The perception of vocal affect in isolated words by individuals varying in subclinical psychopathy

by

Angel Mackenzie

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Abstract

Psychopathy is a disorder of personality characterized by a lack of conscience and impulsive behaviour. Many studies have identified impairments in response to visual emotional stimuli in psychopaths, but perception of emotion in spoken language by psychopaths has received little attention. Blair et al. (2002) identified deficits in psychopaths' identification of fearful prosody in isolated words. Experiment 1 aimed to replicate Blair's findings in a subclinical sample of undergraduates which would support the idea of psychopathic characteristic existing on a continuum. However, Blair et al.'s results were not replicated which may have been due in part to lack of power. Experiment 2 examined attentional factors in identification of isolated words using an auditory emotional Stroop task with predictions made based on the response modulation hypothesis of attention. Findings were somewhat consistent with this theory, suggesting that a deficit in emotion-processing relative to psychopathic characteristics may be related to task complexity.

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Psychopathy is a personality disorder characterized in part by a reduced ability to process information about emotion in others. Although psychopathy is typically defined as a taxonomically distinct disorder of personality, psychopathy also can be measured in individuals who do not meet the full criteria for clinical psychopathy. These individuals exhibit traits that are consistent with psychopathy but not necessarily to the degree that fully-fledged psychopaths exhibit the same traits. Thus, psychopathy may be conceptualized as exhibiting characteristics that vary on a continuum, both as measured by overall measures of psychopathy and by subscales of these measures. The goal of the present investigation is to explore the processing of emotion information in spoken language (i.e., vocal affect) by individuals who vary in the degree to which they present psychopathic characteristics. The perspective taken in the present study is that although psychopathy is generally considered a personality trait, it can also be thought of as way to examine individual differences in cognitive processing.

Psychopathy has various features but the focus of the present study is the impaired ability of psychopathic individuals to perceive emotion in others, specifically, the perception of spoken language expressing emotion. .My first objective will be to establish that individuals who have relatively high levels of psychopathic characteristics perceive spoken words conveying emotions differently than individuals who have relatively low levels of psychopathic characteristics. This part of the proposed study will focus on prosodic cues, the variations in pitch and intensity that are associated with the expression of emotion in spoken language. It is necessary to establish that performance differences exist for spoken words that parallel the pattern of results that have been obtained with other kinds of stimuli when psychopathic and nonpsychopathic individuals are compared if such performance deficits are to be attributed to an overall emotional or attentional impairment. My second objective will be to examine the role of attention as a potential mechanism underlying these differences in performance. I will do so using an emotional Stroop task with spoken words as stimuli.

In the following sections I review some of the features of psychopathy and how it is measured. I also discuss current theories of the disorder and relevant literature. Following this, I consider impairments in the perception of emotion by individuals with psychopathic characteristics. Next, I describe Experiment 1, which was designed to assess the recognition of vocal affect in subclinical psychopathy. While it was not demonstrated that individuals with subclinical psychopathic characteristics have a significantly reduced ability to perceive vocal affect, there was a trend towards difference in affect perception between high and low scorers on a measure of subclinical psychopathy, suggesting that perception of vocal affect may be affected by psychopathic characteristics. I conclude by describing Experiment 2, which was designed to explore differences in auditory attentional capacity in emotional word perception between individuals exhibiting low and high levels of psychopathic characteristics.

Defining psychopathy

Modern-day usage of the term psychopathy originated from the work of Cleckley (1941). In *The Mask of Sanity*, Cleckley characterizes the psychopathic individual as one who exhibits a number of interpersonal, behavioural, and affective impairments that are associated with a lack of conscience and shallow emotional understanding. Cleckley's 16 criteria for psychopathy across these three dimensions include such indicators as unresponsiveness in general interpersonal relationships, inadequately motivated antisocial behaviour, and lack of remorse or shame. The psychopathic individual is incapable of true emotional responsiveness yet demonstrates no visible signs of the disorder and thus paradoxically maintains an appearance of normality (the "mask of sanity"). This reduced emotionality renders the psychopath unable to understand the emotions of others and therefore unable to appreciate the consequences of his actions on them. Cleckley's work provided the foundation for current approaches to understanding psychopathy.

While comprising less than 1% of the population (Forth, Brown, Hart, & Hare, 1996; Coid, Yang, Ullrich, Roberts, & Hare, 2009), psychopathic individuals are disproportionately represented in incarcerated populations. They are much more likely to engage in criminal behaviour and the subset of psychopathic inmates are responsible for the majority of violent crimes (Coid et al., 2009). Psychopathic offenders are also much more prone to recidivate once released from prison, including violent recidivism (Hemphill & Hare, 1995; Singh, Grann, & Fazel, 2011). Nonetheless, it is likely that the largest proportion of those individuals who meet the criteria for psychopathy are not engaged with the criminal justice system and would be considered "successful" psychopaths because they are able to refrain from engaging in criminal behaviour (or at least fail to be caught). However, although these individuals may not break the law, they often succeed in workplace settings as a result of their self-promotion and disregard for others' feelings which allows them to further their own careers through the use of malicious interpersonal tactics. Therefore, they are considered to be "successful" in the community at large in terms of personal success and furthering their own ambitions without engaging in criminal behaviour, but this is often to the detriment of people around them, making them very destructive to form relationships with. A study by Babiak, Neumann, and Hare (2010) found the prevalence of psychopathy in a sample of corporate professionals to be much higher than in an average community sample. Because of the potential for destructive behaviour in individuals with high psychopathic characteristics, developing a better understanding of psychopathy is crucial to addressing some of the challenges inherent in interacting with and treating psychopathic individuals, both in incarcerated and general populations.

It is also important to note that while rates of clinical psychopathy, as per clinical measures such as the PCL-R (Hare, 2003) tend to be higher in corporate samples, individuals who do not meet the criteria for clinical psychopathy but have high levels of psychopathic characteristics ("subclinical" psychopathy) may share similar emotional and behavioural deficits with "true" psychopaths, and these individuals may also be highly represented in such samples. For this reason, it is important to not only examine taxometric psychopathy in the general population, but also to explore the continuum of psychopathic characteristics and whether similar deficits exist in high scoring individuals who can be termed as having "subclinical" psychopathy.

Theories of psychopathy

While the mechanisms underlying psychopathy are not yet fully understood, a number of accounts from various disciplines have been proposed to explain the disorder. These include theories within the cognitive and neurophysiological fields, as well as integrated neurocognitive and developmental theories. These accounts include the dysfunctional fear hypothesis, the violence inhibition mechanism, the response modulation hypothesis, and the frontal lobe dysfunction hypothesis.

The dysfunctional fear hypothesis has been studied largely as an explanation for moral deficiencies in psychopaths, due to a widely held belief that psychopathic individuals do not experience the same aversion to punishment as nonpsychopathic individuals. According to this hypothesis, moral development occurs as a result of fear of punishment. Individuals who experience punishment for engaging in a particular behaviour will avoid that behaviour in the future to avoid being punished (Blair, Mitchell, & Blair, 2005). Support for this hypothesis comes from studies of aversive and fear conditioning (Hare, Frazelle, & Cox, 1978; Birbaumer et al., 2005), passive avoidance learning (Newman & Kosson, 1986; Mitchell et al., 2004) and response reversal (Mitchell, Colledge, Leonard, & Blair, 2002; Blair et al., 2005). Compared to other negative emotions, psychopathic individuals have reduced subjective and physiological responses to fearful situations (Marsh et al., 2011). However, some concerns exist about proposing the fear dysfunction hypothesis as the sole explanation for psychopathic tendencies. These concerns include the inability to predict antisocial behaviour, as well as the argument that moral development is more attributable to the facilitation of empathy rather than avoidance of punishment, and the assumption of a single, unitary fear system (Blair et al., 2005). Recent literature has also found evidence for the ability of higher order cognitive processes to attenuate fear deficits in psychopaths (Newman, Curtin, Bertsch & Baskin-Sommers, 2010). As it is believed that several neural mechanisms are separately implicated in the experience of fear (e.g., instrumental learning and aversive conditioning are both forms of fear processing that are assumed to have distinct mechanisms), the dysfunctional fear hypothesis fails to explain how these would be incorporated. (Blair et al., 2005).

The observation of harm of or experience of distress in another person is aversive for most individuals. We therefore avoid engaging in behaviour that has negative consequences for others. In doing so, we avoid having the negative experience of another's distress. Behaviour indicative of this aversion to others' distress has even been demonstrated in other species, including rats (Rice & Gainer, 1962). The violence inhibition mechanism, as proposed by Blair (1995), postulates that this recognition of others' distress and subsequent aversion is deficient in psychopaths. A number of studies have found that both adults and children with psychopathic tendencies have reduced autonomic responses to others' distress (Blair, Jones, Clark, & Smith, 1997; Blair, 1999), a finding that is consistent with the violence inhibition mechanism. However, this theory fails to account for findings on how temperament and environmental socialization combine to influence moral development. It also cannot account for the empirical data that support the dysfunctional fear hypothesis and the cognitive theory of response modulation (Blair et al., 2005).

The response modulation hypothesis, developed by Newman and colleagues (Newman, 1987; Kosson & Newman, 1986, 1989; Wallace, Bachorowski & Newman, 1991), is an attention-based theory of psychopathy that posits psychopathic individuals have a reduced ability to self-regulate compared to nonpsychopathic individuals. Newman and colleagues argue that this is due to an inability to shift attention from goal-directed behaviour to secondary information that is less salient than that of the dominant response set. Psychopathic individuals are not incapable of self-regulation, but it is much more difficult for them to self-regulate than for the average person because those attentional processes that allow individuals to self-regulate are not automatic for the psychopath. This approach is in contrast with the commonly held belief that the fundamental impairment of psychopathy is one of emotion processing accompanied by the presence of antisocial behaviour because a deficit in response modulation does not necessarily require or overlap with antisocial behaviour (Wallace, Vitale, & Newman, 1999). Cognitive theories of psychopathy have been criticized for their primary application to situations involving goal-directed behaviour in the lab setting, making it difficult to generalize these results to other domains of functioning and real-world behaviour in psychopathic individuals (Kosson, 2009).

Several neural accounts for psychopathy also have been proposed. These include the left hemisphere activation hypothesis, the somatic marker hypothesis, as well as several explanations involving frontal lobe abnormalities (Blair et al., 2005).

Psychopathic individuals have an unusual lateralization of language function, resulting in poorer than average language-processing abilities. For example, Hare and Jutai (1988) found that psychopathic individuals had impaired recognition of word stimuli presented in the right visual field. Specifically, psychopathic participants had greater difficulty when required to associate the word presented with an abstract category (as opposed to a semantic category or matching the word to a previously presented word). However, psychopaths displayed enhanced performance relative to controls for recognition of stimuli presented in the left visual field. Llanes and Kosson (2006) found poorer performance in psychopaths under left hemisphere activation conditions as opposed to equal activation of both hemispheres compared to controls.

Psychopaths have also been found to display deficits in dual-task performance when responding with the right hand (Kosson, 1996), and make more errors on verbal tasks with high executive demands (Suchy & Kosson, 1996), consistent with the left hemisphere activation hypothesis This hypothesis is limited, however, by the lack of specificity in how the impairment operates and whether dysfunction of the left hemisphere can explain impairment of cortical functioning in general (Blair et al., 2005).

Frontal lobe dysfunction has been implicated in the development of psychopathy based on studies of patients with acquired frontal lobe lesions and individuals with antisocial and aggressive behaviour who display decreased frontal lobe activity in neuroimaging studies (Hecaen & Albert, 1978). However, the frontal lobe dysfunction hypothesis is argued to be not specific enough in identifying regions of the frontal cortex involved in the disorder or specifying the reasons damage to this area would result in increased aggressive behaviour; nor does it differentiate between instrumental aggression (intentional and goal-directed) and reactive aggression (unplanned aggression triggered by anger and/or threatening events) which are believed to be relatively separate constructs. Individuals with frontal lobe dysfunction have been found to have heightened aggressive behaviour, but it is instrumental aggression specifically that is associated with psychopathy (Blair et al., 2005).

Studies also have linked the deficits in executive functioning and antisocial behaviour that are found in psychopaths to more specific regions of the frontal lobe. For example, Damasio's (1998) somatic marker hypothesis posits that regulatory bodily states controlled by the ventromedial frontal cortex (encompassing the orbitofrontal and medial frontal cortices) provide feedback that encourage or discourage particular actions or behaviours. These "somatic markers" increase or decrease the likelihood of such actions being performed in the future by identifying them as positive or negative and providing appropriate physiological feedback. Evidence that the somatic marker hypothesis may account for aspects of psychopathy comes from psychopaths who display behaviourial inhibition deficits similar to patients with orbitofrontal lesions (Pham, Vanderstukken, Philippot, & Vanderlinden, 2003) and who fail to demonstrate normative punishment learning. The latter has been identified in a number of studies involving four-pack card game tasks, such as the Iowa Gambling Task (Bechara, Damasio, Damasio, & Anderson, 1994), wherein the participant receives differential reward or punishment depending on which deck of cards they continue to choose to play from (two high-risk decks = high reward, high punishment with overall loss; two low-risk decks = low reward, low punishment with overall gain). Participants should be able to identify the advantage of playing with the low-risk decks over the high-risk decks; however, patients with ventromedial lesions and psychopathic patients show a similar inability to develop this strategy to avoid punishment, continuing to play with the high-risk decks and suffering an overall net loss (Bechara et al., 1994; Bechara, Damasio, Damasio & Lee, 1999; van Honk et al., 2002). K. Blair et al. (2006) found processing deficits related only to the orbitofrontal cortex (using an object alternation task) in psychopathic individuals. Orbitofrontal dysfunction has been linked to both developmental and acquired forms of psychopathy (Mitchell, Avny, & Blair, 2006). Thus, the overlap in theory and neurocognitive impairment suggests that the somatic marker hypothesis may provide a cognitive theory for underlying dysfunction in the orbitofrontal and/or ventromedial cortices.

Amygdala dysfunction in psychopathic individuals may cause impairments in aversive conditioning and instrumental learning that lead to normal socialization (Blair, 2003). A defective amygdala results in failure to achieve normal moral socialization via the processes described earlier because representations of negative affect are more severely impaired than those for positive affect. Therefore, the psychopathic individual fails to learn to avoid engaging in behaviours that cause others harm. It appears that both the orbitofrontal cortex and the amygdala are implicated in the disorder, with potential involvement of other structures of the paralimbic system such as the cingulate cortex (Blair et al., 2005; Kiehl, 2006; Blair & Mitchell, 2009). Mitchell et al. (2006) found deficits in psychopathic individuals on tasks of stimulus-reinforcement -based instrumental learning and relearning, linking performance in these tasks to impairments in the orbitofrontal cortex and the amygdala, providing further support that both these areas are involved in psychopathic characteristics. Moul, Killcross, and Dadds (2012) have recently suggested that several areas of the amygdala may be implicated, with differential amygdala activation of the basolateral amygdala and central amygdala contributing to emotional impairments in psychopaths rather than overall amygdala dysfunction being the cause of such deficits.

One criticism of the structural and functional neurophysiological differences found in psychopaths is that these abnormalities have only been identified in incarcerated samples, in individuals with records of offending. Kosson (2009).proposed that "successful" psychopaths who are able to avoid offending and/or resulting imprisonment may have neurocognitive differences from incarcerated psychopaths, suggesting the possibility of different pathways for psychopathy

Finally, research on the development of attention has identified two possible processes of socialization and development of "conscience" in children that may have important implications for understanding psychopathy. Both of these routes involve the development of empathy, which studies have shown to be associated with effortful control (Rothbart, Ahadi, & Hershey, 1994). The first involves a highly reactive amygdala that allows the child to be acutely aware of distress signals in others, thereby generating an empathic response. The amygdala and anterior cingulate are implicated in this process that facilitates our attention to cues of others' distress. The second involves self-regulation via internalization of morals (often as a result of mild parental discipline), which leads to effortful control of empathy and conscience. Thus, the first route involves emotional, amygdala-based fear responses while the second requires effortful attentional and self-regulatory processes (Posner & Rothbart, 2007). The identification of these separate processes may be important in understanding the causes of psychopathy, as the disorder may be characterized by dysfunction in one or both of these potentially distinct systems.

In summary, a number of theories that purport to account for the mechanisms underlying psychopathy have been proposed, and most have some degree of empirical support. However, many of these approaches are criticized (Blair et al., 2005) for lack of specificity and failure to explain all aspects of the disorder and impairments across various domains of functioning (e.g., attention and emotion). It is possible that some cognitive models of psychopathy overlap, such as the low fear hypothesis and violence inhibition mechanism, and may be attributable to the same underlying neurophysiological mechanism, such as an emotion deficit due to amygdala dysfunction.

Although there are contradictions between some accounts, such as the mechanisms proposed by the response modulation hypothesis versus the amygdala dysfunction hypothesis, recent research has suggested that emotion-based and attention-based mechanisms for psychopathy may exist in tandem (Moul et al., 2012). Several of these accounts (the emotional deficit/amygdala dysfunction hypothesis and the response modulation hypothesis) will be explored more thoroughly in a later section when emotional and attentional impairments in psychopaths are reviewed.

The measurement of psychopathy

Although Cleckley (1941) provided a descriptive illustration of the features that defined psychopathy, his description of the disorder did not permit an accurate assessment of the degree to which an individual exhibited psychopathic characteristics, both in terms of reliability and validity. In order to remedy this issue, Hare (1991) created the Psychopathy Checklist (PCL). The current version, the Psychopathy Checklist Revised (PCL-R; Hare, 2003), is currently the most widely used diagnostic tool for psychopathy. The PCL-R has a factor structure that yields four components (Hare, 2003): Interpersonal and Affective dimensions, as well as Lifestyle and Antisocial behaviour dimensions. The PCL-R incorporates a total of 20 items to define psychopathy: each item is scored on a three-point scale, where 0 indicates the characteristic designated by the item is definitely not present and 2 indicates it is definitely present. This yields a possible total score of 40, with a score of 30 or above serving as the cutoff for psychopathy. In the context of the present investigation, in which the concept of sub-clinical psychopathy is considered, the existence of a cut-off score suggests that psychopathy may be considered a taxon (i.e., either present or not present) as opposed to a dimensional characteristic. However, given that the PCL-R is scored from 0 to 40, the possibility of a continuum for the disorder is implied. Indeed, dimensionality on the individual subscales of the PCL-R as well as the overall score derived by the measure has been demonstrated (Guay, Ruscio, Knight, & Hare, 2007). Although the PCL-R is not the only means of assessing psychopathy and should not be confused with the construct of psychopathy itself (Skeen & Cooke, 2010), it is nonetheless the most widely used diagnostic tool for assessing this disorder in incarcerated individuals.

The PCL-R is designed for use in forensic settings. Various alternative measures of psychopathy for use with nonforensic populations have also been developed. These include the Psychopathic Personality Inventory (PPI; Lilienfeld & Andrews, 1996), the Levinson Self-Report Psychopathy Scale (Levenson, Kiehl, & Fitzpatrick, 1995) and the Self-Report Psychopathy Scale (SRP; Williams, Paulhus & Hare, 2007). (Note that the fact that researchers have created these subclinical measures of psychopathy is a tacit acknowledgement that psychopathy is not a taxon and, hence, can be considered as a continuum along which individuals can vary in the degree to which they exhibit psychopathic characteristics.)

The measure of psychopathy used in the present project is the SRP-III (Williams et al., 2007). The SRP-III has the same underlying factor structure as the PCL-R, including Interpersonal, Lifestyle, Antisocial, and Affective dimensions, making it useful for comparisons of psychopathic characteristics between clinical and subclinical samples. The SRP was been used extensively by Paulhus and colleagues to evaluate subclinical psychopathy (Williams & Paulhus, 2004; 2007) and despite the limitation that is a self-report measure (unlike the PCL-R, which includes a structured interview), appears to to be a valid and reliable measure of psychopathic characteristics. The scoring system of the SRP, like that of the PCL-R, does not preclude the possibility of a dimensional measurement of psychopathy scores.

The four factors of the SRP can be condensed into two broader factors based on similarities and examined based on the 2-factor model: the Interpersonal and Affective dimensions combining to form Factor 1; the Antisocial and Behavioural dimensions combining to form Factor 2. The current study will explore findings relative to overall SRP scores, as well as to relative scores on each of these two factors.

Perception of vocal affect

Semantic and prosodic cues are used to identify emotion in spoken language. Semantic cues include the meaning of individual words plus their collective meaning due to syntax. Prosodic cues include all aspects of vocal affect, including pitch, intonation, and rhythm (Banzinger & Scherer, 2005). Emotional tone congruent with emotional semantic content of words has been found to facilitate processing of the words (Levens & Phelps, 2008; Nygaard & Queen, 2008). Individual speaker differences must be taken into account, as it has been suggested that the idiosyncratic style of the speaker can influence the accuracy of vocal affect recognition (Wallbott & Scherer, 1986).

Deficits in recognition of emotion conveyed by prosody have been found in individuals with disorders such as schizophrenia (Edwards, Jackson, & Pattison, 2002; Bach, Buxtorf, Grandjean, & Strik, 2009) and Asperger's syndrome (Lindner & Rosen, 2006). Vocal affect recognition has been found to be impaired in individuals with right hemisphere damage, underscoring the importance of the right hemisphere's potential role in identifying emotional tone (Adolphs, Damasio, & Tranel, 2002; Harciarek, Heilman, & Jodzio, 2006). Cognitive decline due to age has also been demonstrated to be a factor in recognition of prosodic affect: older adults are poorer at identifying prosodic emotions, particularly emotions with negative valence (Mitchell, Kingston, & Barbosa Boucas, 2011). Additionally, individuals suffering from major depressive disorder have been found to have a tendency to skew emotional prosody towards more negative emotions (Peron et al., 2011).

The perception of emotion by psychopaths

Blair et al. (2004) demonstrated that psychopathic individuals have difficulty identifying emotion expressed in language and facial expressions, in particular, the expression of fear. Similar findings have been obtained in children with psychopathic tendencies, who have difficulty identifying sad expressions and even greater difficulty identifying fearful expressions (Blair, Colledge, Murray, & Mitchell, 2001) and behaviours that elicit fear in others (Marsh & Cardinale, 2012). Other studies have found that psychopathic individuals have a reduced ability to identify facial affect in general and specifically, negative emotions such as sadness and fear, as well as greater difficulty identifying less intense expressions of emotion than controls (Deeley, Daly, Surguladze, Tunstall, & Mezey, 2006; Munro, Dywan, Harris, McKee, Unsal, et al., 2007; Hastings, Tangney, & Steuwig, 2008; Pham & Philippot, 2010). A recent meta-analysis on emotional expression recognition by Wilson, Juodis, and Porter (2011) suggested that recognition of facial affect is attenuated by verbal processing demands: deficits were more pronounced in studies requiring a verbal response for emotions processed in the left amygdala.

Psychopaths also have a deficit in processing emotional imagery. Patrick, Cuthbert, and Lang (1994) found a difference in physiological response (cardiac, electrodermal, and facial muscle responses) between psychopathic and nonpsychopathic inmates when asked to envision scenes of fearful imagery, with psychopathic participants displaying decreased responses to the imagery consistent with an emotional deficit for fear. Psychopathic individuals have also been found to have a reduced physiological response (startle-blink reflex) than nonpsychopaths to unpleasant images (taken from the International Affective Picture System) used to evoke negative affect (Sutton, Vitale, & Newman, 2002).

Perception of emotional language by psychopaths. Psychopathic individuals consistently demonstrate a reduced ability to process emotion-laden words compared to nonpsychopaths. Blair et al. (2006) compared semantic and affective priming in lexical decision tasks in psychopathic versus non-psychopathic individuals. Participants were primed with an emotional (affective condition) or neutral (semantic condition) word prior to presentation of another word that required a categorical congruency judgment (e.g., love-song for the affective condition; cat-dog for the semantic condition). Results showed that the psychopathic participants were comparable to controls in their response to semantic priming for both accuracy and reaction times, but demonstrated slower reaction times and decreased accuracy for affective priming compared to controls. Blair et al. concluded that a psychopath's deficit in emotional language processing is more likely due to an impairment in emotion-processing in general as opposed to a general lexical or semantic impairment.

Long and Titone (2007) examined the relation between processing on several emotional word tasks (lexical decision task and negative word decision task) and psychopathy scores in a non-clinical sample. High scoring (psychopathic) participants demonstrated poorer accuracy for negative words in the lexical decision task than low scorers (controls), with no difference between the groups on lexical decisions for positive and neutral words. Psychopathic participants also had greater difficulty identifying negative words in the negative word task than controls. These results were obtained regardless of concreteness or abstractness of the words, suggesting that the findings support an emotional rather than language-processing deficit, consistent with the results of Blair et al. (2006).

Reidy et al. (2008) associated each of the two factors of the Levenson Self-Report Psychopathy Scale (comparable to Factor 1 and Factor 2 of the PCL-R and SRP) with response latencies to specific emotion categories on a lexical decision task using visually presented emotional words. They found that individuals scoring high on Factor 1 (callous/unemotional) had slower response times to sad words, whereas those with high Factor 2 (impulsive/antisocial) scores had slower response times to angry words. They concluded that Factor 1 appeared to be associated with a decreased experience of sadness, whereas Factor 2 was associated with increased experience of anger. A number of other measures of affect were administered (including the Positive and Negative Affective Schedule, Interpersonal Reactivity Index and Spielberger Trait Anxiety Inventory) and it was determined that none of these measures could account for the results. Interestingly, no significant associations were found when response latencies were compared with overall psychopathy scores, highlighting the importance of consideration of subscale scores for psychopathy.

Perception of emotion in spoken language by psychopaths. Of the total number of studies examining the perception of emotion in language by psychopaths, only a small number have examined the perception of emotion in spoken language. The expression "they know the words, but not the music" was used originally by Johns and Quay (as cited in Blair et al., 2006) to describe psychopathic individuals' ability to learn appropriate emotional reactions and expressions in the absence of truly experiencing these emotions themselves. The expression may also capture the distinction between semantic and prosodic cues to emotion in spoken language. Although understanding the emotional content due to semantic information (i.e., the meaning ascribed to individual words and their ordering) may be deficient in psychopathic individuals, these individuals may have an even greater impairment in the comprehension of the prosodic emotional content (i.e., vocal affect) in speech. Prosodic cues to emotional states may be more difficult to learn without true emotional understanding. Therefore, it is important to isolate semantic and prosodic emotional content in spoken language in order to better understand whether psychopathic individuals process these components of emotional language differently from nonpsychopathic individuals.

In keeping with the distinction between semantic and prosodic cues to emotion in speech, Bagley, Abramowitz, and Kosson (2009) found that psychopathic inmates had a reduced ability to accurately categorize the emotional content of spoken sentence-length stimuli compared to nonpsychopaths. Psychopathic participants demonstrated more deficits in identifying emotion (defined by how accurately they categorized the sentences) in both semantic and prosodic contexts than the other two groups; however, this discrepancy was most pronounced for the prosodic emotional stimuli. Bagley et al. also included a comparison between primary (shallow emotions and impoverished emotion responses) and secondary (antisocial and impulsive behaviour) psychopaths. This distinction is similar to that between Factor 1 and Factor 2 scores on the PCL-R and SRP. Both groups demonstrated overall impairments in affect recognition, but primary psychopaths performed more poorly than secondary psychopaths, particularly in the ability to classify neutral stimuli. Bagley et al.'s results provide evidence of a general deficit in the identification of emotion cues in spoken language by psychopaths which is particularly evident in prosodic contexts and for primary psychopaths who exhibit a greater emotional deficit as opposed to one more related to attention and antisocial behaviour.

Using the Psychopathy Screening Device, Stevens, Chairman, & Blair (2001) tested children with psychopathic tendencies on their ability to categorize emotion in facial expressions and vocal tone. Deficits were found in identification of sad and fearful facial expressions and sad vocal tones, but no difference was found between these children and controls for happy or angry expressions or for fearful, happy or angry tones of voice.

Blair et al. (2002) looked at the ability of psychopathic individuals to perceive emotional affect in individual spoken words. They used isolated words with neutral semantic content (e.g., "carpet"), manipulating the prosodic affect. They found that psychopathic inmates had greater difficulty accurately categorizing the emotional prosody associated with words from five emotion categories (happy, sad, angry, fear and disgust) than non-psychopathic inmates based on error rates for emotion identification. This decreased ability to identify the appropriate emotion was particularly true for the category of fear. Psychopathic participants also had greater difficulty identifying sad affect; however, they demonstrated no impairments in categorization of happy, angry, or disgusted affect. Blair, Budhani, and Scott (2005) found the same pattern of results with boys labeled as having psychopathic tendencies. As with the adult sample, the psychopathic boys had greater difficulty identifying fearful affect (also based on error rates for categorization of emotions). Blair et al. interpreted these results as providing support for the low-fear hypothesis and potential evidence for amygdala dysfunction in psychopaths.

Although there is considerable evidence to support the existence of impairments in the processing of emotion information in psychopathic individuals in domains such as facial expression and visual word recognition, the present literature examining deficits in psychopathy specifically related to spoken language is limited to the four studies described above. While the two Blair et al. (2002) and (2005) studies are comparable in terms of use of the same set of emotions, Stevens et al. (2001) and Bagley et al. (2009) use different emotions for their studies. Stevens et al. used a similar set, with only the emotion of disgust excluded. Bagley et al., however, used anger, surprise, happiness and neutral (Bagley et al. was the only one to include a neutral condition).

Blair et al. (2002) and Bagley et al. (2009) used the PCL-R to characterize psychopathy. The studies by Stevens et al. and Blair et al. (2005) obviously used different measures (the Psychopathy Screening Device and Antisocial Process Screening Device, respectively) as children rather than adult participants were used, but these measures were designed to tap similar characteristics to those measured by the PCL-R. Both Blair et al. studies used only isolated words, and prosodic emotion only in the absence of semantic emotion. Stevens et al. used sentence-length stimuli with neutral semantic content and emotional prosody. Bagley et al. used sentence-length stimuli and used both semantic and prosodic emotion, although the latter is particularly of interest for the present study. The longer presentation of sentence-length stimuli offers listeners more exposure to the conveyed prosody and thus should provide a greater opportunity to interpret the affect. The ability to find robust results using isolated words as opposed to sentence-length stimuli is interesting, due to the short stimulus exposure, and will be explored further. Bagley et al. also compared primary and secondary psychopaths, which is of interest to the current study because of the similarity of comparisons between Factor 1 versus Factor 2 scores.

The overall results are somewhat conflicting, as the two studies by Blair et al. (2002, 2005) suggest an impairment in identification of fearful affect, whereas this was not found by Stevens et al. (2001). Bagley et al.'s (2009) decision to not include fear as an emotion is unfortunate due to the contradictory results of the previous studies for this particular emotion. In all four studies, however, an impairment of identification of sad affect was demonstrated in psychopathic individuals to some extent, suggesting amygdala dysfunction may be an underlying mechanism despite the discrepancies between the findings.

Sex differences in psychopathy

A majority of studies investigating psychopathy have been limited to male participants. Psychopathic women have been found to have higher rates of criminal behaviour than nonpsychopathic women (Salekin, Rogers, Ustad, & Sewell, 1998; Crawley & Martin, 2006;), demonstrate similar decreased startle-blink responses to emotional images (Sutton et al., 2002) and possess similar emotionally-impoverished and antisocial behaviours to those of psychopathic men (Vitale, Smith, Brinkley, & Newman, 2002). However, psychopathic females do not seem to demonstrate the same response perseveration (Vitale & Newman, 2001) or failure of passive avoidance learning (Vitale, Newman, Bates, Goodnight, Dodge, & Petit, 2005; Vitale, Maccoon, & Newman, 2011) as has been demonstrated consistently in male psychopaths. Thus, there are mixed results for the generalizability of psychopathic characteristics across both male and female sexes. Females have also been found to have higher rates of empathy than males in general, including in incarcerated populations, which may affect perception of emotion (Rogstad & Rogers, 2008). Finally, prevalence of psychopathy is lower in females than it is in males: one sex comparison study found 31% of violent male offenders met the cut-off score for psychopathy, compared with only 11% of violent female offenders (Grann, 2000, as cited in Rogstad & Rogers, 2008). Therefore, it is likely that in the sample of interest, high SRP scores will be disproportionately represented in male participants while female participants will likely tend to have lower SRP scores in general. This may may make it difficult to separate the effect of sex from the effect of psychopathy as sex may confound any potential psychopathy effects: if low psychopathy participants produce faster, more accurate responses, it may be because females tend to produce this type of response rather than being truly associated with low psychopathy scores. For these reasons, sex was considered as an additional variable in the present study: results were examined overall and relative to the sex of the participant.

Experiment 1

The objective of Experiment 1 was to replicate and expand on the findings that Blair et al. obtained with an incarcerated sample (2002) by presenting those same stimuli to a non-clinical sample of undergraduate students, none of whom meet the clinical cut-off for psychopathy. Whereas Blair et al.'s study used the PCL-R to identify participants who met the criteria for psychopathy, the present study will use the SRP to identify high and low scoring individuals in the non-clinical sample.

The desire to replicate Blair et al.'s (2002) findings was motivated in part by their use of isolated words as stimuli. Because prosodic cues are generally considered to occur at the level of entire sentences or phrases, Blair et al.'s finding that listeners presented individual words could accurately identify emotion-specific prosodic cues was somewhat surprising. Hence, a successful replication of Blair et al.'s results would result in increased confidence that word-length stimuli are a valid and effective means of portraying prosodic emotion. Moreover, if Blair et al.'s results can be replicated within a subclinical population, it would further demonstrate the strength of the relationship between psychopathy and impaired perception of spoken language conveying emotion via prosodic cues. Moreover, anticipating Experiment 2, it would then be possible to investigate the potential attentional mechanisms underlying this relationship, using isolated words varying in prosodic cues to emotion.

In addition, because Blair et al.'s (2002) study evaluated British listeners and used stimuli produced by speakers who spoke British English, Experiment 1 also incorporated new stimuli produced by Canadian speakers that would be more compatible with Canadian listeners. An additional reason for developing new stimuli was that only a subset of the stimuli originally used by Blair et al. were available for use in the Experiment 1. The addition of these new stimuli enabled the inclusion of a range of stimuli comparable to that used by Blair et al. in terms of number of talkers. The new stimuli also were balanced with respect to sex of talkers across emotion categories. One important consideration to keep in mind when considering the expected results for the two sets of stimuli is that despite the different accents, little to no difference was expected because the expression of emotion is considered to be universal and not culture-specific (cf., Darwin, 1872).

It is worth noting that the dimensional nature of the SRP, as well as the potential for individuals to score higher on one of its underlying factors when using the 2-factor model, highlight the importance of considering individual differences in the discussion of cognitive factors in psychopathy. Experiment 1 will explore whether a similar dichotomy relative to SRP factor structure to that found by Reidy et al. (2008) is evident in the processing of emotion in spoken language, in terms of particular emotional impairments being associated with Factor 1 versus Factor 2. It is possible that individuals who have a high score on the SRP who also have higher scores on the Affective factor will have greater difficulty categorizing emotion than those who score more highly on the Behavioural factor, as this would suggest the contribution of an emotional deficit to poor emotion categorization in high scoring (more psychopathic) individuals.

It is predicted that results will be similar to those of Blair et al (2002): high scoring participants will have greater difficulty categorizing emotion than low scoring participants, particularly for fearful stimuli. It is also predicted that results will be similar between the original and new versions of the stimuli, as recognition of prosodic emotion is considered to be universal and should not be affected by accent of the speaker.

Method

Participants. Participants were 106 (76 female, 30 male) English-speaking Carleton University undergraduate students, recruited through the university's online study participation system. No participants indicated any history of a speech or hearing disorder. A preliminary round of data collection included 45 students who were invited to partake in the study based on previous completion of the SRP-III in a pretest, thereby identifying high and low (top and bottom 25%) scorers on this measure. This was followed by further recruitment of additional 60 students, to whom the SRP-III was administered during the testing session. A median split was used to identify high- and low-scoring groups for the 106 total participants. Participant characteristics are listed in Table 1. Visible ethnicity of participants was recorded: 58% of participants were Caucasian, 42% of participants were recorded as non-Caucasian. The latter group of participants also participated in Experiment 2; therefore, the first 45 participants only partook in Experiment 1 whereas the remaining 60 participants participated in both Experiment 1 and Experiment 2 within the same testing session. Students received course credit in exchange for participation.

Table 1
Psychopathy Scores for Participants (Experiment 1).

	M (SD)	*Median*	*Range (High Scoring Group)*	*Range (Low Scoring Group)*
SRP Total	52.79 (17.11)	50	50-110	29-49
SRP Factor 1	26.848 (9.79)	25	25-54	14-24
SRP Factor 2	26.133 (8.42)	23	24-56	15-23

Measures. The Self-Report Psychopathy Scale III (SRP-III; Williams et al., 2007) short version was administered prior to participation. Individuals who scored higher on psychopathic characteristics than would be found in the subclinical population were not included in the study. The SRP-III short version is comprised of 29 questions (e.g., "I like to watch fist fights") that are scored on a 5-point Likert scale from Strongly Disagree (1) to Strongly Agree (5). It is scored on the four dimensions of Interpersonal Manipulation and Callous Affect (combined to form Factor 1), and Erratic Lifestyle and Criminal Tendencies (combined to form Factor 2), with individual factor scores given in addition to a total SRP score.

Stimuli. Two sets of stimuli were used in Experiment 1. First, original stimuli from Blair et al.'s 2002 study were used. These stimuli consisted of seven neutral words (carpet, daughter, sailor, motor, printer/partner, hammock, finger) each spoken with emotional prosody representing five emotion categories: happy, sad, angry, fear, and disgust. There were four speakers (two males and two females) who each spoke all words in all emotion categories, for a total of 140 words in this condition. Second, an equivalent set of new stimuli were created with four speakers who spoke Canadian English (again, two males and two females) using the same set of seven words represented in the same five emotion categories. Thus, there were a total of 280 stimuli across the two conditions. Multiple speakers were used for each condition to overcome the possibility of idiosyncratic speaker styles interfering with identification of the emotion categories.

Procedure. Participants were tested in a sound-attenuated booth. Stimuli were presented via headphones connected to a laptop. Labels corresponding to the five emotion categories were presented on the laptop screen at all times, and the participant were required to move the cursor to select the appropriate emotion and click on their choice of emotion, as quickly and accurately as possible, once they heard each word. Each stimulus presentation was approximately 500-800 ms long, and onset of each stimulus occurred 1 s after the participant had categorized the previous word.

Stimuli were presented in separate blocks for each type of stimuli (i.e., original British stimuli or new Canadian stimuli). Within each block, all 140 words for each type of stimuli were presented twice in two separate sub-blocks. Upon completion of the first sub-block there was a break in presentation of stimuli. When participants were ready they pressed a key to continue, at which point presentation of the second sub-block was initiated. Once the first block was completed (either original British or new Canadian stimuli), the experimenter switched conditions on the laptop and the same process occurred for the other set of stimuli. Thus, participants were presented with a total of 560 trials across all blocks. Participants were given five practice words to familiarize them with the task at the beginning of each condition. Presentation of stimuli was randomized and the order of presentation for stimulus type (original British or new Canadian stimuli) was counterbalanced. Response latencies were measured from the onset of the stimulus presentation.

Experiment 1 Results and Discussion

Overall accuracy for emotion categorization was high across emotion categories for the new stimuli, with mean accuracy of approximately 78-86% for most emotion categories except for the category of disgust, which had the lowest accuracy rating of 71% (see Table 1). The original stimuli were identified less accurately than the new stimuli, with accuracy ratings ranging from 60-85% for most emotions. Disgust was also the least accurately identified in the set of original stimuli, with a mean accuracy rating of only 55% (see Table 2).The difference in overall accuracy by stimulus set was not expected, as it was predicted that responses to both accents would be the same considering the assumption of universality of emotional expression. However, participants categorized emotional prosody spoken with their "native" English accent (Canadian English) more accurately than the less familiar British English accent. Nonetheless, the pattern of emotion categorization in terms of which emotions were most and least accurately identified relative to the other emotions was the same for both accents.

A preliminary analysis revealed that the categorization accuracy for the sad and disgust emotions produced by two of the talkers in the new set of stimuli was very low (approximately 30%), so these two talkers were removed from further analyses. While 30% accuracy is slightly higher than chance (20%), the decision was made to remove these talkers as there was a considerable discrepancy for both accuracy and response time of responses for these talkers across emotion categories compared to the other two talkers, with the latter producing much more consistent responses, suggestive of an idiosyncratic style which would confound the analysis of accuracy. These effects of individual talker differences may be examined in future analyses. As this problem was not identified in the original stimuli (talkers were more consistent for the original stimuli than new stimuli in accuracy rates and response times produced) and these stimuli were understood to have previously been validated because of their use in the original Blair et al. (2002) study, all four talkers from that set of stimuli were included in the analyses. No participants were removed, but outlying responses beyond 3 standard deviations from the participant's mean for the relevant block and stimulus set were removed. Responses where it was evident that attention had wandered (e.g., 30 second responses) also were removed.

The within-subject comparisons for Experiment 1 did not meet the assumption of sphericity, as per Mauchly's test. To correct for this, Huynh-Feldt corrections were used for all within-subject comparisons. A repeated-measures ANOVA showed a significant effect of emotion on both accuracy ($F(2.967, 299.667)=82.651$, $MSE = 1.584$, $p < .001$, $f = .93$) and response time ($F(2.649, 283.592)= 74.67$, $MSE = 2.808$, $p < .001$, $f= .86$) for original stimuli (see Tables 2 & 3). There was also an effect of emotion on both accuracy ($F(3.677, 375.085)= 15.124$, $MSE = .258$, $p < .001$, $f= .38$) and response time ($F(2.908, 296. 597)= 28.392$, $MSE = 8.496$, $p < .001$, $f= .53$) for the new stimuli (see Tables 1 & 2).

Exploration of the patterns of emotion categorization through interaction plots based on mean accuracy ratings showed sad and angry stimuli were the most accurately identified for the original stimuli, whereas happy and angry were most accurately identified for the new stimuli. Disgust was most poorly identified for both sets of stimuli. The new stimuli were identified more consistently across the emotion categories than the original stimuli, for which happy, fear and disgust were identified much less accurately identified than sadness and anger.

For both original and new stimuli the emotions most accurately identified were also the emotion categories that produced the fastest response times (sad and angry for original stimuli, happy and angry for new stimuli), whereas the emotion most poorly identified, disgust, was also the emotion category that produced the slowest response times.

Table 2
Mean accuracy (proportion correct) for emotion categories in Original and New stimuli.

	Original stimuli	New stimuli
Emotion	*M (SE)*	*M (SE)*
Happy	.592 (.025)	.859 (.017)
Sad	.852 (.018)	.816 (.026)
Angry	.826 (.015)	.871 (.021)
Fear	.602 (.018)	.78 (.025)
Disgust	.552 (.029)	.707 (.032)

Table 3
Mean RTs (seconds) for emotion categories in Original and New stimuli.

	Original stimuli	New stimuli
Emotion	*M (SE)*	*M (SE)*

Happy	4.929 (.025)	4.387 (.95)
Sad	4.34 (.085)	4.395 (.129)
Angry	4.166 (.076)	4.222 (.082)
Fear	4.623(.09)	4.511 (.096)
Disgust	5.187 (.118)	5.099 (.116)

Accuracy

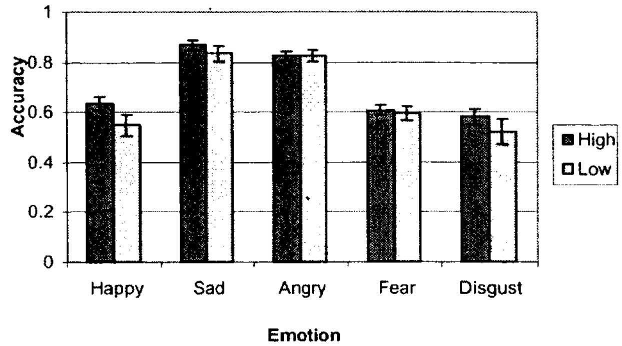
The effect of psychopathy on emotion categorization was first evaluated by examining performance as a function of overall SRP scores, then as a function of Factor 1 and Factor 2 scores. Looking first at the original set of stimuli, no significant effects were obtained for $F(1, 101)= 1.398$, $MSE = .116$, $p = .24$, $f= .12$), Factor 1 group, ($F(1, 101)= 2.665$, $MSE = .212$, $p = .106$, $f= .16$) or Factor 2 group ($F(1, 101)= 1.051$, $MSE = .088$, $p = 308$, $f= .1$). No significant interactions were obtained between emotion and either SRP group ($F(2.979, 300.865)= 1.371$, $MSE = .026$, $p = .252$, $f= .11$), Factor 1 group, ($F(2.967, 299.667)= 1.964$, $MSE = .038$, $p = .12$, $f= .14$) or Factor 2 group ($F(2.962, 299.159)= .678$, $MSE = .013$, $p = .564$, $f= .08$) (see Figs. 1-3). In addition, accuracy did not vary by sex ($F(1, 101)= 2.615$, $MSE = .218$, $p = .109$, $f= .16$). However, the interactions between sex and SRP group ($F(1, 101)= 6.862$, $MSE = .571$, $p < .05$, $f= .26$), Factor 1 group ($F(1, 101)= 11.88$, $MSE = .944$, $p < .01$, $f= .34$) and Factor 2 group ($F(1, 101)= .538$, $MSE = 6.434$, $p <.05$, $f= .25$) were significant, with high scoring females being slightly less accurate than low scorers, but high scoring males producing much more accurate responses than low scoring males (see Figs. 4-6). The interaction between sex and emotion was not significant ($F(2.979, 300.865)= 1.243$, $MSE= .024$, $p= .294$, $f= .11$).

Overall, no group differences were present in overall categorization between high and low scorers for SRP score and for SRP Factor 1 and Factor 2 scores. Sex affected accuracy of emotion identification for SRP, Factor 1 and Factor 2 groups. Sex and SRP or Factor scores are correlated, with males generally having higher scores on the psychopathy measures, and this sex difference is independent of any perceptual task. However, although female high and low scorers identification accuracy was similar, high scoring males were more accurate than low scoring males. This suggests that it is important to consider not only psychopathy characteristics but also how the sex of the individual affects performance on perceptual tasks. There was also a sex-related trend of accuracy, with females producing generally more accurate responses than males.

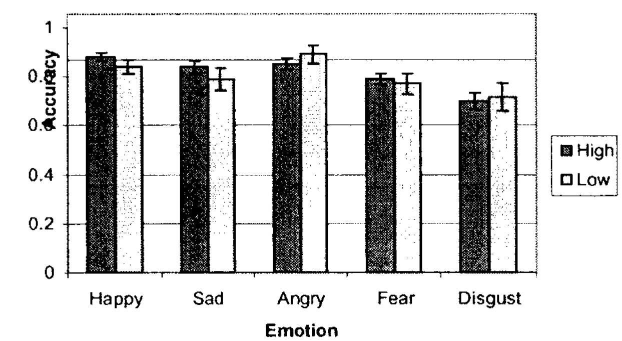
For the new stimuli, no significant effect was found for either SRP group ($F(1, 102) = .072$, $MSE = .007$, $p = .789$, $f = .03$), Factor 1 group ($F(1, 102) = .415$, $MSE = .041$, $p = .521$, $f = .06$) or Factor 2 group ($F(1, 102) = .101$, $MSE = .010$, $p = .751$, $f = .03$). Emotion category did not interact with either SRP group ($F(3.677, 375.085) = 1.18$, $MSE = .02$, $p = .319$, $f = .11$), Factor 1 group ($F(3.692, 376.62) = 1.016$, $MSE = .017$, $p = .395$, $f = .1$) or Factor 2 group ($F(3.678, 375.119) = 1.426$, $MSE = .024$, $p = .228$, $f = .12$) (see Figs. 1-3). No effect of sex was found ($F(1, 102) = 2.292$, $MSE = .229$, $p = .133$, $f = .15$). Sex did not interact with emotion ($F(3.677, 375.085) = .478$, $MSE = .008$, $p = .736$, $f = .07$); nor were there significant interactions between sex and SRP group ($F(1, 102) = .423$, $MSE = .042$, $p = .517$, $f = .06$), Factor 1 group ($F(1, 102) = .378$, $MSE = .037$, $p = .54$, $f = .06$) or Factor 2 group ($F(1, 102) = .096$, $MSE = .010$, $p = .757$, $f = .03$) (see Figs. 4-6).

Figure 1

Accuracy (percent correct) for emotion categories by SRP Group(high/low) in New and Original stimuli. Error bars indicate ± 1 Standard Error of the Mean.



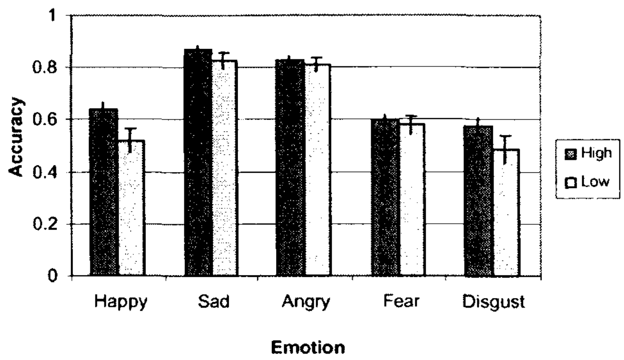
A. Original stimuli



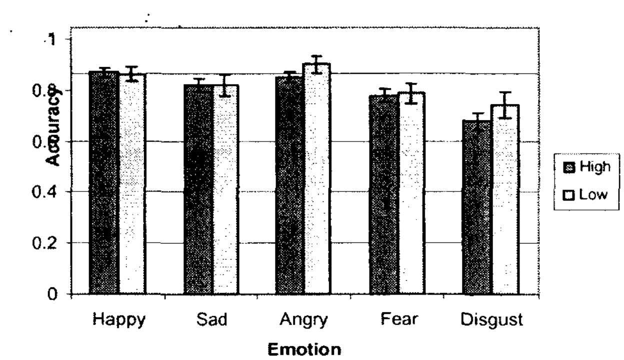
B. New stimuli

Figure 2

Accuracy (percent correct) for emotion categories by Factor 1 Group (high/low) in New and Original stimuli. Error bars indicate ± 1 Standard Error of the Mean.



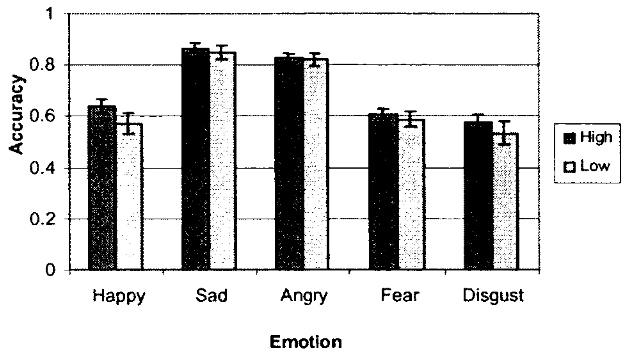
A. Original stimuli



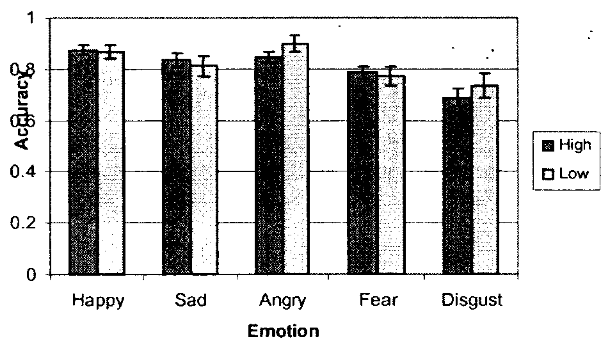
B. New stimuli

Figure 3

Accuracy (percent correct) for emotion categories by Factor 2 Group (high/low) in New and Original stimuli. Error bars indicate ± 1 Standard Error of the Mean.



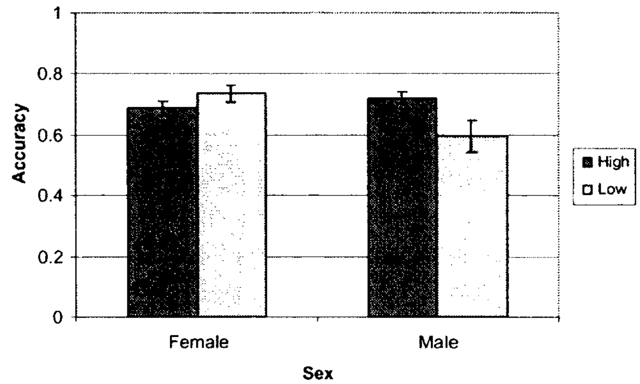
A. Original stimuli



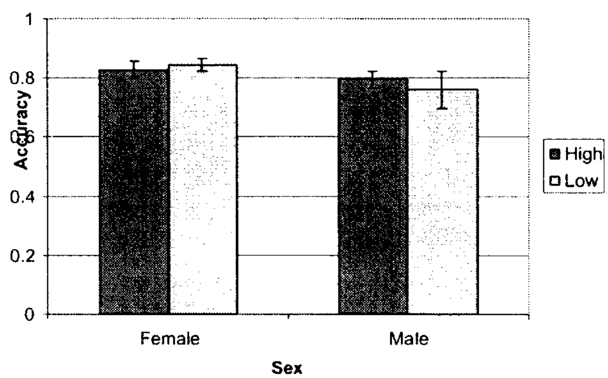
B. New stimuli

Figure 4

Accuracy (percent correct) by Sex (female/male) and SRP Group (high/low) for Original and New stimuli. Error bars indicate ± 1 Standard Error of the Mean.



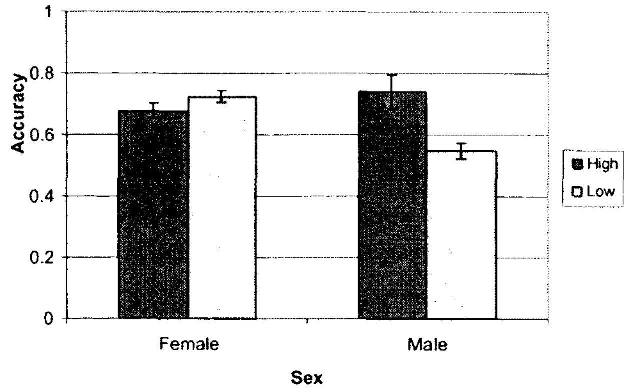
A. Original stimuli



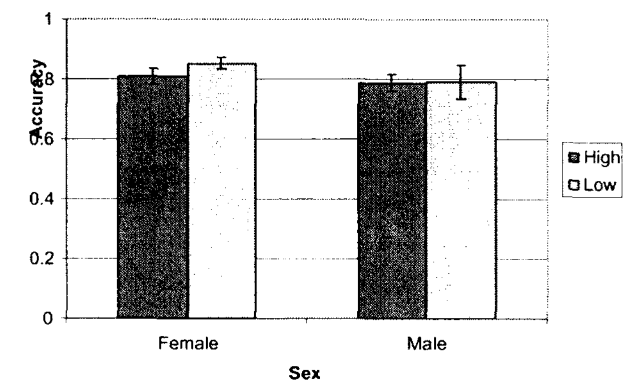
B. New stimuli

Figure 5

Accuracy (percent correct) by Sex (female/male) and Factor 1 Group (high/low) for Original and New stimuli. Error bars indicate ± 1 Standard Error of the Mean.

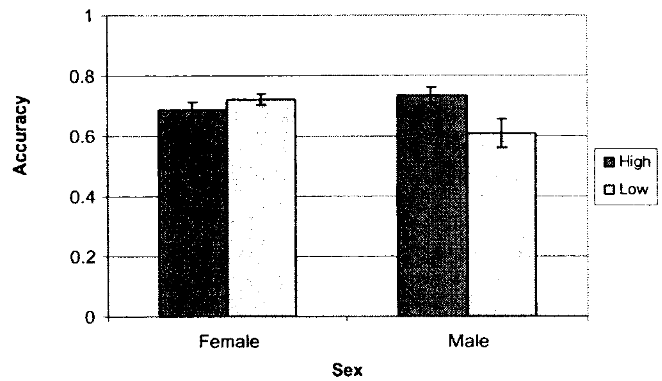


A. Original Stimuli

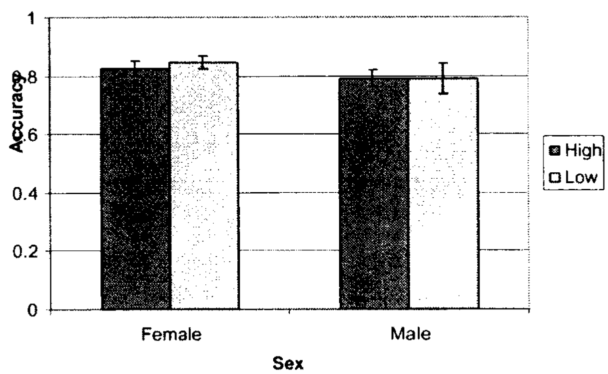


B. New stimuli

Figure 6.
Accuracy (percent correct) by Sex (female/male) and Factor 2 Group (high/low) for Original and New stimuli. Error bars indicate ± 1 Standard Error of the Mean.



A. Original Stimuli



B. New Stimuli

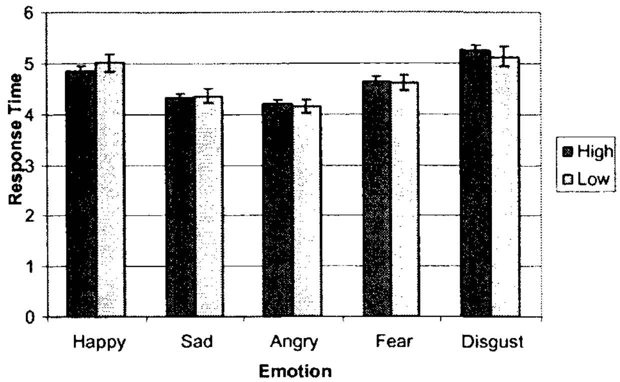
Response Time

For the original stimuli, no significant effect of RT for SRP group SRP group ($F(1, 101)$= .001, MSE = .001, p = .981, f= .00), Factor 1 group ($F(1, 101)$= .214, MSE = .464, p = .645, f= .04), or Factor 2 group ($F(1, 101)$= .009, MSE = .02, p = .923, f= .00) was obtained. Similarly, no significant interactions between emotion and either SRP group ($F(2.808, 283.592)$= 1.194, MSE = .24, p = .312, f= .11) (see Fig. 7), Factor 1 group ($F(2.785, 281.3)$= 1.373, MSE= .278, p = .252, f= .11) (see Fig. 8) or Factor 2 group ($F(2.801, 282.495) = 1.273$, $MSE = .257$, $p = .254$, $f = .11$) (see Fig. 9) were present for RT. RT did not vary as a function of sex ($F(1, 101) = 1.181$, $MSE = 2.54$, $p = .28$, $f = .11$) nor were there any significant interactions between sex and either SRP group ($F(1, 101) = .882$, $MSE = 1.899$, $p = .35$, $f = .1$) (see Fig. 10), Factor 1 group ($F(1, 101) = .04$, $MSE = .088$, $p = .841$, $f = .00$) (see Fig. 11) or Factor 2 group ($F(1, 101) = .587$, $MSE = 1.266$, $p = .446$, $f = .08$) (see Fig. 12). The interaction between sex and emotion for original stimuli RTs was significant ($F(2.808, 283.592) = 4.603$, $MSE = .927$, $p < .01$, $f = .21$), with males and female RT similar on most emotions, but males producing noticeably slower RTs for happy stimuli than females (see Fig. 13).

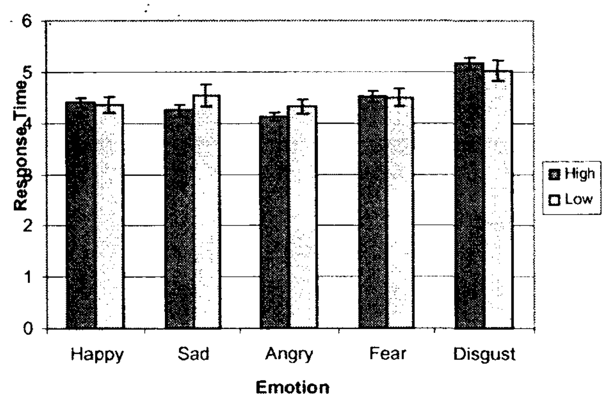
New stimuli RTs did not differ for SRP group ($F(1, 102) = .113$, $MSE = .24$, $p = .737$, $f = .03$), Factor 1 group ($F(1, 102) = 1.176$, $MSE = 2.481$, $p = .281$, $f = .11$) or Factor 2 group ($F(1, 102) = .001$, $MSE = .001$, $p = .979$, $f = .00$). Similarly, emotion did not interact with either SRP group ($F(2.908, 296.597) = 2.104$, $MSE = .63$, $p = .102$, $f = .14$) (see Fig. 7), Factor 1 group ($F(2.918, 297.598) = 1.297$, $MSE = .387$, $p = .276$, $f = .11$) (see Fig. 8), or Factor 2 group ($F(2.916, 297.392) = 2.354$, $MSE = .7$, $p = .074$, $f = .15$) (see Fig. 9). No effect of sex on RT ($F(1, 102) = 1.28$, $MSE = 2.705$, $p = .261$, $f = .11$) was observed. Sex did not interact with emotion ($F(2.908, 296.597) = 1.65$, $MSE = .494$, $p = .179$, $f = .13$); nor did sex interact with either SRP ($F(1, 102) = .395$, $MSE = .835$, $p = .531$, $f = .06$) (see Fig. 10), Factor 1 group ($F(1, 102) = .031$, $MSE = .066$, $p = .86$, $f = .00$) (see Fig. 11), or Factor 2 group ($F(1, 102) = 1.199$, $MSE = 2.523$, $p = .276$, $f = .11$) (see Fig. 12). There was a sex-related trend of response times, with females producing overall faster response times.

Figure 7

RTs (seconds) for emotion categories by SRP Group (high/low) in New and Original stimuli. Error bars indicate ± 1 Standard Error of the Mean.

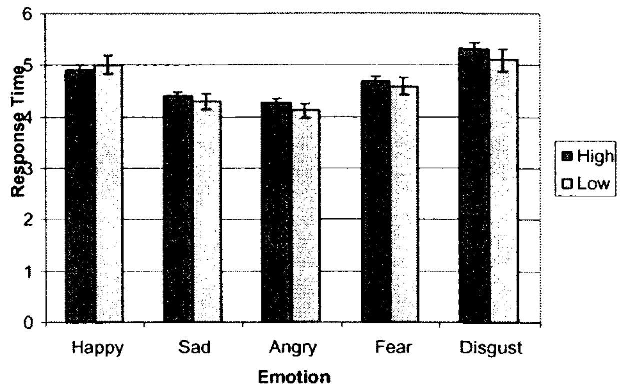


A. Original stimuli

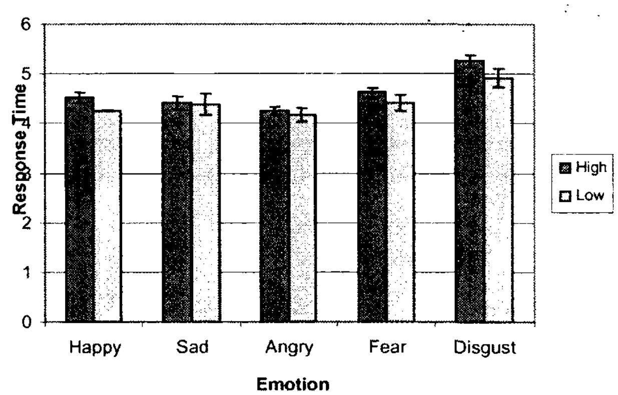


B. New stimuli

Figure 8
RTs (seconds) for emotion categories by Factor 1 Group (high/low) in New and Original stimuli. Error bars indicate ± 1 Standard Error of the Mean.

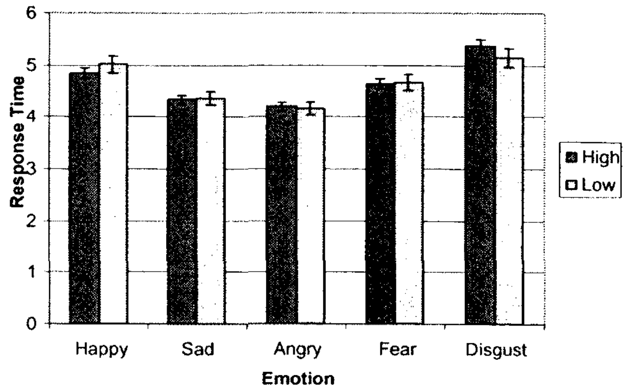


A. Original stimuli

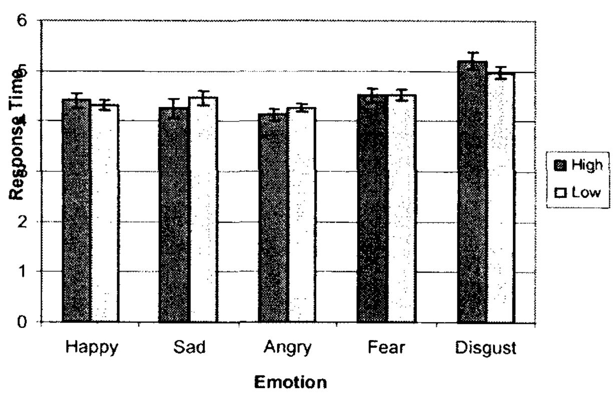


B. New stimuli

Figure 9
RTs (seconds) for emotion categories by Factor 2 Group (high/low) in New and Original stimuli. Error bars indicate ± 1 Standard Error of the Mean.



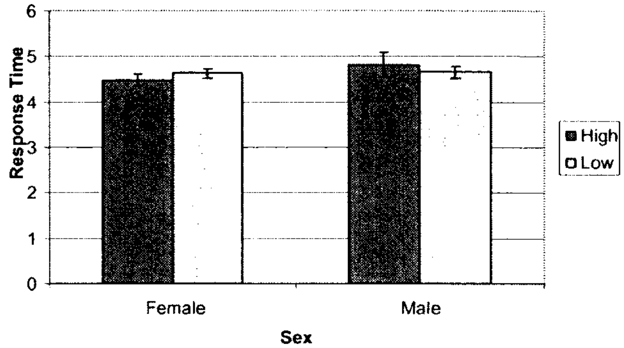
A. Original stimuli



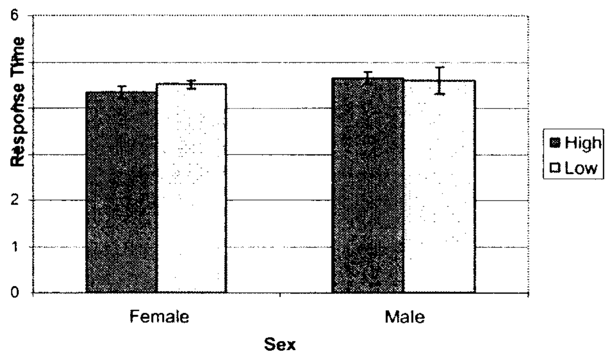
B. New stimuli

Figure 10

RTs (seconds) by Sex (female/male) and SRP Group (high/low) for Original and New stimuli. Error bars indicate ± 1 Standard Error of the Mean.

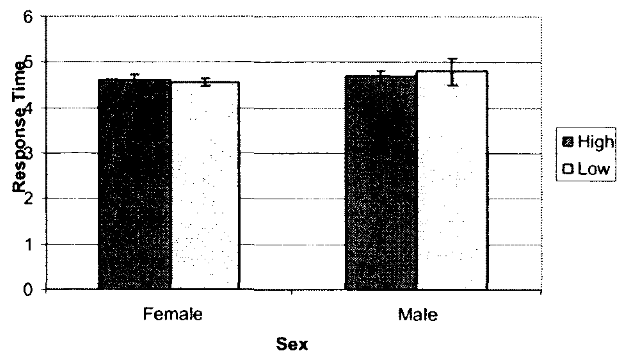


A. Original stimuli

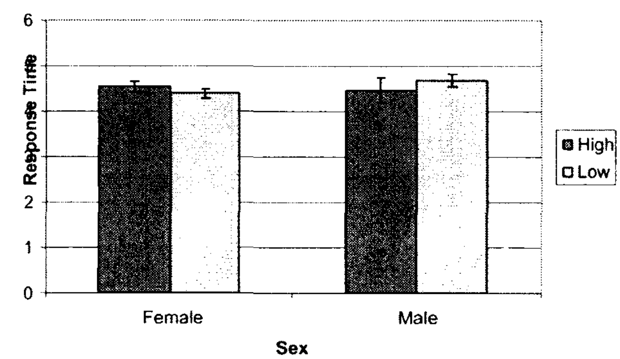


B. New stimuli

Figure 11
RTs (seconds) by Sex (female/male) and Factor 1 Group (high/low) for Original and New stimuli. Error bars indicate ± 1 Standard Error of the Mean.



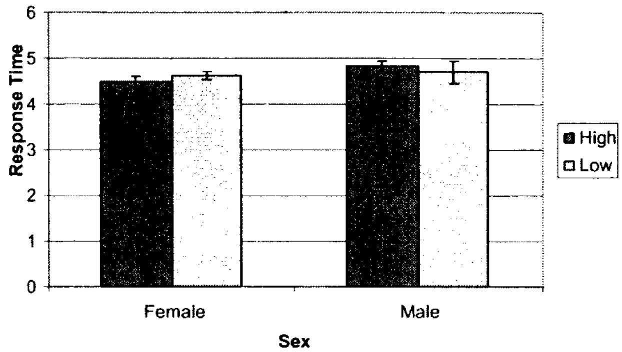
A. Original stimuli



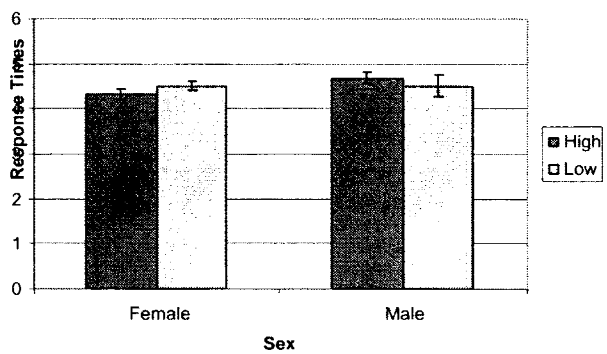
B. New stimuli

Figure 12

RTs (seconds) by Sex (female/male) and Factor 2 Group (high/low) for Original and New stimuli. Error bars indicate ± 1 Standard Error of the Mean.

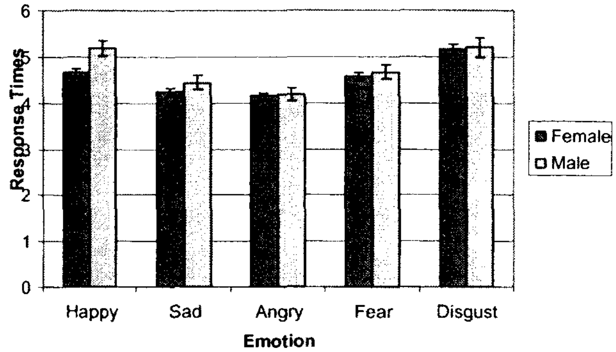


A. Original Stimuli

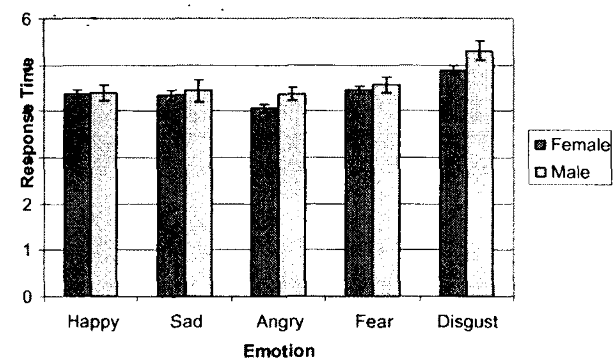


B. New Stimuli

Figure 13
RTs (seconds) for emotion categories by Sex (female/male) for Original stimuli and New stimuli. Error bars indicate ± 1 Standard Error of the Mean.



A. Original Stimuli



B. New Stimuli

The sex of the participants did not play a very important role in categorizing emotion, except for some sex-related interactions with the original stimuli. Perhaps females can identify emotion in speech produced by non-native talkers more easily than males, as this was the only real difference between the two sets of stimuli. The inclusion of a non-native accent may have highlighted sex differences, as the stimuli may have been more ambiguous to the participants due to the unfamiliarity of the accent. As women are said to have a different understanding of emotion and greater capacity for empathy than men (Rogstad & Rogers, 2008), females may be better able to identify emotion in an unfamiliar accent. The only noticeable sex difference in RT was for happy words, suggesting that females find happy stimuli easier to identify, particularly in more ambiguous stimuli such as a foreign accented speech. This sole sex difference is also noteworthy because it also coincided with the only positive emotion in the set of categories, raising the possibility that sex differences in emotion perception also could be related to emotional valence.

Post hoc power was at 100% for the effect of emotion across stimulus types (original/new) and dependent variables (accuracy/response times). For all other effects and interactions, post hoc power was variable. Some interactions had high post hoc power values: the interaction between sex and SRP group for original stimuli accuracy yielded a power value of 93%, and the interaction between sex and emotion for original stimuli response time yielded a power value of 87%. However, most post hoc power values were much lower than desired. Power for within-subjects interactions ranged from 31-50% for the original stimuli and ranged from 16-52% for the new stimuli. Power for between-subjects effects including the effects of psychopathy group, sex and the corresponding interaction yielded power values of 15-30% (the exception to this was the interaction between Factor 2 group and sex for accuracy, for which the power value was not as low at 71%) for the original stimuli. Power for these effects and their interaction for the new stimuli ranged from only 5-19% (the exception this being the effect of SRP group for response time, which yielded a higher value of 73%). Clearly, power values were much lower than the ideal of 80%, with some power values being exceptionally low, due primarily to small effect sizes.

The absence of a difference between the high and low psychopathy groups in their ability to identify emotional prosody in spoken words is surprising given the results of Blair et al. (2002) study. However, the different results are likely attributable to the composition of the participants in the studies. The group difference found by Blair et al. was based on two extreme groups, psychopathic and non-psychopathic, as measured using cutoffs on the PCL-R of >30 and <20, respectively. In contrast, the population from which the Experiment 1sample was drawn was far more homogeneous, with a median split of SRP scores used to divide the sample into high and low psychopathy subgroups. Thus, participants in Experiment 1 scoring near the middle had scores that differed only modestly from participants in the other group. Furthermore, even if only the most extreme scores were included in each group, there were few high scoring participants included in the present study (only two participants scored between 90 and 110 out of the total possible score of 145), with the end result that there was limited variability in SRP scores between high and low groups. Despite the sample size in Experiment 1 being relatively large for this type of study, post hoc power was still quite low for most analyses (between 30 and 50% for most effects, with some as low as 5 or 6% power). Because the effect size is relatively small, increasing power by obtaining a larger, less homogeneous sample is likely necessary in order to identify any group differences.

Blair et al. (2002) found the largest (and only significant) group difference for the categorization of fear, with a marginally significant difference for sadness. In Experiment 1, disgust produced the lowest accuracy and slowest response times, followed by fear. Sad and angry stimuli actually produced the fastest response times, whereas happy and disgust, not fear, produced the slowest response times. These findings are different than Blair et al.'s wherein fearful stimuli had the poorest accuracy, although accuracy for fear categorization was low relative to most other emotional stimuli (other than disgust) in Experiment 1.

Another difference between Experiment 1 and Blair et al. (2002) is that the pattern of categorization by group is very different. Blair et al. found that the psychopathic and nonpsychopathic groups showed very different patterns with respect to which emotions were best identified. In the present study, both groups showed essentially the same pattern for both sets of stimuli. This suggests that the Experiment 1 sample is homogeneous enough that processing differences are minimal. This also may reflect a difference in processing style and ability possessed by the very high scorers in Blair et al., in particular those meeting the >30 cutoff for psychopathy when using the PCL-R. That is, while there may be limited differences between high- and low-scoring non-psychopaths in overall emotion-processing, those who meet the criteria for "true" psychopathy may possess an actual deficit in that processing of emotional stimuli that presents an entirely different type of response than that observed in non-psychopaths scoring highly in the Experiment 1 sample. This is an important consideration because in a sample of undergraduate students, even the high scoring participants would score much lower on a measure of psychopathy than what would be required to meet the criteria for "true" psychopathy. In short, the Experiment 1 sample represents a minimal range of psychopathic characteristics that are near the bottom of the continuum for these scores, and as such, there may be distinct processing differences compared to those who have substantially higher psychopathy scores.

There was an overall sex-related trend, with female participants producing both faster and more accurate responses than males. However, given the disproportionate ratio of females to males (more than 2 to 1), if sex acted as a confound with SRP score, low scoring group members would be expected to be more accurate and respond faster than high scorers, since a common assumption is that males tend to score higher than females on measures of psychopathy. This would therefore result in more males in the high-psychopathy group than in the low-psychopathy group, and results might have been in the predicted direction expected for SRP group differences, with the low scoring (mostly female) group producing faster and more accurate responses to the emotion categorization task. As this was not the case, it does not appear that sex contributed to the group differences sufficiently to confound the results. Additionally, it appeared that a within-sex speed accuracy trade-off occurred, with high-scoring females producing faster and more accurate responses than low scoring females while the reverse was true for male high and low scorers. This sex-related speed-accuracy tradeoff should be addressed in future work, as it is possible that some group differences may be somewhat masked by this pattern of responding.

Paradoxically, the emotion stimuli may not have been ambiguous enough to produce demonstrable group differences in accuracy and response time. It is possible that in the attempt to create stimuli that were clear-cut and easily identifiable exemplars, that all participants, regardless of SRP score, were easily able to categorize the stimuli and that any differences in processing between high- and low-scorers were not really assessed. Perhaps the inclusion of slightly more ambiguous stimuli (i.e., those which produce slightly less accurate yet consistent responses) would produce a greater difference between groups in terms of their ability to categorize the different emotions.

The inclusion of a neutral emotion condition could have provided a baseline for comparison between categorization of emotional versus non-emotional prosody. However, as the original goal of Experiment 1 was to replicate the work of Blair et al. (2002), it did not seem appropriate to include an additional condition beyond what was used in the original study. Including a neutral emotion condition also would have the potential for participants to default to neutral when unsure of the emotion represented in the stimulus, which could complicate interpretation of the results. Nonetheless, given that the results showed a trend toward poorer overall emotion-processing in high scorers as opposed to the deficit specific to fearful stimuli that was observed in psychopathic individuals in Blair et al.'s study, a comparison of high versus low scorers' responses to emotion categorization overall using a neutral baseline may have been useful.

The fact that the new stimuli produced higher overall accuracy rates is surprising since it was predicted that due to the assumption about the cross-cultural nature of emotional prosody, accuracy rates would vary by emotion but would be consistent across the two sets of stimuli. Presumably, accent has had some degree of influence on accuracy rates, with words spoken in a foreign accent being slightly more difficult to categorize. Perhaps the inclusion of English words in an unfamiliar accent resulted in interference for categorization of these particular stimuli. It would be interesting to conduct a similar study with words in the English accent familiar to participants (Canadian English) and varying emotional prosody spoken without the influence of accent, perhaps produced in a language completely unfamiliar to the participants as

Bagley et al. (2009) did with Bulgarian words. Presumably, the complete lack of recognition of the words would result in minimal interference in identification of the emotional prosody with which the words were spoken, thereby potentially being a more pure case of prosodic emotion in the absence of influencing semantic content.

Experiment 2

Attention and psychopathy

Unlike researchers who define psychopathy in terms of an emotional deficit (e.g., Blair, 2006), Newman and colleagues (1986, 1993) argue that an attentionally-mediated mechanism underlies the psychopath's insensitivity to environmental cues (including emotional cues) that in turn lead to poor behavioural inhibition. Newman refers to the problem as a deficit in response modulation. Response modulation is defined as a brief, automatic shift that occurs in one's attentional focus, permitting one to consider peripheral stimuli outside the present focus. This process is believed to be deficient in psychopaths, who when engaged in goal-directed behaviour are unable to process contextual or secondary information external to their dominant response set (Newman & Wallace, 1993). Thus, it may not be that this information is less important to psychopaths, but rather that their goal-directed attention prevents them from being affected by it. This is true regardless of the emotional valence of the information or whether it represents negative consequences towards the individual or others.

Jutai and Hare (1983) initiated modern work examining the role of attention as a possible mechanism underlying psychopathy. Their goal was to determine if psychopathic and nonpsychopathic individuals differed in their processing of external, irrelevant information while engaging in a primary task. They used a sequence of tone pips presented binaurally, in either a passive attention (tones by themselves) or selective attention (tones presented as secondary "irrelevant" stimuli during video game playing) condition and measured participants' ERP (Event- Related Potential) responses to the stimuli in each condition. Participants were inmates scoring high or low on a measure of psychopathy. Results showed that, using the passive attention N100 ERP responses as an index of attention devoted to tone pips, high scorers showed less initial response to the tone pips than low scorers in the selective attention condition. Performance on the primary task (video game playing) was equal for both groups initially; however, while the low scorers' performance progressively improved over the course of the trials, the high scorers' performance worsened. The findings from this study were consistent with the idea that psychopathic individuals have more limited attentional capacity and have greater difficulty than nonpsychopaths attending to stimuli outside of that of immediate interest.

Kosson and Newman (1986) expanded on the work of Jutai and Hare (1983) by using a divided attention task incorporating visual search and probe-reaction time components. They found that psychopathic inmates had greater difficulty than nonpsychopaths in dividing attention equally between two separate tasks. Psychopathic individuals demonstrated a reduced capacity to shift attention from one primary task to another. Both psychopathic and nonpsychopathic participants performed equally well on the primary task when instructed to prioritize said task over the other, but the former displayed poorer performance under divided attention conditions. The initial predictions of the study were made based on the cognitive theory of overfocusing. Overfocusing describes a distribution of attentional resources on a divided attention task wherein emphasis is placed on one task, which should result in increased performance on the task of primary focus with a trade-off of poorer performance on any other tasks. However, the fact that psychopaths demonstrated equivalent rather than superior performance on the primary task compared to controls, and also that their performance on the primary task was poorer rather than improved under divided attention conditions provided support for the response modulation hypothesis rather than the overfocusing hypothesis.

Newman and Kosson (1986) extended previous findings showing reduced attentional capacity in psychopaths under goal-directed conditions by incorporating a more complex task than that of Kosson and Newman (1986) that tested cognitive flexibility. Using a go/no go discrimination learning task, they examined psychopathic individuals' ability to demonstrate inhibition of external stimuli while engaging in goal-directed behaviour. In the task, participants were told to press a button when specific stimuli were presented on a computer screen to win money, and to avoid (inhibit) pressing the button when other stimuli were presented to prevent loss of money. Consistent with the hypotheses, psychopathic participants were less able to inhibit the undesirable response in the latter condition than controls. A slightly modified version of the task also was administered in order to assess whether these results were attributable to a motivational or emotional deficit in general. In this case, the reward contingency was excluded: participants had an initial cash stake and were required to either respond to *go* stimuli or inhibit responding to *no-go* stimuli to avoid losing money. This version of the task found psychopathic individuals demonstrating passive avoidance comparable to controls. These results provide support for the response modulation hypothesis as the explanation for the goal-directed behaviour: that is, when pursuing a specific goal, psychopathic participants were unable to consider peripheral information such as the negative consequences of their task strategy, thereby preventing them from developing a new strategy which would result in greater success in the task. Additional studies have provided further support for the response modulation hypothesis (Howland, Kosson, Patterson, & Newman, 1993; Zeier, Maxwell, & Newman, 2009; Baskin-Sommers, Curtin, Li, & Newman, 2011).

The response modulation hypothesis is criticized as an explanation for psychopathy because it suggests that antisocial behaviour is not a requirement for such characterization, focusing merely on the pattern of behaviour relative to the attention deficit in all contexts. The lack of this requisite, however, makes it an appropriate theory to apply to non-clinical populations, such as the one used in this study, as the majority of participants in this case, even higher scoring individuals, would likely have negligible records of antisocial behaviour.

Emotion and attention in psychopathy

Attentional abnormalities in psychopaths have been well documented. Impairments in goal-directed behaviour on attention tasks have been observed, consistent with the psychopathic characteristics of impulsive behaviour and goal-directed behaviour with an absence of consideration of consequences (Blair et al., 2005). A number of studies, largely consistent with the response modulation hypothesis, have attempted to identify and explain such attentional anomalies by proposing an attention-based framework for the underlying mechanisms of psychopathy.

In a lexical decision task with psychopathic inmates presented affective and neutral words, Williamson et al. (1991) measured participants' ERP responses to the stimuli. They found that psychopaths had lower ERP responses to the affective stimuli than did nonpsychopaths. Nonpsychopaths also showed greater facilitation in the form of faster response times to affective stimuli than neutral stimuli; an effect that was not present in psychopaths. Emotional stimuli, including emotional words, have been found to produce facilitation in memory and recall compared with neutral stimuli in average participants, in the form of faster response times (Levens & Phelps, 2008; Lindstrom & Bohlin, 2011). The inability of psychopathic individuals when focused on a separate primary task to attend to secondary information in words that would allow facilitation of emotional information is consistent with the response modulation hypothesis. Several other studies have also found that psychopaths fail to demonstrate the facilitation for emotional words observed in nonpsychopaths in lexical decision and similar word tasks (Kiehl, Hare, McDonald, & Brink, 1999; Reidy et al., 2008). Blair et al. (2006) found evidence for an emotion deficit in psychopaths in a lexical decision task wherein psychopathic individuals had greater difficulty accurately categorizing negative words. However, this study also found psychopaths to have slower response times to emotional words when affectively primed, indicative of poorer facilitation demonstrated by this group that is consistent with an attentional deficit.

Mitchell, Richell, Leonard, and Blair (2006) assessed differences between psychopathic and nonpsychopathic participants in a motor task when there was emotional interference. Participants were required to identify shapes that were presented with an image that was either affectively positive, negative, or neutral. While control participants demonstrated slower response times when the shapes were associated with positive or negative images as opposed to neutral ones, psychopathic participants showed no such interference. These results are consistent with the response modulation hypothesis, as the psychopathic participants showed an inability to attend to emotion-laden stimuli that was external to the primary goal of the task and were thusly able process the primary task more quickly, without suffering from interference of the emotional content of the stimuli.

Lorenz and Newman (2002) also obtained results consistent with the response modulation hypothesis. Psychopathic and nonpsychopathic inmates were presented emotional words and comparable nonwords in a lexical decision task. Results demonstrated what Lorenz and Newman termed the "emotion paradox": that psychopathic individuals are able to appraise emotion cues as effectively as controls but have greater difficulty utilizing those emotion cues. In keeping with the emotion deficit approach, Lorenz and Newman found that psychopathic participants had less interference from emotion cues in the lexical decision task than controls. They also found, however, that psychopaths had less interference from word frequency in the absence of emotion cues than controls, suggesting that the lack of appreciation for peripheral cues is not restricted to cues for affect[1]. That is, the increased complexity of the task due to the inclusion of word frequency (specifically low frequency words) has no effect on psychopathic participants as they are able to screen out this secondary information, consistent with the response modulation hypothesis. This attentional abnormality was present, regardless of whether the peripheral information had emotional content.

[1] Word frequency refers to a word's prevalence in the lexicon: when a word is identified it is activated in the lexicon, and it is believed that higher frequency words are more easily recognized. Therefore, as low-frequency words should take longer to activate, Lorenz and Newman (2002) suggest that inclusion of low-frequency words adds semantic complexity to the task.

A recent study by Sadeh and Verona (2012) found complexity of emotional stimuli in the form of pictures to moderate emotion-processing (measured as ERPs and fear-potentiated startle reflex). Sadeh and Verona found that the affective-intepersonal characteristics of psychopathy were linked to allocation of attention for processing of the emotional stimuli, but only when stimuli were complex. Therefore, these findings are indicative of the potential involvement of both emotional and attentional systems emotion-processing deficits exhibited in psychopaths.

Lorenz and Newman (2002) found that the poorer performance of psychopathic participants was most evident on trials performed with the right hand, providing evidence for a hemisphere lateralization of the deficit in response modulation. It appears that psychopaths perform similarly to nonpsychopaths when performing simple tasks, but in tasks with increased complexity perform differently, highlighting the processing limitations of psychopaths that occur as a result of their failure to appropriately allocate attentional resources. This discrepancy between the two groups appears to be most evident when the psychopathic individuals are required to process information with the left hemisphere rather than the right (as per the left hemisphere activation hypothesis). Evidence of a hemisphere lateralization for attentional processing in psychopaths also has been identified in other studies (Howland et al., 1993).

Further evidence of asymmetrical language impairments in psychopaths associated with hemisphere lateralization was found by Hiatt, Lorenz, and Newman (2002) using a dichotic listening task. They found that lateralization appeared to be related to emotional tasks as opposed to simple word targets. Hiatt et al. posited that the abnormal language lateralization found in psychopaths was related only to more complex tasks, specifically requiring integration of more than one stimulus or task element.

In summary, response modulation and the amygdala dysfunction hypothesis both account for aspects of psychopathy. Response modulation theory appears to be able to account for many of the impairments associated with the processing of emotional information that are associated with psychopathy. When processing of emotional stimuli is not the primary task, psychopathic participants appear to respond more slowly than nonpsychopaths to emotional stimuli that should facilitate performance, but more quickly to emotional stimuli in tasks where the secondary emotional content is designed to interfere with the primary task (e.g., emotional incongruence). This is consistent with the response modulation, as both facilitation and interference of secondary emotional information demonstrated by nonpsychopaths would not occur for psychopathic individuals if they are able to screen out content that is peripheral to their goal-directed focus. However, whether response modulation can account for all the impoverished emotion-processing associated with psychopathy or whether additional dysfunctional neural mechanisms (e.g., Blair's amygdala dysfunction hypothesis) are implicated remains to be determined, as psychopathic individuals tend to respond more slowly and less accurately than nonpsychopaths when the primary task itself involves emotion-processing (e.g,. categorization of emotion), which may not be as easily explained by an attention deficit as by an actual deficit in processing of emotion. Recent studies have suggested that both attentional and emotional deficits coexist in psychopathic individuals.

Individual Differences and SRP Subscales in Attention and Psychopathy

Attention- or emotion-based mechanisms that underlie performance by psychopathic individuals may be associated with specific factors associated with the measures used to evaluate psychopathy, such as the PCL-R or SRP. Exploring the implications of individual differences in factor loading may be important in uncovering whether separate mechanisms exist, and if they act independently or in tandem.

Patrick, Bradley, and Lang (1993) used PCL-R scores based on the original two-factor structure of the PCL-R identified by Harpur, Hakstian, and Hare (1988; Factor 1 = emotional detachment, Factor 2 = antisocial/impulsive behaviour) to predict eye-blink startle responses to emotional images. They found decreased startle reactivity to unpleasant images in psychopaths to be related to high Factor 1 scores but not Factor 2 scores. These findings may be indicative of two separate processes: high Factor 1 scores may represent a fundamental deficit in emotion-processing, whereas high Factor 2 scores may identify an impairment in the process of inhibition that lead to appropriate regulation of behaviour and emotion (Patrick, Hicks, Krueger, & Lang, 2005).

Malterer, Glass, and Newman (2008) measured trait emotional intelligence (EI) in psychopaths relative to PCL-R scores using the two-factor model. They found that higher Factor 1 scores were associated with decreased scores on the Attention to Feeling scale (citation), while high Factor 2 scores were linked to decreased scores on the Mood Repair scale of the Trait-Meta Mood Scale (TMMS; citation). The Attention to Feeling scale is used to assess one's consciousness of or ability to appreciate one's own feelings, whereas the Mood Repair scale is representative of one's ability to regulate one's emotions. Therefore, the results of this study also provided support for the idea of separate attention and emotion-related processes of psychopathy consistent with greater scores on their respective factors.

These studies suggest that PCL-R subscale scores for Factors 1 and 2 may be useful in resolving questions about whether it is attention- and/or emotion-based mechanisms that are impaired in psychopaths. Similarly, subscale scores for the SRP may be useful for untangling the relative contributions of attention- and emotion-based mechanisms in nonclinical samples. Therefore, as in Experiment 1, results will be examined relative to SRP factor scores using the 2-factor model, in addition to overall SRP scores. The presence of an deficit in attendance to secondary stimuli being associated with higher scores on Factor 2 (Behavioural/Lifestyle) would support the idea of an attention deficit (as opposed to an emotion deficit) as the source of the impaired attentional performance.

The Stroop Task

The Stroop task (Stroop, 1935) is a widely used test of inhibitory function and is believed to assess attentional and executive function resources (Wurm et al., 2001). It has been widely used, in various forms, to assess inhibition and attention in psychopaths. The classic Stroop task involves single words representing colour names (e.g., "blue") printed in a colour that is incongruent with the word itself. The participant is required to name the colour rather than the word itself, with longer response times associated with poor inhibition. Thus, one or more components of the task are not relevant, but interfere with the task of interest (e.g., the naming of the colour). The task requires focused attention, with necessary inhibition of the dominant response. Various adaptations of the Stroop task have been developed, including ones containing emotional words. The assumption is that when emotional activation is high, task performance will be impaired. Because emotion regulation is believed to rely on inhibition and disinhibition, the emotional Stroop paradigm can thereby serve as a tool to help understand the interaction between emotion and cognition (Wurm & Vakoch, 1996; Wurm et al., 2001).

Wurm and Vakoch (1996) developed an auditory version of the emotional Stroop task. They used a lexical decision task in which participants listen to emotional words and comparable non-words spoken with prosodic cues to various emotions. Participants were asked to disregard the emotional tone and merely focus on the lexical decision aspect of the task by identifying whether the stimulus was a word or non-word. The semantic content of the word/non-word was either congruent or incongruent with its emotional prosodic content. For example, the word "contented", which represented the "happy" semantic emotion category would be produced with prosodic happiness (congruent) or disgust (incongruent). Wurm and Vakoch interpreted the higher error rate for identification of non-words as indicating that participants are engaging in effortful processing of the lexical decision component of the task. The inclusion of emotional material is meant to increase emotional activation, thereby interfering with the less dominant task of pseudo-word identification. Specifically, the dissociation between the prosodic and semantic content produces competition for attentional resources.

The Stroop task has been used to assess inhibitory function in psychopaths. An early study by Nyman and Smith (1959) found that psychopathic female delinquents had poorer response control than nonpsychopathic delinquents, which they equated with a deficit in ability to switch behaviour to approximate that required by situational changes. However, more recent studies have found no differentiation between psychopathic and nonpsychopathic participants in terms of interference on the standard colour-word Stroop task (Dvorak-Bertsch et al., 2007).

Hiatt, Schmitt, and Newman (2004) found support for the response modulation hypothesis using a Stroop task with psychopathic inmates. In addition to the standard colour-word Stroop paradigm, they used a "picture-word" paradigm and a spatially separated version of the colour-word Stroop task. While psychopathic participants performed similarly to controls on the standard Stroop task, suggesting comparable levels of interference from incongruent information and facilitation of performance when contextual cues are present, the former had decreased interference on the modified Stroop tasks compared to control participants. In addition, the lower rate of interference on the separated colour-word Stroop seen in psychopathic participants was associated with normal rates of facilitation. Hiatt et al. concluded that psychopaths can process stimuli not attended to (i.e., processing the colour word even when demonstrating decreased interference, as seen in the normal facilitation by this group of congruent words/colours). However, when the unattended information is spatially separate from or incongruent with the primary focus of the task, psychopaths display a reduced ability to attend to this secondary information. Vitale, Brinkley, Hiatt, and Newman (2007) obtained similar results with psychopathic female offenders, suggesting that despite minor sex differences, cross-sex abnormalities in attention consistent with the response modulation hypothesis exist in psychopathic individuals.

Limited research has been done to examine the perception of emotion in spoken language by psychopathic and nonpsychopathic individuals, with no studies looking at nonclinical samples. Moreover, no studies have examined attentional factors and response modulation in the context of emotion in spoken language. Given the success of modified Stroop tasks in elucidating aspects of attentional processing in psychopaths, an auditory emotional Stroop task like the one used by Wurm and Vakoch (1996) seems an appropriate means of examining the potential role of attention mechanisms in accounting for emotional speech perception in individuals with subclinical psychopathic characteristics. Therefore, Experiment 2 used a modified version of Wurm and Vakoch's original auditory emotional Stroop task.

In order to provide consistency between Experiments 1 and 2, the same five emotion categories were used in Experiment 1 were also used in the auditory Stroop task, differing slightly from those used by Wurm and Vakoch, who used only three of the emotion categories in their original auditory emotional Stroop. As a result of the increase in emotion categories, the auditory Stroop created for Experiment 2 had an unbalanced number of congruent versus incongruent stimuli. Typically in this type of experiment when there are only two possible responses (word/non-word in the lexical decision task), congruent and incongruent conditions are balanced. However, Mordkoff (2012) has demonstrated that selective attention tasks such as the Stroop produce greater effects for incongruent conditions when incongruent stimuli immediately follow congruent stimuli. Having only two conditions (congruent/incongruent) is therefore problematic, as it increases the likelihood that there will be repetition of the same stimuli and/or conditions. Typically, if one increases the number of forced-choice alternatives for incongruent stimuli in such a task, it would be logical to increase the number of congruent trials to 50% to match the incongruent trials. However, Mordkoff has suggested that the number of congruent trials included should remain approximately at chance, as increasing the number of congruent stimuli to half can minimize certain incongruent conditions and may adversely affect the effects present in the data.

While there are only two responses possible in the primary task in Experiment 2 as the nature of the task (lexical decision) only permits two choices (word/non-word), the secondary emotional information is integral to the study and involves a number of different emotion combinations (5 congruent and 20 incongruent). Thus, due to the inclusion of all emotion conditions and the issues inherent in increasing the numbers of congruent stimuli, it was decided that the number of congruent stimuli would remain at chance relative to emotion category (20% as per the inclusion of 5 semantic emotion categories), resulting in an unbalanced number of congruent and incongruent trials.

I predicted that participants in general would demonstrate greater interference in the lexical decision task from incongruent emotional stimuli than from congruent stimuli. In addition, as per the response modulation hypothesis, participants who have higher levels of psychopathic characteristics would be more successful at screening out secondary information when engaging in a primary task; in other words, when asked to attend to the lexical decision task and ignore the emotional content of the word, high scorers will have less interference from incongruent emotional stimuli than low-scorers. It is also possible that the congruent condition would result in response facilitation; that is, when the emotional prosody matches the semantic emotion, recognition of the word would be easier for the average listener than it would if the emotional word was present without the corresponding emotional prosody. Therefore, facilitation may occur for low scorers but this effect would not be as likely to occur in high scoring individuals as the emotional content (both congruent and congruent) is secondary to the primary task.

The response modulation hypothesis suggests that peripheral information irrelevant to the primary task will be screened out, regardless of the meaning or consequences of that information. Therefore, while the particular emotional content and congruency of the stimuli should produce cognitive interference and/or facilitation for the average listener, psychopaths should demonstrate neither the same degree of interference nor facilitation because the emotional content of the stimuli is irrelevant to the task. While a lack of facilitation in psychopaths would be consistent with an emotional deficit such as amygdala dysfunction, a lack of interference as well as lack of facilitation in these individuals is consistent with the response modulation hypothesis, and such interference should be evident in similar tasks without emotional stimuli.

As in Experiment 1, results were examined relative to not only overall SRP scores but also relative to SRP factor scores using the 2-factor model. An association between higher scores on the Behaviour/Impulsivity dimension and demonstration of lower interference/facilitation (resulting in little difference in response times between the congruent, incongruent and nonword conditions) would suggest that these results are consistent with the theory of psychopathy as an attention deficit. There is limited research applying the response modulation hypothesis to sex differences in psychopathy; therefore, as in Experiment 1, sex was considered as an additional variable to identify whether any sex differences relative to psychopathy scores exist in attention for emotion in speech.

Method

Participants. Participants were 60 (43 female, 17 male) English-speaking Carleton University undergraduate students recruited through the university's online study participation system. A median split was used to separate participants into high and low scoring groups. Participant characteristics are listed in Table 4. Visible ethnicity was recorded: 55% of participants were Caucasian, 45% were recorded as other than Caucasian. Participants were required to have no history of a speech or hearing disorder. High and low scoring groups were separated using a median split. All participants in Experiment 2 also participated in Experiment 1 during the same testing session. Students received course credit in return for participation.

Table 4
Psychopathy Scores for Participants (Experiment 2).

	M (SD)	*Median*	*Range (High Scoring Group)*	*Range (Low Scoring Group)*
SRP Total	50.90 (12.99)	49	49-84	29-48
SRP Factor 1	26.05 (8.19)	25	25-48	14-24
SRP Factor 2	24.17 (6.13)	22	22-42	15-21

Measures. The Self-Report Psychopathy Scale III (SRP-III; Williams et al., 2007) was administered participants at the beginning of their testing session.

Stimuli. Stimuli were based on those used by Wurm and Vakoch (1996), who used "pure emotion" words identified by Morgan and Heise (1988). These include words for which connotations, either cognitive or behavioural, were relatively absent (e.g., "glad", "happy" and "pleased" represented happiness). There were four words for each of the five semantic emotion categories (happy, sad, angry, fear and disgust, as in Experiment 1). Each word was spoken with emotional prosody representing all five emotion categories, resulting in one congruent and four incongruent presentations of each word. There were an equivalent number of pseudo-words for the number of real

English words, which are also taken from Wurm and Vakoch. The pseudowords were derived by replacing a phoneme in the original word (e.g., "charmed" was transformed into the pseudoword "charned"). All stimuli were spoken by one male and one female speaker. The speakers selected were the speaker of each sex with the highest accuracy ratings for emotion categorization in Experiment 1. Stimuli were approximately 500-1000 ms in length. Presentation of stimuli was randomized. In total, there were 400 stimuli: 5 (emotion) x 4 (words per emotion category) x 5 (prosodic emotion presentations of each word: 1 congruent, 4 incongruent) x 2 (word/pseudoword) x 2 (speaker)

Procedure. Participants were tested in a sound-attenuated booth. Stimuli were presented via headphones connected to a laptop. For each auditory stimulus participants were required to judge whether the stimulus is a word or non-word. The two options, "word" and "non-word", were presented visually on the laptop screen. Participants were asked to indicate their response after each stimulus presentation by pressing a key to indicate whether they thought the stimulus was a word or non-word. They were asked to indicate their response as quickly and accurately as possible. The onset of each stimulus occurred immediately following the lexical decision of the previous stimulus. Response time was measured from the onset of each stimulus. There was a break halfway through the presentation, at which point participants were required to press a key to continue. Stimuli were approximately 500-1000 ms in length. There were 5 practice stimuli prior to the start of the first trial.

Experiment 2 Results and Discussion

All within-subject comparisons in Experiment 2 met the assumption of sphericity as per Mauchly's test. One participant was excluded from the study due to excessively high error rates in the lexical decision task (approximately 50%).

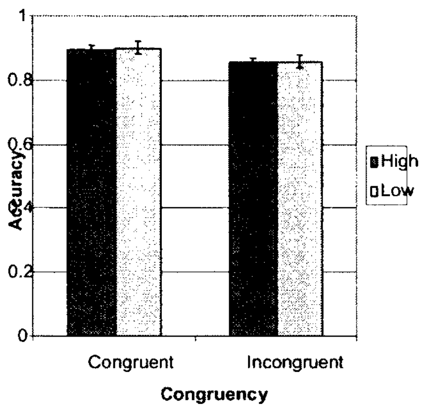
Accuracy

Across all SRP measures congruent stimuli were identified more accurately (.898 proportion correct)_as words than incongruent stimuli (.856 proportion correct) ((F(1, 55)= 121.035, MSE = .032, p < .001, f = 1.48), suggesting that overall, congruent emotional prosody and semantic emotion information facilitated accurate word recognition, compared with incongruent prosodic and semantic emotion information.

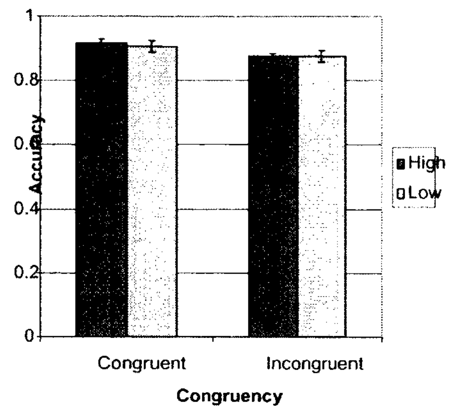
Accuracy did not significantly differ by either SRP group (F(1, 55)= .044, MSE = .000, p = .835, f = .00), Factor 1 group (F(1, 55)= .117, MSE = .001, p = .734, f = .04) or Factor 2 group (F(1, 55)= .881, MSE = .008, p = .352, f = .13). Neither was there was a significant interaction between congruency and either SRP group (F(1, 55)= .523, MSE = .000, p = .477, f = .1), Factor 1 group (F(1, 55)= .064, MSE = 1.649, p = .801, f = .03) or Factor 2 group (F(1, 55)= 2.149, MSE = .001, p = .148, f = .2) (see Fig. 14). Accuracy did not vary as a function of sex (F(1, 55)= 1.648, MSE = .016, p = .205, f = .17). Sex and congruency did not interact (F(1, 55)= 1.983, MSE = .001, p = .165, f = .04) (see Fig. 15). There was no significant interaction between sex and either SRP group (F(1, 55)= .01, MSE = 9.074, p = .922, f = .00), Factor 1 group (F(1, 55)= .233, MSE = .002, p = .631, f = .06) or Factor 2 group (F(1, 55)= .000, MSE = 1.550, p = .997, f = .00) for accuracy.

Figure 14

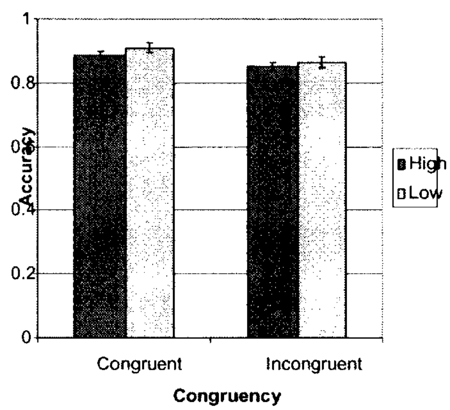
Accuracy (percent correct) by Congruency (congruent/incongruent) and high- vs. low-scoring SRP group/subgroups (SRP group, Factor 1 group, Factor 2 group). Error bars indicate +/- 1 Standard Err of the Mean.



A. SRP Group

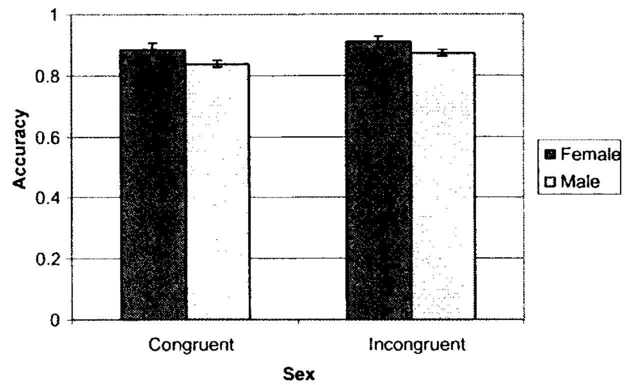


B. Factor 1 Group



C. Factor 2 Group

Figure 15
Accuracy (percent correct) by Congruency (congruent/incongruent) and Sex (female/male). Error bars indicate ± 1 Standard Error of the Mean.



Response Time

Counter to what was predicted, RTs for incongruent stimuli (1.312 s) were faster than for congruent stimuli (1.336 s) ($F(1, 55)= 4.295$, $MSE = .01, p < .05, f= .28$). Matching semantic and prosodic emotion was predicted to facilitate performance, whereas the discrepancy between the two types of emotion information in the incongruent stimuli was predicted to create interference that would result in slower RTs. A speed-accuracy trade-off may account for this pattern of results since congruent stimuli produced more accurate but slower responses, while the reverse was true for the incongruent stimuli.

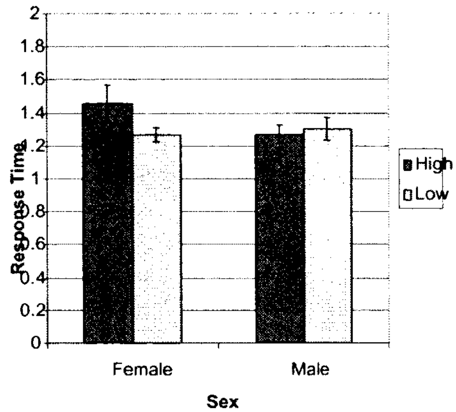
RTs did not differ between SRP groups SRP groups ($F(1, 55)= 1.043$, $MSE = .105, p = .312, f= .14$), nor Factor 1 groups ($F(1, 55)= 1.341$, $MSE = .137, p = .252, f= .16$) or Factor 2 groups ($F(1, 55)= .002$, $MSE = .000, p = .964, f= .00$). RTs did not differ for males and females ($F(1, 55)= 1.244$, $MSE = .123, p = .273, f= .15$). RTs as a function of sex and SRP score did not interact ($F(1, 55)= 3.741$, $MSE = .009, p = .058, f = .21$), nor did sex and Factor 1 group ($F(1, 55)= 2.566$, $MSE = .006, p = .115, f=$

.11).However, there was a significant interaction between sex and Factor 2 score (F(1, 55)= 5.6, MSE = .517, p < .05, f = .32) with males and females exhibiting opposite patterns of RTs relative to Factor 2 group: low scoring females had faster response times than high scoring females, whereas low scoring males had slower response times than high scoring males (see Figure 16). No significant interaction was obtained between sex and congruency (F(1, 55)= 3.741, MSE = .009, p = 0.058, f = .26) (see Figure 17).

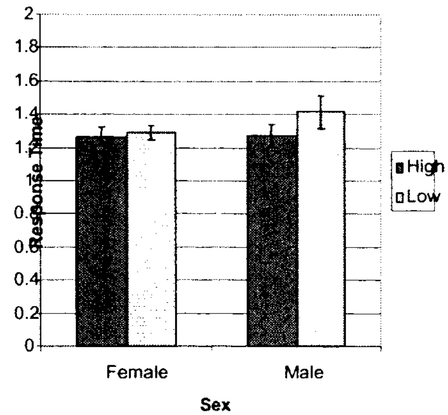
The interaction for RTs between congruency and SRP Group was significant F(1, 55)= 6.991, MSE = .017, p < .05, f = .36), with high scorers responding more quickly to congruent stimuli than incongruent stimuli, while the reverse was true for low scorers. Low scorers also demonstrated a larger difference between RTs for the two conditions than was seen for high scorers. The interaction between congruency and Factor 1 group was also significant (F(1, 55)= 4.831, MSE = .012, p < .05, f = .3) with a similar pattern of condition-specific group differences for response time. However, the interaction between congruency and Factor 2 group was not significant (1, 55)= 1.273, MSE = .003, p = .24, f = .15) (see Figure 18). Thus, there appears to be a differential effect of congruency on RT depending on which psychopathic characteristics are being considered. For Factor 2 scores the high-scoring and low-scoring groups displayed a similar pattern of responses to one another, both demonstrating the unexpected slower responses to congruent stimuli than to incongruent stimuli. The only group difference for Factor 2 groups is that the low scorers tend to be slower overall at making responses than the high scorers, with both groups responding more quickly to incongruent stimuli. In all three analyses of SRP scores low scoring participants showed a greater discrepancy in speed of responding between conditions than high scoring participants.

Figure 16

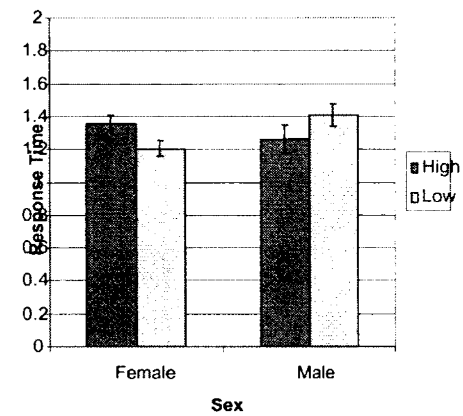
RTs (seconds) by Sex (female/male) and high- vs. low-scoring SRP group/subgroups (SRP group, Factor 1 group, Factor 2 group). Error bars indicate ± 1 Standard Error of the Mean.



A. SRP Group



B. Factor 1 Group



C. Factor 2 Group

Figure 17

RTs (seconds) by Congruency (congruent/incongruent) and Sex (female/male). Error bars indicate ± 1 Standard Error of the Mean.

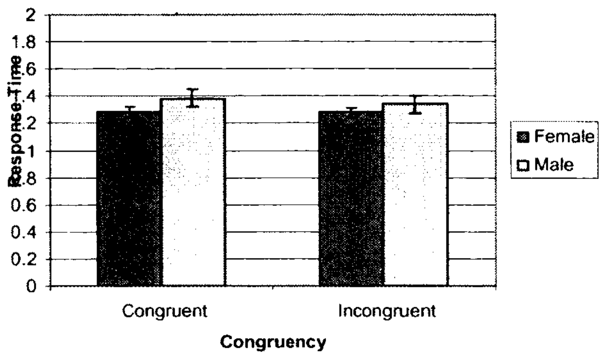
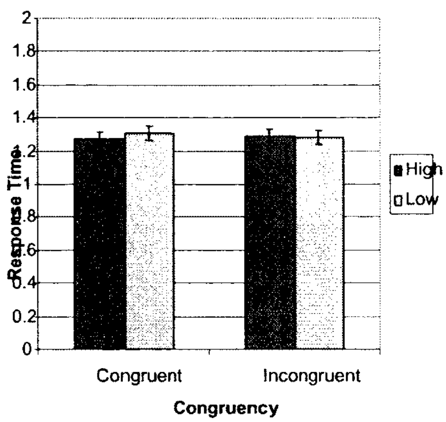
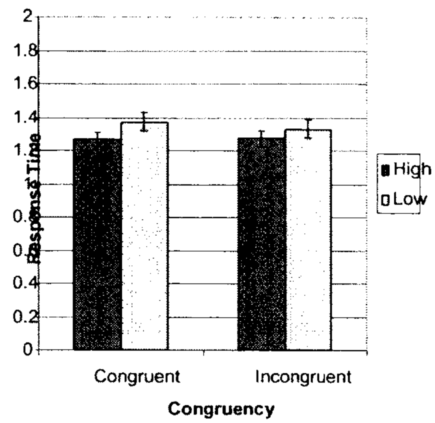


Figure 18

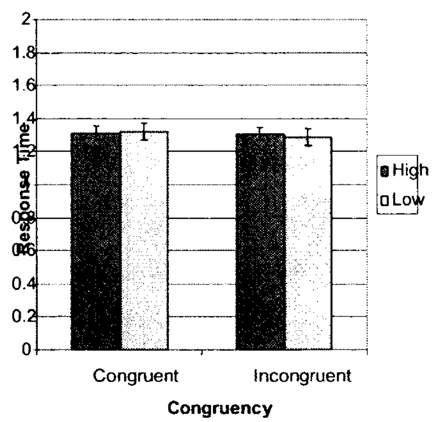
RTs (seconds) by congruency (congruent/incongruent) and high- vs. low-scoring SRP group/subgroups (SRP group, Factor 1 group, Factor 2 group). Error bars indicate ± 1 Standard Error of the Mean.



A. SRP Group



B. Factor 1 Group



C. Factor 2 Group

Males and females were expected to demonstrate different patterns of performance. However, not only did sex not have an effect on accuracy or response time for categorization, it did not interact with SRP group. This is surprising, as typically males tend to score higher on measures of psychopathy whereas females tend to score lower. The lack of sex differences suggests that in this particular sample psychopathy score was independent of sex. However, the sample also has an imbalance in the number of males and females included (the sample consisted of 76 females and 30 males).A larger sample with more male participants may be necessary to observe any sex differences.

Overall, the results of Experiment 2 were mixed, relative to what was predicted. Congruent stimuli in the lexical decision task were identified more accurately as words than incongruent stimuli across SRP group (groups separated by high versus low overall SRP scores) and SRP Factor groups (groups separated by high versus low scores on Factor 1 and Factor 2 scores), which is not surprising. However, RTs were faster overall for incongruent than congruent stimuli, which was the opposite of what was predicted. Although a surprising result, perhaps this is due to the fact that a word with congruent emotional prosody and meaning generates a better representation of the emotion associated with word, resulting in participants processing this type of word to a greater extent than they would emotional words with incongruent emotional prosody. This could explain the higher accuracy rate and slower RT for this condition. However, when the interaction between group and congruency is examined for each of the three SRP categories (SRP group, Factor 1 group and Factor 2 group), this hypothesis does not necessarily hold.

SRP group and Factor 1 group membership differentially affected RT as a function of congruency condition. In contrast, psychopathy did not affect accuracy. This suggests that individuals scoring high and low on psychopathic characteristics engage the same process when identifying emotion words and non-words, regardless of whether the accompanying emotional tone is congruent or incongruent. The difference between high and low SRP and Factor 1 groups on RT, on the other hand, indicates that the speed at which this processing occurs differs depending on the individual's psychopathic characteristics. This may be suggestive of how congruency of semantic and prosodic emotion produce processing differences between high and low scorers, a process that is distinct from the identification of words versus non-words per se.

Participants in the high-scoring SRP group showed minimal interference or facilitation between the two conditions, with minimal difference in speed of response to congruent or incongruent stimuli. Participants in the low-scoring group, on the other hand, demonstrated a considerable difference between their RTs for congruent versus incongruent stimuli. This general group difference was as predicted and fits with the response modulation hypothesis: high-scoring (more psychopathic) individuals, when focused on the primary task, were less affected by the emotional content of the stimuli that was irrelevant to this task; whereas the low-scoring individuals were much more affected by the emotional content of the stimuli. However, the low-scoring participants produced much faster responses to the incongruent stimuli than the congruent, which was the opposite of what was predicted. Therefore, there does not appear to be either the predicted facilitation effect or interference effect, as the predicted facilitation effect would have produced faster RTs in the congruent condition and the predicted effect of interference would have produced slower RTs in the incongruent condition, both for the low-scoring group but not for the high-scoring group.

Wurm, Labouvie-Vief, Aycock, Rebucal, and Koch (2004) found that young adults (as compared to older adults) can inhibit the interference of incongruent emotional prosody and do not benefit from congruent emotional prosody. This is the type of result that was predicted for the higher scoring group in Experiment 2, as it suggests the ability to screen out the influence of prosody when it is information secondary to the primary task (consistent with the response modulation hypothesis). In fact, results from Experiment 2 are more consistent with the predicted group difference based on the response modulation hypothesis than the results obtained by Wurm et al. for young adults in general. The presence of group differences between high and low scorers (based on SRP and Factor 1 scores) indicates that such a generalization about processing of congruent versus incongruent emotional words and prosody by young adults must consider other individual difference characteristics. Wurm et al. (2004) found a greater discrepancy in responding between congruency conditions for older adults than younger adults when using the same type of task used in Experiment 2. This difference was attributed to the cognitive decline experienced by older adults that resulted in interference from incongruent emotional stimuli. However, results of Experiment 2 indicate that there may be more to the story. Differences between older and younger adults in ability to screen out emotional prosody when it disrupts the primary task may be more attributable to age-related differences in attention than level of cognitive functioning in general.

Results for high scoring SRP and Factor 1 participants were actually in the direction that was predicted for the low-scoring participants, in that the high scoring participants displayed faster RTs to the congruent stimuli than the incongruent stimuli (although the difference in RTs between conditions for this group was less dramatic than said difference for the low-scoring group). This group interaction was noticeable when participants are separated into groups by SRP score, wherein high-scoring participants exhibited the opposite pattern for speed of responding by condition to low scorers. The pattern of RTs for high versus low scorers actually resulted in high Factor 1 scorers producing faster RTs for congruent stimuli than low Factor 1 scorers. This group difference is consistent with the response modulation hypothesis when participants are separated by Factor 1 score. Low scorers, regardless of SRP or Factor score, are slower to respond overall than high scorers and the difference is exaggerated for incongruent stimuli, with the result that high scorers display a minimal difference in RT between conditions while low scorers have very discrepant RTs by condition.

The results suggest a speed-accuracy trade off that varies as a function of group. High scorers tend to be faster at responding but less accurate than the low-scorers. Perhaps the low scoring (less psychopathic) individuals are more deliberate in their judgments with the result that they attend to the congruent stimuli (which are better representations of the emotion word than the incongruent stimuli) more than the high scorers do. The high scoring groups for SRP score and Factor 1 score were the only ones who demonstrated a pattern resembling the predicted interference/facilitation effect. Perhaps these unconscious effects are most noticeable when the individual focuses less on the word identification judgment, as the high scoring individuals appear to do based on their reduced accuracy and faster response times overall. Conversely, such effects of interference or facilitation may not occur when the individual places more conscious effort on the task as may be the case for low scorers.

An aspect of Experiment 2 that warrants further examination was that this unpredicted group interaction was more attributable to the difference in Factor 1 scores. The fact that high Factor 2 scorers produced faster overall responses (and poorer accuracy) than low scorers fits with the idea that individuals who score highly on Factor 2 tend to be more impulsive than those with lower scores. However, the group interaction that fits most closely the response modulation hypothesis, that is, where high scorers demonstrate faster but less discrepant responses between conditions than low scorers, is based on differences in Factor 1 scores. This effect is still seen when groups are split by overall SRP score, but the effect is somewhat diluted by the lack of similar interaction based on Factor 2 scores. If the results may be attributed to a deficit in response modulation exhibited by psychopathic individuals, it would make sense for this deficiency to be accounted for by higher scores on Factor 2 which represents behavioural and attentional abnormalities, consistent with the argument that the deficit in response modulation in psychopaths is, by definition, an attentional one. The fact that this group difference is more noticeable when considering the range of Factor 1 scores is suggestive of an emotional rather than attentional deficit. Perhaps this is a good example of the attention and emotional deficit working in tandem to contribute to psychopathic characteristics.

Future analyses could examine the pseudowords to identify what effects these have on attentional processes relative to the equivalent words, and to identify whether any group interactions exist for these stimuli as well. Despite the fact that these are not recognizable words, the similarity (differing by one letter) to the real words may still reveal differences in accuracy and response time for congruent versus incongruent conditions. For example, it is possible that prosody that is "congruent" with the non-word (in actual fact, with its equivalent real word) may cause a kind of interference that won't be present in the incongruent condition, as the congruent prosody may result in the non-word being perceived as its equivalent real word. Such results might provide a different insight into the attentional mechanisms used in this kind of task in a way that has not been explored previously relative to psychopathic characteristics.

Future work could also investigate the inclusion of balanced congruent and incongruent conditions (cf. Mordkoff, 2012). If repeated trials of incongruent stimuli tend to minimize the interference produced by the incongruence, perhaps group differences will be greater when more congruent stimuli are included randomly as this would provide more opportunities for the interference produced by an incongruent stimulus to be exaggerated following exposure to a congruent stimulus.

General Discussion

Despite a failure to find significant differences between high and low SRP scorers in Experiment 1 and successfully replicate Blair et al.'s results in a non-clinical population, the results of Experiment 2 suggest a deficit in processing of emotional words in individuals scoring high on the SRP-III. The difference in results between Experiment 1 and 2 suggests that the nature of the deficit depends upon task requirements. The replication of Blair et al. (2002) in Experiment 1 using both original and new stimuli required participants to complete a relatively simple task, the forced-choice categorization of the emotion associated with an isolated word. The auditory emotional Stroop paradigm used in Experiment 2 was a more complex task as it required participants to focus their attention on multiple aspects of the stimuli, arguably requiring more advanced allocation of attentional resources than the task used in Experiment 1.

Blair et al.'s (2002) results suggested the presence of an emotional deficit in psychopathic individuals. However, Experiment 1 showed that a sample of nonclinical nonpsychopathic participants scoring high and low on a measure of psychopathic characteristics categorized emotions very differently than the psychopathic (and nonpsychopathic) participants in Blair et al. The original study by Blair et al. found that fear was identified least accurately overall, with psychopathic participants' performance even worse than nonpsychopathic participants. In Experiment 1, the least accurately identified emotion overall was disgust, followed by fear. With respect to psychopathy scores, there was no group interaction found between high and low scorers. There was no interaction between group (high vs. low SRP scores) and emotion; therefore, the difference between psychopathic and non-psychopathic individuals in categorization of fearful prosody found by Blair et al. was not replicated in Experiment 1.

Blair et al. (2002) attributed the results of their study to the low-fear hypothesis and a poorly functioning amygdala in psychopathic individuals. However, the results of Experiment 1, in particular the failure to observe an impairment in the identification of fearful affect by high SRP scorers is not consistent with Blair et al.'s finding and consequently does not support the theory of amygdala dysfunction in such individuals. Therefore, differences in perception of emotional prosody observed between high and low scorers on a subclinical measure of psychopathy may not reflect the same deficient process in high scorers as is seen in individuals with "true" psychopathy. An overall deficit in emotion-processing may exist in individuals in the general population who do not meet the cut-off for "true" psychopathy, but perhaps this impairment is more related to emotional understanding in general rather than being strictly related to fearful emotional stimuli. Further exploration using a larger sample size to increase power may reveal more about this potential emotion-processing deficit in high SRP scorers.

The homogeneity of the sample likely contributed to the lack of significant group differences in Experiment 1. The original study by Blair et al. (2002) found a robust group difference in accuracy for emotion categorization but they used extreme groups of psychopaths and non-psychopaths. The participants in Experiment 1were divided into high and low groups by a median split and the sample was fairly homogeneous to begin with. Moreover, the Experiment 1 sample would be considered to be low on psychopathic characteristics overall relative to the population from which Blair et al.'s high-scoring sample was drawn. Therefore, a larger sample with more extreme groups may be required to observe an effect of SRP and Factor scores in a non-clinical population for the task used in Experiment 1. A larger sample may also be required to clarify the group differences observed in Experiment 2.

Analyzing performance as a function of individual differences (i.e., sex and SRP score) using hierarchical linear modeling, rather than splitting participants into high and low groups may be a more suitable statistical procedure than using ANOVA. As the sample overall was quite homogeneous with limited differences in psychopathy scores found between high and low scorers, perhaps examining responses to emotional stimuli relative to continuous psychopathy scores would yield different results.

Other participant characteristics in Experiment 1 and 2 may have attenuated potential effects associated with performance. The mean RTs provided by the participants in Experiment 2 were substantially longer than those observed in previous studies. Wurm et al. (2004) obtained RTs in the Stroop/LDT that averaged ~1.1 s for the older participants, whereas the RTs in Experiment 2 averaged ~1.3 s for university students with an average age of ~20 years, with accuracy similar across the two studies. This suggests that perhaps the participants in Experiment 2 (and by extension, Experiment 1) were not performing optimally.

Another possible explanation for the absence of significant group differences in Experiment 1 is that isolated words provided an insufficient presentation of emotional prosody to differentiate listeners who only varied modestly in the degree to which they had psychopathic characteristics. The use of sentence-length stimuli, such as those used by Bagley et al. (2009), may have produced more noticeable group differences. The low scorers may have had an easier time identifying the emotional prosody present in sentence-length stimuli, which might have separated high from low scorers on RT and accuracy more effectively. However, arguing against this account is the possibility that the brief nature of isolated words compared to sentence-length stimuli should prove harder for the high scorers, thus differentiating high and low scorers (although this did not prove to be the case in Experiment 1).

Group differences also may have been more evident for Experiment 2 had the stimuli been sentence-length as opposed to word-length. As the auditory emotional Stroop was primarily an attention task, the stimulus length likely did not play as important a role as it did for the task in Experiment 1. However, the original version of the auditory Stroop used by Wurm and Vakoch (1996) to test young adults (and subsequently older adults)used sentence-length stimuli to present emotional prosody.

Therefore, using sentence-length stimuli in the auditory Stroop task could be more effective in differentiating high and low scorers.

The fact that Factor 1 contributes most to the group difference seen in Experiment 2 for congruency judgments on the auditory Stroop was unexpected. The response modulation hypothesis would predict that psychopathic individuals would be faster at responding to the emotional stimuli in the lexical decision task than non psychopaths, as they would not attend to the emotional content which would serve as peripheral information. Non-psychopaths, on the other hand, would process and thus be affected by the emotional content of the stimuli despite it being irrelevant to the primary task, resulting in slower RTs. This pattern of results was predicted for the high (more psychopathic) versus low (less psychopathic) SRP scorers. While this general group difference was observed as predicted, the predicted facilitation versus interference effect for low scorers of congruent relative to incongruent conditions was not observed and was, in fact, reversed from what was predicted. The high scorers, on the other hand, demonstrated a response pattern closer to that which was predicted for low scorers, as they responded to congruent stimuli more quickly than incongruent stimuli. The existence of differential group patterns of responses relative to condition suggests not only the presence of overall differences between groups for speed and accuracy but also potential group differences in the how this type of stimuli is processed. That is, high scorers not only demonstrate a different speed-accuracy trade off (displaying faster but less accurate responses), but the fact that high scorers respond more quickly to congruent stimuli when the opposite is true for low scorers suggests that the way in which high scorers attend to and process the different types of stimuli must be different than that of the low scorers. As a trend toward a sex related speed-accuracy trade-off was also observed in Experiment 1, one way to clarify the effects of a speed-accuracy trade-off would be to split participants into two groups based on based on speed of responding, creating a fast-RT groups and a slow-RT group. This would permit the analysis of categorization accuracy with RT held approximately constant within each of the two groups. Different results with respect to group differences in both speed and accuracy of responding may then be identified.

Regardless of the process which resulted in the low-scorers and high Factor 2 scorers more easily identifying incongruent stimuli than congruent stimuli, the group difference is primarily based on differential Factor 1 scores as opposed to overall SRP score or Factor 2 score. The response modulation hypothesis not only provides an alternative explanation to the emotional deficit and amygdala dysfunction theory in psychopaths, proponents of the response modulation hypothesis insist that this attention deficit can account for the emotional deficits demonstrated by psychopathic individuals and that these two theories do not operate in tandem. If this is the case, it is highly surprising that the emotion-related aspect of participants' psychopathy scores is not only highly associated with the results that are consistent with the response modulation hypothesis, but also much more so than Factor 2 scores.

High scorers consistently respond differently to the emotional stimuli compared to low scorers, regardless of the different tasks used in Experiments 1 and 2. However, the differential requirements for the two tasks suggest the task in Experiment 1 is assessing perception of emotion, while the task in Experiment 2 is primarily assessing attentional capacity,and emotion perception secondarily. Thus, it is surprising that in

Experiment 2, Factor 1 score makes a greater contribution to the interaction between psychopathy scores and congruency condition in attention for emotional stimuli than Factor 2. As the latter is associated with impulsive behaviour, it seems this factor would be more likely to be associated with an attention deficit than Factor 1 score which would seem more likely to be linked to an emotional deficit. It appears that the lines between emotional and attentional deficit may be more blurred than was originally thought if the emotional component of individuals' psychopathy characteristics accounts primarily for discrepancies that would be predicted due to differences in attentional capacity between high and low scorers.

Although limited sex differences were found in Experiment 1, these differences were minimal for Experiment 2. Some (e.g., Rogstad & Rogers, 2008) have argued that women understand emotion differently than men, having greater empathy than men, for example. The results of this study suggest that perhaps sex differences relative to psychopathic characteristics are more identifiable when the task is strictly emotion-related, and these differences may be less obvious when attention tasks are considered.

Experiments 1 and 2 provide a window into how individuals from the general population who vary in psychopathic characteristics process emotional prosody. The results of these experiments indicate high scoring individuals have reduced emotional processing that corresponds to the difference observed between psychopathic and nonpsychopathic individuals in previous studies. The effect of psychopathy on emotion processing, however, is reduced in high scoring participants from the general population compared to "true" psychopaths. The lack of sex differences identified in both Experiment 1 or 2 suggests more similarities than differences between sexes with respect to perception of emotional speech and emotional stimuli in general, or at least that the group differences based on psychopathic characteristics are strong enough to minimize any separate sex differences.

Across both Experiment 1 and 2, SRP Factor 1 scores made the largest contribution to group differences, particularly when the task was more complex and involved a higher level allocation of attentional resources. In future studies it may be worthwhile to focus further on how processing emotion information relates not only to overall psychopathy scores but also to separate factor scores. Different patterns may emerge relative to factor scores when exploring combined attention and emotional tasks that may shed light on the emotion-processing of psychopathic individuals.

Evidence from Experiments 1 and 2 suggest that psychopathy involves both emotional and attentional factors rather than one of these components alone, as noted by other researchers (Moul et al., 2012). It is clear that there are differences in the processing of emotional stimuli, such as emotional speech, between individuals that vary (modestly) in the degree to which they have psychopathic characteristics. This may have implications for individuals in the general population who do not meet the clinical cutoff for psychopathy.

An obvious extension of Experiment 2 would be to using a similar paradigm to evaluate the processing of emotional prosody in a clinical population of psychopaths and non-psychopaths. The results might be expected to show a similar pattern but with a greater discrepancy between psychopath and non-psychopath than in Experiment 2's high and low SRP groups. However, there is also the possibility that while there are differences between individuals scoring high versus low on a subclinical measure of psychopathy, the pattern may be very different between true psychopaths and non-psychopaths. Blair et al. (2002) found a distinct difference in pattern of responses between true psychopaths and non-psychopaths in their emotion categorization task, yet no group differences were identified between high and low scoring nonpsychopaths in the student sample used in the present study on an equivalent task in Experiment 1. The Auditory Stroop paradigm used in Experiment 2, on the other hand, did yield evidence for a strong group interaction between high and low SRP scorers. Whether the same kind of result would be replicated in a clinical population, or whether there would be an entirely different set of responses from "true" psychopaths reflecting a different type of emotion-processing in this population remains to be seen. The fact that the group difference is noticeable when the task becomes more complicated and potentially taps greater cognitive resources suggests that differences in psychopathic characteristics in non-psychopaths can be identified more distinctly with increasing task complexity, or possibly when the task involves an attentional component rather than simply an emotional one.

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Appendix A

SRP-III (short version)

Please rate the degree to which you agree with the following statements about you. You can be honest because your name will be detached from the answers as soon as they are submitted.

1. I'm a rebellious person.
2. I have never been involved in delinquent gang activity.
3. Most people are wimps.
4. I've often done something dangerous just for the thrill of it.
5. I have tricked someone into giving me money.
6. I have assaulted a law enforcement officer or social worker.
7. I have pretended to be someone else in order to get something.
8. I like to see fist fights.
9. I would get a kick out of 'scamming' someone.
10. It's fun to see how far you can push people before they get upset.
11. I enjoy doing wild things.
12. I have broken into a building or vehicle in order to steal something or vandalize.
13. I don't bother to keep in touch with my family anymore.
14. I rarely follow the rules.
15. You should take advantage of other people before they do it to you.
16. People sometimes say that I'm coldhearted.
17. I like to have sex with people I barely know.
18. I love violent sports and movies.
19. Sometimes you have to pretend you like people to get something out of them.

20. I was convicted of a serious crime.

21. I keep getting in trouble for the same things over and over.

22. Every now and then I carry a weapon (knife or gun) for protection.

23. You can get what you want by telling people what they want to hear.

24. I never feel guilty over hurting others.

25. I have threatened people into giving me money, clothes or makeup.

26. A lot of people are 'suckers' and can easily be fooled.

27. I admit that I often "mouth off" without thinking.

28. I sometimes dump friends that I don't need any more.

29. I purposely tried to hit someone with the vehicle I was driving.