

Note. ** $p < .01$