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ATENTION AND EMOTIONAL DEFICITS IN INDIVIDUALS WITH CONDUCT PROBLEMS AND CALLOUS-UNEMOTIONAL TRAITS

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DEPARTMENT OF PSYCHOLOGY

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MELINA NICOLE KYRANIDES

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The present doctoral dissertation was submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy of the University of Cyprus. It is a product of original work of my own, unless otherwise mentioned through references, notes, or any other statements.

Melina Nicole Kyranides

ΠΡΟΣΩΠΙΚΑ ΔΕΔΟΜΕΝΑ

ABSTRACT IN GREEK

Τα προβλήματα συμπεριφοράς και τα ψυχοπαθητικά χαρακτηριστικά σχετίζονται με συναισθηματικά προβλήματα και δυσκολίες προσοχής. Συγκεκριμένα τα ψυχοπαθητικά χαρακτηριστικά έχουν συσχετιστεί με περιορισμένη αντιδραστικότητα και έλλειψη ενδιαφέροντος προς κοινωνικά σημαντικά ερεθίσματα, ενώ τα προβλήματα συμπεριφοράς έχουν συσχετιστεί με συναισθηματικές δυσκολίες απορύθμισης και επαγρύπνησης προς απειλητικά ερεθίσματα. Η παρούσα μελέτη εξετάζει κατά πόσο ετερογενείς ομάδες νεαρών ενηλίκων που επιλέγηκαν με βάση τα προβλήματα συμπεριφοράς και ψυχοπαθητικά χαρακτηριστικά, που αξιολογήθηκαν κατά την εφηβεία, διαφέρουν ως προς την προσοχή και συναισθηματική αντίδραση, με βάση φυσιολογικές αντιδράσεις, και συμπεριφορικές μετρήσεις που λήφθηκαν. Εβδομήντα έξι συμμετέχοντες (n = 76; 53,8% γυναίκες, μέσης ηλικίας M = 19.96, SD = .97) επιλέχθηκαν από ένα μεγάλο δείγμα (n = 1893; 50,2% γυναίκες, μέσης ηλικίας M = 16.99, SD = .91) κατά τη διάρκεια της εφηβείας. Στους συμμετέχοντες που επιλέγηκαν, χορηγήθηκε μια σειρά από δοκιμασίες που εξετάζουν την προσοχή και συναισθηματική αντίδραση σε διάφορα συναισθηματικά ερεθίσματα (λέξεις, εικόνες, εκφράσεις του προσώπου, σκηνές της ταινίας) με μετρήσεις καταγραφής της εστίασης και κινητικότητας των ματιών και φυσιολογικών μετρήσεων όπως καρδιακού ρυθμού, αντιδερμικής αγωγιμότητας (καταγραφή της εφίδρωσης) και αντανακλαστικό ξαφνιάσματος. Τα άτομα με προβλήματα συμπεριφοράς μόνο (χωρίς ψυχοπαθητικά χαρακτηριστικά), παρουσίασαν χαμηλότερη εφίδρωση (σε κατάσταση ηρεμίας, καθώς και κατά την παρουσίαση των διάφορων συναισθηματικών σκηνών), χαμηλότερο καρδιακό ρυθμό σε κατάσταση ηρεμίας, αν και δεν παρουσίασαν διαφορές από την ομάδα ελέγχου όσον αφορά το αντανακλαστικό ξαφνιάσματος. Επιπρόσθετα τα άτομα με προβλήματα συμπεριφοράς μόνο, επιδεικνύουν επιλεκτική δυσκολία προσοχής κατά την έκθεση συναισθηματικών λέξεων και εικόνων (όπως υποδεικνύεται από τις μετρήσεις καταγραφής εστίασης των κινήσεων των ματιών), αλλά όχι όταν εκτίθενται σε εκφράσεις προσώπων ή σκηνές ταινιών. Σε αντίθεση με την ομάδα ατόμων με ψυχοπαθητικά χαρακτηριστικά που παρουσίασε μειωμένη εστίαση της προσοχής στο πρόσωπο (όπως αυτή καταγράφηκε από τις κινήσεις των ματιών) και περιορισμένη αντίδραση του αντανακλαστικού ξαφνιάσματος κατά την παρουσίαση συναισθηματικών ερεθισμάτων. Τα αποτελέσματα αυτά επιβεβαιώνουν την υπόθεση ότι η

παρουσία ψυχοπαθητικών χαρακτηριστικών σε άτομα με αντικοινωνική συμπεριφορά, σχετίζεται με προβλήματα εκδήλωσης φόβου, δυσκολίες εκδήλωσης εμπάθειας, όπως αυτές καταγράφηκαν από αυτό-αναφορές και ψυχοφυσιολογικές μετρήσεις. Από την άλλη, τα άτομα με προβλήματα συμπεριφοράς, χωρίς ψυχοπαθητικά χαρακτηριστικά, σχετίζονται με δυσκολίες προσοχής και συναισθηματική απορύθμισης. Τα αποτελέσματα της παρούσας μελέτης έχουν σημαντικές πρακτικές εφαρμογές, αφού τα ευρήματα συμβάλλουν στην κατανόηση της προσοχής και των συναισθηματικών προβλημάτων που παρατηρούνται σε άτομα με προβλήματα συμπεριφοράς και ψυχοπαθητικά χαρακτηριστικά. Επιπρόσθετα τα ευρήματα παρέχουν ενδείξεις ότι τα άτομα με προβλήματα συμπεριφοράς αποτελούν ετερογενή ομάδα που διαφοροποιούνται όσον αφορά τις δυσκολίες προσοχής και τις συναισθηματικές αντιδράσεις που εκδηλώνουν.

ABSTRACT

Conduct Problems (CPs) and Callous Unemotional (CU) traits have both been associated with attention and emotional deficits. Specifically, CU traits have been associated with diminished reactivity to distress cues and lack of interest to socially important cues, while CPs have been associated with emotional dysregulation difficulties and hyper vigilance towards threatening cues. The present study examines whether heterogeneous groups of young adults identified based on their longitudinal scores on CPs and CU traits, measured during adolescence, differ on physiological, attention/emotional and behavioral measures. Seventy-six participants (n =76; 53.8% females, M age =19.96, SD = .97) were selected from a large sample (n=1893; 50,2% females, M age =16.99, SD = .91) during adolescence. Identified participants were administered a series of tasks assessing attention allocation and emotional reactivity to different affective stimuli (words, pictures, facial expressions, movie scenes) using eye-tracking measures (i.e. proportion of gaze duration) and physiological measures of heart rate, skin conductance and startle reflex (i.e. index of defensive motivation). Individuals with CPs-only exhibited lower skin conductance (resting as well as during the presentation of affective scenes) and lower resting heart rate, although they were not differentiated from controls on startle reactivity. The CPs-only group show selective impairment in attending to distressing words and pictures (as indicated by eye gaze behavior) but not when attending to facial expressions or movie scenes. In contrast the presence of high CU traits was associated with restricted eye gaze to the face and restricted startle reactivity during the presentation of emotional stimuli. This pattern of results verifies the hypothesis that the presence of CU traits in individuals with antisocial behavior is associated with lack of fear, and empathy towards others, as measured by both self-reports and physiological measures. On the other hand, CPs on their own might be fueled by other attentional deficits and emotional dyregulation. The results of the current study have scientific interest as well as considerable practical applications, as findings contribute to the understanding of the attentional and emotional deficits that are implicated in individuals with CPs and CU traits. Importantly, the findings provide evidence that individuals with CPs represent a heterogeneous group, differentiated on attentional, emotional and physiological measures.

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DEDICATION

In loving memory of my mother Mary Jayne Kyranides,

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Introduction

There is substantial interest in understanding attention and emotional processing in youth with severe and impairing levels of antisocial behavior often classified as having Conduct Problems (CPs). These behavioral problems displayed by individuals with CPs have considerable costs to society because they are associated with criminal and delinquent behavior and greater incarceration rates. In a study in the UK, costs for individuals with CPs were found to be 10 times higher (mean individual costs £70 019) compared to the costs for individuals with no antisocial problems (mean individual costs £7423) (Scott, Knapp, Henderson & Maughan, 2001).

One issue that has become increasingly clear in this research domain is that individuals with CPs, constitute a heterogeneous group of individuals with substantial variations in the behavioral, emotional and attentional deficits they display (Frick, Ray, Thornton, & Kahn, 2013; Frick & Dickens, 2006; Frick & Ellis, 1999). These differences are not insignificant in terms of the aetiology, prognosis and treatment success. One method of subtyping individuals with CPs that has received acceptance in research and practice is the presence or absence of significant levels of callous-unemotional (CU) traits (Frick, 2012; Frick & Dickens, 2006; Frick & White, 2008). CU traits refer to specific affective (lack of empathy, absence of guilt, constricted display of emotion) and interpersonal (e.g. use of others for one's own gain) style that is characteristic of a subgroup of individuals with severe CPs (Frick, Bodin & Barry, 2000; Frick, Cornell, Barry, Bodin & Dane, 2003). These traits are similar to those often used to define the affective dimension of psychopathy in adults (Hare, Hart & Harpur, 1991) and are believed to be a developmental precursor to adult psychopathy (Frick, 2012; Lynam, Caspi, Moffit, Loeber, Stouthmer-Loeber, 2007). The distinction between CU/non-CU dimensions has been proven so important that a specifier to the diagnosis of Conduct Disorder defined as "Limited prosocial emotions" (Frick & Moffitt, 2010; Moffitt, Arseneault, Jaffee, Kim-Cohen, Koenen, Odgers, Slutske, & Viding, 2008) has been added to the fifth edition of the *Diagnostic and Statistical Manual (DSM-V).* The present study aims to identify these heterogeneous groups of youth during adolescence, and compare them on measures designed to assess their emotional and attentional deficits during adulthood.

Among individuals with CPs, those high on CU traits represent a more severe and aggressive subgroup of antisocial individuals, as documented in incarcerated (Kruth, Frick, &

Clements, 2005), clinic-referred (Christian, Frick, Hill, Tyler, & Frazer, 1997) and community samples (Fanti, Demetriou & Kimonis, 2013). Furthermore, antisocial individuals high on CU traits are more likely to show a fearless temperament characterized by thrill-seeking behaviors (Essau, Sasagawa, & Frick, 2006; Frick, Lilienfeld, Ellis, Loney, Silverthorn, 1999; Van Goozen, Fairchild, Snoek, & Harold, 2007), to experience low emotional distress when exposed to novel or threatening situations (Frick & Morris, 2004; Pardini, Lochman, & Frick, 2003), to display deficits in affective empathy (Frick et al., 2013), to be less sensitive to cues of punishment (Fisher & Blair, 1998; Frick et al., 2003; Frick et al., 2013) and to have intact general intelligence (Van Goozen et al, 2007). On the other hand, individuals with CPs but without CU traits tend to show anxiety, difficulties managing and regulating emotions, intense emotional arousal (Frick & Morris, 2004), lower general intelligence and attentional difficulties (Euler, Sterzer & Stadler, 2014; Frick et al., 2013; Loney Frick, Ellis, & McCoy, 1998; Salekin, Neumann, Leistico, & Zalot, 2004).

These findings point to the existence of two subtypes, possibly related to distinct etiological pathways leading to the manifestation of CPs, through distinct neurobiological, emotional and cognitive impairments. Based on existing theoretical perspectives, the first subtype is strongly associated with callous-unemotional traits, low empathy, and low emotional distress, while the second subtype is associated with impulsive and emotionally dysregulated traits (Frick et al., 2013; Frick & Morris, 2004). Prominent neurobiological models that have been put forward, differ in the emphasis placed on the emotional versus cognitive deficits for the development of CU and psychopathic traits. Some models propose that individuals with psychopathic traits are characterized with an innate deficit in emotion processing (Blair, 1999; 2013; Fowles, 1980) whereas others posit an attention abnormality that affects the processing of emotion and other important information (Baskin-Sommers, Curtin, & Newman, 2013; Newman Curtin, Bertsch, Baskin-Sommers, 2010). Furthermore, it is argued that the CU component of psychopathy is associated with reduced empathetic responsiveness to the distress of other individuals, which primarily reflects reduced amygdala responsiveness (Blair, 2013). The second impulsive/emotionally dysregulated subtype, is possibly associated with deficits in decision making and in reinforcement learning, which reflects dysfunction in the ventromedial prefrontal cortex and striatum (Blair, 2013). The present study helps to advance this line of research by examining how distinct patterns of cognition and emotion can differentiate these two subtypes. Complicating matters even further, recent work has identified a group of individuals showing high CU traits and low CPs (e.g. Fanti, 2013; Ishikawa, Raine, Lencz, Bihrle, & LaCasse, 2001). This third subtype is different as it associated with intact emotional responding (Gao & Raine, 2010) but also is associated with impulsivity (Fanti, 2013).

Emotional Processing Deficits in individuals High on CPs and CU traits

Theorists have postulated that psychopathic traits are associated with deficits in emotional circuitry of the brain that modulates the experience of fear (Fowles, 1980; Patrick, 1994; Patrick, Bradley, & Lang, 1993). According to the fearlessness theory, individuals high in psychopathic traits show a pattern of under-reactivity to aversive-punitive stimuli, which may form a predisposition towards antisocial behavior due to lack of concern for the negative consequences of their behavior (Frick, 2012; Raine, 2002). Supporting this low-fear hypothesis, individuals with psychopathic traits display poor fear conditioning, weak elecrodermal responses in anticipation of aversive events, such as loud noises (Blair, 1999; Hare, 1965), and less heart rate reactivity (Anastassiou-Hadjicharalambous & Warden, 2008b; De Wied et al., 2012) when viewing unpleasant stimuli. Empirically the most cited and arguably strongest evidence of this fear deficit in individuals scoring high on the affective dimension of psychopathy, including CU traits, is the lack of startle potentiation to fearful stimuli (Fanti, Panayiotou, Kyranides, & Avraamides, under review; Justus & Finn, 2007; Patrick et al, 1993; Levenston, Patrick, Bradley & Lang, 2000; Sadeh & Verona, 2012). Limited evidence suggests that this pattern is also present among high CU individuals (Fanti et al., under review). Studies with normative sample have repeatedly shown that the reflex eye blink response to a sudden, acoustic probe is larger during the viewing of unpleasant stimuli than during the presentation of pleasant stimuli (Bradley, Cuthbert, & Lang, 1990; Bradley & Lang, 2000; Bradley, Lang, & Cuthbert, 1993). This lack of startle potentiation in individuals with CU traits indicates a specific deficit in the defensive system that undermines their reaction to threatening/unpleasant stimuli (Partick, 1994). It is argued that this deficit will not be evident in individuals with high CPs without CU traits. To explain, these deficits, Levenston and colleagues (2000) propose that individuals with psychopathic traits have a higher threshold for generating an affective –defensive response. The resent study aims to investigate the fearless deficit in high CU individuals by collecting measures of heart rate, skin conductance and startle reactivity during viewing of naturalistic emotional material (i.e. violent scenes).

In addition to emotional deficits, CU individuals also show impairments in the recognition of emotion. Blair (1995; 2013) theorized that it is through the role of recognition of emotion that CU traits contribute to the development of CPs. According to Blair, when normal developing individuals witness distressing cues in others, these causes an aversive physiological arousal, which acts as a punishing stimulus, making distressing cues undesirable. This process of avoidant conditioning fails if the individual has poor understanding of others distress, coupled with the low fear of punishment. Individuals with CU traits have been shown to be less emotionally responsive to fearful and sad facial expressions (Blair, Colledge, Murray, & Mitchell, 2001; Dadds, El Masry, Wimalaweera, & Guastella, 2008; Dadds, Perry, Hawes, Merz, Riddell, Haines, Solak, & Abeygunawardane, 2006; Deeley, Daly, Suguladze, Tunstall, Mezey, Beer, et al, 2006; Leist & Dadds, 2009; Marsh & Blair, 2008), to sad vocal voices (Blair, Budhani, College, & Scott, 2005; Stevens, Charman, & Blair, 2001) and to fearful body postures (Munoz, 2009), and are less sensitive to cues of punishment (Fisher & Blair, 1998; Frick et al., 2003). The theory proposed by Blair highlights the role of fear in the development of empathy. The term empathy subsumes two distinct critical processes: cognitive empathy, which involves the representation of the intentions and thoughts of other individuals, and emotional empathy, which involves affective responses to emotional displays of other individuals (Blair, 2013). It has been proposed that individuals with CU traits are not associated with deficits in cognitive empathy but are more associated with reductions in emotional empathy, such as low response to fear, sadness, pain (Blair, 1999; Blair, Jones, Clark & Smith, 1997; Blair, Peschardt, Budhani, Mitchell, & Pine, 2006; de Wied, Van Boxtel, Matthys, & Meeus, 2012; Frick et al, 1999). A few studies that have used self-reports to examine empathetic dysfunction (Anastasiou-Hadjicharalambous, & Warder, 2008; Jones, Happe, Gilbert, Burnett, & Viding, 2010) demonstrate that individuals with high CU traits are particularly impaired in emotional empathy (sharing another person's emotions), but relatively competent in cognitive perspective taking abilities (Frick et al, 2013; Van Goozen et al, 2007). The present study aims to investigate the facial affect recognition deficits in high CU individuals, using eye tracking methodology.

Attention Processing Deficits in individuals High on CPs and CU traits

While there are numerous studies emphasizing the emotional deficits evident in individuals with CU traits it has also been suggested that individuals with psychopathic tendencies may act immorally because they fail to attend to the emotional information that would typically inform their social interactions with others (Glenn, Raine, & Schug, 2009). For example, participants with CU traits, have been found to display appropriate emotional responses when their attention is focused or directed to emotional stimuli (Adolphs, Gosselin, Buchanan, Tranel, Schyns, & Damasio, 2005; Dadds et al, 2006; Dadds et al., 2008). An alternative explanation for this tendency to neglect new novel information within emotionally neutral and affective contexts may reflect problems in selective attention. Based on models of selective attention it is proposed that once an early attention bottleneck is established, it blocks the processing of secondary information that are not goal-relevant (Baskin-Sommers, Curtin, & Newman, 2013; Newman et al., 2010). According to this perspective, the fear conditioning and emotional deficits as seen in high CU individuals reflect a failure to process affective inhibitory and other potential important information when it is peripheral to their ongoing goal-directed behavior. This deficient filter can affect processing at the level of the visual cortex and perception. Two recent studies show the importance of perceptual load on emotional modulated-startle in individuals with psychopathic traits, one by manipulating picture complexity (Sadeh & Verona, 2012) and the other by manipulation familiarity (Baskin-Sommers et al., 2013). Both studies show that individuals with psychopathic traits display a deficit in startle potentiation while viewing pictures with high perceptual load (more complex scenes, novel) but showed no deficit while viewing pictures with low perceptual load (simple images, familiar). However, no prior work investigated this deficit specifically among high CU individuals. While this potential attention bottleneck may allow individuals with CU traits to be more effective in filtering out distractions and focusing on personal goals, it may also leave them vulnerable to over-allocate attention to goal-relevant cues at the expense of processing important context-relevant information. A deficit in the ability to process multiple aspects of a situation may leave these individuals oblivious to the potential consequences of their actions, which makes this an important area of research with possible treatment implications.

In general, this pattern of results suggests that individuals with CU traits show problems in emotional reactivity (they show higher threshold for emotional activation), a deficit in the defensive activation of the motivational system that is important for responding to threatening stimuli. Furthermore CU traits are also associated with attention difficulties (selectively filtering out affective cues). While deficits in emotional reactivity seem relatively stable, attentional deficits in these individuals can be overcome by manipulating their attention focus. The present study is designed to provide evidence that individuals with CU traits can orient their attention to emotionally salient stimuli, like the eyes, using experimental manipulations. Distracting cues will also be used to examine if attention allocation is affected by monitoring eye gaze behavior.

Attention and Emotional Deficits in individuals with High CU traits and low CPs

Absent from this body of research are studies on individuals with psychopathic traits that do not display CPs, commonly referred to in the adult literature as successful psychopaths (Gao & Raine, 2010). The community psychopaths bear some similarities to incarcerated individuals with these traits, with respect to biological deficits, including impaired behavioral modulation, attenuated startle potentiation and reduced autonomic responses to aversive stimuli (Belmore & Quinsey, 1994; Justus & Finn, 2007). There are however evidence of intact autonomic functioning in this group of individuals (Ishikawa et al., 2001). Gao and Raine (2010) argue that this group has relatively intact fear conditioning compared to individuals with elevated psychopathic traits and behavioral problems (unsuccessful psychopaths) and display superior cognitive empathy – the ability to understand another's perspective without necessarily feeling any level of emotional empathy. While a group of non-antisocial individuals high on CU traits has been identified (i.e. Fanti, 2013), evidence concerning emotional and attentional deficits among this subgroup of individuals does not exist; an aim of the present study.

Attention Deficits in individuals with High CPs and low CU traits

It has been hypothesized that individuals with CPs, but without CU traits, show a temperament characterized by high levels of impulsivity, strong emotional reactivity (lower threshold for emotional activation), difficulties managing and regulating their emotions and intense emotional arousal (Euler, Sterzer & Stadler, 2014; Frick & Morris, 2004; Keenan, 2002; Loney et al; 2003), worry and apprehension (Dodge & Crick, 1990; Dodge & Pettit, 2003). This group of individuals show a profile that has been associated with "hot heated" impulsive aggressive tendencies and deficits in executive function, such as inability to anticipate the negative consequences of behavior or an inability to delay gratification (Euler et al., 2014; Loney et al., 2003). Not surprisingly this group (CP-only) has also been uniquely related to expected ease in enacting aggression, and has been associated with reactive aggression, where as proactive aggression has been associated with individuals high in both

CPs and CU traits. Due to limited evidence on the CP-only group, findings regarding proactive and reactive aggression are also mentioned. Dodge et al (1997) found that attentional problems were more strongly related to reactive aggression than proactive aggressors and that attention problems were related to several aspects of reactive aggressors' difficulties in understanding aspects of their social environment (e.g. interpreting others intentions might stem in part from difficulties in attending to relevant aspects of that environment), whereas this was not the case for proactive aggressors. Furthermore a number of studies have found that individuals with CPs in comparison to individuals with CU traits, show a heightened sensitivity to emotional stimuli i.e. preferentially attend to hostile cues or stimuli. This result has been found in studies using the Emotional Stroop task (Chan, Raine, & Lee, 2010; Eckhardt & Cohen, 1997, Smith & Waterman, 2003; Van Honk, Tuiten, van den Hout, Putman, de Haan & Stam, 2001a), visual search tasks (Van Honk, Tuiten, van den Hout, de Haan & Stam, 2001b) and spatial cuing paradigms (Smith & Waterman, 2003). Based on this evidence, deficits in the CP-only group are expected to be strongly associated with executive function deficits, similar to impulsive aggressors. Inhibitory control, which is one of the three core executive functions (with working memory and cognitive flexibility) that involves, being able to control behavior attention, thought and emotions, is expected to characterize the CP-only group. The evidence regarding attentional deficits among this subgroup of individuals is limited which makes it an important area of research.

Emotional deficits in individuals with high CPs and low CU traits

Individuals with CPs but without CU traits typically do not show problems in processing emotional information (deficit in emotional activation as found in high CU). In fact they often show high rates of anxiety and appear to be highly distressed by the effects of their behavior on others (Barry, Frick, Gooms, McCoy, Ellis, & Loney, 2000; Dodge & Pettit, 2003; Pardini, Lochman & Wells, 2004). Individual differences in emotionality are related to how easily emotions are aroused (emotional activation), their intensity, duration and "fade time". Individuals with high emotionality and poor emotion regulation skills (i.e. like individuals with CPs) display behavioral problems, but individuals with good emotion regulation skills regardless of emotionality level did not show this pattern of risk (Eisenberg, Fabes, Guthrie, Murphy, Maszk, Holmgren, et al., 1996). Individuals with emotional dysregulation are less likely to think of the potential consequences of their acts and react impulsively with hostile emotions (Dodge & Pettit, 2003; Eisenberg, 2000; Loney, Frick, Clements, Ellis, & Kerlin, 2003). These problems in emotional regulation result in committing impulsive, unplanned acts for which the individual is remorseful but may still have difficulty controlling in the future (Pardini, Lochman & Wells, 2004). Problems in regulating emotion would also explain the findings that aggressive behavior displayed by individuals with CPs and low CU traits tends to be confined to reactive forms of aggression (Frick et al., 2003; Kruth et al., 2005). Individuals with CPs and low CU traits are expected to be emotionally responsive to others feelings, as indicated by enhanced fear-potentiated startle reflex (Sadeh & Verona, 2012), but show poor regulatory skills and high emotional distress. Individuals with affective dysregulation also experience a slower return to emotional baseline, returning to calmer state.

Given these characteristics it seems that the antisocial behavior of individuals with CPs but without significant levels of CU traits, is associated with the impulsive-antisocial component of psychopathy or the impulsive aggressive behavior. They are expected to show impairments in executive function and more specifically deficits in their ability to control and inhibit their attention recourses. Furthermore, this group is expected to show deficits in emotional regulation but not in emotional reactivity.

Current Study

Though much of the research mentioned here has examined either the emotional or the cognitive processes in these individuals, emerging evidence from psychophysiological research has indicated that attention and emotion are not mutually exclusive process but rather are reciprocally interconnected and influential (Sadeh & Verona, 2012). The processing of emotional stimuli has historically thought to be largely an automatic process, because research has shown that motivationally relevant cues are processed quickly and interfere with the perception of non-emotional stimuli. However other studies have indicated that the processing of emotional information is not entirely automatic and competes for the processing resources with attentional demands (Baskin-Sommers et al., 2013; Newman et al., 2010; Sadeh & Verona, 2012). In the present study we try to examine the interactive effects of emotional and attentional deficits associated with CU traits and CPs.

A first aim of the present study is to identify distinct groups of adolescents based on their longitudinal reports of CPs and CU traits (screening phase). The screening phase is important in that it will enable the investigation of heterogeneity within CPs. In the case that heterogeneity is important individuals with combined CPs and CU traits will differ from individuals with CPs-only. The identified groups are expected to show continuity in CP and CU during adulthood.

A second aim is to examine attention and emotional deficits in identified participants using various stimuli and measures (experimental phase). On the basis that individuals with CU traits are linked to fearlessness and low distress, show diminished reactivity to aversive stimuli (Patrick, 1994; Patrick, Bradley, & Lang, 1993), it is hypothesized that participants with high CPs and CU participants will display impairments in emotional reactivity of affective stimuli, a) by failing to attend to affective cues (experiment 1), b) by showing a selective impairment in the processing of sad and fearful facial expressions (experiment 2), c) by failing to attend to the eye region of the face (experiment 2) and d) by displaying reduced physiological reactivity (low HR, low SCR and reduced SR) when exposed to negative stimuli (experiment 3). The non-CU subtype of individuals with CPs on the other hand, which has been associated with problems in inhibitory control and emotional dysregulation (Frick, 2012; Hicks & Patrick, 2006; Keenan, 2002; Stanford et al., 2003), are hypothesized to show a) hyper vigilance for negative stimuli, showing a preference in attending to negative stimuli (Experiment 1), b) will not show a specific impairment in facial affect recognition but their overall performance on the task might be affected by impulsivity with low accuracy ratings (Experiment 2), c) will attend to all face regions of the face (Experiment 2) and d) will be highly reactive (higher HR, higher SCR and heightened SR) to negative stimuli (Experiment 3). Regarding the high CU but low CPs subtype it is difficult to make specific hypothesis based on the limited literature and the investigation of attention and emotional deficits, for this subtype, is more exploratory.

General Method

Participants

The sample for the experiments was selected from 1893 adolescents participating in a longitudinal study investigating the development of psychopathological problems. Participants who scored reliably high on CP symptoms and reliably high on callous-unemotional traits across two waves of data collection (six months apart) were selected to participate in the experimental phase of the study. Two criteria were used to select participants high or low on CPs and CU traits: (1) continuous high (above 1 SD) or low (below 1 SD) levels of CU traits and/or CP, and (2) co-occurrence between reports of CU traits and CP symptoms across time (i.e., identify adolescents high on both CP and CU traits). Seventy six participant (41 females) provided consent to participate, and comprised the final sample of the study. From the 76 participants, 33 (17 females) scored high and 43 (24 females) scored low on CU traits across time. In terms of CP, 30 (12 females) participants scored high and 46 (29 females) low on CP at both Times 1 and 2 during adolescence. Participants high in CP were divided into those with low (*n* = 14; 7 females) or high (*n* = 16; 5 females) CU traits. Seventeen participants (12 females) scored high on CU traits, but low on CP, and the remaining 29 (17 females) scored low in both CP and CU traits (see table 1).

Screening Phase

CU traits were assessed with the Inventory of Callous-Unemotional traits (ICU; Frick 2004). The ICU is a self-report scale that comprises of 12 positively-worded (e.g., "I express my feelings openly") and 12 negatively-worded items (e.g., "I do not feel remorseful when I do something wrong") that are rated on a 4-point Likert-scale ranging from 0 (not at all) to 3 (definitely true). Item scores are summed to form a total score which demonstrated adequate internal consistency at the three time points (Cronbach's alpha: t1 = .77, t2 = 80, t3 = .89). Previous research has verified the validity of the ICU in community and high risk samples of German, American and Greek Cypriot individuals (Essau et al, 2006; Fanti, Frick & Georgiou, 2009; Kimonis et al., 2008), as well as in college (Kimonis & Frick, 2010; Fanti et al., under review) and incarcerated samples (Kimonis, Fanti, Isoma, & Donoghue, 2013).

CPs were assessed using the Youth's Inventory-4 (YI-4; Gadow & Sprafkin, 1999). The YI-4 is a self-report rating scale that helps to evaluate DSM-IV emotional and behavioral disorders in adolescents. Only the items corresponding to Conduct Disorder were used. Symptoms on the YI-4 are rated on a 4-point Likert-type scale with ranges of 0 (never), 1 (sometimes), 2 (often), and 3 (very often). The YI-4 can be scored to derive Symptom Count Scores (diagnostic model) or Symptom Severity scores (normative data model). As recommended by Gadow and Sprafkin (1999) a symptom is considered present if it is rated by the participants as being displayed *often* or *very often.* The Conduct Disorder items exhibited adequate internal consistency at the three time points (Cronbach's alpha: t1 = .88, t2 = .89, t3 = .82). The symptom count score also exhibited acceptable internal consistency at the three time points (Cronbach's alpha: t1 = .83, t2 = .82, t3 = .69). Both symptom and total score were used for the selection of participants.

General Procedure

Upon arrival at the lab participants were greeted, briefed about the procedure and written consent was obtained. Participants were administered all tasks (word dot-probe, picture dot-probe, facial expression task, physiological task) individually, in one session. The experiment was conducted in two phases, based on whether the eye-tracker or physiological monitoring was used. The order of administration of the experimental tasks was counterbalanced across participants, phases and individual tasks within each phase. For the physiological phase, participants were fitted with the physiological monitors and were instructed to relax in order to check the accuracy of recordings. Earphones were then placed on participants and baseline measures were collected for a minute while participants were looking at an empty computer screen. Once the physiological task was completed all electrodes were removed. For the eye tracking phase, participants performed a calibration test before the administration of the task in order to check that eye gaze was recorded correctly. During the administration of all tasks, the experimenter was monitoring the participant from the observation room. Following the completion of all 4 experimental tasks, participants were debriefed about the purposes of the study. The experimental session lasted 2 hours. For their participation participants received a small financial compensation (€15-20).

Evidence for stability: Late adolescence to adulthood

Even though CU traits have been found to be relatively stable across development and to be associated with adult psychopathy (Frick, Kimonis, Dandreux, & Farell, 2003), prior work suggested individual variability and change over time in these traits during different developmental periods (Fanti & Centifanti, 2013; Fontaine, Rijsdijk, McCrory, & Viding, 2010; Frick et al., 2003; Lynam, et al., 2007). Similarly, conduct and externalizing problems demonstrate variability in different development periods (e.g., Fanti & Henrich 2010). However, late adolescence is considered a time of greater maturity and stability than childhood and early adolescence (Monahan, Steinberg, Cauffman & Mulvey, 2009). As a result, stability in the development of CP and CU traits is expected to be identified, showing continuity from late adolescence to young adulthood.

Results

Repeated analyses of variance (ANOVA) in SPSS 20 were performed to investigate how CPs and CU traits change from Time 1 to Time 3 and test for main and interactive effects of identified groups. Specifically, for CPs and CU traits, we conducted 2 CP group (low, high) x 2 CU group (low, high) x 3 Time (time 1, time3, time3) repeated measures ANOVA. Greenhouse-Geisser corrected effects are reported in the text.

Conduct problems. Findings from the repeated measures ANOVA suggest a significant main effect of time on reported CPs, $F(2,108) = 10.04$, p<.05. Contrasts reveal that the total score on CPs reported at time 2 (*M*=8.18, *SE*=.78) for the selected participants was higher than time 1 (*M*=5.90, *SE*=.62) and time 3 (*M*=4.64, *SE*=.46). A significant Time x CP group interaction, $F(2,108) = 8.84$, $p < .001$, $\eta^2 = .14$) was also found. As shown in figure 1, participants from the low CPs group showed continuously low CP behaviors across time, while participants in the high CPs group showed increased CPs at time 2. Between group differences suggested that identified high CP participants (*M*=9.99, *SE*=.87) were more likely to engage in CP behaviors than identified low risk controls (*M*=2.49, *SE*=.52), $F(1, 54) = 75.43$, $p < .001$, $\eta^2 = .58$). Further, on average identified participants high on CU traits exhibited higher CPs (*M*=7.44, *SE*=.58), than the identified low CU group (*M*=5.04, *SE*=.64), $F(1, 54) = 7.73$, $p < .05$, $\eta^2 = .13$) who exhibited the lowest levels of CP. The three way interaction was not significant.

Callous unemotional traits. Findings from the repeated measures ANOVA suggest that identified high CP participants reported higher CU traits (*M*=26.79, *SE*=1.24) than identified low CP participants (*M*=20.69, *SE*=.95), $F(1, 54) = 15.36$, $p < .001$, $\eta^2 = .22$). Further, on average identified participants high on CU traits exhibited higher CU traits (*M*=31.39, *SE*=1.04), than the identified low CU group (*M*=16.09, *SE*=1.16), $F(1, 54) = 96.55$, $p < .001$, $\eta^2 = .64$) who exhibited the lowest levels of CU traits. In addition a significant Time x CP group x CU group interaction, $F(2,108) = 4.38$, $p < .05$, $\eta^2 = .08$ was found. As shown in figure 2, participants form the low CPs low CU group and the high CPs low CU group both showed continuously low CU traits across time, while participants in the high CPs high CU group reported higher CU traits across time. The low CPs high CU group showed an increase in reported CU traits from time 1 to time 2 and a decrease from time to 2 to time 3.

The findings provide evidence for stability in both CPs and CU traits, enabling the comparison of co-occurring CP/CU groups on the follow-up experimental tasks. Findings also agree with prior work showing continuity in psychopathic traits form adolescence to adulthood (Lynam et al. 2007) and findings indicating persistency in antisocial behavior across adolescence into adulthood (Farrington, Ttofi, & Coid, 2009; Monahan, Steinberg, Cauffman & Mulvey, 2009).

Experiment 1: Attending to Words and Pictures

Previous work has highlighted that individuals with CU traits and CPs display emotional processing difficulties and problems in selective attention especially when attending to negative valent stimuli (Chan, Raine, & Lee, 2010; Lorenz & Newman, 2002; Loney et al., 2003). Some argue that this happens because they fail to attend to the emotional information that would typically inform their social interactions with others (Blair, 1999; 2013; Glenn, Raine, & Schug, 2009). To be more precise CU traits have been associated with reduced attentional orienting to negative emotional words (Frick et al, 2003; Loney et al, 2003), and reduced autonomic responses to distressing (crying child) and threatening (i.e. attacking dog) visual images (Blair, 1999; Blair et al., 1997). On the other hand, individuals with CPs but without CU traits may in fact show an enhanced response to emotional stimuli (Chan, Raine, & Lee, 2010; Loney et al., 2003), suggesting very different patterns of emotional processing in the two groups. Some argue that the differences between the two groups arise by an innate deficit in emotion processing (Blair, 1999; 2013; Fowles, 1980), whereas others posit an attention abnormality that affects the processing of emotion and other important information (Baskin-Sommers et al., 2013; Newman et al. 2010). Experiment1 aims to investigate both theoretical perspectives and provide evidence for the attention and/or emotional deficits among individuals differentiated in their levels of CPs and CU traits.

Prior research using multiple methods demonstrated that, antisocial individuals with CU traits show abnormalities in the processing of emotional stimuli, including emotional words (Loney, et al., 2003; Williams, Mathews, & MacLeod, 1996; Williamson, Harbur, & Hare, 1991), and emotional pictures (Kimonis, Frick, Fazekas, & Loney, 2006; Kimonis, Frick, Munoz, & Aucoin, 2007; Sadeh & Verona, 2012), and show emotional deficits in how they respond to the distress cues in others (Blair, Peschardt, Budhani, Mitchell, & Pine, 2006; Kimonis et al., 2006; Kimonis, Frick, Skeen, Marsee, Cruise, Munoz, Aucoin, & Morris, 2008; Stevens, Charman, & Blair, 2001). Specifically individuals with CU traits have shown to be less emotionally responsive to fearful and sad facial expressions (Blair et. al., 2001; Dadds et al., 2008; Dadds, et al., 2006; Deeley et al, 2006; Leist & Dadds, 2009; Marsh & Blair, 2008), to sad vocal voices (Stevens, Charman, & Blair, 2001), to fearful body postures (Munoz, 2009), and when exposed to empathy-inducing film clips (de Wied, et al., 2012) or vignettes (de Wied, Goudena, & Matthys, 2005). There are however studies which show that participants with CU traits display appropriate emotional responses when their attention is focused on emotional stimuli (Adolphs et al, 2005; Dadds et al, 2006; Dadds et al., 2008), pointing to attentional deficits.

According to the fearlessness theory, individuals high in psychopathic traits show a pattern of under-reactivity to aversive-punitive stimuli (Raine, 2002), which has been mostly supported by findings of low arousal. An alternative explanation for this tendency to neglect new novel information within emotionally neutral and affective contexts may reflect problems in selective attention. Based on models of selective attention it is proposed that once an early attention bottleneck is establish, it blocks the processing of secondary information that is not goal-relevant (Baskin-Sommers, Curtin, & Newman, 2013). This filter can affect processing at the level of the visual cortex and perception. Two more recent studies show the importance of perceptual load on emotional modulated-startle in individuals with psychopathic traits, one by manipulating picture complexity (Sadeh & Verona, 2012) and the other by manipulating familiarity (Baskin-Sommers et al., 2013). Both studies show individuals with psychopathic traits displaying a deficit in startle potentiation while viewing pictures with high perceptual load (more complex or novel scenes) but showed no deficit while viewing pictures with low perceptual load (simple or familiar images). While this attention bottleneck may allow individuals with CU traits to be more effective in filtering out distractions and focusing on personal goals, it may also leave them vulnerable to over-allocating attention to goal-relevant cues and ignoring important context-relevant information.

Many studies have found that individuals with CPs preferentially attend to hostile cues or stimuli. This pattern has been found in studies using the Emotional Stroop task (Eckhardt & Cohen, 1997, Smith & Waterman, 2003; Van Honk, Tuiten, van den Hout, Putman, de Haan & Stam, 2001a), visual search tasks (Van Honk, Tuiten, van den Hout, de Haan & Stam, 2001b) and spatial cuing paradigms (Smith & Waterman, 2003). Unlike studies that have studied selective attention from preference, reaction time and experimental manipulations, a more recent study (Wilkowski, Robinson, Gordon, & Troop-Gordon, 2007) used eye tracking to measure actual looking behavior which provides a precise time course of visual attention allocation. Results from this study show that adults high on trait anger allocated their attention longer to non-hostile than hostile cues. These results indicate that individuals with CPs show a different pattern or results compared to individuals with high CU traits. It is possible that individuals with CPs but without CU traits show a hypervigilance to negative cues while individuals with both CPs and CU traits selectively filter out negative cues.

There are several important avenues for extending this work. It is unclear whether the abnormalities in emotional processing are more strongly related to the presence of CU traits, the presence of CPs or to the co-occurrence of CP and CU traits. Furthermore, no study to my knowledge has examined attention allocation in individual with CPs and CU traits, using eye tracking methodology. Although the abnormal processing of emotional stimuli seems to be limited to negative stimuli in both individuals with CPs and CU traits (Loney et al., 2003), it is unclear whether it is specific to certain types of negative stimuli (i.e. threat or distress). A study that did differentiate between negative stimuli (Kimonis et al., 2006) indicates that the reduced sensitivity to negative emotional stimuli is not consistent to all types of negative emotional stimuli but was found only for distressing cues. It is possible that participants with high CU traits show a selective impairment in attending to distressing cues and not threatening cues, while individuals with CPs but without CU traits show a hypervigilance to both distressing and threatening cues. Examining CPs and CU traits as well as their co-occurrence will help resolve contradicting findings, and provide important theoretical evidence leading to avenues for future work.

Most studies in this domain have used primarily emotional manipulations and neglected the attentional deficits associated with CU traits. The present study aims to investigate whether the presence of CU and CPs or their combination, moderates eye gaze behavior during an affective dot probe task that includes both selective attention and an emotional processing manipulation. The dot-probe paradigm is a widely used task that assesses selective attention and has been used extensively in the anxiety literature (Mogg & Bradley, 2005; Mogg, Bradley, de Bono, & Painter, 1997). The dot-probe task provides an indication of attention allocation on the basis of stimuli competing for attention, just as social cues would compete for attention during a social interaction. It is a spatially oriented attention task that captures the pre-attentive mechanism, which automatically directs attention toward biologically relevant aversive stimuli, providing an indirect index of emotional reactivity

(Kimonis et al., 2006). This task has been suggested to assess utilization of emotional linguistic cues when used with word stimuli. The response time can be viewed as theoretically assessing the implicit or automatic allocation of resources to emotional material. The traditional dot probe task, uses reaction response time measures to indicate attention allocation and preference (van Goozen, Cohen-Kettenis, Matthys, & van Engeland, 2002; Schippell, Vasey, Cravens-Brown, & Bretveld, 2003). That is the time between when the probe appears and when the participant presses the corresponding key. In this respect it is not a direct index of emotional responsiveness, since a number of cognitive, affective and motoric processes are operating between the participants' perception of the stimuli and their motoric response concerning the location of the dot. In this experiment however, real-time attention allocation was accessed with eye-tracking software, which is expected to be free of unnecessary perceptual and motoric responses.

The aim of experiment 1 was to examine the effect and possible interaction of CU traits and CPs in processing different emotional stimuli (distressing, threatening, and positive), in two selective attention tasks, using words (task 1) and pictures (task 2). Based on past research, it was predicted that deficits in the possessing of emotional stimuli would be associated with both CU traits and CPs but in opposite directions. Given prior work demonstrating an emotional deficit in individuals with CU traits, it was predicted that high CU/CPs participants are expected to show a selective impairment in attending to distressing cues, while individuals with high CPs but low CU are expected to show a hyper vigilance towards negative affective stimuli especially distressing and threatening cues. The processing of positive emotional stimuli is not expected to differ in these groups.

Method

Materials

The dot-probe task is typically modified in terms of specific emotional content based on the focus of a given investigation. Experiment 1 included two tasks, one designed using affective words and the second included affective pictures.

Words. The emotional word dot-probe task (task 1) consisted of four lists of words: positive words (e.g. happy, joy, success, friendship), distressing/negative words (e.g., death, lonely, sad, blame), aggressive/threatening words (e.g., anger, violence, gun, hit) and neutral words (e.g., mile, cup, step, call). Emotionality of the words was rated by 5 independent raters. Disagreement on the emotionality of the words by the raters resulted in the word being excluded from the study. The remaining words from the tree categories (positive, negative, aggressive) were matched in length, number of letters, number of syllables, concreteness/imagery and frequency of use in the Greek language with neutral words. Twelve pairs were represented in one of the four potential pairings: neutral-neutral, neutral-distressing, neutral-threatening and neutral-positive, with equal number of emotional and neutral stimuli appearing in both top and bottom locations of the screen. The emotional word dot-probe task, consisted of one block of word pair presentations, of 96 word pairs, presented in pseudo-randomized order to avoid sequential repetition of identical type of pairs.

Pictures. The emotional picture dot-probe task included primarily slides taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1997). The IAPS is a widely used stimulus set and presents one of the most reliable and valid systems for the experimental investigation of emotional processing. The pictures were carefully selected to tap distress (e.g. crying child), threat (e.g. a snake in position to attack), positive (e.g. puppies) and neutral emotional content (e.g. book) following prior work (Kimonis, Frick, Fazekas, & Loney, 2006; Loney, 2003). Pictures selected according to normative ratings in the dimensions of valence and arousal reported in the IAPS manual (Lang et al. 2005), to differ in valence and matched on arousal. Neutral pictures were selected to represent the midpoint between pleasant and unpleasant valence but were lower in arousal. Because the number of neutral and distressing images was not sufficient additional pictures were added that directly matched the IAPS slide content. For example additional slides of a book were added to the existing IAPS neutral pictures. Twenty-two picture pairs were represented in one of the four potential pairings: neutral-neutral, neutral-distressing, neutral-threatening and neutral-positive, with equal number of emotional and neutral stimuli appearing in both top and bottom locations of the screen. The emotional picture dot-probe task, consisted of 176 picture pairs, presented in pseudo-randomized order to avoid sequential repetition of identical type of pairs.

Apparatus

To assess real-time attention allocation the eye-tracking software Tobii X120 (Tobii Technology, Inc, Washington, USA) was used. The Tobii X120 is a standalone eye tracking unit that uses infrared diodes to generate reflection patterns on the corneas of the user's eyes, which are collected by image sensors. Sophisticated image processing algorithms are used to calculate the three-dimensional position of each eyeball, and finally the gaze point on the screen. The Tobii X120 tracks eye gaze of virtually everyone, and offers excellent compensation for head movement allowing a more natural user environment. The eye tracking method is appealing because it is objective and noninvasive. Tobii Studio 3.0.1. was used for the presentation of stimuli and recording eye movements. Two regions of interest were defined for each slide presented, containing the two stimuli, as shown in figures 3 and 4.

Procedure

Participants were tested individually. They were seated approximately 50 cm from the eye tracking screen (47 cm X 24.5 cm). During calibration participants were asked to follow a red bouncing ball around the screen to 5 locations. If the calibration process failed it was repeated. Following a calibration on the Tobii X120 eye tracker and a head position check immediately prior to the experiment, participants were presented with instructions on the computer screen which were also explained by the experimenter. Each stimuli pair consisted of three sequential and non-overlapping components: (1) a 1s fixation cross appearing in the center of the a black screen, (2) a 1s simultaneous presentation of two stimuli that were centered and located immediately above and below the location of the fixation cross, and (3) an asterisk (i.e. dot-probe) appearing in either the top or bottom picture location immediately after the offset of the stimuli. Participants were asked to fixate their gaze on the fixation cross when it was presented and to look at the slides for as long as they appeared on the screen, and to indicate the location of the presenting probe by selecting a key on the keyboard (up or down), as quickly as possible. Measures included eye-gaze duration (total milliseconds spent fixating on the region of interest). Both tasks lasted 50 minutes.

To control for potential location effects such as attentional preference for top or down location of the screen, the following formula was used to calculate the facilitation indices, which were adapted from the one used in Kimonis et al. (2006). The emotional facilitation index was calculated by subtracting the mean reaction time (RT) for total eye gaze for distressing stimuli from the mean RT for neutral stimuli, but compared emotional to neutral stimuli in the same location: ½ [(distress stimuli up – neutral only stimuli up) – (distressing matched neutral stimuli down – neutral only stimuli down) + (distressed stimuli down – neutral only stimuli down) – (distressing matched neutral stimuli up – neutral only stimuli up)]. The facilitation indices for eye gaze for threatening and positive emotion stimuli were calculated in the same way. Given that emotional stimuli typically facilitate allocation of attention, participants were generally expected to allocate their eye gaze longer to emotional stimuli because these stimuli capture their initial attention. This normal response would be indicated by larger positive scores on the facilitation index, in normal participants.

Plan of analysis

Using the facilitation indexes as dependent variables, separate repeated measures ANOVA for word and picture stimuli, were conducted with CP group (low, high), and CU group (low, high) as between subject variables and the 3 stimuli-type (threatening, distressing, positive) as the within subject variable.

Results

Words. This analysis yielded a significant main effect for type of stimuli, $F(2,134) = 5.33$, $p<.05$, $\eta^2 = .07$. Post hoc comparisons using the Bonferroni correction indicate a significant lower facilitation to positive (M= -.07, SE=.02), compared to either distressing (M=.01, SE=.02) or threatening (M=.02, SE=.02) words. The difference in facilitation between distressing and threatening words did not reach significant level. Between group differences suggested that participants with high CPs demonstrated lower facilitation (M= -.04, SE=.02), than participants with low CPs (M= .01, SE=.01), $F(1,67) = 5.39$, $p<.05$, $\eta^2 = .07$. No other main effects or interactions were significant.

Pictures. The repeated measures ANOVA showed a significant main effect for type of stimuli, $F(2,144) = 4.91$, $p<.05$, $\eta^2 = .06$. Post hoc comparisons using the Bonferroni correction indicate a significantly higher facilitation to distressing (M= .35, SE=.03), compared to either threatening (M=.28, SE=.02) or positive (M=.27, SE=.02) pictures. The difference in facilitation between threatening and positive pictures did not reach significant level. In addition a significant main effect for CP group, $F(1,72) = 4.40$, $p<.05$, $\eta^2 = .06$, was found. Participants with high CPs demonstrated lower facilitation (M= .26, SE=.03), than participants with low CPs (M= .34, SE=.02). No other main effects or interactions were significant.

Discussion

The present study aimed to determine how individuals with CPs and CU traits differ in allocating their attention to threatening, distressing and positive stimuli using words and pictures. It aimed to highlight the importance of the co-occurrence between CU traits and CPs to understand their eye gaze allocation. In contrast to the study's hypothesis individuals with CPs, irrespective of CU traits, failed to attend to affective stimuli.

The findings of the present study are in accordance with studies showing that individuals with CPs fail to direct attention to emotionally affective stimuli (Wilkowski, Robinson, Gordon, & Troop-Gordon, 2007). Wilowiski and colleagues (2007) used eye tracking to measure actual looking behavior, and results from this study show that adults high on trait anger allocated their attention longer to non-hostile than hostile cues. He argues that participants directed their attention to non-hostile cues in an attempt to resolve schema-inconsistent information. The schema-inconsistent hypothesis posits that hostile intent schemata direct attention, but will direct attention towards, that is away from the expected hostile cues, schema-inconsistent non-hostile cues. This hypothesis is derived from perception psychology, where it is generally acknowledged that attention is mainly given to novel, unexpected cues, whereas little attention is devoted to schema-consistent information. An increase in attention for interpretation mismatching cues (in the case of non-hostile cues, being inconsistent with a hostile schema) compared to interpretation matching cues (in this case hostile cues) has been shown for scene perception as well as for reading comprehension (Henderson, Weeks, & Hollingworth, 1999; Rinck, Gamez, Diaz, & de Vega, 2003). In this context, the longer attention allocation to inconsistent information probably reflects an attempt to verify unexpected information in light of an already existing interpretation of the situation.

An alternative explanation to our findings is a prominent idea about attentional processing of threat, refer to as the "vigilance-avoidance" pattern (Mogg, Bradley, Miles, & Dixon, 2004) often studied in anxious individuals (Koster, Verschuere, Crombez & van Damme, 2004). It is argued that highly anxious individuals initially attend to threat, but this is often followed by attentional avoidance to threat. Individuals with CPs have been associated with difficulties managing and regulating their emotions, and anxiety (Frick & Morris, 2004; Keenan, 2002), indicating that they also may be avoiding threatening stimuli in a similar way. Initial attention to threat facilitates rapid response to danger and is believed to be evolutionary hard-wire mechanism (Ohman, Flykt, & Esteves, 2001). It is normal to direct attention to highly threatening information, however it is possible that individuals with high CPs, like highly anxious individuals, have difficulty differentiating/evaluating the level of threat.

Experiment 2: Facial Expression Recognition

Face perception is a basic process in interpersonal communication as facial expressions are social cues available to aid the negotiation of social encounters. For example an angry facial expression conveys to an observer a readiness to attack another (i.e. "Back off or I will attack") while a fearful facial expression conveys a readiness to submit or back down (i.e. "don't hurt me! I give up"). If these social cues are not attended to or recognized correctly they will not aid the observer in understanding the intention and the actions that might follow. Developmental and behavioral research shows that distress cues possess perceptual properties that elicit empathy and inhibit aggressive behavior (Marsh & Ambady, 2007; Marsh & Blair, 2008). A meta-analysis study demonstrated that antisocial individuals demonstrate deficits in recognizing and processing specifically fearful expressions rather than a global expression processing deficit (Marsh & Blair, 2008). Other empirical studies on facial affect recognitions (Blair et al., 2001; Dadds et al., 2006; Fairchild, Van Goozen, Calder, Stollery, & Goodyer, 2009; Deeley, et al., 2006; ; Leist & Dadds, 2009; Stevens et al., 2001) demonstrate that it is antisocial individuals with CU traits that have selective impairments in the recognition of fearful and sad expressions (but not anger, surprise or happiness). Dadds (2006) suggests that individuals with CPs alone and individuals with CU/CPs are associated with different emotion recognition problems (Leist & Dadds, 2009). Specifically Dadds argues that individuals with CPs-only display a tendency to oversee hostility, which was demonstrated with poorer recognition of neutral faces in his study, where neutral faces were most often mistakenly rated as angry. In contrast CU traits were related to poor recognition of fearful expressions (Dadds et al., 2006). Individuals with anxiety also show enhanced sensitivity to fearful expressions (Succinelli et al., 2006) that is more related to the pattern of results expected to be displayed by individuals with high CPs but low CU traits.

Dadds and colleagues (2011) suggest that fear blindness in individuals with CU traits is in part due to impaired attention to the eye region of the face while others suggest that it is centrally involved in the detection and direction of the eye gaze (Fox & Damjanovic, 2006). When recognizing facial expressions critical information is taken when focusing on the eyes and to a lesser extent the mouth, where individuals assess the degree of interest, threat and emotion of another (Domes, Heinrichs, Michel, Berger, & Herpertz, 2007). In more recent studies, Dadds et al (2011; 2012) tested whether impaired eye contact is a characteristic of children with antisocial behavior and CU traits. They observed male children and their parents during free play and “emotional talk” scenarios and eye contact was measured. Children with CU traits showed consistent impairments in eye contact towards their parents (Dadds et al, 2011) and displayed lower levels of reciprocal verbal and physical affection (Dadds et al., 2012). According to Dadds, failure to attend to the eyes of attachment figures may be a critical feature of CU traits that emerges very early and leads to cascading errors in the development of empathy and conscience (Dadds et al. 2006; 2008; 2011). The emotional impairment often found in individuals with CU traits has also been attributed to dysfunction in the amygdala (Jones, Laurens, Herba, Barker, & Viding, 2009). Facial affect processing relies on a distributed network of structures that includes occipitotemporal cortex (particularly fusiform gyrus and superior temporal gyrus), anterior cingulate cortex, amygdala and ventromedial prefrontal cortex (Adolphs, 2006). Detection of fearful expressions relies disproportionately on the amygdala. Individuals with CU traits and amygdala damage patients fail to fixate on the eye region when processing facial expressions which is essential for recognizing fear (Adolphs, et al., 2005). Although it is unlikely to be the only factor in the development of CU traits, it is likely that amygdala dysfunction is associated with the origins of psychopathy, which may be mediated by low attention to emotional stimuli, especially the eyes, when interacting socially. Furthermore what is surprising is that facial recognition can be improved. Neuropeptide Oxytocin has been found to enhance gaze specifically to the eye region of human faces (Dome et al., 2007; Guastella, Mitchell & Dadds, 2008) and it has been suggested that this may be a mechanism by which oxytocin enhances emotion recognition. Moreover the deficit in fear recognition can be temporarily reversed in individuals with CU traits and patients with amygdala damage by directing their attention focus to the eye region (Adolphs et al, 2005; Dadds et al, 2006; Dadds et al., 2008).

Experiment 2 aims to investigate whether individuals differentiated on their levels of CPs and CU traits vary in their ability to recognize facial expressions. It is expected that individuals with high CU traits will display selective impairments in the recognition of fearful, sad expressions (Marsh & Blair, 2008) and difficulty in the correct recognition of pain. Although most studies on facial affect recognition do not include pain, individuals with high CU traits have shown impairments in the correct interpretation of distress cues in others (Blair, Peschardt, Budhani, Mitchell, & Pine, 2006; Kimonis et al., 2006; Kimonis, Frick, Skeen, Marsee, Cruise, Munoz, Aucoin, & Morris, 2008; Stevens, Charman, & Blair, 2001). To correctly recognize pain, fear and sadness, requires that the individuals displays empathy, an effective response that individuals with CU traits lack. If this pattern of results is displayed, because they fail to attend to the eye region as suggested by Dadds, it is expected that individuals with high CU traits will attend less to the eye area compare to controls or individuals with CPs and low CU traits. Individuals with high CPs are not expected to avoid the eye region as they are characterized by hypervigilance towards negative stimuli. It is therefore expected that individuals with high CPs only, will be more likely to attend to the eye area, compared to the CPs individuals with CU traits. This group of individuals are also expected to display a tendency to oversee hostility, which might by demonstrated with poorer recognition of neutral faces, mistakenly rating them as angry as indicated by previous work (Dadds et al., 2006).

While research has identified a robust link between antisocial behaviors and impairments in facial affect recognition, the use of primarily static and posed stimuli to test this relationship remains a serious shortcoming. In this study we use dynamic snapshots of facial expressions which are more ecologically valid. Furthermore in the current study we explore how silent cues might aid or impair participants' performance in face recognition with the use of probes prior to stimulus presentation. The used of silent cue manipulation if effective can have important implications for intervention efforts. Based on a previous study (Dadd et al., 2006), participants high on CU traits are expected to show an improvement when the probe directs their attention to the eye area and improve their accuracy, while when their attention is guided away for the eye region (to the mouth or forehead) their performance on the task in expected to suffer. Dadds (2006), asked participants to identify facial expressions and then introduced two conditions whereby he asked them to focus on a) the eyes and b) mouth area and examined how it affected their facial recognition ability. In Dadds et al (2006) study the presentation order of conditions could explain the improved accuracy. In this study silent cues were used to guide participants' attention to the areas of interest, while trials were randomized, to control for practice effects.

Method

Materials

The Facial Expression Recognition Task (task 3) was used to examine participants' ability to recognize emotional facial expressions and to establish if there is a link between CU traits and impairments in facial affect recognition. The task includes six facial expressions:

happy, sad, angry, fear, pain and neutral. Participants viewed dynamic snapshots of 4 female and 4 male adults, making the 6 facial expressions, resulting in 48 snapshots. Each trial consisted of three sequential and non-overlapping components: (1) a 1s fixation cross appearing in the center of the screen, (2) an asterisk (i.e. probe) and (3) a 1s presentation of the facial expression snapshot. To examine if participants' ability to recognize faces can be affected (improved or impaired), before each snapshot a probe appeared focusing the participant's attention a) at the level of the eyes, b) the forehead and c) the mouth. The distance between the probes appearing at the eyes and the forehead was the same as the distance between the probe appearing at the eyes and mouth. A forth condition was also added where no probe was presented (control). The dynamic face recognition task, consisted of two blocks of face expressions, each consisting of 48 expressions, presented in pseudo-randomized order to avoid sequential repetition. After each snapshot participants were asked to decide whether the expression presented was happy, sad, angry, fear, pain or neutral and to log their response by pressing a key on the keyboard. The task was described without informing the participants of the investigations objectives.

Apparatus

To assess real-time attention allocation the eye-tracking software Tobii X120 (Tobii Technology, Inc, Washington, USA) was used. Tobii Studio 3.0.1. was used for the timing of events, presentation of visual stimuli and recording eye movements. Three regions of interest were defined for each face presented, the forehead, the eyes and the mouth (see figure 5). The three regions of interest were the same size for all face stimuli. Measures included eye-gaze duration (total milliseconds spent fixating on the region of interest). The task lasted 30 minutes.

Plan of analysis

Prior to the main analysis data was screened for outliers. To examine the effectiveness of the probe location manipulation on eye gaze performance was first verified, using data from all facial expressions and then was conducted separately for each facial expression, namely anger, fear, pain, sad, happy and neutral facial expression. A repeated measures ANOVA, in SPSS 20 was conducted with CP group (low, high), and CU group (low, high) as between subject variables and the 3 face areas of interest (eyes, forehead, mouth) and probe location (up, down, center, none) as the within subject variables. For accuracy ratings a repeated measures ANOVA, was conducted with CP group (low, high), and CU group (low, high) as between subject variables and the 6 facial expression (anger, fear, sad, pain, happy, neutral) and probe location (up, down, center, none) as the within subject variables. Greenhouse-Geisser corrected effects are reported in the text.

Results

All Facial Expressions. This analysis yielded a significant main effect for face area, $F(2,144) = 35.77$, $p<.001$, $\eta^2 = .33$. Post hoc comparisons using the Bonferroni correction indicate that participants showed less attention to the forehead area (*M*=.043, *SE*=.004) than both the eye (*M*=.181, *SE*=.018) and mouth (*M*=.242, *SE*=.019) area. The difference between participants eye gaze for the mouth and eye area was not significant. A significant main effect for probe location, $F(3,216) = 2.68$, $p<.05$, $\eta^2 = .04$, was also found. Post hoc comparisons using the Bonferroni correction indicate that participants attended to the face less when no probe appeared (*M*=.152, *SE*=.007). Similarly low attentional focus was obtained when the probe appeared at the center (*M*=.153, *SE*=.007), the lower part of the face (*M*=.156, *SE*=.007) and increased eye focus when the probe appeared at the forehead (*M*=.160, *SE*=.007). Only the difference between the probe appearing at the top part of the face and the no probe condition reached significant level. Between group differences indicate that participants high on CU attended to the face less (*M*=.142, *SE*=.009) than low CU participants (*M*=.169, *SE*=.010), $F(1,72) = 4.17$, $p<.05$, $\eta^2 = .06$. In addition a significant Area x Probe interaction was found, $F(6,432) = 26.25$, $p<.001$, $\eta^2 = .27$. As shown in figure 6, when looking at the mouth area participants eye gaze increased when the probe appeared on the bottom part of the face and decreased when the probe appeared at the top part of the face (distraction). Similarly, when looking at the forehead area of the face, participants' eye gaze increased, when the probe appeared at the top part of the face. When looking at the eye area participants focus appears to be similar across probe conditions except when probe appears at the lower part of the face (distraction). In addition a significant Area x CU group interaction was also found, $F(2,140) = 3.82$, $p<.05$. As shown in figure 7, participants in the low CU group show a preference for the mouth area, followed by the eyes and least preference for the forehead area. High CU participants however show equal preference for the eye and mouth area and least to the forehead, when looking at faces. Moreover when compared to low CU participants eye gaze behavior in relation to the eye region, participants with high CU look at the eyes longer, although this effect is small (Cohen's $d = 0.27$). These findings indicate that the probe manipulation affected participants' eye gaze depending on where the probe appeared.

Anger. The repeated measures ANOVA, yielded a significant main effect for face area, $F(2,134) = 41.17$, $p<.001$, $\eta^2 = .38$. Post hoc comparisons using the Bonferroni correction indicate that participants showed more preference for the mouth (*M*=.244, *SE*=.021) followed by the eyes (*M*=.155, *SE*=.015) and least preference for the forehead area (*M*=.035, *SE*=.004). Between group differences indicate that participants high on CU looked at the face less (*M*=.13, *SE*=.009) than low CU participants (*M*=.16, *SE*=.009), $F(1,67) = 5.22$, $p<.05$, $\eta^2 = .07$. In addition a significant area x probe interaction was found, $F(6,402) = 13.28$, $p<.001$, $\eta^2 = .17$. As shown in figure 8, when looking at the mouth area, participants' eye gaze increased when the probe appeared on the lower part of the face and decreased when the probe appeared at the top part of the face or at the center (distraction), compared to the no probe condition. Similarly, when looking at the forehead area, participants' eye gaze increased, when the probe appeared at the top part of the face in relation to the other probe location conditions. When looking at the eye area, participants focus increases when the probe appears at the center or the top part of the face in comparison to when no probe or the distraction probe appears.

Fear. This analysis yielded a significant main effect for face area, $F(2,144) = 31.00$, $p<.001$, $\eta^2 = .30$. Post hoc comparisons using the Bonferroni correction indicate that participants looked at the eyes (*M*=.203, *SE*=.019) and mouth (*M*=.206, *SE*=.019) area equally, but significantly more than the forehead (*M*=.040, *SE*=.004). In addition a significant area x probe interaction was found, $F(6,432) = 8.79$, $p<.001$, $\eta^2 = .11$. As shown in figure 9, when looking at the mouth area, participants' eye gaze increased when the probe appeared on the bottom part of the face and decreased when the probe appeared at the top part of the face (distraction). Similarly, when looking at the forehead area of the face, participants' eye gaze increased, when the probe appeared at the top part of the face in relation to the other probe location conditions. When looking at the eye area, there seems to be an increase in eye gaze when the probe appears at the top part of the face and the center and decreases when the probe appears at the lower part of the face or does not appear at all.

Pain. The repeated measures ANOVA, showed a significant main effect for face area, $F(2,132) = 40.02$, $p<.001$, $\eta^2 = .38$. Post hoc comparisons using the Bonferroni correction indicate that participant's gaze preference for each area of the face significantly differed from each other. Highest preference was shown for the mouth (*M*=.267, *SE*=.021), then the eyes area (*M*=.171, *SE*=.018), and least for the forehead (*M*=.045, *SE*=.004). Between group differences, indicate that participants with high CU show decreased eye gaze (*M*=.144, *SE*=.009) compared to low CU participants (*M*=.178, *SE*=.010), $F(1,66) = 6.12$, $p<.05$, $\eta^2 = .09$. In addition a significant area x probe interaction was found, $F(6,396) = 10.38$, $p<.001$, $\eta^2 = .14$. As shown in figure 10, when looking at the mouth area, participants' eye gaze increased when the probe appeared on the bottom part of the face and decreased when the probe appeared at the top part of the face (distraction). Similarly, when looking at the forehead area of the face, participants' eye gaze increased, when the probe appeared at the top part of the face in relation to the other probe location conditions. When looking at the eye area, there seems to be a decrease when the probe appears at the lower part of the face, compared to all other probe conditions.

Sad. A significant main effect for face area, $F(2,130) = 30.28$, $p<.001$, $\eta^2 = .32$, was found. Post hoc comparisons using the Bonferroni correction indicate that participant's gaze preference for the mouth (*M*=.232, *SE*=.021) and eye area (*M*=.167, *SE*=.017) compared to the forehead (*M*=.047, *SE*=.005). The difference in eye gaze for the eye and mouth area was not significant. Also a significant main effect for probe location was found $F(3,195) = 7.00$, $p<.001$, $\eta^2 = .10$. Post hoc comparisons using the Bonferroni correction indicate that participant's gaze was higher when the probe appeared at the top part of the face (*M*=.165, *SE*=.009), followed by the no probe condition (*M*=.156, *SE*=.008), the probe appearing at the center (*M*=.143, *SE*=.009) and finally the probe appearing at the lower part of the face (*M*=.130, *SE*=.009). The difference in eye gaze, for the probe appearing at the top and lower part of the face were significant, as well as the no probe and probe appearing at the lower part of the face ($p<.05$). Between group differences, indicate that participants with high CU show less eye gaze (*M*=.133, *SE*=.010) compared to low CU participants (*M*=.164, *SE*=.011), $F(1,65) = 4.52$, $p<.05$, $\eta^2 = .07$. In addition a significant area x probe interaction was found, $F(6,390) = 5.862$, $p<.001$, $\eta^2 = .08$. As shown in figure 11, when looking at the mouth area of a sad facial expression, participants showed similar eye gaze performance across probe conditions, except when the probe appeared at the top part of the face (distraction) and eye gaze dropped. When looking at the forehead area of the face, participants' eye gaze increased, when the probe appeared at the top part of the face and dropped when the probe appeared at the lower part of the face (distraction). When looking at the eye area, there seems to be a decrease when the probe appears at the lower part of the face (distraction), and an increase when the probe appeared at the top part of the face. Eye gaze performance for the probe appearing at the center and the no probe condition are very similar across face areas.

Happy. This analysis yielded a significant main effect for face area, $F(2,136) = 44.91$, $p<.001$, $\eta^2 = .40$. Post hoc comparisons using the Bonferroni correction indicate that participant's eye gaze for each area of the face significantly differed from each other. Longer eye gaze was found for the mouth (*M*=.275, *SE*=.021), then the eyes (*M*=.161, *SE*=.017), and least for the forehead (*M*=.045, *SE*=.005). A significant area x CU group interaction was found, $F(2,136) = 3.92$, $p<.05$, $\eta^2 = .05$. As shown in figure 12, when looking at happy faces low CU participants focus their gaze longer at the mouth, then the eyes and least on the forehead. High CU participants however show equal fixation to the mouth and eye area, and less to the forehead. High CU participants also show longer fixation to the eye region compared to low CU but this difference is not significant, (Cohen's $d = 0.26$). In addition a significant area x probe interaction was found, $F(6,408) = 13.70$, $p<.001$, $\eta^2 = .17$. As shown in figure 13, when looking at happy people and specifically the mouth area, participants eye gaze increased when the probe appeared on the bottom part of the face and decreased during when no probe appeared. When looking at the forehead area of the face, participants' eye gaze increased, when the probe appeared at the top part of the face in relation to the other probe location conditions, which was similar across probe conditions. When looking at the eye area, the presence of any probe had a decreasing effect on participants' eye gaze performance.

Neutral. The repeated measures ANOVA, showed a significant main effect for face area, $F(2,134) = 25.08<.001$, $\eta^2 = .27$. Post hoc comparisons using the Bonferroni correction indicate that participant's gaze was significantly less for the forehead area (*M*=.044, *SE*=.005) compared to the longer eye gazes displayed for the eyes (*M*=.192, *SE*=.019), and the mouth (*M*=.215, *SE*=.022). The difference in eye gaze behavior for the eye and mouth region was not significant. In addition a significant area x probe interaction was found, $F(6,402) = 2.878$, $p<.05$, $\eta^2 = .04$. As shown in figure 14, when looking at Neutral faces the presence or absence of probes did not affect participants' eye gaze to the eyes. However the probe manipulation appeared to work for the forehead and eye area.

Facial Recognition Accuracy. This analysis yielded a significant main effect for facial expression, $F(5,380) = 17.09$, $p<.001$, $\eta^2 = .18$. Participants' accuracy was highest for Happy (*M*=.963, *SE*=.007), followed by Neutral (*M*=.924, *SE*=.012), Fear (*M*=.893, *SE*=.015), Angry

(*M*=.892, *SE*=.011), Sad (*M*=.878, *SE*=.013) and lowest for Pain (*M*=.807, *SE*=.022). Post hoc comparisons indicate that participants were significantly more accurate when recognizing Happy faces compared to all other facial expressions except Neutral ones. Participants' accuracy for Neutral expressions only differed significantly from accuracy ratings on Pain. Accuracy for Fear differed significantly from accuracy ratings for Pain. Angry accuracy ratings differed significantly from Pain. Sad accuracy ratings differed significantly from Pain. A significant main effect for probe location, $F(3,328) = 8.32$, $p<.001$, $\eta^2 = .10$ was also found. Post hoc comparisons using the Bonferroni correction indicate the participant's accuracy was highest when the probe appeared at the lower part of the face (*M*=.925, *SE*=.009) compared to all other probe positions. Similar accuracy ratings were reported when the probe appeared at the top part of the face (*M*=.890, *SE*=.011), the center (*M*=.874, *SE*=.010) and least for the no probe condition (*M*=.883, *SE*=.012). Between group differences, indicate that participants with high CPs showing lower accuracy ratings (*M*=.876, *SE*=.013) compared to low CPs participants (*M*=.910, *SE*=.010), $F(1,76) = 4.44$, $p<.05$, $\eta^2 = .06$. In addition a significant Expression x Probe interaction was found, $F(15,1140) = 10.82$, $p<.001$, $\eta^2 = .10$. As shown in figure 15, accuracy ratings when recognizing angry facial expressions decreases when the probe appears on the top part of the face and is highest when the probe appears at the center. When recognizing fear, pain and sad facial expressions participants' accuracy increases when the probe appears at the lower part of the face. When recognizing pain and sadness, drop in accuracy is noticed when the probe appears at the center. A marginal Expression x CU interaction was found, $F(5,380) = 2.13$, $p=.085$, $\eta^2 = .03$. As shown in figure 16, participants high on CU traits tend to show lower accuracy ratings when recognizing angry (Cohen's *d* = 0.54), and sad (Cohen's *d* = 0.64), facial expressions, but surprisingly were better at recognizing pain (Cohen's *d* = 0.17). Furthermore participants with high CU are less accurate in recognizing happy (Cohen's *d* = 0.31), neutral (Cohen's *d* = 0.28) and fear (Cohen's *d* = 0.08), but the latter is small as indicate by the small effect size.

Discussion

The present study aimed to determine how individuals with CPs and CU traits eye gaze behavior is affected when probes are used to aid or distract them when recognizing dynamic facial expressions but also to explore the co-occurrence between CU traits and CPs to understand eye gaze behavior and attention orientation. In this respect, this study contributes four key findings. First, participants high on CU traits show deficits mostly in recognizing angry and sad faces extending previous work arguing that accurately attending to distress cues in others helps in the development of empathy (Blair, 2013). Second, while individuals low on CU traits show different attention to the eye and mouth regions, participants high in CU traits attend equally to the eye and mouth regions. These findings might indicate that the eye region specifically is not responsible for their impairment in face recognition among high CU individuals, but a combination of how they attend to both the eyes and the mouth. Third, the silent cue manipulation used to guide participants attention was effective in all individuals irrespective of CPs or CU traits, addressing the implications for understanding and intervening with high risk individuals with CU traits. Fourth, the silent cue manipulation did not have the same effect for all facial expression and in the same direction, noting the importance of addressing the distinct characteristics of each facial expression.

The current findings contribute to the literature on emotion recognition processes (Blair et al., 2001; Marsh & Blair, 2008). Participants high on CU traits in our study show deficits mostly in recognizing angry and sad faces, extending previous work (Fairchild et al., 2009; Stevens et al., 2001) arguing that not attending to others distress cues is associated with deficits in emotional empathy (Blair, 2013; Blair et al., 2001). It has been proposed that facial distress cues possess perceptual properties that elicit empathy and inhibit aggression; however, individuals with CU traits do not process these facial cues as aversive, possibly because they are unable to recognize them correctly (Marsh & Blair, 2008). Because the amygdala is involved in the formation of stimulus-reinforcement associations, it is theorized that amygdala dysfunction impairs the learning that typically results following distress cues (Blair, 2013). However, the present findings contradict previous studies arguing for a specific impairment in fear recognition (Adolphs et al., 2005; Dadds et al., 2006; Marsh & Blair, 2008). Participants with high CU traits are less accurate in recognizing fear but this difference is small, while they do display more pronounce impairments in accurately recognizing sad and angry faces.

Dadds et al. (2006) argue that fear blindness evident in individuals with CU traits is due to visual neglect of the eye region of the face. As indicated by the present findings, participants high on CU traits, focused equally to the eye and mouth region when recognizing facial expressions. Moreover when compared to low CU participants eye gaze behavior in relation to the eye region, participants with high CU traits attended to the eyes longer, although this effect is small. This discrepancy between the present study and Dadds et al. (2006), must be considered with reference to methodological differences. In Dadds et al

(2006) study, participants were specifically instructed to look at the eyes after being administered a first block of trials where no instruction was provided. The researchers asked participants to look at the eyes, and concluded based on the improved accuracy ratings, that the instruction was the reason for the improvement in performance. However, improved performance could be attributed to practice effects, due to presentation order. The eye-tracking technique, used in the present study provides the benefit of identifying the allocation of attention that was not captured by the behavioral task used in Dadds et al (2006) study. Further, it could be argued that the stimuli used in the present study were harder to recognize as we included dynamic snapshots of people depicting various expressions (including movement of different face regions) arguably making the task more difficult. This might also be the reason for the higher attention to the mouth area. However, high accuracy ratings obtained in the present study, do not point to task difficulty as the reason for the absence of a more pronounce fear-blindness effect.

The presence of CU traits affects participants' attention allocation to the different face regions of the face. The pattern of eye gaze behavior indicates that the mouth region is attended to more by low CU participants. This probably means that participants high on CU scanned the background more or shifted their eye gaze to the different regions more frequently. This finding is difficult to interpret in light of the absence of time-course data that would reveal more information regarding the viewing patterns exhibited by high CU participants. In a study examining visual fixation patterns of static scenes, in high-functioning adolescents with Autism Spectrum Disorders (ASD) and typically developing matched controls (Freeth, Chapman, Ropar & Mitchell, 2010) using eye tracking measures, no difference between groups was found regarding fixation time to the face region. However time-course analyses, revealed differences between the viewing patterns of the two groups. Attending to the face was highly prioritized by typically developing participants than those with ASD. The typically developing participants were faster to first fixate on the face when it was presented for 5s while ASD participants were faster to fixate on other objects in the scene first, and fixation to the face came later, indicating a fixation pattern that is more evenly distributed. It is possible that high CU participants, fixated to the eyes and mouth area equally but not with the same priority. It is also possible that low CU participants attended to the eye area first and were happy to move away from the eye area to the mouth region and explore the rest of the scene. We therefore hesitantly suggest, based on the pattern of findings that it's not the eyes specifically that aid or apprehend participants' performance on facial affect recognition, but all facial regions collectively. For real (as oppose to schematic) faces, the emotion depicted is derived by a set of gestures including movement in the eyebrows (i.e. anger), the eyes (i.e. curving downwards indicating sadness), and the mouth (i.e. upwardly turned corners indicating happy). These regions are therefore likely to play a key role in the signaling of facial expressions, often ignored in studies examined single features of the face in isolation (i.e. Fox & Damjanovic, 2006).

The probe manipulation used, was effective in guiding participants' eye gaze behavior mostly as expected, further supporting the literature that participants with CU traits attention can be manipulated (Dadds et al.,2006), similar to other individuals. Evidence of intact gaze cuing has also been reported in individuals with ASD (Freeth et al., 2010). When the probe appeared at the lower part of the face, eye gaze to the mouth increased, while when the probe appeared at the top part of the face, eye gaze to the forehead area increased. Surprisingly, no such effect was found when the probe focused on the eye area. This might be explained due to a possible ceiling effect. Participants' attention is instinctively directed towards the eyes as indicated by other studies (Freeth et al., 2010) and the probes used to improve eye gaze behavior, did not have the expected effect. In contrast to the distracting probe, which was able to guided attention away from the eye region as expected. The findings from this study provide important implications for intervention efforts with CU individuals. It is possible that the silent cues used in the present study to guide participants' attention to the three most important regions of the face had an overall positive effect in helping all participants scan the face more thoroughly, making them more vigilant, and aware of possible distressing cues, that would normally elute their attention. But it is important to note that the silent cues did not have the same effect and in the same direction for all facial expressions. For example when recognizing fear, participants' performance was aided when probes appeared to the top and lower part of the face but had not improvement when focusing on the eye region. In some cases, such as when recognizing pain, looking at the eyes had an impairing effect on participants' accuracy, indicating that each facial expression is best studied separately in order to draw more accurate conclusions.

Participants high on CU traits were less accurate and displayed less fixation duration to the face regions under study than low CU participants, when identifying angry faces. This findings is in line with studies emphasizing a fear deficit in individuals with CU participants

(Fowles, 1980; Patrick, 1994; Raine, 2002) and also attention related theories arguing for a selective impairment in the processing of threatening cues (Baskin-Sommers, Curtin, & Newman, 2013; Newman et al., 2010). Anger, is threat related cue while sadness and pain, are considered distressing cues. Difficulty in identifying anger could explain their low fearless temperament and tendency to be involved in more thrill-seeking behaviors (Essau et al, 2006; Frick., 2013; Frick, et al., 1999). The probe manipulation however did not affect the high and low CU participants differently. When silent cues appeared at the level of the eyes and the lower part of the face participants were more accurate, while their performance was impaired when the probe appeared at the top part of the face. The emotion of anger is indicated by a set of gestures including pronounced frowning eyebrows (v shaping), intensely staring eyes, and a shut mouth with downwardly turned corners. It seems that movement in the mouth and eyes are more helpful cues in accurately recognizing angry faces, whereas the frowning eyebrows were not. This is surprising as the movement in the eyebrows and the distinct “v” shape formation make it a distinguishing characteristic from other facial expression and yet it did not help improve accuracy rates.

Fear like, sadness and pain are distressing social cues. Individuals with high CU traits have been associated with impairment in responding to distressing cues in others (Blair, 2013) and yet this finding was not replicated here. CU traits were not associated with participants' accuracy or their eye gaze behavior. This is unexpected considering other studies who have found CU traits being uniquely related to fear recognition (Dadds et al., 2006; Leist & Dadds, 2009; Marsh & Blair, 2008), and specifically attributing this impairment to lack of attention to the eye region of the face (Dadds et al., 2011). Overall accuracy was improved when probes guided attention to the top and lower part of the face but had no improvement, when the probe focused on the eye region. As mentioned earlier this could be attributed to different methodologies.

Sadness was identified less accurately by high CU participants who also showed less fixation to the face compared to low CU participants. This is in accordance with studies that have found high CU being associated with reduced responsiveness to distressing cues (Blair, 1999; Blair et al., 1997; Marsh & Ambady, 2007). The probe manipulation however did not affect the two groups performance differently. In general participants were more accurate when silent cues appeared at the top and lower part of the face and accuracy was impaired when directed to eye region. The expression of sadness often includes subtle downwardly turned corners of the mouth and eyes (Marsh & Blair, 2008). Therefore it is not surprising that these two regions attracted participants' attention as indicated by eye gaze behavior. What is surprising however is that when the silent cue guided their attention to the distressing eye region, their accuracy was impaired. This pattern of results seems to be characteristic for sadness and pain, than when identifying any other facial expression. It is possible that looking directly into the eyes of a sad face was distracting and impairing to their performance.

When recognizing pain expressions, participants high on CU were more accurate even thought they fixated less on the face, compared to low CU participants. This finding is in line with Blair's (2013) theory, who proposes that high CU traits are not associated with deficits in cognitive empathy but are more associated with reductions in emotional empathy. This is an unexpected finding, indicating that participants with high CU might show superior visual scanning patterns when identifying painful facial expressions, compared to low CU participants. The probe manipulation however did not affect the two groups performance differently. Participants were more accurate when silent cues appeared at the lower part of the face and accuracy was impaired when directed to the eye region and the forehead. Pain expressions include squinting of the eyes and movement in the mouth area. As these movements occur instantaneously it is possible that looking at the mouth area captured their attention first and shifted their attention to the eyes at a later stage. However these assumptions are made hesitantly, due to the lack of time course eye tracking data. What is surprising is that when the silent cue guided participants' attention to the distressing eye region overall accuracy was impaired significantly. It is possible that looking directly into the eyes of person in pain, was distracting and made participants switch to another region of the face, as no improvement in eye gaze behavior is evident.

Happy expressions are more easily identified (Leist & Dadds, 2009). Participants were more accurate when recognizing happy facial expressions and the silent cue manipulation had a lesser affect on both accuracy and eye gaze behavior. Happy faces, include increased movement in the mouth area (curving upwards), which captured participants attention as indicated by eye gaze behavior. Interestingly, participants seem to look at the eye region when looking at happy faces, as indicated by the prolonged fixation to the eyes which was also less affected by the appearing probes. Surprisingly high CU participants, show longer fixation to the eye region of the face when presented with happy faces, but this difference in not significant.

When recognizing neutral expressions, participants were more accurate when the probe appeared at the forehead and the level of the eyes as oppose to when the probe appeared at the bottom part of the face. Neutral faces as oppose to all other facial expressions do not include much movement of the different face regions. Therefore it is not surprising that both the eye and mouth region were scanned equally as indicated by their eye gaze fixations.

The current findings add to the literature on perception and emotion recognition processes (Schonenberg, Christin, Gauber, Mayer, Hautzinger, & Jusyte, 2013). The current study examined the relationship of CU traits, CPs and there interaction to the recognition of specific emotions using eye tracking equipment to measure actual eye gaze behavior. This study shows that the presence of CU traits can affect emotional processing accuracy, due to a failure to direct attention to emotionally significant aspects of the environment, but as indicated by the present results it's not the eyes specifically that aid face recognition. It is possible that individuals with high CU traits miss many subtle, rabidly changing social cues that typically developing individuals are particularly perceptive of. The differences in facial affect recognition are in the early stages of being delineated, highlighting the importance of more research in this direction. The assessment of dynamic emotional expressions instead of the recognition of static full-blown emotions as an outcome variable may represent a more valid tool to capture changes in the ability to detect subtle emotional cues (Schonenberg et al., 2013). The use of silent cues can be used to guide participants' attention to different face regions. It is argued that this is a promising direction for future research in improving attention allocation deficits in individuals with CU traits and improving facial affect recognition. The results of this study may assist researchers in developing more precise hypotheses regarding the processing of facial expressions.

Experiment 3: Physiological Reactivity

One important focus of research on antisocial behavior has been to investigate how individuals with CPs and psychopathic traits process and react to emotional stimuli. Well-established evidence indicates that negative emotions activate the defensive system while positive emotions activate the appetitive system of the brain (Fowles, 1980; Lang, 1995). Psychopathic traits, more specifically the affective/interpersonal features (CU traits) have been associated with diminished reactivity to aversive and other emotionally charged stimuli (Patrick, 1994; Patrick, Bradley, & Lang, 1993). Importantly, individuals with affective psychopathic traits show poor fear reactivity, a pattern that has been described as a fundamental deficit in defense motivation (e.g. Fowles, 1980; Lopez, Poy, Patrick, & Molto, 2013). High CPs on the other hand entail externalizing proneness, executive-regulatory deficits, anxiety but no deficit in emotional reactivity. It is therefore expected that participants high on CPs will show a different pattern of reactivity as oppose to individuals with high CU/CPs.

Findings on emotional deficits in adults with psychopathic traits and differential physiological correlates of the affective /interpersonal and antisocial components suggest distinct etiological pathways (Sadeh, et al, 2013). Functional magnetic resonance imaging (fMRI) research has indicated that the affective/interpersonal dimension is related to decreased activation of the amygdala during processing of emotional stimuli, whereas the impulsive/antisocial dimension is associated with increased neural activation of brain regions related to motivational salience (amygdala, orbitofrontal cortex, insula), emotional regulation (temporal cortex superior frontal gyrus) and attention control (dorsal anterior cingulated cortex) (Sadeh et al,2013). It has also been suggested that each dimension is associated with distinct emotional and cognitive deficits (Patrick et al., 1993; Patrick et al., 1994; Sprague & Verona, 2010). For example the affective –interpersonal dimension is associated with abnormal early selective attention (Sadeh & Verona, 2012; Baskin-Sommers et al., 2013) while the impulsive antisocial dimension is associated with deficits in working memory, including difficulty to suppressing the effects of distractors. The CP/CU group is associated with affective /interpersonal component of psychopathy, while the CP-only group is associated to the antisocial component. The current experiment adopts a multi-measure approach to examine patterns of affective responding (including self-report measures, heart rate, skin conductance and startle reflex) in individuals with high and/or low CU traits and high or/and low CPs while they were exposed to affective (pleasant or unpleasant) video scenes.

Physiological indices

Skin conductance

Skin conductance reactivity (SCR) is used as a tonic measure of sympathetic nervous system activity indicating physiological arousal. In most individuals, skin conductance increases following the presentation of novel or significant stimuli (increasing in both pleasant and unpleasant arousing stimuli compared to low arousal neutral stimuli) which is also considered a component of the orienting response. Reduced orienting responses have been found in conduct-disordered youth (Herpertz, Wenning, Mueller, Qunaibi, Sass, & Herpertz-Dahimann, 2001), and have been associated with criminal behavior in a community sample of male adolescents (Raine, Venables, & Williams, 1990). Reduced electodermal response during anticipation of a noxious event (Hare, 1965) or when viewing distressing pictures (Blair, 1999) has also been found in individuals with psychopathic traits. Emotional processing deficits have been documented with reduced SCR in children (Blair, 1999; Isen, Raine, Baker, Dawson, Bezdjian & Lozano, 2010), adolescents (Fung, Raine, Loeber, Lynam, Steinhauer, Venables, & Stouthamer-Loeber, 2005) and adults (Babcock, Green, Webb & Yerington, 2005; Benning, Patrick & Iacono, 2005; Lorber, 2004) with CU traits and affective psychopathic traits. The question still remains as to whether low SCR is related to heterogeneous groups of antisocial individuals with and without CU traits; this question is thus addressed in the current study. However, electrodermal activity alone should not be used as an isolated index of fear. Elecrodermal activity tends to increase as emotional arousal increases, whether the eliciting stimulus is pleasant or aversive (Patrick et al, 1993).

Heart Rate

One of the most commonly used measures of autonomic nervous system (ANS) activity is heart rate (HR). HR has been examined while participants are at rest and during various types of challenges. Measurement at rest indexes the tonic level of phasic ANS activity that is homeostatic regulation, whereas measurement during challenge or stimuli presentation indexes phasic ANS activity and provides insight into the dynamic process of reactivity and self-regulation. HR responses have often been used to differentiate between sympathy and personal distress. In control participants, passive exposure to film clips eliciting sadness, anger or happiness is generally associated with HR deceleration, with greater deceleration for unpleasant, relative to pleasant stimuli, possibly reflecting an orienting/attention response (Bradley & Lang, 2000). Sympathy or empathetic concern is an another-oriented emotion, involving an observer perspective. This state has been associated with HR deceleration. In contrast personal distress is self-focused emotion, which has been associated with HR acceleration (Eisenberg, & Fabes, 1990).

Low resting HR, thought to be driven by sympathetic under-activation, is one of the best replicated biological markers of aggressive and antisocial behavior (Ortiz & Raine, 2004, Raine, 2002) and has been found in individuals with CPs (de Wied, Van Boxtel, Posthumus, Goudena, & Matthys, 2009; Lorber, 2004; Ortiz & Raine, 2004) compared to controls.

Nevertheless, some studies have demonstrated high resting HR in clinic-referred Disruptive Behavioral Disorder boys (Cole, Zahn-Waxler, Fox, Usher, & Welsh, 1996; de Wied et al., 2009). Lorber (2004) examined the relation between resting HR and antisocial behavior across three age groups (children, adolescents, and adults) and across three types of antisocial behaviors (aggression, psychopathy/sociopathy, and CPs). By summing across age groups the author found that resting HR was significantly negatively related to aggression and CPs but not to psychopathy/sociopathy.

Contrary to these findings, additional research shows that when exposed to negative stimuli CPs are associated with high HR (Crozier, Dodge, Fontaine, Lansford, Bates, Pettit & Levenson, 2008; Lorber, 2004; Ortiz & Raine, 2004). Two possible psychological explanations for the robust relations between low resting HR and aggressive/antisocial behavior: (a) a low tonic level of autonomic activity is a marker of fearlessness, which contributes to antisocial behavior by lowering the limit value of potential retaliation and punishment, and (b) chronically low tonic autonomic activity is an uncomfortable state that motivates behaviors such as aggressive/antisocial acts that raise arousal to more optimal levels (Raine, 2002). Stimulation-seeking and fearlessness theories may be complementary perspectives in that a low level arousal may predispose to antisocial behavior because it produces some degree of fearlessness and also because in encourages antisocial stimulation-seeking.

However the theory fails to explain why some antisocial individuals show high resting HR. It is proposed that individuals with CPs constitute a heterogeneous group differentiated on their levels of resting HR and HR reactivity. It may be possible that the presence of CU traits in individuals with CPs, that have been associated with lack of fear, explain the low resting HR shown in some antisocial individuals. High resting HR and HR reactivity during exposure to affective stimuli, might be identified in individuals with CPs but low CU traits, related to the problems in self-regulation. Few studies that differentiate between individuals with CPs with or without CU traits (Anastassiou-Hadjicharalambous & Warden, 2008b; de Wied et al, 2012) showed that children high on CPs/CU traits showed less HR rate change than high CPs/low CU children or controls. Examining CPs and CU traits as well as their interaction will help resolve contradicting findings and provide important evidence informing the fearlessness theory.

Startle Reflex (SR).

One measure that has been used for studying the regulation of affect is the acoustic startle reflex (SR). The acoustic SR is a fast defensive response to an unexpected and intense acoustic stimulus, which includes eye-lid closure and contraction of facial muscle (Koch, 1999). It has been proposed to serve as a protection against harmful stimuli and to prepare for a fight/flight response. The acoustic startle response can be used to study affect regulation, as it can be modulated by emotional stimuli, but also by internal emotional states (Bradley, Lang, & Cuthbert, 1993). Its magnitude is potentiated by negatively-valent affective contexts (i.e., fear, threat, mutilation and assault) in relation to neutral situations (e.g. Bradley & Lang, 2000). Unpleasant stimuli prompt a state of defense readiness that is synchronous with the response, producing larger blink reflex compared to pleasant stimuli which elicits an opposing appetitive distortion, producing a smaller startle reaction. Research has established that the fear-potentiated eye-blink startle response is absent or reduced among individuals high on the affective dimension (Fanti, Panayiotou, Kyanides, & Avraamides, under review; Patrick et al, 1993; Levenston, Patrick, Bradley & Lang, 2000; Justus & Finn, 2007), providing evidence for a fear deficit in individuals with psychopathic traits (Patrick, 1994; Vaidyanathan, Hall, Patrick, & Bernat, 2011). However, few studies (Fairchild, Stobbe, van Goozen, Calder, & Goodyer, 2010; Fairchild, Van Goozen, Stollery, & Goodyer, 2008) have used this experimental manipulation in younger populations, emphasizing the need to explore the heterogeneity of CPs/CU. Although it has been reported in adolescents with CPs by comparing sub-groups of individuals with CP with and without CU traits we will be able to provide support that individuals high in CU traits will respond with restricted startle reflexes to fearful contexts especially.

In adults, while individuals high on the affective-interpersonal component display reduced startle potentiation by negative affect, those high on the impulsive-antisocial component show normal potentiation (Patrick, Bradley, & Lang, 1993; Vaidyanathan et al., 2011) suggesting that it is the affective-interpersonal/fearless aspect that explains this finding (Patrick, 1994). To the contrary, those high on the impulsive-antisocial component have been found to report high levels of anxiety and distress proneness, and tend to show strong startle potentiation after viewing aversive images, similar to individuals with high anxiety and negative affectivity (Cook, Davis, Hawk, Spence, & Gautier, 1992). Furthermore, the CU dimension of psychopathy has been uniquely related to attenuated eye-blink SR to acoustic probes administered during the presence of negative stimuli (Patrick et al, 1993). While SRs are increased or potentiated after viewing negatively valence stimuli, SRs are reduced or inhibited after viewing positively valent or pleasant stimuli (Bradley, Cuthbert, & Lang, 1990;

Patrick, 1994). Similar to normal controls, studies using the affective picture paradigm reveal that participants high on psychopathic traits exhibit the typical pattern of SR inhibition when viewing pleasant pictures (Lang, Bradley, & Cuthbert, 1990; Patrick et al., 1993; Pastor, Moltó, Vila & Lang, 2003). These findings support the hypothesis that psychopathic motivational deficits are restricted to the defensive system, while their appetitive system functions normally.

Current study

Taken together these findings lead to the theoretically important possibility that CU traits are associated with under-reactivity (fearless), while CPs are associated by a lack of impulse control and self regulations difficulties, but no fear deficit. The central aim of the current study was to compare affective responsiveness in individuals with high and low, CPs and CU traits and the interaction between them. Identified participants were compared on physiological measures (heart rate, skin conductance and startle reflex) and self report measures. Both the main effects of CP and CU traits are investigated as well as the potential unique effects of the interaction of these two variables on indices of fear.

On the basis that CU traits are linked to low fearlessness and low distress, whereas CPs without CU traits is associated with impulsivity, emotional dysregulation, and high distress (Frick, 2012; Hicks & Patrick, 2006; Stanford et al., 2003), we anticipated that differences in fear deficits would become evident when examining the interaction between CPs and CU traits. Similar to adults high on the affective/interpersonal factor of psychopathy, lower fear is expected to be identified among participants high on both CU traits and CPs, by displaying, restricted physiological reactions (lower SC, lower HR and lower startle potentiation). Individuals high on CPs but without CU traits are expected to show enhanced physiological reactions (heightened skin conductance and heart rate, startle potentiation), similar to high anxious individuals and emotionally dysregulated individuals. This study is believed to be amongst the fist that examines emotional deficits in relation to CPs and CU traits, and the inclusion of SC, HR and SR measures are expected to provide important evidence towards understanding heterogeneous CP groups.

Another aim of the study is to determine whether, self report measures compliment physiological measures in understanding antisocial behavior. Even though self-report measures have been used in other studies, biases in self-presentation and self-perception render this source problematic if used exclusively.

Moreover, the study uses more naturalistic stimuli, namely violent scenes.

Physiological measures have mostly been studied using picture and imagery stimuli (e.g. Panayiotou, Witvliet, Robinson, & Vrana, 2011) but accumulating evidence suggests that similar effects can be obtained with more complex stimuli, such as affective films. Jansen and Frijda (2007) documented startle potentiation by fearful movie scenes compared to positive (sexual), and heart rate change has also been monitored during the presentation of affective video scenes (Anastassiou-Hadjicharalambous & Warden, 2008b; de Wied et al, 2012). Also, similar to threatening and fearful content, violent stimuli depicting victim attacks have been shown to prime defensive reactions (Vaidyanathan et al., 2011). Hence, in this study movie scenes were used to induce positive and negative emotions in order to simulate violent situations in a more realistic manner. Violent films were expected to prompt defensive motivation, resulting in more intense physiological reactions (heightened skin conductance and heart rate, startle potentiation) among controls and high CPs/low CU individuals, and restricted physiological reactions (lower SC, lower HR and lower startle potentiation) in individuals high on CU traits and CPs. Erotic scenes which were rated as high arousing and pleasant, were expected to prompt the appetitive-approach system similar to positive pictures or other visual stimuli.

Method

The same individuals participated in the physiological part of the experiment, although one participant's data were omitted from analyses due to equipment malfunction, leaving 75 participants (43 females).

Experimental material. Pilot data were collected from an independent sample (N = 75), similar in age (M = 20.49, SD = 2.37) and gender (49.33% female) as the experimental sample, in order to pre-rate the video scenes to be used in the experiment. An initial pool of 44 violent, erotic and neutral scenes was rated on valence, arousal and the intended content (violence, erotic). Violent and erotic scenes were selected according to normative ratings in the dimensions of valence and arousal, to differ in valence and matched on arousal (Mean Valence: 5.37 (erotic), 3.92 (neutral), 1.44 (violent); Mean Arousal: 5.71 (erotic), 1.10 (neutral), 6.27 (violent). Neutral scenes were selected to represent the midpoint between pleasant and unpleasant valence but were lower in arousal. The final scenes selected for the experiment included 6 erotic scenes, 6 violent scenes, and 6 neutral scenes lasting 1 minute each. Because film materials, in contrast to static pictures, are more variable in their content every effort was made to standardize and equate materials within and between affective categories. The violent scenes were excerpts from cinematic productions and included scenes from the following movies: *Law Abiding Citizen*, *American History X*, *Lucky Number Slevin*, *Rambo 4*, *The Killer Inside Me* and *The Brave One*. All scenes included realistic depictions of shooting, fighting, beatings, amputations, stabbings and other injuries inflicted on victims. An effort was made to select sections that contained violence for the entire 60 seconds with a clear distinction between the victim and perpetrator. The erotic scenes were chosen from the following movies: *Cruel Intentions*, *Original Sin*, *The Lucky One*, *Shout 'Em Up*, *The Sleeping Dictionary* and from the TV series *Suits*. Erotic scenes included kissing, nudity and love making, spanned across the 60 seconds of the scene and included male and female actors. Neutral scenes were obtained from open-access documentaries on the World Wide Web and depicted nature and environment scenes with little human or animal activity (e.g., Himalayan, Solar System, Andes, Limestone, Tanami desert, Hoodoos). All scenes were in English and included music and some dialog or commentary of approximately equal duration across categories. Video clips were edited so that their volume was reduced to 90-dBA to ensure that the acoustic startle stimuli could be easily perceived.

Apparatus and data reduction. The timing of events, the presentation of auditory and visual stimuli, and the logging of participants' responses to the rating questions were controlled by an E-Prime script (E-Prime 2.0; Schneider, Eschman & Zuccolotto, 2002). Auditory stimuli (i.e., the sound of the video and the startle probe) were presented binaurally via supra-aural headphones in order to mask ambient noise. The task computer was sending digital markers to the MP150 system to indicate fixation and scene onset and offset, the onset of probes in additional digit channels. All physiological signals were collected using BIOPAC MP150 for Windows bioamplifiers and transducers and the Acq4.2 data acquisition software (Biopac Systems Inc, Santa Barbara, CA).

Heart Rate (HR) was recorded via Lead 110 electrocardiogram (ECG) by two 11mm disposable pre-gelled electrodes Ag/AgCl which were placed on each forearm. The ECG signal was filtered by a Biopac ECG100C bioamplifier and was converted to beats per minute.

Skin conductance recording (SCR). Elecrodermal activity (EDA) for determining SCR were measured using two 11mm disposable pre-gelled electrodes placed on the palm of the non-dominant hand. SCR is used as a tonic measure of sympathetic nervous system activity indicating physiological arousal. SCR was scores in microsiemens (μS).

Electromyography (EMG) signals for the orbicularis occuli (ORB) were sampled at 1000 Hz using miniature Ag/Agcl electrodes filled with electrode gel at the ORB muscle under the right eye, using the guidelines of Fridlund and Cacioppo (1986).

For data analysis purposes, mean HR and SCR average values were computed for 8 seconds prior to each scene onset (baseline) and during the presentation of different scenes (positive, negative, neutral). Raw EMG was rectified and integrated using a 10 seconds time constant. Startle magnitude was scored off-line by identifying peak microvolts (μV) within a 100ms window following each startle probe. Zero responses and responses that could not be visually detected were scored as missing. Mean baseline orbicularis occuli EMG was calculated for the 2 seconds prior to each startle probe and was subtracted from the peak magnitude. These difference scores were then converted to T-scores for each participant (using all startle responses collected for all films) to account for individual differences in startle responding. For each participant, startle magnitudes, HR and GSR were averaged across all presentations within the same film category. Extreme outlier trials, at the level of each film segment, were detected using a Boxplot and were excluded from the analyses.

Startle probes were created using the Audacity software and constituted 50ms bursts of 120-dBA white noise with instantaneous rise time. To avoid predictability, startle probes were presented in a quasi-random order. Nine scenes included 3 startle probes presented at the beginning, middle and end of the video (10, 25 and 45s from video onset). Three scenes included 2 startle probes presented at the beginning and middle of the video (10 and 25s) or at the beginning and the end (10 and 45s) or at the middle and the end (25 and 45s) of the video. Finally, three scenes included only 1 startle probe presented either at the beginning, the middle or the end (10s or 25s or 45s) and the remaining 3 scenes included no startle probes. Participants heard a total of 36 startle probes (12 presented during violent clips, 12 during neutral clips, and 12 during erotic clips), equally distributed across each film category throughout the duration of the experiment.

Subjective ratings. After each video segment, participants provided self-ratings of their reaction to the materials, including valence (1= unpleasant to 7 = pleasant), arousal (1 = calm/relaxed to 7 = aroused/ tense), dominance (1 = not in control of the situation to 7 in control of the situation) and fear (1 = not at all to 7 =very much). Valence (i.e. how positive or negative an emotional situation is experienced) and arousal (how intense an emotion is) are two basic dimensions of affective experience and account for most of the variance in affective ratings (Mehrabian & Russell, 1974). A third dimension, dominance, refers to experiencing oneself as potent, or in control of the situation, versus uncontrolled or submissive. Although it also explains substantial variance, it is highly correlated with ratings of positive valence in most previous accounts (e.g. Bradley & Lang, 1994). Ratings of dominance were included both because they are part of the standard approach when rating emotional materials, and because feelings of dominance as a response may be pertinent to individuals high on psychopathic traits, in interpersonal situations. Participants also provided ratings (0=not at all to 9=very) on intended content (violence, erotic). After the presentation of violent scenes 4 empathy (i.e. "At the end of the scene I felt bad for the victim") and 3 villain acceptance items (i.e. "The villain's acts were justified") were included. Items were rated on a 5-point Likert-scale ranging from 0 (strongly disagree) to 4 (completely agree). Item scores are summed to form a total score which demonstrated adequate internal consistency (Cronbach's alpha: α = .92; α = .94 respectively). Participants also rated how sad the violent scene made them fell (1=not at all to 7=very much).

Procedure

Participants were seated in a padded, reclining chair and were given detailed information about the experiment. After signing the informed consent material, participants were fitted with physiological monitors and were instructed to relax for a few minutes in order to check the accuracy of recordings. Earphones were then placed on participants and baseline measures were collected for a minute prior to experiment onset, while participants were looking at an empty computer screen. Next, a fixation point appeared in the center of the screen (47 cm X 24.5 cm) for 5 seconds on which participants were told to focus their gaze. The presentation of the fixation screen was also used as a baseline measure prior to scene onset. Participants then viewed the 18 video segments. The video segments were presented in a randomized order, same for all participants with the constraint that no two scenes of the same type could appear in sequence. Following each video, participants entered their ratings on a computerized likert-type scale for the video they had just viewed using a compact keyboard placed by their dominant hand. The presentation of the video segments ended with neutral scene, in order to help participants return to a neutral mood before leaving. Once the experiment was completed, participants were asked to remain seated for a minute while baseline measures were collected, again. Then all electrodes were removed and participants were debriefed.

Plan of analysis

Separate repeated analyses of variance (ANOVA) in SPSS 20 were performed for self report ratings and physiological responses to test for main and interactive effects of identified groups.

To test how self-reported ratings of valence, arousal, dominance, and fear, separate repeated measures ANOVAs were conducted with CP group (low, high), and CU group (low, high) as between subject variables and the 3 levels of film-type (violent, erotic, neutral) manipulation as within subject variables. For erotic content, violent content, sadness, empathy and acceptance of the villain a two way analyses of variance (ANOVAs) were conducted with CP group (low, high), and CU group (low, high) variables.

For physiological responses resting heart rate and resting GSR a 2 (CP group: low, high) by 2 (CU group: low, high) analyses of variance – ANOVA was conducted. For HR and GSR during scene presentation repeated measures ANOVAs, were conducted with CP group (low, high), and CU group (low, high) as between subject variables and the 3 levels of film-type (violent, erotic, neutral) manipulation as within subject variables. Repeated measures ANOVA were conducted with startle amplitude as the dependent variable and the 3 levels of scene-type as the independent variable.

Startle Index (SI). For startle index, the amplitude (T-scores) of the startle signal recorded during violent scenes was subtracted from the corresponding amplitude obtained from neutral films. Hence, in this analysis responses to neutral films are treated as the baseline affective condition. Two startle indexes were computed one for violent and one for erotic scenes. For startle indexes a 2 (CP group: low, high) by 2 (CU group: low, high) analyses of variance – ANOVAs was conducted. Greenhouse-Geisser corrected effects are reported in the text.

Results

Self-Report Responses

Valence. Findings from the repeated measures ANOVA suggest a significant main effect of type of scenes, $F(2,65) = 451.14$, $p<.001$, $\eta^2 = .87$. Post-hoc comparisons using the Bonferroni correction reveal that all 3 types of scenes differed significantly from each other. Violent scenes (*M*=1.77, *SE*=.09) resulted in higher negative valence scores than both neutral (*M*=5.21, *SE*=.10) and erotic (*M*=5.47, *SE*=.10) scenes. The degree of pleasantness of the erotic scenes (on a 7 point scale) and unpleasantness of violent scenes are close to the end-points of the scale and correspond to the pleasantness and unpleasantness of evolutionary significant picture content (e.g. erotica, babies vs. human attach, mutilation) as described by Bradley, Codispoti, Cuthbert, and Lang, (2001) where a 20 point scale was used (corresponding means were around 15/20 for pleasant and 5/20 for unpleasant pictures in that study). Thus, the results show that the affective materials used captured the valence dimension adequately and, similarly to the most often used affective pictures, differed in terms of valence, as reported by self-report measures.

Arousal. Participants rated the scene content differently in arousal $F(2,144) = 275.00$, p<.001, $\eta^2 = .79$, with post hoc comparisons using the Bonferroni correction indicating that all scene types were rated as significantly different in arousal form each other. Violent scenes were rated as the most arousing (*M*=5.82, *SE*=.09), followed by erotic (*M*=4.13, *SE*=.15) and neutral (*M*=2.16, *SE*=.12).

Hence, scenes induced the anticipated emotions mostly as expected. In spite of our efforts, however, to match violent and erotic scenes on the arousal dimension, while keeping them significantly different in valence, erotic scenes in the experimental phase were rated as lower in arousal than violent scenes but still more arousing than neutral.

Dominance. Participants rated the scenes differently in dominance $F(1,144) = 63.44$, p<.001, $\eta^2 = .49$, and ratings were different from each other as indicated by post hoc comparisons using the Bonferroni correction (p<.001). Participants reported feeling more in control during neutral scenes (*M*=6.02, *SE*=.12), than erotic (*M*=5.57, *SE*=.12) and less in control during the presentation of violent scenes (*M*=4.23, *SE*=.21).

Fear. Participants reported feeling more fear during the presentation of violent scenes (*M*=4.02, *SE*=.21), than neutral (*M*=1.17, *SE*=.04) and erotic (*M*=1.03, *SE*=.02) scenes, $F(2,144) = 211.26$, p<.001, $\eta^2 = .75$. Surprisingly the difference in fear reported during neutral and erotic presentation was significant (p<0.5). Between group differences suggested that identified high CU participants report less fear (*M*=1.92, *SE*=.11) than identified low CU individuals (*M*=2.221, *SE*=.11), $F(1,70) = 3.98$, $p < .05$, $\eta^2 = .05$. A significant Scene Type x CU group interaction $F(2,144) = 6.79$, $p < .05$, $\eta^2 = .09$), was found on fear reported. As shown in figure 17, high and low CU participants report similar ratings of fear during the presentation of erotic and neutral scenes, however, during the presentation of violent scenes high CU participants reported less fear than low CU participants. Further a significant CU group x CP group interaction $F(1,70) = 4.42$, $p < .05$, $\eta^2 = .06$) was found. As shown in figure 18, for participants low on CPs the presence or absence of CU traits did not affect participants' ratings on self-report fear. For participants with high CPs however the presence of CU traits shows a very different pattern, with participants low on CU traits reporting more fear and participant with high CU traits reporting the least. A significant Scene type x CU group x CP group interaction $F(2,144) = 5.32$, $p < .05$, $\eta^2 = .07$) on self-reported fear was also found. As shown in figure 19, no distinct differences are noticed between CPs and CU groups when rating fear for erotic and neutral scenes. For participants low on CPs the presence of CU traits did not affect their ratings on fear after viewing violent scenes. Among participants high on CPs the presence of CU traits was related to less fear during violent scenes compared to those low on CU traits.

Erotic content. Findings from the two way ANOVA suggest a significant main effect of CP group when rating erotic scenes, $F(1,72) = 4.13$, $p<.05$, $\eta^2 = .05$. Post hoc comparisons using the Bonferroni correction indicated that participant with high CPs rated erotic scenes as less erotic (M=6.59, SE=.26) compared to low CPs participants (M=7.26, SE=.20) who rated the erotic scenes as more erotic.

Violent content. Findings from the two way ANOVA suggest a significant main effect of CP group when rating violent scenes, $F(1,72) = 6.38$, $p<.05$, $\eta^2 = .08$. Post hoc comparisons using the Bonferroni correction indicate that participant with high CPs rated violent scenes as less violent (M=7.069, SE=.24) compared to low CPs participants (M=7.83, SE=.19).

Sadness. Findings from the two way ANOVA suggest a significant main effect of CU group on sadness when viewing violent scenes, $F(1,72) = 11.70$, $p<.001$, $\eta^2 = .14$. Post hoc comparisons using the Bonferroni correction, indicate that participant with high CU reported feeling less sad (M=5.18, SE=.22) compared to low CU participants (M=5.42, SE=.18).

Empathy. Findings from the two way ANOVA suggest a marginal significant main effect of CU group on empathy when viewing violent scenes, $F(1,72) = 3.86$, $p=.053$, $\eta^2 = .05$, indicating that participant with high CU reporting less empathy (M=13.50, SE=.31) compared to low CU participants (M=14.38, SE=.32). A significant main effect of CP group on empathy is also reported, $F(1,72) = 7.34$, $p<.05$, $\eta^2 = .09$. Post hoc comparisons using the Bonferroni correction, indicate that participant with high CPs reported less empathy (M=13.34, SE=.35) compared to low CPs participants (M=14.54, SE=.28).

Acceptance of the villain. Findings from the two way ANOVA suggest a significant main effect of CP group on reported acceptance to the villain in violent scenes, $F(1,72)$ =

10.28, $p<.05$, $\eta^2 = .13$. Post hoc comparisons using the Bonferroni correction, indicate that participant with high CP reported being more accepting to villains actions (*M*=1.69, *SE*=.27) compared to low CP participants (*M*=0.58, *SE*=.22).

Physiological Responses

Resting Skin Conductance (RSC). Findings from the 2 way ANOVA suggest a significant main effect of CP group, $F(1,74) = 6.53$, $p<.05$, $\eta^2 = .09$. Post-hoc comparisons using the Bonferroni correction reveal that RSC was significantly lower (*M*=3.70, *SE*=.91) for identified participants with high CPs compared to low CPs participants (*M*=6.65, *SE*=.72).

Skin Conductance (SC). Findings from the repeated measures ANOVA suggest a significant main effect of type of scene, $F(2,134) = 15.07$, $p<.001$, $\eta^2 = .18$. Post-hoc comparisons using the Bonferroni correction reveal that SC during the presentation of violent scenes was significantly higher (*M*=6.15, *SE*=.58) than during the presentation of erotic (*M*=5.92, *SE*=.56) and neutral scenes (*M*=5.97, *SE*=.56). SC during the presentation of erotic and neutral scenes did not reach a significant level. Between group differences suggested that identified high CPs participants showed a lower SC level during scene presentation (*M*=4.82, *SE*=.88) than low CPs participants (*M*=7.20, *SE*=.70), $F(1,67) = 4.47$, $p < .05$, $\eta^2 = .06$.

Resting Heart Rate (RHR). Findings from the two-way ANOVA suggest a significant main effect of CPs group, $F(1,67) = 4.06$, $p<.05$, $\eta^2 = .06$. Post-hoc comparisons using the Bonferroni correction reveal that RHR for high CPs was significantly lower (*M*=73.27, *SE*=1.95) compared to participants with low CPs (*M*=78.31, *SE*=1.57).

Heart Rate (HR). Findings from the repeated measures ANOVA suggest that participants with high CPs showed lower HR (*M*=73.45, *SE*=1.41) than low CPs participants (*M*=76.78, *SE*=1.19) during scene presentation but this difference did not reach significant level $F(1,64) = 3.24$, $p=0.8$, $\eta^2 = .05$. A significant CP x CU interaction, $F(1,64) = 4.96$, $p<.05$, $\eta^2 = .07$) is also reported. As shown in figure 20, HR in participants with high CPs is low in both high and low CU traits participants. Among low CPs however the presence of CU traits is related with lower HR.

Startle amplitude. As using videos to examine affective startle modulation is a novel procedure, the effectiveness of the scene-type manipulation was first verified. Results showed that differences in amplitude were significant between scene types, $F(2, 66) = 10.07$, $p<.001$,

ε=.14. Post-hoc comparisons using the Bonferroni correction indicated that violent (*M*=.013, *SE*=.002) and erotic (*M*=.012, *SE*=.003) scenes resulted in significantly larger startle responses compared to neutral scenes (*M*=.004, *SE*=.002). Differences between violent and erotic scenes were not significant. These findings verify that the expected startle potentiation by negatively and positively valent materials can be obtained using violent films and replicates previous work using picture stimuli.

Startle Index Violent. For violent scenes there was a marginal significant main effect of the CP group, $F(1,65) = 3.92$, $p=.052$, $\eta^2 = .06$). Post-hoc comparisons using the Bonferroni correction show that identified high CP participants showed lower startle index during violent scenes (*M*= .004, *SE*=.004) than low CP participants (*M*=.014, *SE*=.003). A significant CP group x CU group interaction, $F(1,65) = 4.23$, $p < .05$, $\eta^2 = .06$) on startle index is also reported. As shown in figure 21, high CPs-low CU and low CPs-high CU individuals were not differentiated form the normative group on startle responses. However those high on both CPs and CU traits were the ones differentiated from the rest of the groups by showing the smallest startle index.

Startle Index Erotic. For erotic scenes there was a significant CP group x CU group interaction, $F(1,65) = 7.13$, $p < .05$, $\eta^2 = .10$). As shown in figure 22, for participants with low CPs- high CU and high CPs-low CU show similar startle index between them but higher than controls. However the high CPs high CU group, showing the smallest startle index, similar to violent scenes.

Discussion

The present study aimed to determine how individuals with CPs and CU traits differ in terms of physiological and self-report responses after viewing violent or erotic scenes. It aimed to highlight the importance of the co-occurrence between CU traits and CPs to understand their physiological responses. In this respect, this study contributes three key findings. First among individuals with high levels of CPs, those high on CU traits show low startle response obtained during the presentation of both negative and positive valent stimuli, and report experiencing low fear (self-report) when viewing violent scenes. Second, the CPs-only group score similarly to the low risk group on startle index during violent scenes, but show relatively high startle index during the presentation of erotic scenes. Furthermore the CPs-only group report the highest fear during the presentation of violent scenes. The findings also provide novel evidence that the CU-only group demonstrated high physiological responsiveness to fear, by obtaining the highest startle index during the presentation of violent scenes. Third, individuals high on CU traits, irrespective of level of CPs, showed low subjective experience of being sad, and low empathetic responsiveness to victims of violence.

The study's findings replicate prior work in adults, documenting that the affective/interpersonal features of psychopathy, including CU, are related to physiological measures of low fear. Similar to the affective dimension of psychopathy, CU traits are associated with poor negative affect startle modulation. The fearless temperament of individuals with CU traits is related to a dysfunction of the defense motivation system, possibly leading to the restricted fear responses when viewing violent scenes, as verified by the low fear ratings of these materials by those high on CU traits. These assertions are supported by self-report ratings collected in this study suggesting that CU traits are associated with low fear responses when viewing violent scenes, experiencing less sadness and low empathy reports. Furthermore this study contributes the novel finding that it is individuals high on both CP and CU traits, but not youth high on CU traits alone who showed the pattern of diminished eye-blink startle reactivity to fearful stimuli compared to neutral stimuli. Therefore, it might be the combination of antisocial behavior and CU traits that relates to abnormal activation of the defensive system and amygdala dysfunction. The low defensive activation to fearful stimuli shown by individuals high on CP and CU traits is also reflected in their low emotional arousal in heart rate. The study findings in combination suggest that antisocial individuals high on CU traits are generally emotionally under-responsive, and are less likely to experience emotional distress when presented with violent video scenes.

Preliminary analyses with regards to emotion induction effects showed that erotic scenes elicited equally high startle reflex magnitudes to violent scenes compared to neutral scenes. This is a rather unexpected finding. While startle is increased or potentiated after viewing negatively valence stimuli, it is reduced or inhibited after viewing positively valent or pleasant stimuli (Bradley, Cuthbert, & Lang, 1990; Patrick, 1994). This could be due to the use of affective scenes. In adult imagery studies startle was found to increase as a function of arousal for pleasant scripts (vanOyen Witvliet & Vrana, 2000). Similarly Miller, Patrick and Levenston (2002) found greater startle reactivity for personal pleasant imagery scenes rated higher in arousal and vividness than standard imagery scenes. It is possible that erotic scenes probably captured participants attention (they were rated as more arousing that neutral scenes) resulting in increased engagement of mental processing and consequently, enhanced startle magnitude upon interruption by the loud noise probe. This would also explain the low reactivity in individuals with high CPs/CU when exposed to erotic scenes which contradict previous findings (Lang, Bradley, & Cuthbert, 1990; Patrick et al., 1993; Pastor, Moltó, Vila & Lang, 2003; Vaidyanathan et al., 2011) of an intact appetitive system.

Second, the findings also provide initial evidence that individuals high on CP-only show normalized startle activity during negative stimuli but enhanced during positive stimuli, compared to individuals high combined CPs/CU. The startle findings suggest that the CP-only group display the typical pattern encountered in normal participants when exposed to negative stimuli and an exaggerated pattern when presented with positive stimuli. This finding, replicates previous studies regarding the second dimension of psychopathic characteristics, involving impulsivity and antisocial behavior. Like in the adult literature this dimension is unrelated to startle reflex modulation and can be interpreted due to high emotional reactivity and dysregulation difficulties often seen in individuals with CPs and low CU traits (Hicks & Patrick, 2006). The present findings of low ratings on skin conductance (both resting and during the presentation of various scenes) among individuals high on CPs also support this proposition. In accordance with Frick and Viding (2009), deficits in both cognitive and emotional regulation of behavior, seen among CP-only youth, could lead to strong reactivity to negative stimuli. These deficits in dysregulation make this group especially vulnerable to distress cues.

In contrast to youth high on both CP and CU traits, non-antisocial youth with high CU traits were similar to controls in terms of behavioral and physiological responding to fear. It is unclear from prior work how individuals high on CU traits with limited antisocial behavior respond to fearful stimuli, and current findings indicate that they process fear-related information in a normative way. What is interesting about this group is that they are highly reactive but are also able to regulate their behaviors by not engaging in antisocial behaviors. Thus, it can be concluded that although individuals high on CU traits show low levels of empathy and remorse, they do not seem to have a problem in processing emotional information, and specifically fear-related information, which may act as a protective mechanism against the engagement in antisocial behavior.

The present findings contribute to the hypothesis that antisocial behavior is related to general autonomic deficits of reduced arousal (Raine, 2002), while core deficits of psychopathy (CU traits) result in a pattern of responses that indicate deficits in the defensive motivation system. Specifically the findings demonstrate that deficiencies in defense system are present not only in incarcerated individuals with psychopathic traits but also among community samples.

General Discussion

In summary, the current study emphasizes that, individuals with high CU and CPs, exhibit deficits in attention allocation and emotional processing. The study demonstrates that a set of core psychopathic characteristics, specifically CU traits, lead to the typical absence of startle potentiation by negative valent stimuli, are related to facial affect recognition deficits and attention allocation deficits to distressing cues, deficits that are able to differentiate individuals with CU traits from individuals with high CPs but low CU. Eye tracking evidence suggests that high CU participants attend less to the human faces but not when processing pictures or words. Individuals with CPs on the other hand show the reverse pattern of findings, showing deficits in processing words, pictures and lower accuracy ratings in the face recognition task. This indicates that the attention related deficit evident in individuals with high CU is specific to the processing of dynamic human faces and does not extent to the processing of pictures (that also included human faces) and words, while participants with CPs show a pattern of results that points to general impairments in executive function, possibly inhibition control. This assumption is further supported by the findings from the third experiment where movie scenes were used. Dynamic faces and movie scenes are arguably higher in perceptual load than isolated words and pictures.

It could be argued that the startle potentiation deficits among CU individuals could be attributed to an attentional rather than an affective deficit (Baskin-Sommers et al., 2013; Sadeh & Verona, 2012). The findings from this study are compatible with models of selective attention, that argue that once an early attention bottleneck is establish, it blocks the processing of secondary information that is not goal-relevant (Baskin-Sommers, Curtin, & Newman, 2013; Newman et al., 2010). According to this perspective, individuals with CU traits fear conditioning deficits as well as their other behavior and emotion deficits reflect a failure to process affective inhibitory and other potential important information when it is peripheral to their ongoing goal-directed behavior. While this attention bottleneck may allow individuals with CU traits to be more effective in filtering out distractions and focusing on personal goals, it may also leave them vulnerable to over-allocate attention to goal-relevant cues at the expense of ignoring important context-relevant information. However, this conclusion should be made tentatively, as the experiments 1, 2 and 3 differed not only in type of stimuli used and perceptual load.

Emerging findings about the specificity of emotion processing deficit in individuals with CU traits and the promising intervention manipulations that could be used, are encouraging. There is support (Hawes, Price, & Dadds, 2014) that skill training targeting social-cognitive deficits related to emotional regulation and problem solving can be beneficial for both individuals with CPs and CU traits, especially with the involvement of parents in the intervention. Taking into account specific attentional and emotional impairments in heterogeneous CP groups and tailoring interventions around their specific impairments/deficits will produce lasting improvements particularly when delivered at an early stage. For example, interventions targeting facial affect recognition including cues like the ones used in the current study, may help individuals with CU traits become more vigilant to distressing cues in others. Correctly recognizing distress cues has been associated with increased prosocial behavior (i.e. desire to help others) (Marsh & Ambany, 2007), and paying attention to facial cues has been shown to decrease CPs associated with CU traits (Dadds, Cauchi, Wimalaweera, Hawes, & Brennan, 2012; Hawes et al., 2014). Sensitivity of facial affect recognition (Schonenberg, Christin, Gauber, Mayer, Hautzinger, & Jusyte, 2013) indicates that this training approach is successful and has lasting effects. For individuals with CPs interventions could also emphasize improving emotional regulation and problem solving deficits. Relaxation and anger management techniques might be important for this subgroup of individuals.

Strengths and Limitations

Strengths of this project include first the fact that a very large community sample of participants, with varying levels CU traits and CPs, was screened in order to identify a sample with the profile of characteristics under study. In addition, findings from the current study reinforced by the variety of stimuli used (words, pictures, dynamic facial expressions, video scenes) as well as various measures (eye gaze, physiological measures, self reports) for the constructs under study, allowing a more thorough explication of the findings. This study also helped to generalize previous findings of emotion processing deficits in psychopathy and aggressive behavior to affective contexts beyond affective picture stimuli, by using more ecologically valid stimuli (films, dynamic facial expressions). Violent scenes clearly evoke negative affect based on the obtained ratings, including fear while dynamic facial expressions affected participants' performance in attention allocation and accuracy measures. Findings are important both for psychopathy research, facial affect recognition, startle modulation and attention research in general. The results add to the scarce previous evidence that startle potentiation by negative contexts can be achieved using negative and high arousing films, and that facial affect recognition is a useful way of differentiate individuals with high CU traits.

These findings must be considered in light of several methodological issues. While this study represents a useful starting point for investigating the unique contributions of CU traits and CPs to attentional and emotional processes, a larger sample for the experimental phase would increase power to reliably detect smaller effect sizes. Furthermore the short presentation times of stimuli in experiments 1 and 2, that included eye tracking measures, did not allow for a thorough investigation of the executive function deficits theorized to be associated with the impulsive-antisocial dimension, namely impaired cognitive control and response inhibition and of how these processes might influence emotional processing. A useful direction for future research may include longer presentation times that will allow the examination of time-course visual scanning patterns of eye gaze behavior such as, prioritizing, shifting patterns, disengaging from one stimulus etc. Distinct viewing patterns will help in the understanding of these deficits and how to overcome them.

Despite these limitations, the project advances the literature on antisocial behavior and affective psychopathic traits by providing new evidence that these problems are not solely characterized by emotion or attentional deficits but rather indicate that they are characterized by interactive cognition-emotion deficits that manifest differentially in pure or co-occurring forms of CPs and CU traits. Importantly, the findings provide evidence that individuals with CPs represent a heterogeneous group, differentiated on attentional, emotional and physiological measures. This is an important line of research that can enhance existing treatment efforts and point to avenues for new and creative interventions, especially among individuals with CU traits who are less likely to be benefitted from intervention efforts.

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Table 1.

Participating groups

	CU	
	Low	High
Low CPs	29	17
High CPs	14	16

Table 2.

Descriptive Statistics for Screening Phase Data.

	CPs		CU	
	Mean	SD	Mean	SD
Time 1 (*N* = 1893):				
Low CPs Low CU	1.67	1.62	13.00	4.82
Low CPs High CU	3.07	1.87	27.13	8.60
High CPs Low CU	7.50	4.21	19.88	6.33
High CPs High CU	11.39	8.10	34.52	9.02
Time 2 (*N* = 117):				
Low CPs Low CU	1.90	1.87	12.52	5.82
Low CPs High CU	3.40	2.23	32.33	7.10
High CPs Low CU	12.50	9.72	20.53	6.57
High CPs High CU	14.93	8.26	33.85	7.92
Time 3 (*N* = 76):				
Low CPs Low CU	2.05	1.77	13.48	5.88
Low CPs High CU	2.87	1.51	25.67	9.17
High CPs Low CU	4.63	2.20	17.13	4.42
High CPs High CU	9.00	5.88	34.85	6.80

Figure 1. CP Group by Time interaction with CPs as the dependent variable.

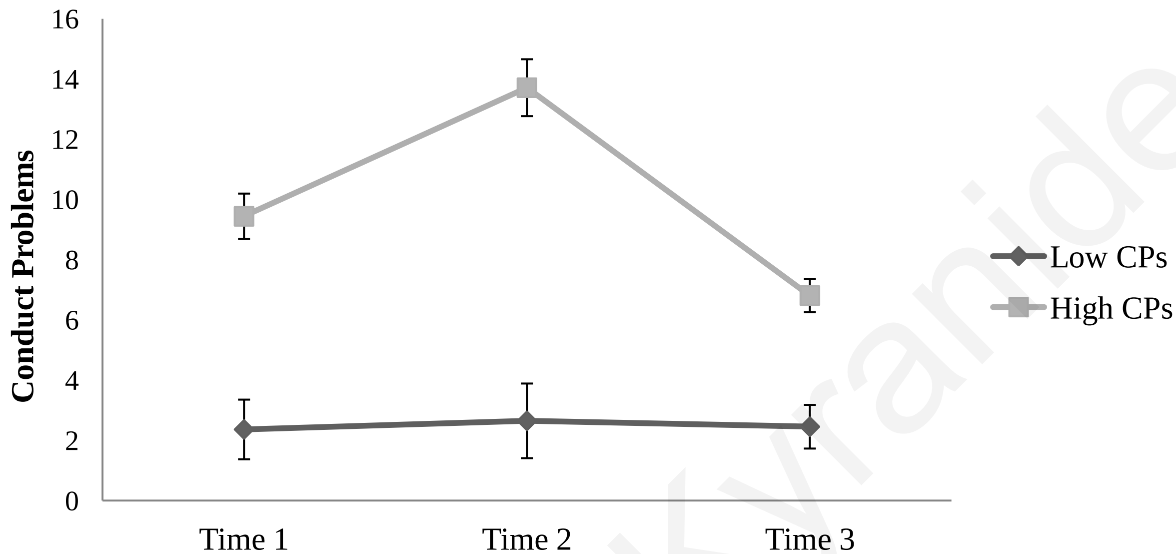


Figure 2. CP Group by CU group by Time interaction with Callous Unemotional traits as the dependent variable.

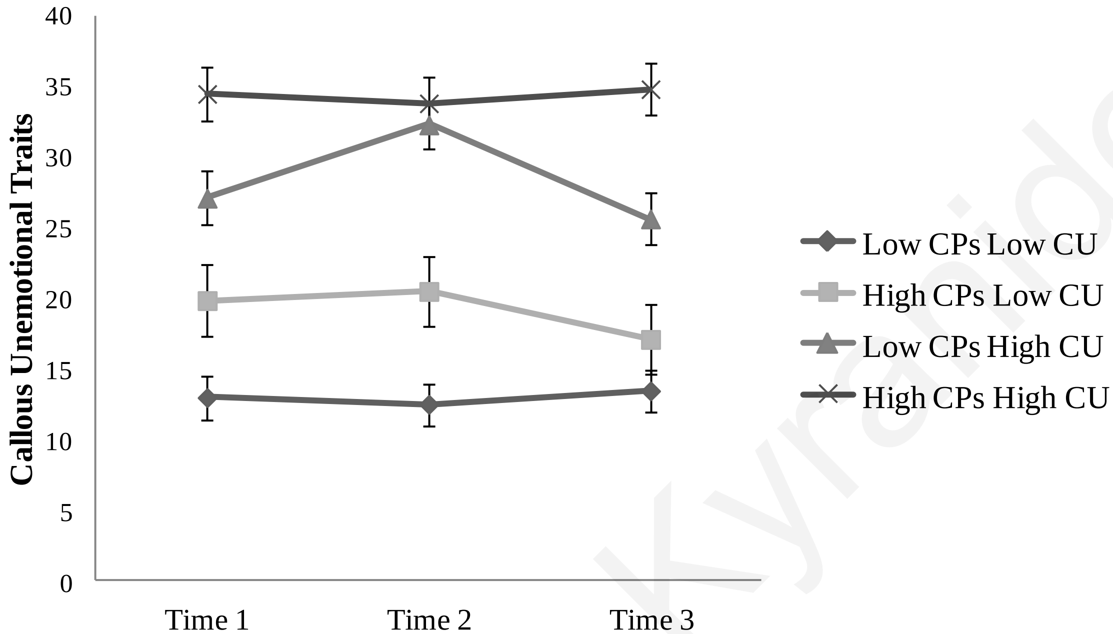


Figure 3. Areas of interest for emotional word dot-probe task.

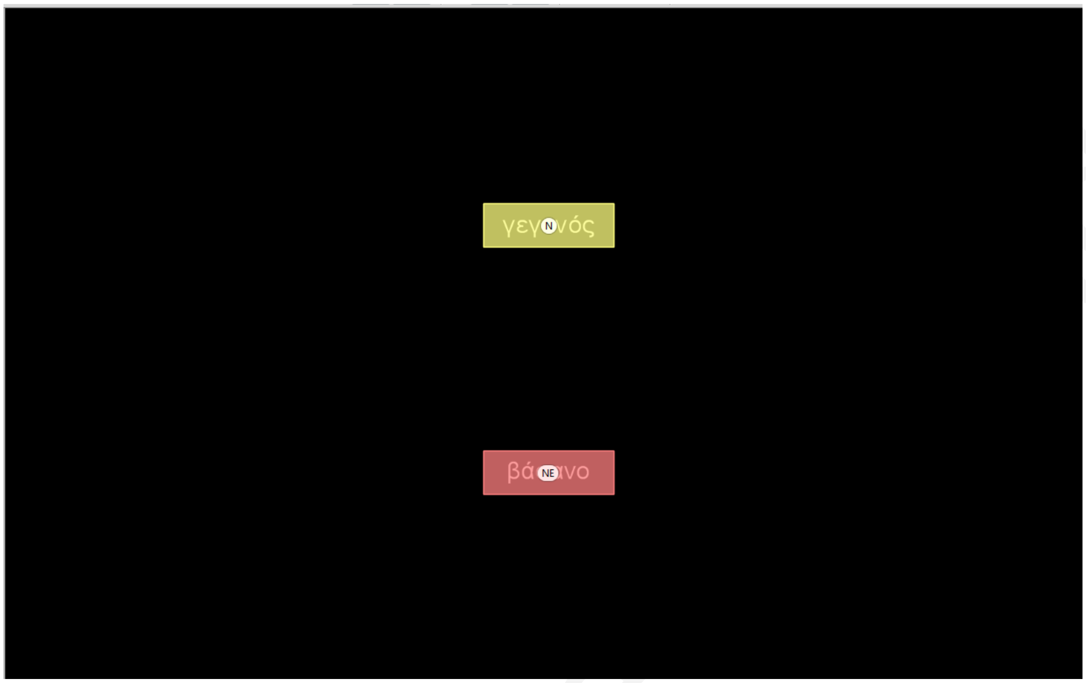


Figure 4. Areas of interest for emotional picture dot-probe task.

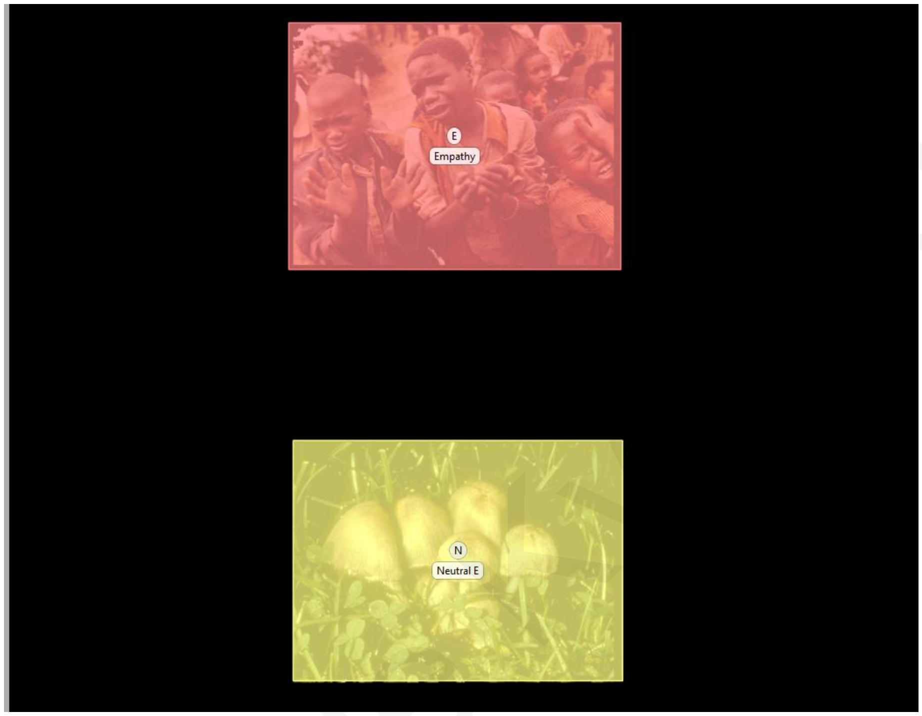


Figure 5. Areas of interest for Facial Expression Recognition task

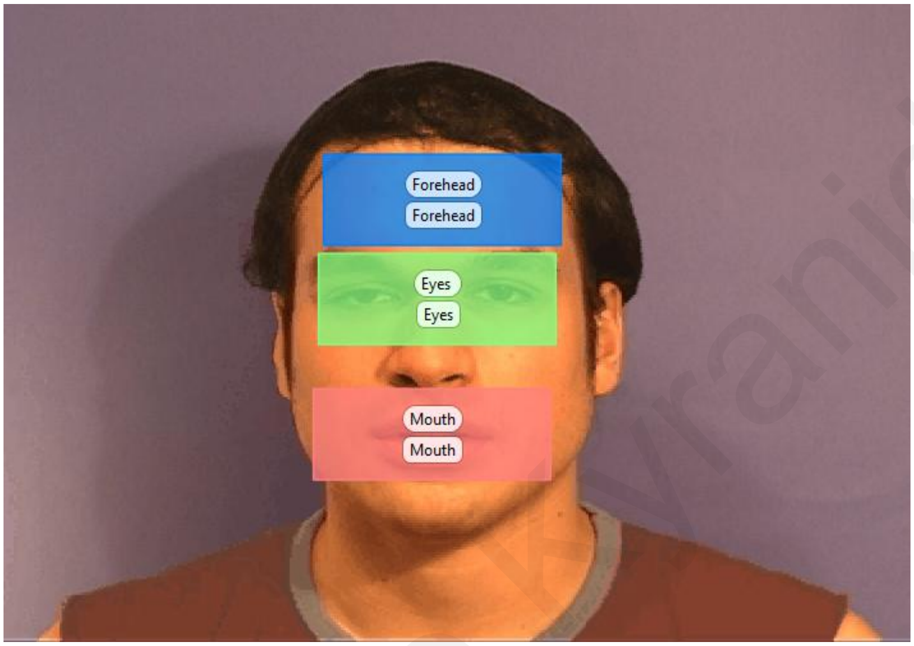


Figure 6. Face Area by Probe Location interaction with eye gaze as the dependant variable for all facial expressions.

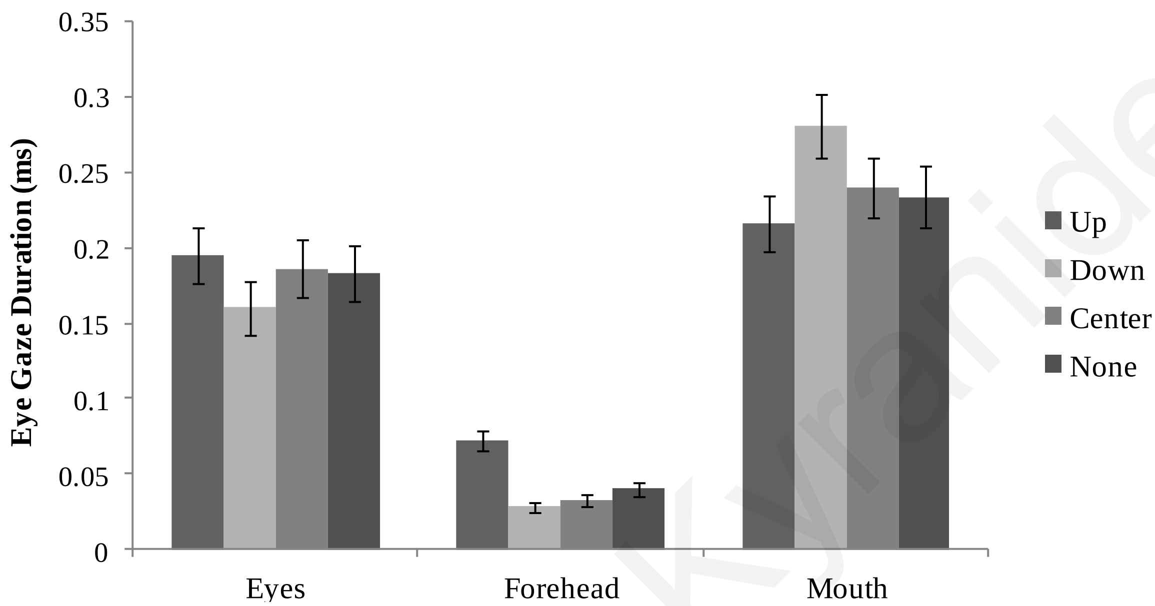


Figure 7. Face Area by CU group interaction with eye gaze as the dependant variable for all facial expressions.

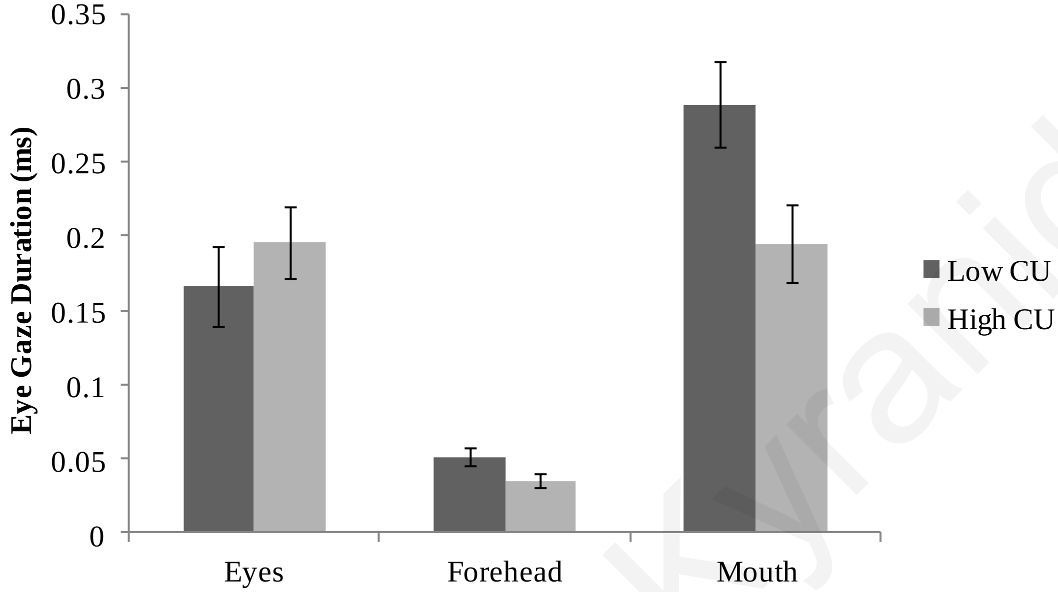


Figure 8. Face Area by Probe Location interaction with eye gaze as the dependant variable for all angry expressions.

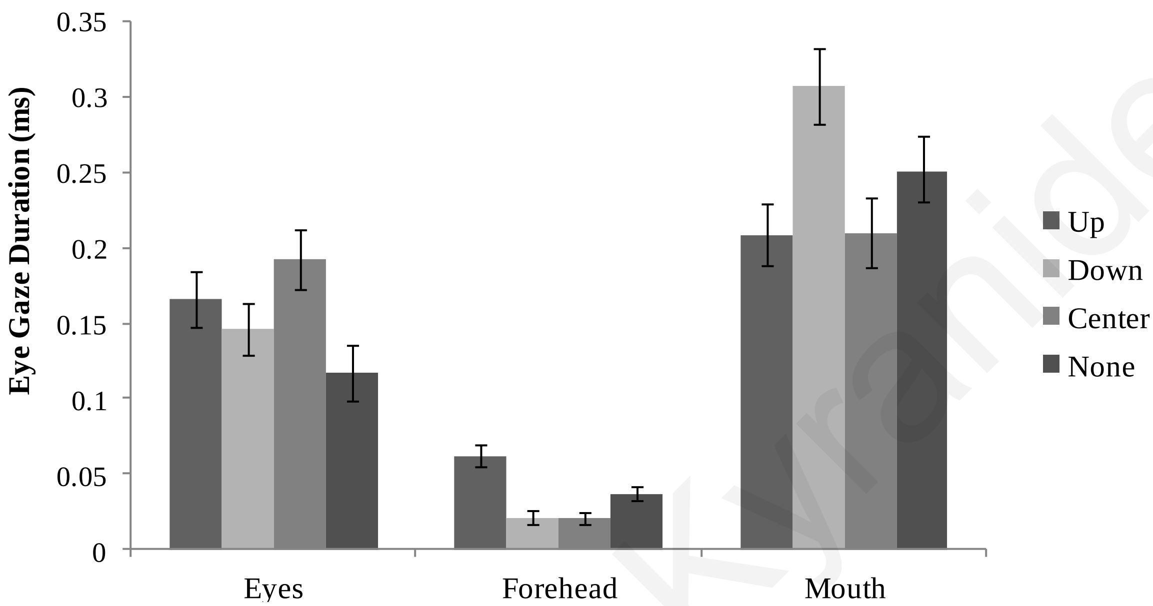


Figure 9. Face Area by Probe Location interaction with eye gaze as the dependant variable for all fear expressions.

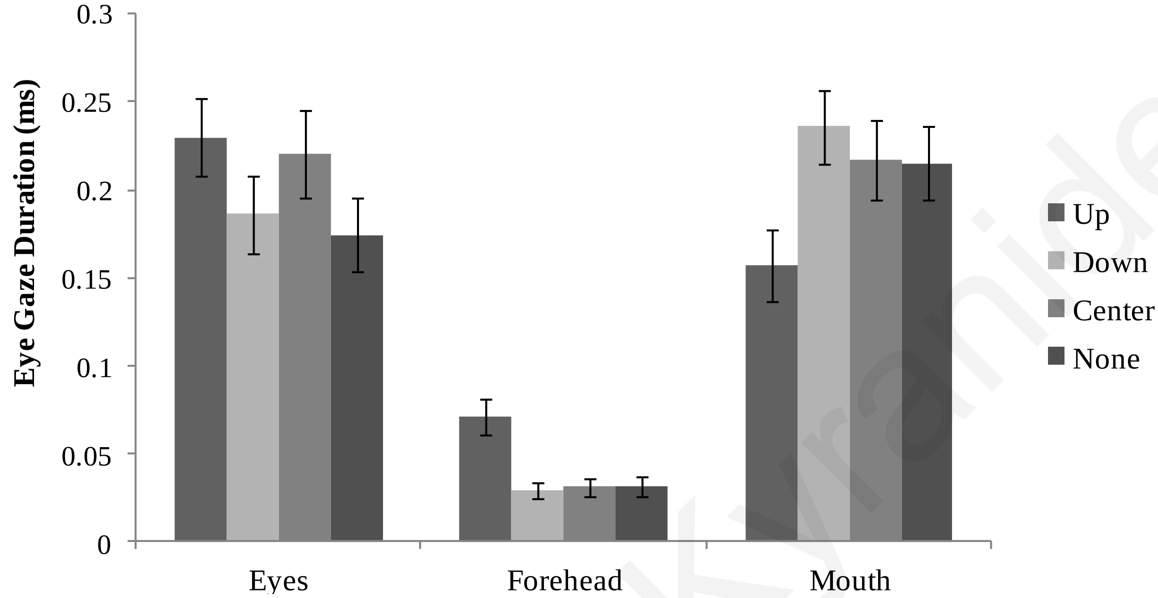


Figure 10. Face Area by Probe Location interaction with eye gaze as the dependant variable for all pain expressions.

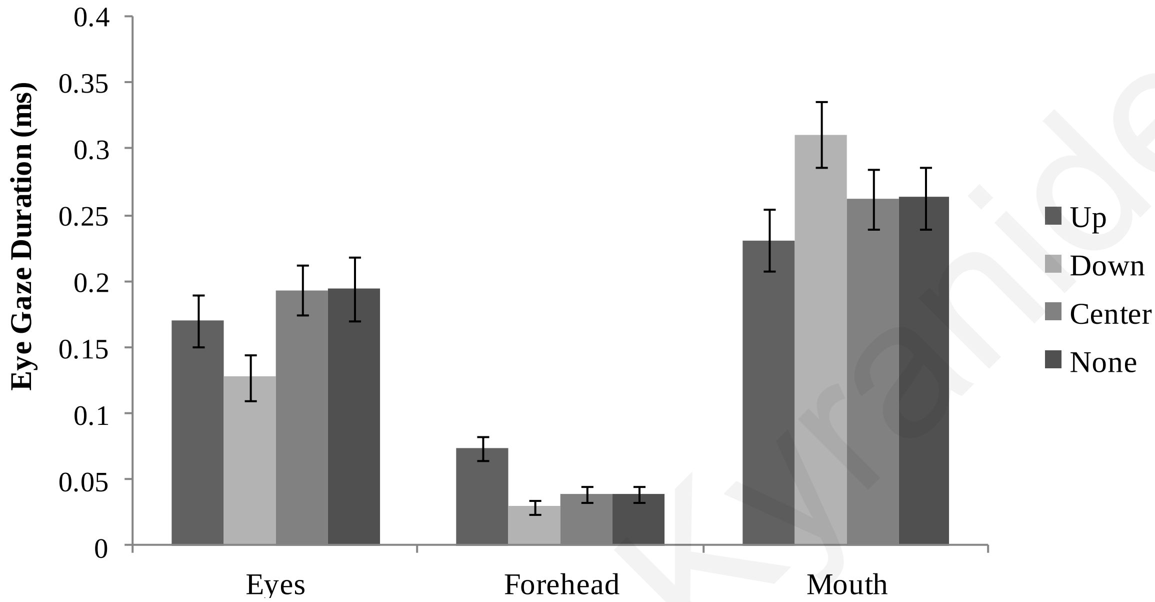


Figure 11. Face Area by Probe Location interaction with eye gaze as the dependant variable for all sad expressions.

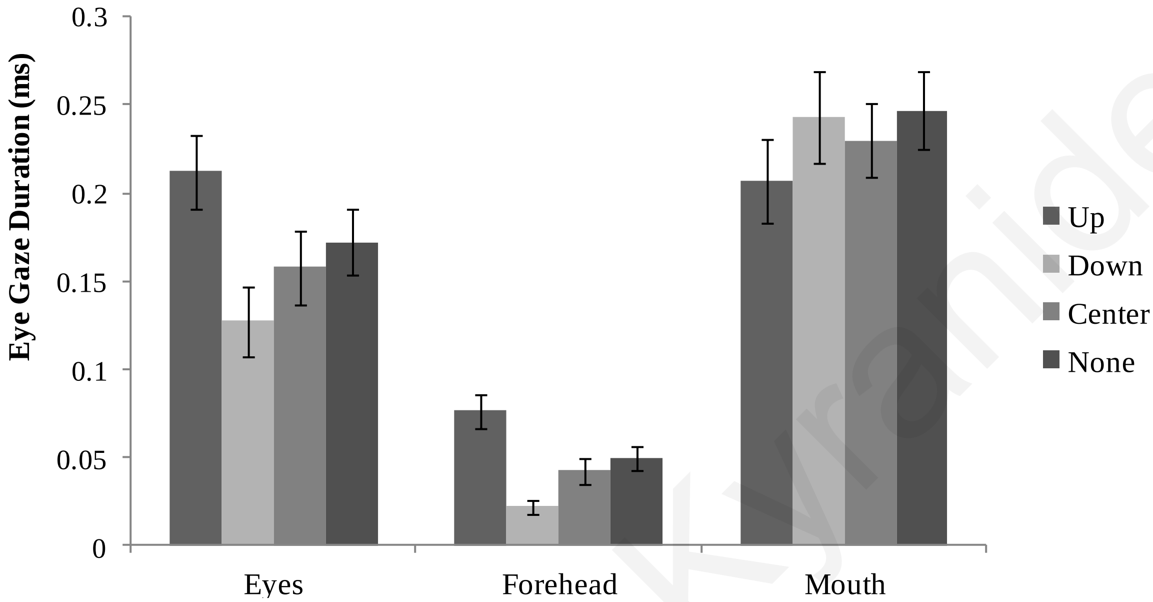


Figure 12. Face Area by CU group interaction with eye gaze as the dependant variable for all happy expressions.

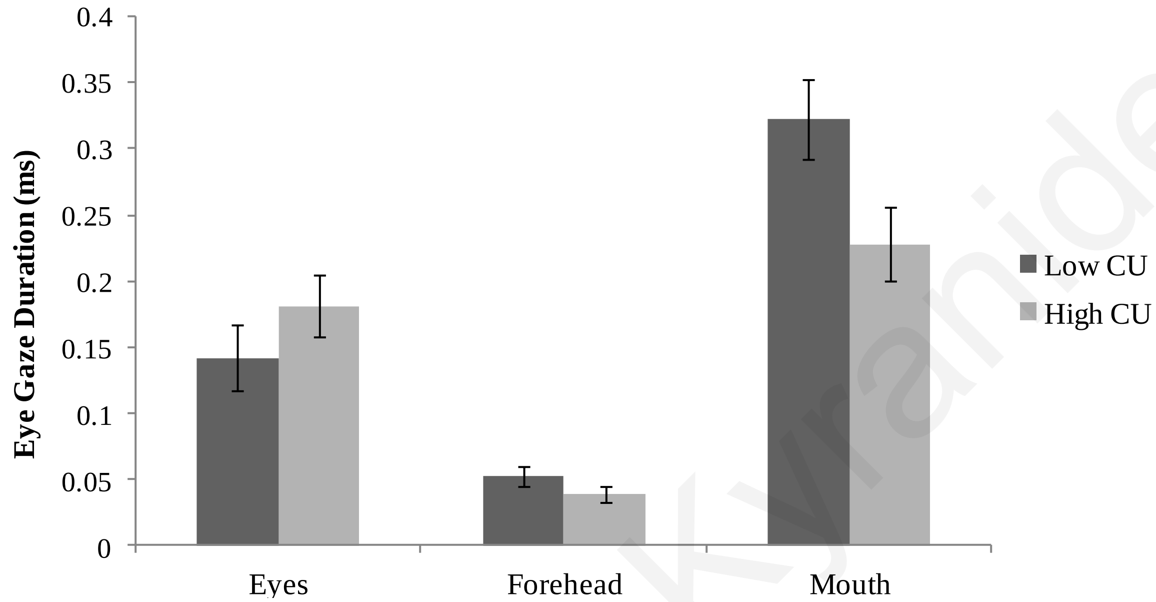


Figure 13. Face Area by Probe Location interaction with eye gaze as the dependant variable for all happy expressions.

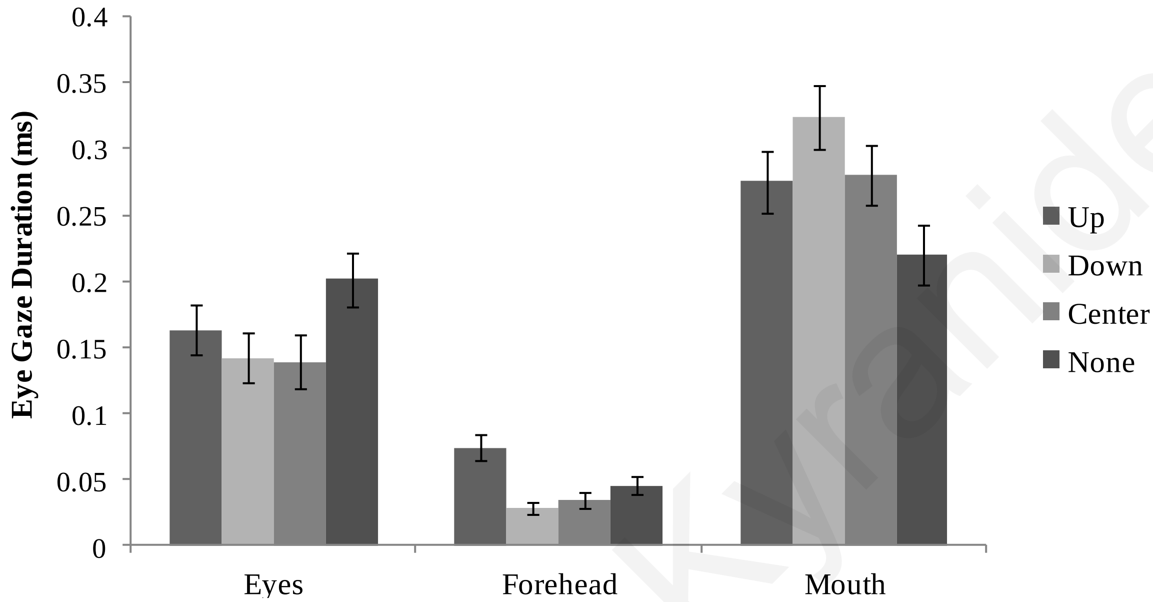


Figure 14. Face Area by Probe Location interaction with eye gaze as the dependant variable for all Neutral expressions.

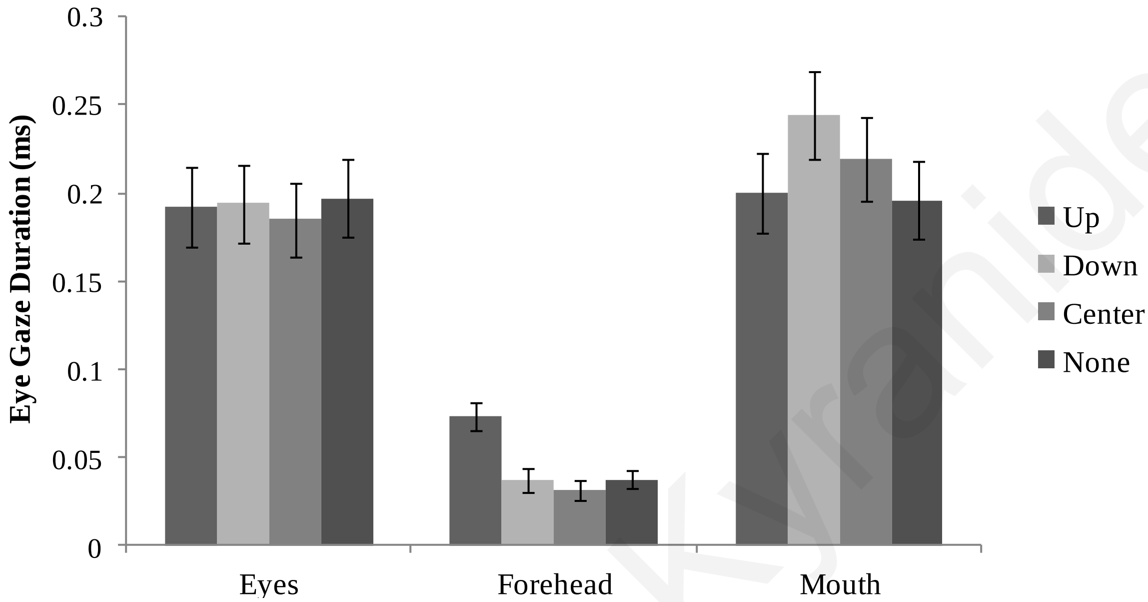


Figure 15. Expression by Probe Location interaction with accuracy as the dependant variable.

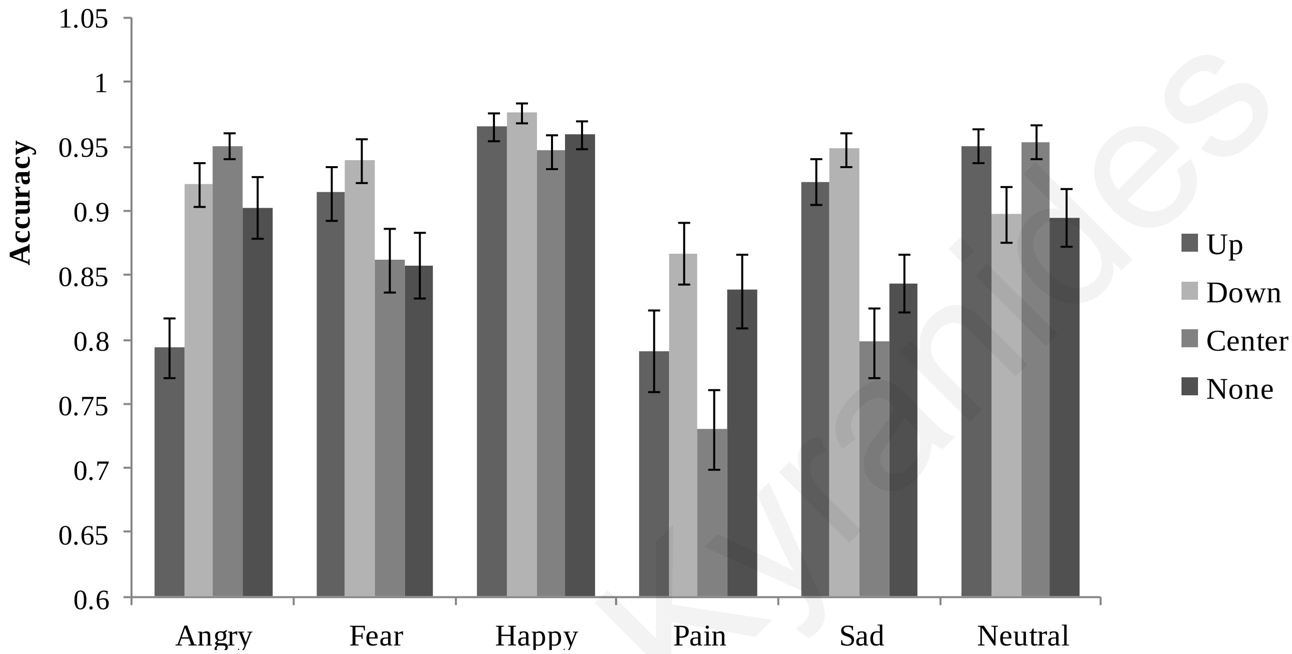


Figure 16. Expression by CU group interaction with accuracy as the dependant variable.

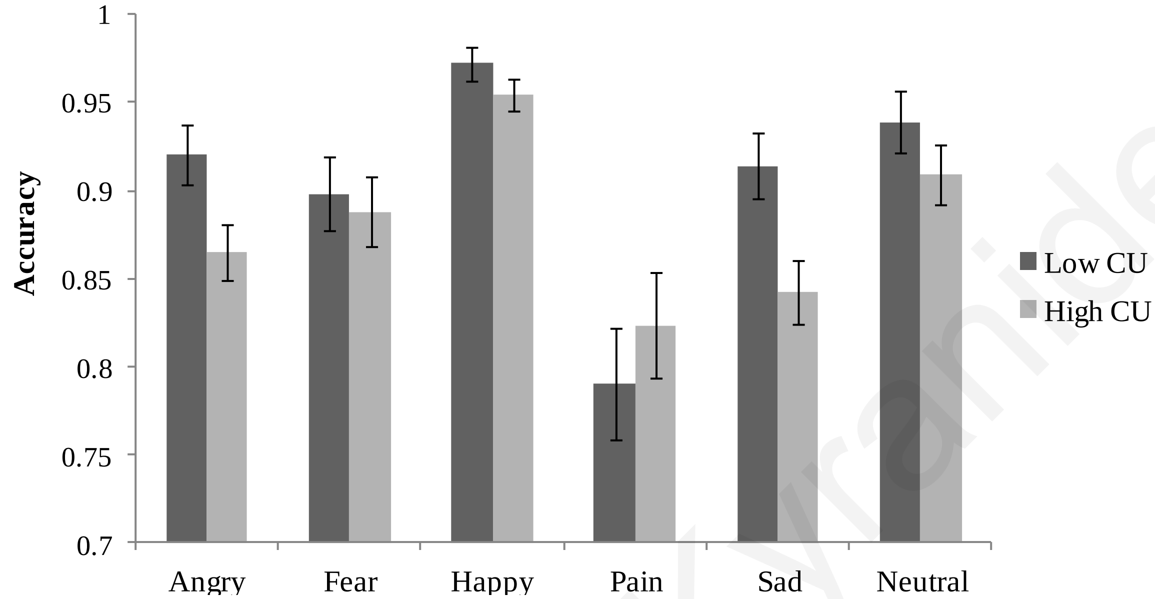


Figure 17. Scene Type by CU group interaction with self-reported fear as the depended variable.

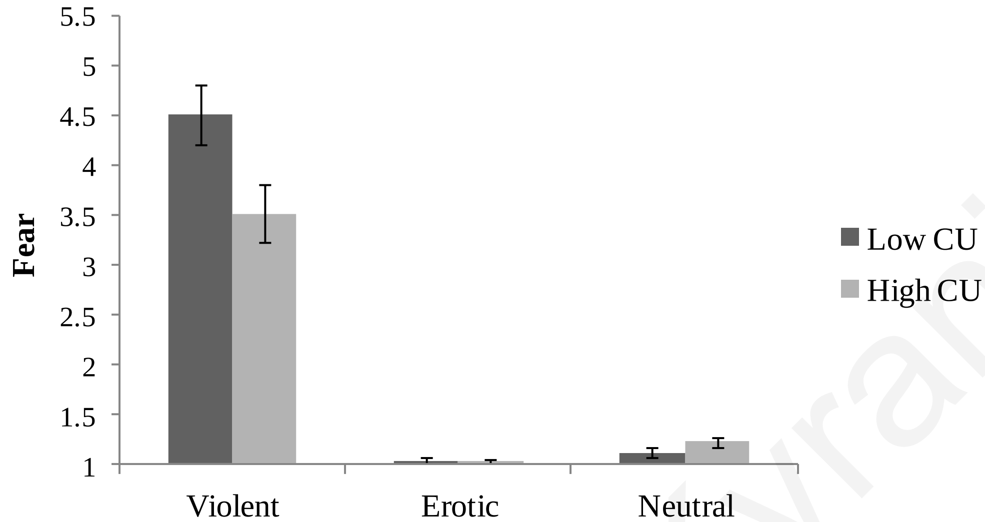


Figure 18. CU group by CPs group interaction with self-reported fear as the depended variable.

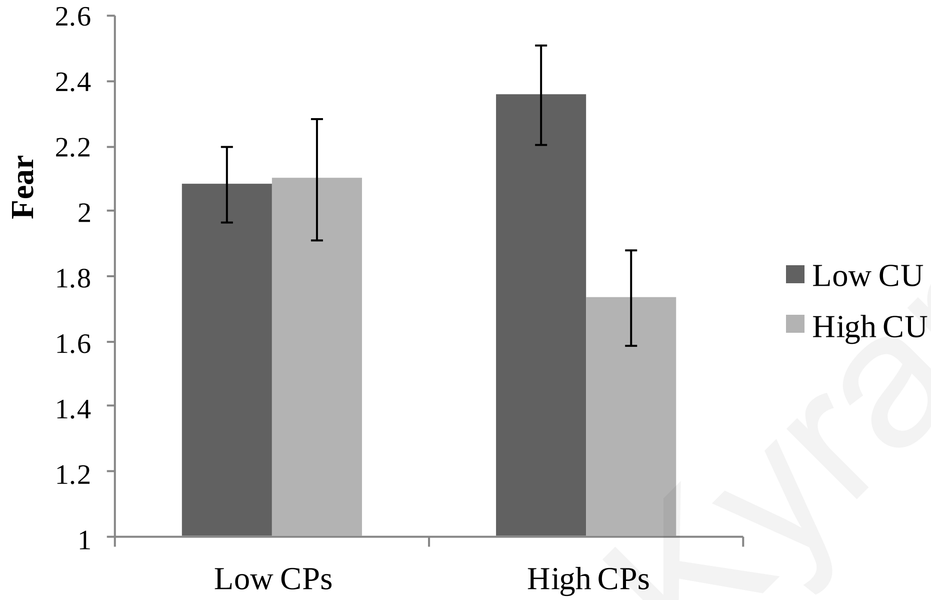


Figure 19. Scene Type by CU group by CP group interaction with self-reported fear as the depended variable.

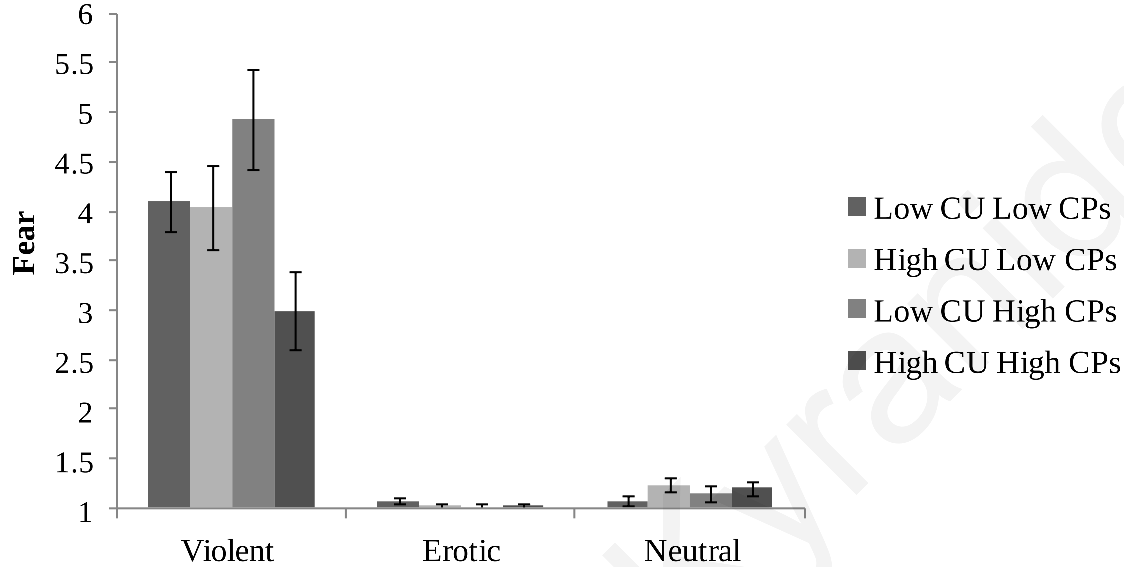


Figure 20. CPs group by CU traits interaction with heart rate as the dependent variable.

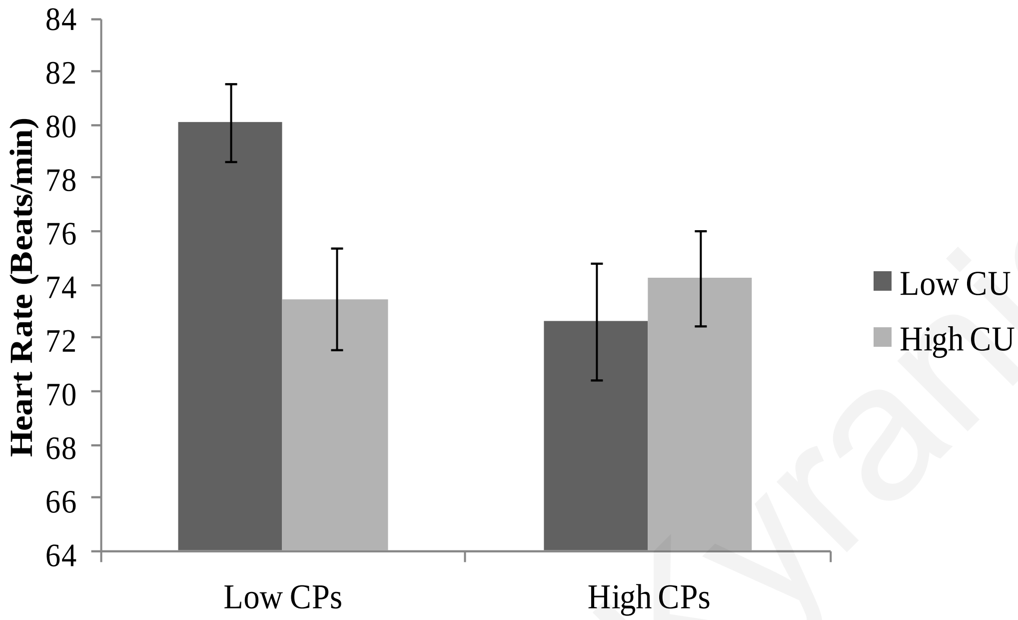
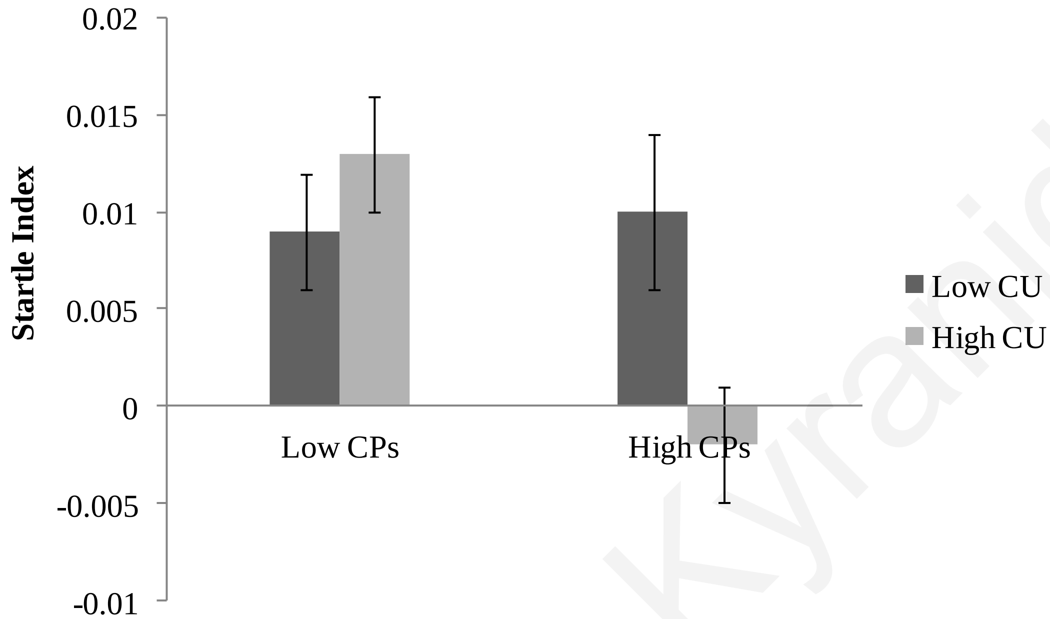
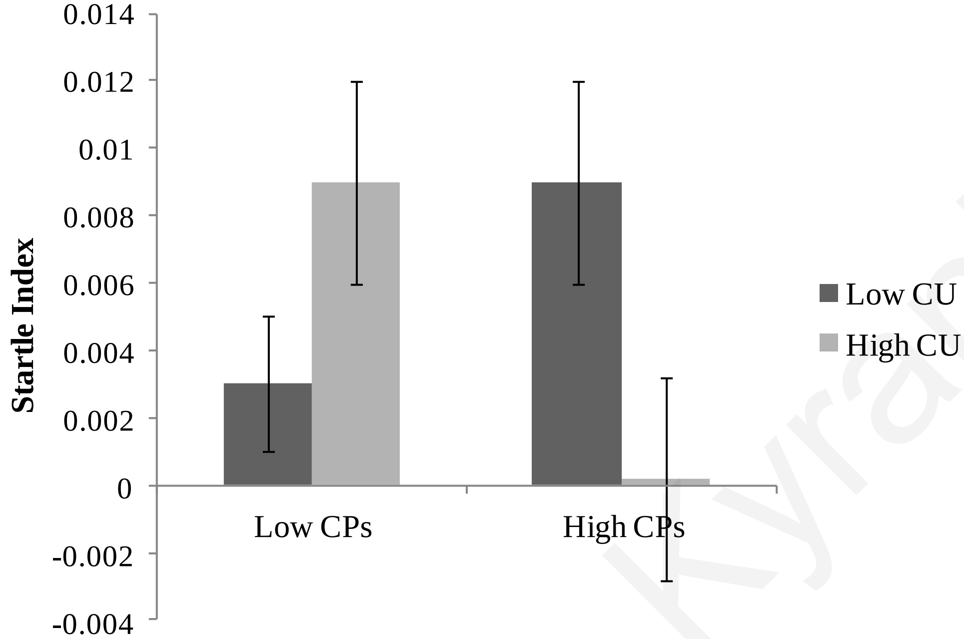


Figure 21. CP group by CU group interaction with Startle index as the dependent variable for violent scenes.



Note. Startle Index = Startle magnitude for violent scenes minus startle magnitude for neutral scenes.

Figure 22. CP group by CU group interaction with startle index as the dependent variable for erotic scenes.



Note. Startle Index = Startle magnitude for erotic scenes minus startle magnitude for neutral scenes.