Neural and behavioural correlates of empathy and morality and their associations with psychopathic traits

Ana Bernardo Seara Cardoso

Prepared under the supervision of:

Prof. Essi Viding and Dr. Jonathan P. Roiser

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Division of Psychology and Language Sciences

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I, Ana Bernardo Seara Cardoso, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

ABSTRACT

Psychopathy is a personality disorder that can be defined by profound disturbances in empathic response to others and repeated engagement in immoral behaviour. This thesis set out to investigate how individual differences in psychopathic traits in the general population are associated with variability in distinct components of empathy and morality.

This thesis endeavoured to answer five outstanding research questions: 1) Given the complexity and multidimensionality of empathy and morality constructs, which components of these constructs are associated with psychopathic traits at the behavioural level? [Chapters 2-3] 2) Are behavioural correlates of empathy and morality in psychopathic traits specific to affective-interpersonal traits/lifestyle-antisocial traits, or common to both? [Cs. 2-3] 3) Are these correlates consistent across genders? [Cs. 2-3] 4) Are associations between psychopathic traits and empathic [C. 4] and 5) moral processing reflected at the neural level [C. 5]?

This thesis' findings suggest that: 1) individual differences in psychopathic traits are associated with lesser empathic response to emotional stimuli, lesser propensity to feel moral emotions and atypical moral decision-making; 2) empathic atypicalities are driven by the joint variance between affective-interpersonal and lifestyle-antisocial facets, but those related to affective aspects of moral cognition seem to be driven by variance in affective-interpersonal traits; 3) empathic and moral atypicalities seem to be similar in men and women; 4) atypical amygdala and anterior insula function may represent neural markers of disrupted empathic processing for individuals with high levels of psychopathic traits; and 5) atypical functioning of the vmPFC/mOFC during moral processing may contribute to the

disordered lifestyle and antisocial behaviour exhibited by individuals with high levels of psychopathic traits. These findings contribute to a more comprehensive understanding of the empathic and moral processing impairments that underlie psychopathic traits.

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: General Introduction

Psychopathic Traits, Empathy and Morality

1.1. What is Psychopathy?

1.1.1. Psychopathy as a constellation of affective, interpersonal, lifestyle and antisocial characteristics

Psychopathy is a personality construct that involves a constellation of personality and behavioural characteristics, including lack of guilt, remorse and empathy, callousness, manipulativeness, impulsiveness, sensation-seeking, and frequent engagement in antisocial and immoral behaviour (e.g. Blair, Mitchell, & Blair, 2005; Cleckley, 1941; R. D. Hare, 2003; R. D. Hare & Neumann, 2008).

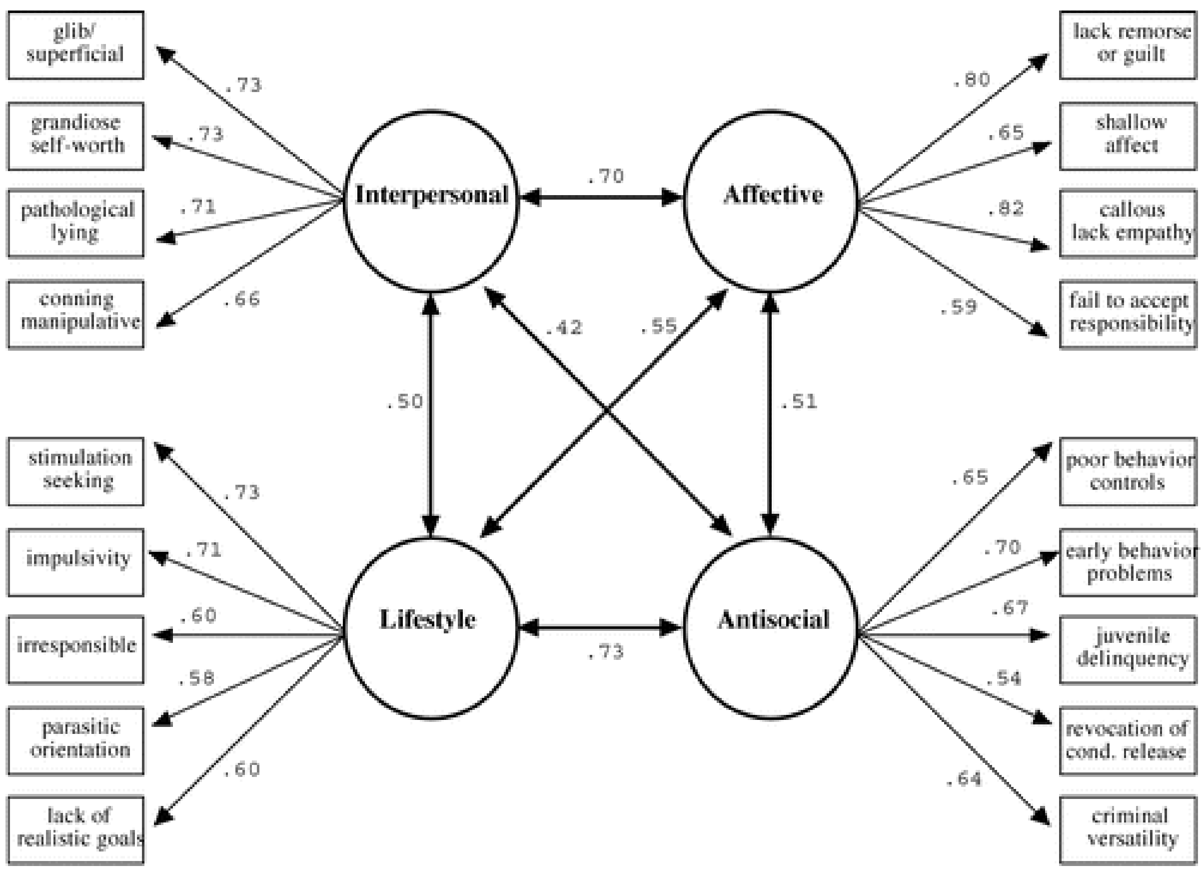
The modern conception of psychopathy derives from Hervey Cleckley's work "The Mask of Sanity" (1941). Based on his clinical experience, Cleckley described sixteen "common characteristics" of the psychopath. These included superficial charm and good "intelligence"; absence of delusions and other signs of irrational thinking; absence of 'nervousness' and psychoneurotic manifestations; unreliability, untruthfulness and insincerity; lack of remorse and shame; inadequately motivated antisocial behaviour; poor judgement and failure to learn by experience; pathological egocentricity and incapacity for love; and general poverty in major affective reaction. Cleckley's seminal work has had an important influence not only on clinical settings but also on the empirical research of psychopathy. Based on Cleckley's description of psychopathy and on his own clinical observations and extensive empirical work, Robert Hare developed a formal tool for the assessment of the disorder, the Psychopathy Checklist (PCL; 1980) and later the PCL-

Revised (PCL-R; 1991, 2003), which is currently considered to be the standard instrument for the formal assessment of the disorder in forensic settings.

Based on formal assessment with the PCL-R, the syndrome of psychopathy can be diagnosed in forensic settings when a person scores high on two dimensions, that can be further divided in four facets (R. D. Hare, 2003; R. D. Hare & Neumann, 2008). The first dimension traditionally referred to as Factor 1, can be divided in affective and interpersonal facets. The affective facet includes characteristics such as lack of remorse or guilt, shallow affect, callousness and lack of empathy, failure to accept responsibility for actions; whilst the interpersonal facet includes characteristics such as glibness/superficial charm, grandiose sense of self-worth, pathological deception, and manipulation of others. The second dimension, Factor 2, is comprised of lifestyle and antisocial behaviour facets. Lifestyle characteristics include need for stimulation/proneness to boredom, parasitic lifestyle, lack of realistic long-term goals, impulsivity and irresponsibility; whilst antisocial behaviour facet records poor behavioural controls, early behaviour problems, juvenile delinquency, revocation of conditional release and criminal versatility.

Evidence from forensic and community male samples suggest that the two dimensions of psychopathy (i.e. affective-interpersonal and lifestyle-antisocial behavior) present distinct associations with various criterion measures of personality, emotionality and behavior, particularly when their shared variance is controlled for. For example, the affective-interpersonal dimension presents negative associations with emotional correlates such as fearfulness, distress and emotinal reactivity, whlist the lifestyle-antisocial dimension presents positive associations with these correlates (e.g. Hicks & Patrick, 2006; Uzieblo, Verschuere, van den Bussche, & Crombez, 2010). This suggests that, although co-occuring, the different dimensions of psychopathy might tap into two separable, distinctive underlying constructs (Patrick, Hicks, Nichol, & Krueger, 2007) and present distinct contributions to psychopathy. Affective-interpersonal traits are thought to represent the distinct personality traits defining psychopathy in that their presence distinguishes individuals who are psychopathic from those who manifest antisocial characteristics but who are not psychopathic (Blair et al., 2005).

Figure 1.1. Four-factor model of psychopathy, based on items of the PCL-R



Note: Reproduced from Hare and Neumann (2008), with permission of the copyright owner.

1.1.2. Psychopathy as a dimensional construct

There is now good evidence that the structure of psychopathy is dimensional in nature, whether it is measured by the PCL-R or by its derivative self-report measures normally used in non-forensic contexts (see Hare and Neumann, 2008, for a review). The strength of the dimensional perspective has led to a growing number of community studies on psychopathy (Lilienfeld & Fowler, 2006). In fact, findings from these studies often mirror those observed in clinical/forensic samples. Recent evidence suggests that individuals with high levels of psychopathic traits in college and community samples show some similar deficits to psychopaths in incarcerated samples, including reduced startle potentiation (Benning, Patrick, & Iacono, 2005; Justus & Finn, 2007) reduced autonomic responses to aversive images (Benning et al., 2005; Osumi, Shimazaki, Imai, Sugiura, & Ohira, 2007), reduced amygdala reactivity to negative emotional faces (Gordon, Baird, & End, 2004; Carré, Hyde, Neumann, Viding, & Hariri, 2013), and poor decision-making during gambling tasks (Mahmut, Homewood, & Stevenson, 2008). These findings are also in line with data from neuroimaging studies of adult psychopathy and children with psychopathic tendencies (e.g. Birbaumer et al., 2005; Jones, Laurens, Herba, Barker, & Viding, 2009; Kiehl et al., 2001; Kiehl, 2006; Marsh et al., 2008; Sebastian et al., 2012; Viding et al., 2012), which further strengthens the view that there are continuities between community and forensic participants in the mechanisms underlying psychopathy.

If psychopathy is a dimensional construct, and its traits vary in a continuum, than we can expect to be able to find variation in its underlying processing atypicalities to be associated with its normal variation within the general population.

1.1.3. Measurement of Psychopathy in the General Population

The most commonly used measures of psychopathy in the general population are Levenson's Primary and Secondary Psychopathy Scales (LPSP; Levenson, Kiehl, & Fitzpatrick, 1995), the Psychopathic Personality Inventory Revised (PPI-R; Lilienfeld & Widows, 2005) and the Self-Report Psychopathy measure and its revisions (SRP; e.g. Paulhus, Neumann, & Hare, in press; Williams & Paulhus, 2004).

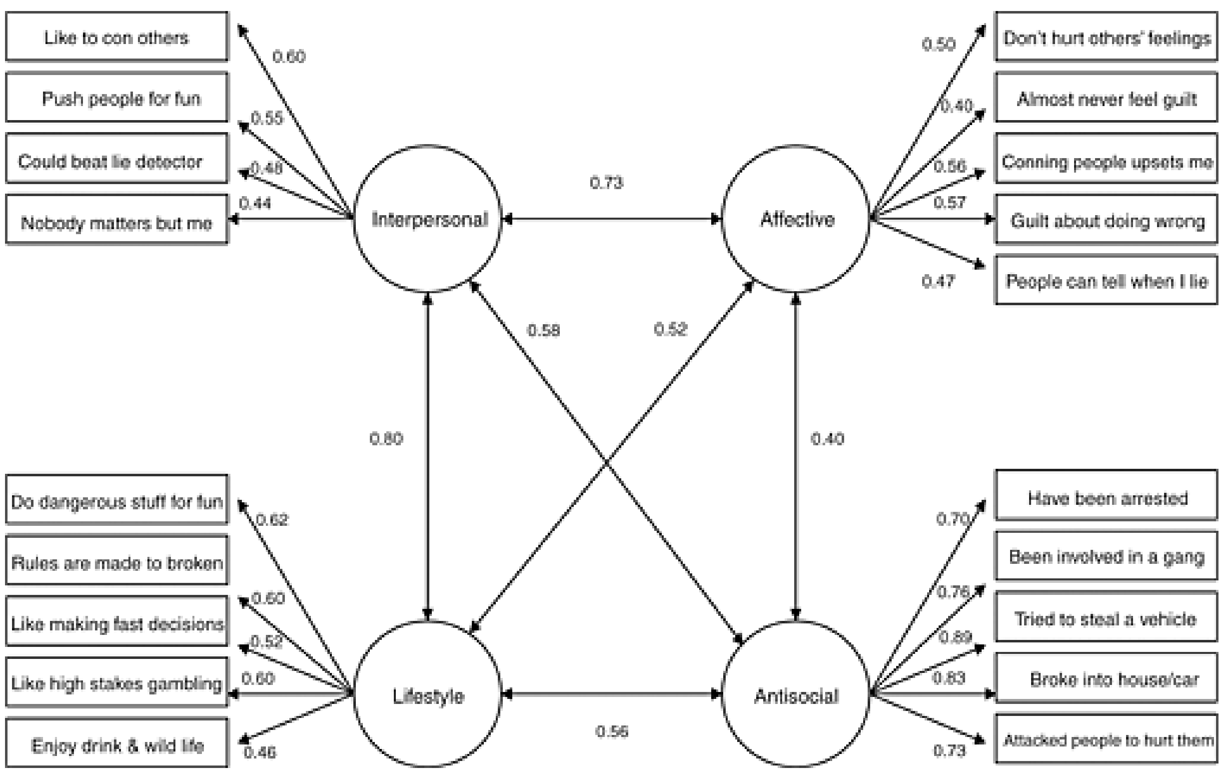
The LPSP scales were created in an attempt to provide a measure of psychopathic traits based on Factor 1 (i.e. affective and interpersonal facets) and Factor 2 (i.e. lifestyle and antisocial behaviour facets) of the PCL-R in the general population. However, several studies have shown that the LPSP is more related to antisocial behaviour in general, making the discrimination and identification of the affective-interpersonal features of psychopathy difficult using this scale (Lynam, Whiteside, & Jones, 1999; Marcus, John, & Edens, 2004) and calling into question its construct validity. The PPI yields eight subscales measuring "lower order" factors of psychopathy that combine to give a global index of psychopathy. Although it was not originally designed to do so, some researchers have demonstrated that the PPI somewhat conforms to model that can be likened to the PCL-R, with one factor indexing an affective-interpersonal features, a second factor indexing lifestyle and antisocial behaviour, and a third non-related factor indexing fearless dominance (Benning, Patrick, Hicks, Blonigen, & Krueger, 2003).

The PPI has been found to correlate moderately with the PCL-R (Lilienfeld & Fowler, 2006). However, recent critiques have emerged about its apparent lack of statistical scrutiny, stating that it has remained relatively immune from modern model-based analyses, and that there are serious issues with respect to the psychometric properties of the PPI and PPI-R (Neumann, Malterer, & Newman, 2008; Neumann, Uzieblo, Crombez, & Hare, 2013).

1.1.3.1. The Self-Report Psychopathy Scale

The Self-Report Psychopathy Scale (SRP) has been developed to overcome the shortcomings of other self-report measures of psychopathy. The SRP was specifically developed by Hare and colleagues as an extension of PCL-R to identify psychopathic traits in the general population. Importantly, the SRP mirrors the latent structure of the PCL-R, allowing a more direct comparison with forensic/clinical findings. Like the PCL-R, the SRP assesses four facets of psychopathic traits – interpersonal, affective, lifestyle and antisocial – which can also be modelled in terms of the traditional two-factor dimensions. The SRP and its short-form have been shown to have a clear latent structure (Carré et al., 2013; Mahmut et al., 2008; Neumann, Schmitt, Carter, Embley, & Hare, 2012; Williams & Paulhus, 2004; Williams, Paulhus, & Hare, 2007), and to be strongly positively correlated with both the PCL-R and the Youth Psychopathic Traits Inventory (Andershed, Hodgons, & Tengstrom, 2007; Neumann & Pardini, 2012; Paulhus et al., in press), as well as with a psychopathy self-report scale based on the five-factor model of personality (Lynam et al., 2011). The traits measured by the SRP are associated in the expected theoretical directions with relevant external correlates, such as criminal offenses and externalizing psychopathology (Neumann & Pardini, 2012), as well as reduced amygdala activation to fearful faces (Carré et al., 2013). The construct validity of the SRP has been further supported by studies examining the association with related personality measures (Williams et al., 2007), measures of deviant and antisocial behaviour (Fite, Raine, Stouthamer-Loeber, Loeber, & Pardini, 2010; Nathanson, Paulhus, & Williams, 2006) and cognitive functioning (Mahmut et al., 2008). For the reasons outlined here, this measure was employed in this thesis to assess psychopathic traits in community samples of adults. The items comprising the SRP-SF can be found in Appendix 1.

Figure 1.2. Four-factor model of psychopathy, based on items of the SRP



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1.2. Psychopathy as a disorder of empathy and morality

Psychopathy can be considered as a disorder associated with empathy and moral dysfunction, as the capacity to inflict serious harm to others repeatedly can be an indicator of profound disturbances in appropriate empathic responses to the suffering of others (Blair, 1995) and in appropriate moral behaviour. However, empathy and morality are complex and multidimensional constructs, and although lack of empathy and immoral behaviour are considered core features of the psychopathic personality (Blair, Mitchell, & Blair, 2005), little is known about how behavioural and neural substrates of specific dimensions of these constructs are associated with variation of psychopathic traits in the general population.

1.2.1. What is Empathy?

Despite having its linguistic roots in ancient Greek (*ἐμπάθεια* [*empatheia*, literally "passion"] formed from *ἐν* [*en*-, "in, at"] + *πάθος* [*pathos*, "feeling"]) the term "empathy" was first introduced into the English language in 1901 by the British psychologist Edward Titchener, as a translation of "Einfühlung" a German word that literally means "feeling into" (Stüber, 2008). The term "*Einfühlung"* was originally used in a technical sense in 1873 by Robert Vischer, a German philosopher, but was Theodor Lipps, also a German philosopher, who came to promote the word and to study empathy in the most thorough manner. Lipps conceived empathy as a psychological resonance phenomenon, a phenomenon of "inner imitation", where one's mind would mirror the mental activities or experiences of another person, through the observation of his or hers bodily movements or facial expressions (Stüeber, 2008).

1.2.1.1. Empathy and its related constructs

Although theorists are not in complete agreement regarding the precise definition of empathy and its constitutive components (see Batson, 2009), most agree that empathy is a multidimensional phenomenon, which involves the understanding of another person's experience through the vicarious experience of their emotional states (Davis, 1983; Decety & Jackson, 2004; Eisenberg, 2000; Eisenberg & Eggum, 2009; Hoffman, 2000). At present, and mostly due to the critical contribution of the field of social neuroscience (e.g. Adolphs, 1999; Blair, 2005; Decety, 2011; Decety & Jackson, 2004; Singer, 2006; Singer & Lamm, 2009), much of the empathy literature distinguishes between cognitive and emotional aspects of empathy and further distinguishes emotional empathy from emotional contagion, sympathy and empathic concern.

Emotional empathy, affective empathy or, simply, empathy is normally understood as an affective state, caused by sharing the emotions of another person. It is thought to be defined by the subject’s emotional state resulting from the observation or imagination of the other person’s state. However, although the observer’s emotional state is isomorphic with the other person’s, the subject is aware that his or her own affective state is vicariously elicited by the emotional state of the other person (de Vignemont & Singer, 2006). This definition of empathy will be adopted throughout this thesis. Cognitive empathy, also referred to as perspective taking, mentalising or Theory of Mind, on the other hand, is regarded as the ability to understand other people's intentions, desires or beliefs, through cognitive reasoning (Frith & Frith, 2003).

Concepts such as emotional contagion, sympathy or empathic concern, although often occurring concurrently with emotional empathy, should be distinguished as different phenomena (Eisenberg, 2000; Hein & Singer, 2008; Singer & Lamm, 2009a). Emotional contagion refers to the subject's state resulting from the observation of another person's emotional state but without self-awareness and self-other distinction. It denotes the predisposition to "catch" other people's emotions and has been described as "the tendency one has to automatically mimic and synchronise facial expressions, vocalizations, postures, and movements with those of another person and, consequently, to converge emotionally" (Hatfield, Rapson, & Le, 2009). Emotional contagion is considered to be a potential precursor of empathy (Hatfield et al., 2009).

The terms sympathy, compassion, or empathic concern, are used interchangeably to denote that a person feels sorry for someone else. These terms refer to affective changes that are induced in the observer in response to the perceived or imagined affective state of another person, but these affective changes are not necessarily isomorphic with those experienced by the other. Sympathy (or compassion or empathic concern), is therefore an emotional response stemming from the apprehension or comprehension of another's emotional state or condition, which is not the same as what the other person is feeling (or is expected to feel) but consists of feelings of sorrow or concern for the other (Eisenberg, 2000). According to Eisenberg (2000), further cognitive processing is necessary to turn the initial empathic response to another person's distress into empathic concern.

In sum, there are several processes that form components of, or are closely related to, empathy. It is therefore critical that the precise processes under study are carefully defined, particularly when 'empathy' is related to other constructs, such as moral behaviour or psychopathy.

1.2.2. What is morality?

Morality is an ambiguous word. Dictionary definitions of Morality state that it refers to "a personal or social set of standards for good or bad behaviour and character, or the quality of being right, honest, or acceptable" or to "principles concerning the distinction between right and wrong or good and bad behaviour" (Oxford Dictionary). The term "morality" can be used *descriptively*, and refer to codes of conduct that are put forward and accepted by a society, a group or an individual (*"what is"*); or *normatively*, and refer to a universal code of conduct that all rational persons would put forward for governing the behaviour of all moral agents (*"what ought to be"*) (Bernard, 2012). According to a descriptive perspective of morality (e.g. John Haidt's *Moral Foundations Theory;* Haidt & Graham, 2007) there are multiple moralities which are specific to each society, group, or even individual. These moralities can therefore include different elements. One element, however, seems to be present in all guides of conduct, all moralities: avoiding and preventing harm to others. Nonetheless, in a descriptive perspective, there are no universal morals. Whilst all guides of behaviour might include avoiding and preventing harm to others, they can also include other elements such as respect for authority, loyalty and sanctity. Causing harm to another person can thus be morally acceptable if, for example, it is the result of an act of loyalty. In contrast, in a normative perspective, morality (e.g. Immanuel Kant's *Categorical imperative "Act only on that maxim through which you can at the same time will that it should become a universal law";* c. 1800) refers to a universal code of conduct that all rational persons, under plausible specified conditions, should put forward for governing the behaviour of all moral agents. In a normative perspective, avoiding and preventing harm would be considered the most important element of morality, and as such should never be overridden. It is a universal code, and to disrespect it is always morally inacceptable (Bernard, 2012). Nevertheless, despite different perspectives on what morality refers to, the one feature they have in common is that they refer to guides of behaviour which involve avoiding and preventing harm to other persons (e.g. Bernard, 2012; Blair, Jones, Clark, & Smith, 1995).

1.2.2.1. The nature of human morality

The nature of human morality, and in particular the interplay of emotion and reason, has long been the concern of moral philosophers (e.g. Rene Descartes, Immanuel Kant, David Hume). In psychology, the studies of morality begun with Piaget (1932) and Kohlberg (1969), and their rationalist developmental theories have dominated moral psychology until recently. However, during the past decades, a growing number of researchers have focused their attention on experimentally investigating the nature of human morality. These studies have focused, for example, on the role of basic emotions in moral judgement (e.g. Haidt, 2001; Schnall, Haidt, Clore, & Jordan, 2008; Wheatley & Haidt, 2005), the neural basis of moral judgment (e.g. Greene, 2009; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001; Koenigs et al., 2007), or neural basis of moral emotions (Green et al., 2010; Moll & de Oliveira-Souza, 2007; Moll, De Oliveira-Souza, Eslinger, et al., 2002). This increased attention on the study of morality, and its neural correlates, has not only advanced our understanding of the processes involved in moral cognition, but also contributed to a paradigm shift in moral psychology whereas human morality is no longer conceptualised as a product of pure reason but rather as emerging from the sophisticated integration of rational, emotional and motivational mechanisms (Moll, Zahn, de Oliveira-Souza, Krueger, & Grafman, 2005).

1.2.2.2. Moral judgement, moral emotions and moral behaviour

The precise role of emotion in moral judgement *per se* (i.e. in evaluations, good *versus* bad, of actions or character of a person that are made with respect to a moral code) is still under debate (see Huebner, Dwyer, & Hauser, 2009). But emotions, in particular moral emotions, do seem to play a critical part in moral behaviour (i.e. the expression of the interpretation of what is acceptable, of the moral code). Moral emotions can be defined as those "that are linked to the interests or welfare either of society as a whole or at least of persons other than the judge or agent" (Haidt, 2003, p. 276), in contrast to basic emotions that spring from ideas or perceptions endowed with personal relevance. Guilt and compassion (also referred to as sympathy or empathic concern) are considered moral emotions, guilt being experienced when we recognise ourselves as the cause of another person's misfortune, and compassion when we witness someone being hurt (Moll & de Oliveira-Souza, 2007). Guilt is considered to be the *quintessential* moral emotion

(Eisenberg, 2000; Hoffman, 2000) as it refers to regret over wrong-doing and can motivate one to help one's victim, or otherwise to make up for one's transgression.

Moral emotions are thought to provide the motivational force to do good and avoid doing wrong, and therefore to play a central role in the guidance of social behaviour in everyday life (Moll & de Oliveira-Souza, 2007). Tangney et al. (2007) believe that moral emotions function as an emotional 'moral barometer', providing immediate and salient feedback on our behaviour, by giving immediate punishment of the behaviour. Actual behaviour is not be necessary for this barometer to have effect. People can anticipate their likely emotional reactions as they consider behavioural alternatives. As a result, moral emotions can exert a strong influence on moral choice and behaviour by providing critical feedback regarding both anticipated and actual behaviour. Indeed, research suggests that guilt is negatively related to hostility and aggression (Stuewig, Tangney, Heigel, Harty, & McCloskey, 2010); is positively linked to empathy (Leith & Baumeister, 1998); and that guilt-proneness promotes prosocial and is protective against antisocial and risky behaviour, be it in adolescents, children or adults (Stuewig et al, 2010; see also Tangney et al, 2007 for a review).

1.2.3. Psychopathy, empathy and morality / Individual differences

Based on what is outlined above, it is possible to draw clear conceptual links between affective empathy and moral behaviour. Affective empathy is thought to be preceded by emotional contagion and, with further cognitive processing, to give rise to feelings of empathic concern and/or guilt. These moral emotions, in turn, would function as moral barometers motivating moral behaviour (or inhibiting immoral acts).

The relationship between empathy and moral behaviour has also been more formally described in terms of a Concern Mechanism (Nichols, 2001) or a Violence Inhibition Mechanism (VIM; (Blair, 1995, 2005). These models share a central tenet that, in typically developing individuals, observing other people's distress cues automatically leads to emotional processes like empathy and empathic concern. These, in turn, increase the likelihood of prosocial behaviour (as specified by the CM model) and decrease the likelihood of antisocial behaviour (as specified by the VIM model). Ultimately, the absence of a robust empathic response to the distress cues of others would lead to a failure to inhibit aggression towards others and impair a normal moral socialization (Blair et al, 2005).

In fact, previous research has shown that the ability to correctly identify fearful and sad facial expressions seems to predict individual differences in prosocial behaviour (Marsh & Ambady, 2007; Marsh, Kozak, & Ambady, 2007). Furthermore, both adults with high levels of psychopathic traits and children with psychopathic tendencies seem to show a selective impairment in the recognition of others' distress, particularly fear and sadness (e.g.Blair, Colledge, Murray, & Mitchell, 2001; Blair et al., 2004; Blair et al., 2002; Fairchild, Van Goozen, Calder, Stollery, & Goodyer, 2009; Marsh et al., 2007; Montagne et al., 2005). However, this impairment does not appear as consistent in community samples (Del Gaizo & Falkenbach, 2008). Adults with psychopathy and children with psychopathic traits also seem to present deficits on their affective response to the distress of others. They show reduced autonomic response to stimuli associated with distress in others (Blair, 1999), and adults with high traits of primary psychopathy (analogous to affective and interpersonal features) show blunted affective empathic responses to the emotional displays of others (Ali, Amorim, & Chamorro-Premuzic, 2009).

In respect to moral processing, previous research has shown that both adults with psychopathy and children with psychopathic tendencies show a diminished capacity to distinguish between moral and conventional distinctions (Blair, 1995, 1997; Blair et al., 1995). Although there is no consistent evidence that adults who score highly on measures of psychopathy show a different pattern of responses to moral dilemmas when compared to controls (Cima, Tonnaer, & Hauser, 2010; Glenn, Raine, & Schug, 2009; Koenigs, Kruepke, Zeier, & Newman, 2011), it has been shown that they do seem to show different neural activation when responding to these dilemmas, namely activity in the amygdala activity medial prefrontal cortex, posterior cingulate and angular gyrus (Glenn, Raine, & Schug, 2009)**.** Some researchers (Cima et al., 2010; Hauser, 2006; Huebner et al., 2009), believe that these results support the thesis that psychopaths are able to distinguish what is right and wrong but do not care. Their moral judgement abilities would be intact but their moral emotions are damaged and that reflects in their behaviour. In face of that, it has been predicted that the clinical problem observed among psychopaths does not come from damage to their moral reasoning abilities, but rather from damage to the emotional systems that lead to action. However, this theory is yet to be validated by solid experimental data.

In sum, while empathy and morality seem to be conceptually linked, and there is increasing evidence that they are impaired in psychopathy, we still known little about how behavioural and neural substrates of specific dimensions of these constructs are associated with variation of psychopathic traits in the general population. Understanding the specific deficits on the basis of this disorder is extremely important if we are to understand, prevent it and possibly minimise its consequences. In this respect, it is important not only to identify and understand possible deficits that constitute the disorder but also the possible biological vulnerabilities that contribute to it. Investigating variability in these correlates along the continuum of psychopathic traits in the general population, using methods from experimental psychology and neuroimaging, can be valuable for furthering our understanding of psychopathy and the underlying processing atypicalities that give rise to such traits and behaviour.

1.2.4. Neurobiology of empathy and morality

1.2.4.1. Neurobiology of empathy

As described above, empathy is a complex phenomenon that likely involves both cognitive and affective components. Given its complexity, it is necessary not only to carefully define the phenomenon in study but also to break down its distinct (but interrelated) components if we are to understand it.

In recent years, the field of social neuroscience has begun to shed light on the neural underpinnings of affective empathy, i.e. the ability to share another person's affective state (but with the awareness that the source of our affective state is the other person). These studies suggest that observing or imagining another person in a particular emotional state automatically activates a representation of that state in the observer (e.g. Decety & Ickes, 2009; Decety & Jackson, 2004; Singer, 2006; Singer & Leiberg, 2009). These studies though have also suggested that experience of empathy is not necessarily purely automatic and sensory-driven, but that top-down cognitive processes, such as contextual appraisal, can also play a role in the empathic experience (e.g. Decety, 2011; Singer & Lamm, 2009b). For example, Decety et al. (2011) proposed a neurocognitive model of empathy that includes both bottom-up and top-down processing. This model explains the experience of empathy through a number of distinct and interacting components: 1) affective arousal or sharing, a bottom-up process grounded in perception–action coupling in which the amygdala, hypothalamus and orbitofrontal cortex play would play a critical role; 2) emotion awareness and understanding which involves the anterior insula cortex (AI), medial prefrontal cortex (mPFC), and ventromedial PFC (vmPFC); and 3) emotion regulation which depends on executive functions instantiated in the intrinsic cortico-cortical connections of the orbitofrontal cortex (OFC), mPFC and dorsolateral PFC (dlPFC). These latter networks (mOFC, mPFC and dlPFC) are proposed to operate as top-down mediators, regulating emotions and enhancing flexible and appropriate responses. These top-down factors can, for example, inhibit or amplify representations that have been activated via sensory channels and mechanisms associated with perception-action coupling. Or they can generate empathic responses through imagination or anticipation of the other’s state in the absence of any bottom-up stimulation. This top-down generation of feelings can be particularly important when minimal sensory information about the other is available, requiring the use of context, affective memory, and self-to-other projection to infer and empathise with the affective condition of the other person (Singer & Lamm, 2009b).

The majority of social neuroscience studies on empathy so far, has either used the observation of pain (e.g.de Vignemont & Singer, 2006; Decety & Lamm, 2009; Decety & Porges, 2011; Singer & Leiberg, 2009) or disgust ((Jabbi, Swart, & Keysers, 2007; Wicker et al., 2003) in other people as paradigms to evoke empathic responses. Recent meta-analyses (Fan, Duncan, de Greck, & Northoff, 2011; Lamm, Decety, & Singer, 2011) of these studies have shown that empathy recruits robust activation in anterior insula (AI), extending into the inferior frontal gyrus (IFG) and dorsal anterior cingulate cortex / anterior medial cingulate cortex (dACC/aMCC).

Although emotional facial expressions constitute important cues to others' emotional states that can be readily perceived, the neural basis of empathic response to facial expressions of basic emotions remains elusive. Emotional expressions are fundamental to the empathic experience. Moreover, they are thought to act as reinforcers and have specific communicatory functions, conveying specific information to the observer (Blair, 2005) and it has even been suggested that emotional empathy should be defined as the translation of the communication of the emotional expressions by the observer (Blair & Fowler, 2008). Identifying the neural basis of emotional empathy for faces, in particular for fear and sadness, might be particularly important for the understanding of psychopathic traits and antisocial behaviour. As described before, it has been hypothesised that psychopathy is underlied by the absence of a robust empathic response to the distress cues of others.

Indeed, precursors of psychopathic traits in children (i.e. callous-unemotional traits) have been found to be associated with functional deficits consistent with low emotional responsiveness to others' distress and poor ability to learn from reinforcement information. Aberrant neural functioning (as compared with typically developing children) has been observed for children with high levels of callous-unemotional traits in the amygdala, ventromedial prefrontal cortex (vmPFC), orbitofrontal cortex (OFC), anterior insula and caudate (e.g. Jones et al., 2009; Marsh et al., 2011; Marsh et al., 2008; Sebastian et al., 2012; Viding et al., 2012; White et al., 2012); brain areas that are involved in processing basic emotional salience, reinforcement learning, and emotion regulation. Children with high levels of psychopathic traits show reduced amygdala response to other's distress (e.g. Jones et al. 2009; Marsh et al. 2008; White et al. 2012) and reduced functional coupling between amygdala and OFC when viewing fearful facial expressions (Marsh et al. 2008). Furthermore, in a recent study (Lockwood et al., 2013) it was found that, callous traits in children with conduct problems were negatively associated with responses to others' pain in AI and ACC during the observation of pictures of others' in pain (vs. no pain).

In adults, there is so far less evidence with regard to empathic processing impairments at the neural level. Although a recent study has shown a negative association between psychopathic traits and amygdala reactivity to fearful faces (Carré et al., 2013), to our knowledge, only one other study has addressed empathic processing directly in adults with psychopathy. In that study, contrary to findings in children with high levels of callous traits (Lockwood et al. 2013; Marsh et al., 2013), Decety et al. (2013) found that, when observing body parts in painful situations and when observing facial expressions of pain, the neural activity of incarcerated men with high levels of psychopathy (score of >30 on the Psychopathy Checklist Revised (PCL-R; Hare, 2003) was significantly higher in a number of regions, including bilateral anterior insula, dACC and IFG, from the neural activity of incarcerated men with low levels of psychopathy (score >20 on the PCL-R). The increased activity in these regions was associated with both dimensions of psychopathy (affective-interpersonal and lifestyle-antisocial). The source of inconsistency between these studies remains to be investigated, but could reflect differences in developmental stage, task variables, as well as differences in samples (no healthy comparison group was included in the adult study).

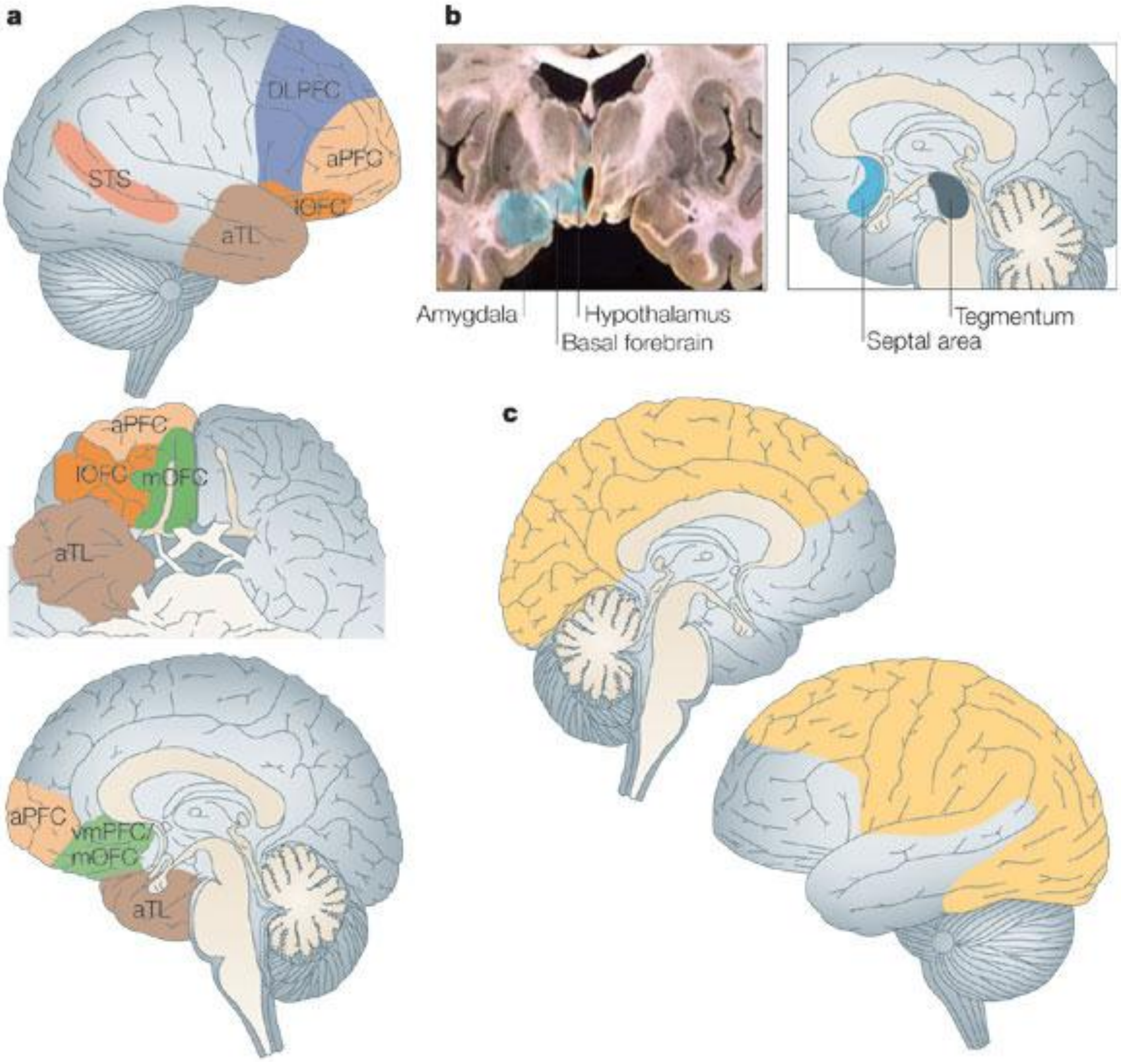
In sum, despite the role that empathic processing of emotional expressions is thought to have in psychopathic traits, to our knowledge, no study so far has investigated how atypical empathic response to distinct basic emotional facial expressions is observed at the neural level.

1.2.4.2. Neurobiology of morality

During the last decades, neuroscientific research has started to provide important clues to the knowledge of fundamental aspects of human morality. Past neuroimaging studies of moral cognition have focused mainly on the identification of what parts of the brain are recruited during moral judgement, i.e. evaluations (good vs. bad) of the actions or character of a person. These studies have employed a number of different paradigms such as: evaluation of moral vs. non-moral statements (e.g. 'We break the law when necessary' vs. 'Stones are made of water' (Moll, Eslinger, & De Oliveira-Souza, 2001); 'A admires a car' vs.' A steals a car ' (Heekeren, Wartenburger, Schmidt, Schwintowski, & Villringer, 2003); of moral vs. non-moral visual stimuli (e.g. pictures of physical assaults vs. pictures of body lesions (Moll, De Oliveira-Souza, Bramati, & Grafman, 2002); or of ethical moral dilemmas (e.g. trolley dilemmas (Greene, Nystrom, Engell, Darley, & Cohen, 2004; Greene et al., 2001; Koenigs et al., 2007)). These studies have consistently identified an extensive network of brain regions involved in moral cognition. This functional network includes the dorsolateral, ventromedial and dorsomedial prefrontal cortex (dlPFC, vmPFC and dmPFC), orbitofrontal cortex (OFC), anterior temporal lobes (ATL), insular cortex, amygdala, posterior cingulate cortex (PCC), precuneus, temporo-parietal junction (TPJ) and posterior superior temporal sulcus (pSTS) (see Fumagalli & Priori, 2012; Young & Dungan, 2012, for recent reviews). This extensive network of regions is consistent with the engagement of, not only higher-order cognitive abilities including prospective evaluation, cognitive control, and strategic decision-making, but also the recruitment of emotional and social processing, including detecting emotional saliency, monitoring outcomes related to reward and punishment, and Theory of Mind abilities (i.e. reflecting about other people's beliefs and intentions) during moral judgement (Bzdok et al., 2012; Moll & Schulkin, 2009).

Unfortunately, many of these studies have been limited in their interpretability as they have not included unambiguous contrast conditions matched for important design parameters such as: participant perspective and consequent experience of agency; clarity about the intentionality and causality of the action in evaluation; recruitment of ToM representations; emotional arousal; order of presentation of relevant information; vocabulary (which can cause expression style and word framing effects); and word number count (Christensen & Gomila, 2012). Controlling for these factors is important to allow us to more precisely identify brain regions specific to different components involved in moral cognition. Furthermore, the majority of these studies has focused mainly on moral judgment and moral deliberation, through the manipulation of highly theoretical and abstract scenarios which might not translate accurately how one processes everyday first-person moral transgressions.

Figure 1.3. The “Moral Brain”



Nature Reviews | Neuroscience

Notes: a) Cortical regions include anterior prefrontal cortex (aPFC), medial and lateral orbitofrontal cortex (mOFC and lOFC), dorsolateral PFC (DLPFC) ventromedial PFC (vmPFC), anterior temporal lobes (aTL) and superior temporal sulcus (STS). **b)** Subcortical structures include amygdala, hypothalamus and septal area; **c)** Brain regions that have not been consistently associated with moral cognition and behaviour (including parietal and occipital lobes, large areas of the frontal and temporal lobes, the brain stem and basal ganglia). Reproduced from Moll, Zahn, et al. (2005) with permission of the copyright owner.

A small number of studies has also focused on the identification of the neural subtracts of guilt, the feeling of regret thought to follow a moral transgression, using scripts of hypothetical personal transgressions. Guilt responses deriving from personal transgressions are thought to depend on the engagement of several cognitive processes, including action and conceptual knowledge, emotion and motivation, also requiring integration among cortical and limbic circuits (Moll et al., 2007; Moll & Schulkin, 2009). Studies focusing on guilt processing have consistently identified a smaller subset of brain regions (as compared with neuroimaging studies of moral judgment), including subgenual/medial PFC, superior ATL and frontopolar cortex (Moll et al., 2007; Moll & Schulkin, 2009; Takahashi et al., 2004; Zahn et al., 2009). Studies of moral guilt, although employing more realistic and first-person scenarios, also present some of the design issues common in moral judgement studies, the most important being related to intent. In these studies, the scripts used to elicit guilt were mainly comprised of unintentional actions (e.g. Kédia, Berthoz, Wessa, Hilton, & Martinot, 2008) or actions that lacked context to ascertain unambiguous intent (e.g.Green et al., 2010; Moll et al., 2007; Takahashi et al., 2004; Zahn et al., 2009). Intent is a key factor for judging the morality of an action (Cushman, 2008) and including scenarios that lack clear intent renders a certain level of ambiguity in regards to their moral content and consequently in the emotion that they are supposed to elicit.

The majority studies on human morality thus have been limited in elucidating everyday moral processing of personal transgressions in at least three respects. First, they have typically employed extreme scenarios and/or a third-person perspective (e.g.Greene et al., 2004; Heekeren et al., 2003; Koenigs et al., 2007; Moll, De Oliveira-Souza, Bramati, et al., 2002), making it difficult to generalise findings to one's own moral transgressions in everyday life. In everyday life, we are seldom faced with the dilemma of sacrificing one person's life to save many. But we might be tempted to behave immorally when facing situations where doing what is morally correct comes at a cost to the self, as in when inflicting harm to another person is necessary to achieve our desired goal. Second, even when more realistic first-person scenarios have been employed (to identify the neural correlates of personal transgressions and of moral guilt) these studies have been problematic to interpret either because the emotional content of experimental and control scenarios has not been equated (e.g.Sommer et al., 2010), or because the intention to transgress has not been clear – yet, intention is a key factor when judging the morality of an action (Cushman, 2008). Specifically, previous studies have utilised scripts comprising actions that are either unintentional (e.g. Kédia et al., 2008), or where the intent is difficult to ascertain unambiguously (e.g. Green et al., 2010; Moll et al., 2007; Takahashi et al., 2004; Zahn et al., 2009). It is important to control for factors such as emotional content and intentionality if we are to disentangle neural substrates that are specific to moral cognition (Christensen and Gomila, 2012). Third, the structure of the tasks employed in these studies precludes the separation of different processes that are likely involved when we process the morality of our actions. These likely include an initial appraisal phase during which we make meaning out of and understand the morality (or otherwise) of a particular course of action; as well as processes involved in reflecting on feelings of moral guilt triggered by the realisation that we have intentionally caused harm to another person (e.g. Eisenberg, 2000). Addressing each of these limitations is essential if we are to characterise how our brains process personal moral transgressions in everyday life.

Previous studies, from both clinical and community samples, have shown that individual differences in psychopathic personality traits are associated with atypical neural activity during moral judgement and moral decision making, especially in vmPFC and amygdala (Glenn, Raine, & Schug, 2009; Harenski, Harenski, Shane, & Kiehl, 2010; Marsh & Cardinale, 2012; Marsh et al., 2011; Pujol et al., 2012). This atypical activity has been hypothesised to be a reflection of the emotional and interpersonal impairments of the psychopathic personality (Glenn, et al., 2009; Harenski, et al., 2010; Marsh & Cardinale, 2012; Marsh et al, 2011). However, these studies have either used visual stimuli comprising third person or abstract actions (Haresnki et al., 2010; Marsh et al., 2012) or have been confounded by emotionality, with the scenario implicated in the moral transgression typically being characterised by higher levels of emotional content (Glenn, Raine & Schug, 2009; Marsh & Cardinale, 2012). The fact that the contrasted scenarios were not equated for emotional saliency makes it unclear to discern whether psychopathic traits are associated with atypical moral specifically or with emotional processing in general. Furthermore previous studies have not investigated how individual differences in psychopathic traits can account for variation in neural processing of everyday personal moral transgressions.

1.3. Summary and current thesis

In summary, although psychopathy is considered to be a disorder of affect, empathy and morality, some questions remain unanswered. Empathy and morality are complex and multidimensional constructs, and although lack of empathy and immoral behaviour are considered core features of the psychopathic personality (Blair, et al., 2005), little is known about how specific dimensions of these constructs are associated with variation of psychopathic traits in the general population. As argued by Carré et al. (2013), if psychopathy is a dimensional construct, than we may expect that subclinical levels of variability in psychopathic traits map onto behavioural and neural processes found to be dysfunctional in criminal psychopaths.

In Chapter 2 of this thesis, a comprehensive study is described where we employed several paradigms concurrently to investigate how different features of the psychopathic personality are associated with distinct components empathy and morality described above. We put together an extensive battery of questionnaires and experimental tasks probing emotional recognition ability, affective empathic response to different types of emotional facial expressions and emotional-eliciting stories, empathic concern and other moral emotions such as guilt and anger, and moral decision-making. We collected data from a sample of healthy males from the general population and conducted correlational analyses, correcting for multiple comparisons, to investigate which of these specific constructs were associated with psychopathic traits; and further tested whether the associations found were unique to any of the psychopathy facets.

In Chapter 3, we extend the findings of Chapter 2 to a female sample to probe the consistency of atypical functioning found in Chapter 2. In women, experimentally tested empathic and moral processing correlates have seldom been studied in relation to psychopathic traits. We collected data from a sample of females from the general population, and employed the same battery of paradigms and statistical tests used in Chapter 2, to investigate how different dimensions of psychopathic personality traits in women relate to empathic and moral processing. Additionally, statistical tests were performed to verify whether these associations were similar across sexes using male data from the previous study.

In chapter 4, we describe a study conducted to identify the neural structures involved in empathic responses to different types of emotional facial expressions. Diminished empathic response to emotional faces was identified to be associated with high levels of affective and interpersonal traits of psychopathy both in males and females. Our goal was to verify whether this weakened response to other people's emotional facial expressions would also be apparent at the neural level and help elucidate the nature of the behavioural association. We adapted the affective empathy for emotional faces task used in the behavioural studies described in Chapter 1 and 2 to an event-related functional Magnetic Resonance Imaging (fMRI) design. We predicted that psychopathic traits would be associated with diminished neural activity in regions previously identified to subserve empathic processing, in particular those that are associated with affective arousal or sharing (e.g. amygdala) and emotion awareness and understanding (e.g. anterior insula cortex).

In chapter 5, we describe a study conducted to identify the neural structures and circuits involved in processing everyday personal moral transgressions and how activity in these structures and circuits are associated with individual differences in psychopathic traits. Our aims were two-fold. First, we wanted to identify the neural structures that subserve moral cognition in everyday personal moral transgressions. We developed a novel, more realistic and rigorously controlled task that comprised scripts of everyday moral scenarios, written in the second person. To control for other cognitive processes that might be necessary for moral cognition but are not specific to it, we included control scripts matched for intentionality, causality, emotional valence and arousal, and mentalising requirements. We predicted that by equating these confounding factors in our task design, we would observe a more circumscribed set of brain areas than those identified in previous studies. We also predicted that we would observe partially separable and overlapping neural circuits recruited during the initial appraisal of the moral transgressions and during the later effortful reflection on feelings of guilt resulting from the transgression. By equating emotional saliency and mentalising requirements, our second aim was to test whether individual differences in neural responses specific to everyday moral (rather than emotional or mentalising) processing were associated with inter-individual variability in psychopathic traits in the general population. We further explored the associations found between the magnitude of neural response during everyday moral processing and individual differences in psychopathic traits, by conducting exploratory psychophysiological interaction (PPI) analyses. These analyses allowed us to elucidate whether individual differences in psychopathic traits modulate the functional integration that occurs between brain regions (Friston et al., 1997) during processing of everyday moral transgressions.

In short, this thesis set out to investigate how individual differences in psychopathic traits in the general population are associated with variability in distinct components of empathy and morality. On a first stage, we set out to identify these associations at a behavioural level (Chapters 2 and 3); and on a second stage, investigated how these associations are reflected at the neural level, in order to shed more light to how these processes might be atypical for people with high levels of psychopathic traits (Chapters 4 and 5). In chapter 6, we summarise the findings from these empirical studies and discuss possible implications.

CHAPTER 2: Behavioural correlates of empathy and morality in a sample of males from the general population

2.1. Chapter Introduction

As set out in the introduction of this thesis, lack of empathy and immoral behaviour are considered core features of the psychopathic personality (Blair et al., 2005). However, little is known about how specific dimensions of empathy and morality are associated with psychopathic traits in the general population. In the current chapter we describe a study where several paradigms were employed concurrently to investigate these associations.

2.1.1. Dimensions of psychopathic personality

As described earlier, the syndrome of psychopathy can be diagnosed in forensic settings when an individual scores high on two dimensions of the Psychopathy Checklist – Revised (PCL-R; Hare, 2003). One, traditionally referred to as Factor 1, is characterized by affective and interpersonal facets such as reduced guilt, empathy and attachment to significant others, along with deceptive, manipulative interactions. The other, Factor 2, relates to facets involving impulsivity, poor behavioural control and antisocial behaviour (Hare, 2003; Hare & Neumann, 2008). The presence of dysfunctional affective-interpersonal features is considered to be the core characteristic of psychopathy, distinguishing individuals who are psychopathic from those who are antisocial but not psychopathic (Blair, et al., 2005). Evidence from forensic and community samples also suggest that the two dimensions of psychopathy present distinct associations with various criterion measures of personality, emotionality and behaviour, particularly when their shared variance is controlled (Hicks & Patrick, 2006; Patrick et al., 2007; Uzieblo et al., 2010). For example, the affective-interpersonal dimension presents negative associations with emotional correlates such as fearfulness, distress and emotional reactivity, whlist the lifestyle-antisocial dimension presents positive associations with these correlates (e.g. Hicks & Patrick, 2006; Uzieblo, Verschuere, van den Bussche, & Crombez, 2010). The two dimensions appear to present distinct contributions to psychopathy, and so it is important to inspect the contribution of each dimension to relevant correlates in order to provide a more comprehensive map of the psychopathy construct.

2.1.2. Emotional empathy, morality and psychopathy

Although there isn't complete agreement regarding the precise definition of empathy and its constitutive components (Batson, 2009) empathy is normally understood as an affective state caused by sharing the emotions of another person (Eisenberg, 2000; Hoffman, 2000; Singer, 2006). Emotional empathy, or simply empathy, can be defined by the subject's emotional state resulting from the observation or imagination of another person's state; the subject's emotional state is isomorphic but the subject is aware that it is vicariously elicited by the emotional state of the other person (Singer, 2006).

Empathy and morality have long been conceptually linked (Eisenberg, 2000; Hoffman, 2000), and empathy is thought to play a crucial role in moral behaviour. However, empathy is not considered to be pro-social *per se*. Only with further cognitive processing, empathic response may develop into empathic concern, guilt or a combination of the two. These prototypical moral emotions are thought to provide the motivational force to 'do good' and avoid 'doing bad' (Moll & de Oliveira-Souza, 2007), and function as an emotional moral barometer, providing immediate and salient feedback on behaviour (Tangney et al., 2007). Actual behaviour is not necessary for this barometer to function, as people can anticipate their likely emotional reactions when considering behavioural alternatives. Emotional empathy can thus be regarded as a necessary step in a chain that begins with affect recognition and emotional contagion, and is followed by understanding another person's feelings; this understanding provides the basis for experiencing moral emotions, such as concern and guilt that in turn motivate moral behaviour.

Past research has found that adults and children with high levels of psychopathic traits have a selective impairment in the recognition of others' distress, particularly fear and sadness (e.g. Blair et al., 2001; Blair et al., 2004; Blair et al., 2002; Montagne et al., 2005). However, this impairment does not appear as consistent in community samples (Del Gaizo & Falkenbach, 2008). Adults and children with psychopathic traits have also shown reduced autonomic response to stimuli associated with distress in others (Blair, 1999; Blair, et al., 1997) and, in a community sample, adults with high traits of dysfunctional affective-interpersonal features have shown blunted affective empathic responses to the emotional displays of others (Ali, et al., 2009).

There is no consistent evidence that adults who score highly on measures of psychopathy show a different pattern of responses to moral dilemmas when compared to controls (Cima et al., 2010; Glenn, Raine, & Schug, 2009; Glenn, Raine, Schug, Young, & Hauser, 2009; Koenigs et al., 2011). However, they do show reduced amygdala activity when responding to the same moral dilemmas, and those with particularly high scores of callousness show further reduced activity in several regions considered to be part of the moral circuitry (Glenn, Raine, & Schug, 2009). Some researchers have argued these individuals are able to distinguish between right and wrong but do not care (e.g. Cima, et al., 2010) as their moral knowledge appears to be intact but their moral emotions appear deficient failing to motivate moral behaviour.

2.1.3. The current study

In the current study we employed several paradigms concurrently to investigate how different features of the psychopathic personality are associated with distinct components of affect, empathy and morality described above. Based on previous research, we predicted that affective-interpersonal features would be associated with lower scores on various measures of affect, empathy and morality.

2.2. Material and Methods

2.2.1. Participants

One-hundred-twenty-four adult males from western English speaking countries with ages between 18 and 48 (M= 26.23; SD= 7.07), and estimated IQ between 79 and 137 (M= 115.81; SD= 13.14), were recruited from the University College London Psychology Subject Pool and through online advertisement. Participants provided written informed consent and were compensated with £10 for their time.

2.2.2. Procedure

All tasks and questionnaires, apart from the *Wechsler Abbreviated Scale of Intelligence* (WASI; Wechsler, 1999), were presented on a computer using Psytools software (Delosis Limited). All tasks were presented randomly across participants and were followed by the questionnaires.

2.2.3. Materials

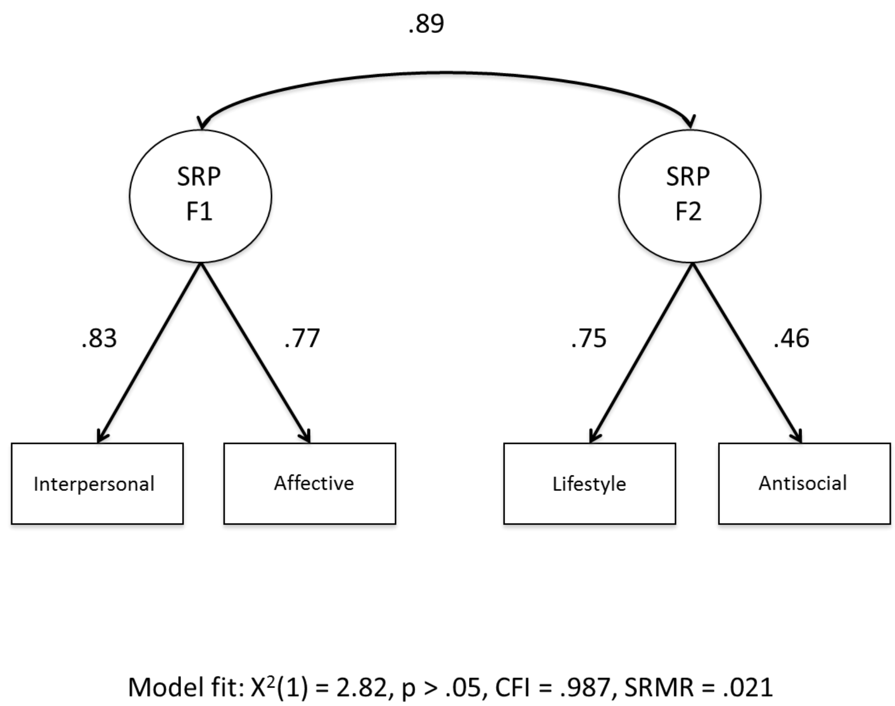
2.2.3.1. Assessment of General ability

The *WASI* (Wechsler, 1999) Full-Scale IQ Two-Subtest (FSIQ-2) was used to produce an estimate of general cognitive ability.

2.2.3.2. Assessment of psychopathic traits

Psychopathic traits were assessed with the *Self-Report Psychopathy Scale Short Form* (SRP-SF; Paulhus, Neumann & Hare, in press), a 29-item scale designed to measure psychopathic attributes in non-institutionalised samples. The SRP-SF assesses psychopathic traits, organised in four facets – interpersonal, affective, lifestyle and antisocial — consistent with recent research on the PCL-R. However, like the PCL-R, the four facets can be modelled in terms of the traditional two-factor dimensions. The SRP has been shown to have good construct validity and is strongly correlated with the PCL-R (e..g. Lilienfeld & Fowler, 2006; Paulhus, Neumann, & Hare, in press), To verify the scale integrity of the SRP in our sample, scale reliability analyses were conducted. Mean inter-item correlations for the SRP Interpersonal (0.23), Affective (0.24), Lifestyle (0.28), and Antisocial (0.21) scales suggested item homogeneity indicating that they were unidimensional indicators of their respective factors. Alpha for the total SRP scale was good (0.85), and similarly for the items used to form composite scores of the traditional Factor 1 (0.79) and F2 (0.73) dimensions. The Factor 1 and Factor 2 composites were significantly correlated ($r = 0.62$, $p < 0.001$). To verify the adequacy of the two-factor model of the SRP-SF, confirmatory factor analysis (CFA) was conducted using Mplus, Version 6.1 (Muthen & Muthen, 1998-2010). Using the Interpersonal and Affective scale scores as indicators of Factor 1, and Lifestyle, Antisocial scales as Factor 2 indicators, the 2-factor solution of the SRP showed good model fit (Model fit: $X^2(1) = 2.82$, $p > 0.05$, CFI = 0.987, SRMR = 0.021).

Figure 2.1. CFA model of the 2-factor solution in our sample



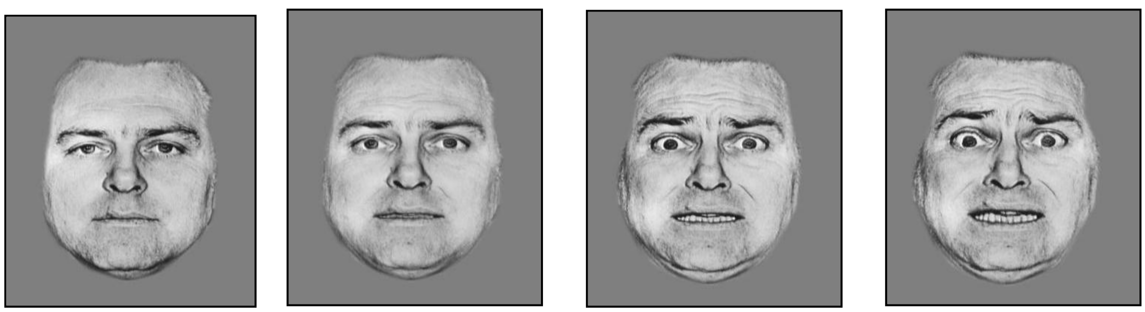
2.2.3.3. Measures of Affect, Empathy and Morality

Emotion Multimorph Task

The Emotion Multimorph task, previously used by Blair et al. (2004) and Rogers et al. (2006), is a measure of sensitivity to recognise emotional facial expressions. The stimuli used in this task are taken from the empirically validated pictures of facial affect series (Ekman & Friesen, 1976). Three identities were prepared for four basic emotions (sadness, fear, anger and happiness) by gradually morphing a neutral affect expression into the prototypical emotional expression in 20 stages of 2 seconds each. Before the beginning of the task, participants read instructions on a computer screen. They were instructed that they would be presented with facial expressions; the expressions would start out looking neutral, but would slowly change in steps to reveal one of four emotions: sadness, fear, anger or happiness; below the each facial expression four buttons would be presented, labelled with one of each emotion. Participants were asked to watch each expression and to press the corresponding button as soon as they thought they knew what it was without merely guessing. Participants were also informed that the face would continue to change even after they had made their response, and that they could alter their response at any time during the presentation. Participants were presented with the 12 test stimuli in random order (three identities per emotion). Presentation order of stimuli was randomized across participants.

Mean expression recognition stage scores were computed following the procedure used in Blair et al. (2004). Stage scores were scored according to the number of stages that were required before successful expression recognition took place For example, successful recognition for the prototypical expression would score 1 point; successful recognition on the penultimate stage would score 2 points; successful recognition 2 stages before the last would score 3 points and so on. A failure to recognize the expression at all scored 0 points. A mean expression recognition score for each of the three emotions was obtained by collapsing the score for the three trials of each emotion. The last response given was considered to be the target response, regardless of the validity of earlier answers.

Figure 2.2. Examples of different stages of a morph trial

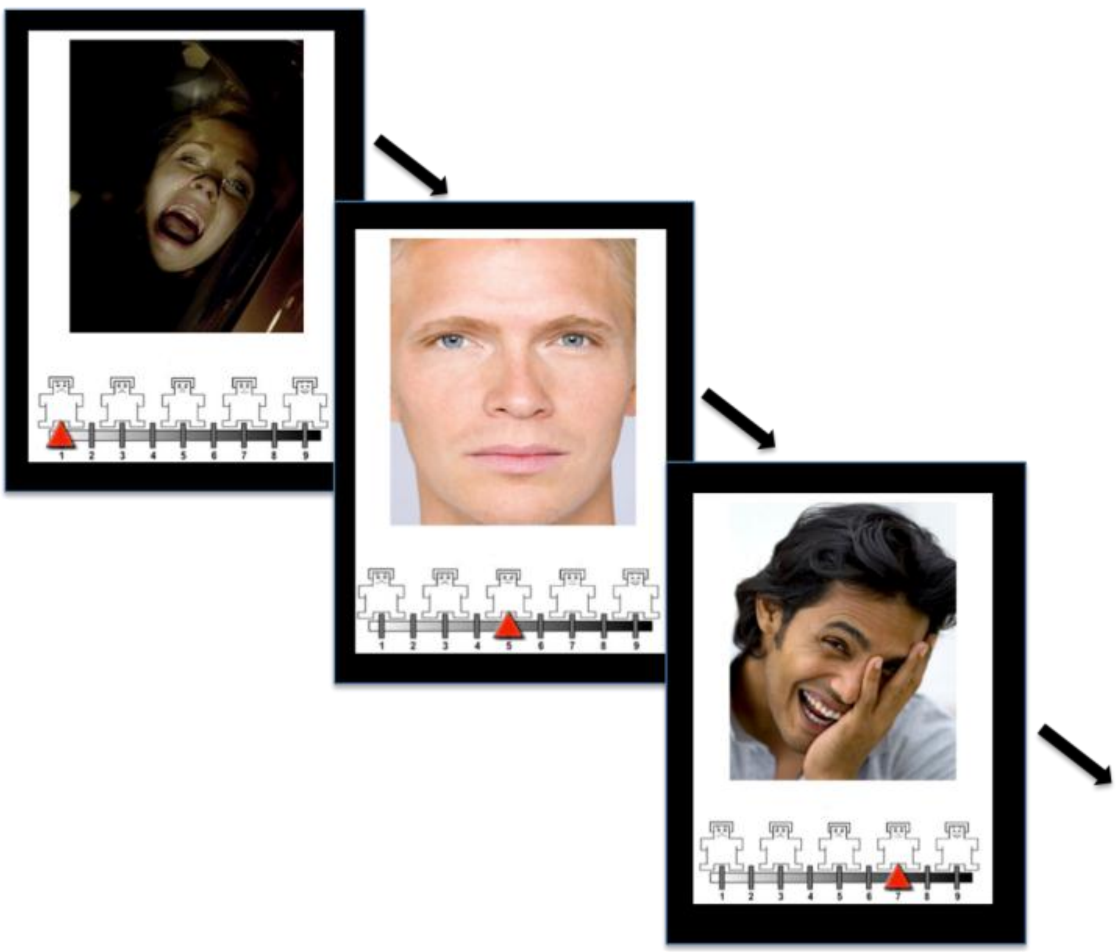


Notes: Trial starts with a neutral affect expression into a prototypical emotional expression of fear.

Empathy for emotional facial expressions task (SAM-Faces)

Based on Ali et al. (2009), this task estimates participants' emotional response to emotional faces using the Self-Assessment Manikin (SAM) methodology. The SAM has strong psychometric properties and is widely used to measure affective response (Bradley & Lang, 1994). In the present task, participants were asked to rate their affective state when watching images depicting a person showing a sad, fearful, angry, happy or neutral expression. The valence scale ranges from a low-spirited manikin to a widely smiling one, going through a middle neutral stance; low ratings on the manikin mean negatively valenced affective responses and high ratings mean positively valenced affective responses. This task includes realistic and naturalistic stimuli, and is thought to tap into the emotional empathy construct as it not only estimates participants' vicarious response to emotional stimuli, but also comprises elements of self-awareness (participants have to evaluate their emotional response) and self/other distinction (participants are asked how *the* stimulus makes them feel).

Figure 2.3. Examples of three different trials of the SAM-Faces task



To create the image set for this task, 30 pictures for each emotion were selected from gettyimages_database, istockphoto and other public sources. Each picture consisted of one person, whose face was the focal point of the image. Eight postgraduates rated each picture according to what emotion was displayed, its valence and arousal. From the initial set, 8 images were selected for each emotion (4 female and 4 male). Criteria for selection were complete inter-rater agreement over emotion portrayed, and consistency of valence and arousal ratings.

The selected images were randomised for each participant and displayed individually on a computer screen. Participants were instructed to look at each image and rate their affect on the Self-Assessment Manikin's valence scale. Once they completed the rating the next image was displayed. In the current study, Cronbach's α for the valence scales were .82 for fearful faces, .88 for happy faces, .89 for sad faces, and.72 for angry faces. Examples of the stimuli used can be found in Appendix 2.

Empathy-Eliciting Short Stories task (SAM-Stories)

The SAM-Stories was designed to assess participants' emotional response to emotional short stories also using the SAM methodology. Participants were presented with 12 short stories portraying one of three target emotions: sadness, anger and happiness. The stories were randomised across participants and shown one-by-one on the computer screen. Participants were instructed to read each story and to rate how reading the story made them feel on the Self-Assessment Manikin's valence scale. Once they completed the rating the next story was displayed. As in the previous one, this task is thought to tap into the emotional empathy construct as it not only estimates the participant's vicariously response to an emotional stimuli, but also comprises the elements of self-awareness and self/other distinction.

An example of a sadness-eliciting story would be: "*It was a harsh winter evening and Michael was driving home after picking up his youngest son, Tom, from school. It was raining heavily and the visibility was rather poor. Tom was in the back seat happily talking about his day at school: about what he had learnt in his History lesson and about a joke that he told on the playground that made everyone laugh. Suddenly, a huge truck came from nowhere and everything turned black. When Michael woke up he was in the hospital, his wife by his side crying. Help had arrived too late and Tom had died from his injuries*." Other examples of the stories can be found in Appendix 3.

For the present task, 24 original short stories were created: 8 portraying sadness, 8 portraying anger and 8 portraying happiness. Eight postgraduates were asked to rate each story according to what emotion was portrayed and its intensity. From the initial set of stories, 12 were selected, 3 portraying each target emotion. The criteria for selection were the inter-rater agreement over the emotion portrayed, and the consistency and coherence on intensity ratings. The stories were randomised across each participant, with no more than two stories portraying the same emotion in a row. In the current study, Cronbach's α for the valence scales were .79 for anger eliciting stories, .83 for happy stories, and .78 for sad stories.

Empathic Concern Scale of the Interpersonal Reactivity Index (IRI; Davis, 1980)

The IRI is a 28-item self-report scale designed to measure both cognitive and emotional components of empathy, and consists of 4 subscales. The perspective taking (PT) scale measures the tendency to spontaneously adopt the point of view of others in everyday life, akin to the “Theory of Mind” construct ("I sometimes try to understand my friends better by imagining how things look from their perspective"). The empathic concern (EC) scale assesses the tendency to experience feelings of sympathy and compassion for others ("I often have tender, concerned feelings for people less fortunate than me"). The personal distress (PD) scale relates to the tendency to experience distress and discomfort in response to extreme distress in others or in stressful situations ("Being in a tense emotional situation scares me"). The fantasy (FS) scale measures the tendency to imaginatively transpose oneself into fictional situations ("When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me"). As the main focus of the present study was investigating the relationship between affect, emotional empathy, other-oriented moral emotions and morality, only the Empathic Concern scale was used in the analyses.

Moral emotions task

Adapted from Kédia et al. (2008), this task comprised the presentation of brief stories depicting prototypical moral situations, i.e. “an agent harms a victim”. Depending on whether the agent and the victim are the self or other, these stories would elicit four kinds of moral emotions: Guilt, Compassion, Self-Anger and Other-Anger. The harmful action is performed unintentionally in all stories to prevent possible interferences from other cognitive processes likely involved in moral judgement. In the original task 20 different scenarios were used, with 6 possible endings each. In order to make the task less extensive, 18 scenarios were chosen, with 3 possible endings each: two portraying a harmful action and one neutral. Participants were asked to read each story and rate to what extent they would experience each emotion on a 7-point scale (1=not at all; 4=fairly; 7=extremely). Mean ratings of each moral emotion were created after subtracting neutral ratings from target ratings within each scenario.

Figure 2.4. Example of one scenario of the Moral Emotions task with its 6 possible endings

Scenario:		***You park at the same time as your boss outside your office***		
Possible endings:		**Victim**		
		Self	Other	Neutral
Agent	Self	**Self-Anger** *You misjudge your steering and ram the front of your new car against a pole*	**Guilt** *You misjudge your steering and ram the front of your boss's new car*	**Neutral-Self** *You get out of the car and, after greeting him, start discussing the day's workload*
	Other	**Other-Anger** *Your boss misjudges his steering and rams the front of your new car*	**Compassion** *Your boss misjudges his steering and rams the front of his new car against a pole*	**Neutral-Other** *He gets out of the car and, after greeting you, starts discussing the day's workload*

Moral dilemmas task

Based on previous published work (e.g. Greene et al., 2004; Greene et al., 2001; Koenigs et al., 2007), this task is a scenario-based measure of moral decision comprising moral dilemmas. These moral dilemmas are modified versions of classical moral dilemmas developed by philosophers to explore our intuitions about the permissibility of harming and duty to help others. Participants were asked to make decisions on a series of 8 moral dilemmas, selected and adapted from Greene et al. (2004; 2001), and previously used in Cima, et al. (2009). All dilemmas selected portrayed a choice of whether or not to sacrifice one person's life in order to save the lives of a group of others and differ on whether there is direct physical contact with the victim (Personal dilemmas) or not (Impersonal dilemmas).

An example of a Personal dilemma would be: "*A runaway trolley is heading down the tracks toward five workmen who will be killed if the trolley proceeds on its present course. You are on a footbridge over the tracks, in between the approaching trolley and the five workmen. Next to you on this footbridge is a stranger who happens to be very large. The only way to save the lives of the five workmen is to push this stranger off the bridge and onto the tracks below where his large body will stop the trolley. The stranger will die if you do this, but the five workmen will be saved. Would you push the stranger on to the tracks in order to save the five workmen?";* whilst an example of an Impersonal dilemma would be: "*You are at the wheel of a runaway trolley quickly approaching a fork in the tracks. On the tracks extending to the left is a group of five railway workmen. On the tracks extending to the right is a single railway workman. If you do nothing, the trolley will proceed to the left causing the deaths of the five workmen. The only way to avoid the deaths of these workmen is to hit a switch on your dashboard that will cause the trolley to proceed to the right, causing the death of the single workman. Would you hit the switch in order to avoid the deaths of the five workmen?".*

Participants were asked to answer if they *'Would do… in order to…?'* and to rate the difficulty of the decision on a 10-point scale.

2.3. Data analyses

Pearson and Spearman correlational analyses were conducted using SPSS, version 13.0 for Windows. Preliminary analyses showed that estimated IQ was significantly correlated with some of the measures. Therefore, two sets of analyses were conducted. First, estimated IQ was entered as a control variable in order to adjust for the influence of cognitive ability on the relationships. Second, to examine the unique variance of each dimension in relation to criterion variables, each dimension of SRP was also partialled out from one another.

Benjamini and Hochberg False Discovery Rate (Benjamini & Hochberg, 1995) was used to control for the probability of making a Type I error on multiple comparisons. Corrected p-values are presented.

Where distinct associations between the two SRP dimensions and a given criterion variable were identified, Steiger's Z-tests (two-tailed) were conducted to test if the difference between the correlations was significantly different.

2.4. Results

Descriptive statistics are presented on Table 2.1. A complete correlational table for all experimental paradigms is also presented in Table 2.2 for illustrative purposes, and will only be briefly discussed in this section.

Table 2.1. Participants' and criterion variables descriptive statistics

Outcome variables	Mean	SD	Minimum	Maximum
Age	26.23	7.07	18	48
IQ	115.81	13.14	79	137
SRP-4-SF				
Total	61.84	13.28	33	102
Emotional dimension	32.15	7.98	14	56
Behaviour dimension	28.56	6.57	16	45
Multimorph: Recognition stage score				
Sad faces	9.38	0.32	0	17.33
Fearful faces	10.90	0.26	3.67	17.67
Angry faces	11.10	0.34	1	19
Happy faces	14.65	0.27	2	19.33
SAM-Faces: Valence ratings				
Valence sad faces	2.88	0.92	1	5.13
Valence fearful faces	3.63	1.07	1	6
Valence angry faces	4.01	1.20	1	6.63
Valence neutral faces	5.16	0.65	2	6.63
Valence happy faces	6.53	1.12	2.13	9
SAM-Stories: Valence ratings				
Sad stories	2.31	1.13	1	8.5
Anger stories	3.62	1.16	1	6.5
Happy stories	7.12	1.21	2.25	9
IRI: Empathic concern	18.40	4.87	5	28
Moral Emotions task: Ratings				
Compassion	2.55	1.61	-2.25	5.25
Guilt	4.14	1.23	0.44	6
Other-Anger	3.54	1.24	-0.3	6
Self-Anger	3.90	1.24	0	6
Moral dilemmas: Action endorsement				
Impersonal dilemmas	3.38	1.04	0	4
Personal dilemmas	1.27	0.99	0	4
Moral Dilemmas: Difficulty ratings				
Impersonal dilemmas	5.67	2.33	1	10
Personal dilemmas	4.97	2.24	1	10

Table 2.2. . Correlations between all criterion variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Estimated IQ																					
Multimorph: Recognition stage score[1]																					
2. Sad faces	.26**																				
3. Fearful faces	.40***	.41***																			
4. Angry faces	.23**	.50***	.53***																		
5. Happy faces	.35***	.49***	.51***	.59***																	
SAM-Faces: Valence ratings[1]																					
6. Sad faces	.06	-.02	.00	-.02	.01																
7. Fearful faces	.12	.12	.06	.06	.09	.64***															
8. Angry faces	.05	.11	.01	.09	-.01	.52***	.75***														
9. Neutral faces	-.05	-.02	-.16	-.12	-.09	.14	.31***	.30***													
10. Happy faces	**-.17***	-.03	-.12	-.15	-.02	-.34**	-.16	-.12	.50***												
SAM-Stories: Valence ratings[1]																					
11. Sad stories	.11	.04	.07	.08	.10	**.55*****	**.28****	.15	**-.30****	**-.40*****											
12. Anger stories	.07	.08	.06	.09	.04	**.48*****	**.39*****	**.31*****	-.14	**-.34****	.65***										
13. Happy stories	**-.26****	-.08	-.15	-.09	-.13	**-.40****	**-.32****	**-.20***	.14	**.48*****	-.48**	-.47***									
14. IRI: Empathic concern[1]	-.04	-.01	-.10	-.06	-.09	**-.18***	-.13	-.07	.08	**.18***	**-.24****	-.11	**.29*****								
Moral Emotions task: Ratings[1]																					
15. Compassion	**.29****	.08	.12	.11	.04	-.08	.04	.02	.00	-.01	-.01	.01	.16	**.24****							
16. Guilt	.00	.05	.17	.16	-.03	**-.33****	-.17	-.05	.08	**.26****	**-.35****	**-.32****	**.45*****	**.25****	.41***						
17. Other-Anger	-.09	.02	.06	-.05	-.05	**-.20***	-.12	-.02	.03	.07	**-.23****	**-.28****	**.26****	.02	.16	.38***					
18. Self-Anger	**-.18***	.03	.07	.03	-.11	**-.29****	-.13	-.01	-.03	.07	**-.26****	**-.27****	**.33*****	.02	.23**	.62***	.59***				
Moral dilemmas: Action endorsement[2]																					
19. Impersonal dilemmas	**.27****	.02	.14	.05	.08	.12	.07	.06	.07	.03	.05	.00	-.06	.02	.09	-.11	-.07	-.16			
20. Personal dilemmas	-.17	.12	-.06	.02	-.04	.04	.02	-.03	.06	-.02	-.04	-.02	-.05	-.01	**-.18***	-.17	.05	-.05	.25**		
Moral Dilemmas: Difficulty ratings[1]																					
21. Impersonal dilemmas	-.03	.02	-.04	-.06	-.02	**-.24****	**-.26****	-.16	-.15	.05	-.15	-.13	**.18***	**.19***	-.07	**.21***	.06	.12	-.29**	-.21*	
22. Personal dilemmas	-.02	.14	.08	-.03	-.05	-.01	-.14	-.10	-.03	-.03	-.10	**-.18***	.12	.10	-.10	-.02	-.03	-.04	.05	.29**	.46***

Notes: [1]Pearson correlation coefficients are reported; [2] Spearman correlation coefficients are reported; ***p< 0.001, **0.001<p<0.01, *0.01<p<0.05 (2-tailed). Values in bold indicate significant associations across measures.

As can be observed on the Table 2.2, all affect recognition stage score variables from the Emotion multimorph task presented significant positive correlations between themselves, but none with other criterion variables. These results might indicate that emotional recognition is a distinct process from affective empathy and that caution should be used when using affect recognition as a proxy of affective empathy. All valence ratings variables from the SAM-Faces and SAM-stories tasks showed significant correlations between themselves; and all, except the valence ratings of angry and happy faces, showed significant correlations with guilt ratings from the moral emotions task (correlations with guilt ratings were positive for positively valenced stimuli and negative for negatively valenced stimuli, i.e. more positive emotional responses to positive stimuli and more negative responses to negative stimuli correspond to higher ratings of feelings of guilt). Valence ratings for sad and happy faces were also correlated with ratings on the empathic concern scale (correlations were positive for positively valenced stimuli and negative for negatively valenced stimuli); and valence ratings of fearful and sad faces showed an additional significant negative correlation with difficulty in making decisions in impersonal dilemmas. The empathic concern scale, from the IRI, showed additional significant positive correlations with the moral emotions' ratings of compassion and guilt, with difficulty ratings in making decisions in impersonal moral dilemmas, and with valence ratings of happy stories. Compassion and guilt ratings, from the moral emotions task, had an additional significant positive correlation with difficulty ratings on on impersonal moral dilemmas. These findings seem to confirm a link between empathic responding and the propensity to feel moral emotions, in particular guilt, and are in line with theories that postulate that guilt is directly linked to empathic abilities (e.g. Eisenberg, 2000; Hoffman, 2000). The results also suggest a link between affective empathy and guilt proneness and difficulty in making decisions regarding hypothetical moral behaviour, but not with the type of decisions (i.e. endorsement of utilitarian actions). In sum, these results seem to confirm the conceptual links between affective empathy and propensity to feel moral emotions, and between affective empathy, moral emotions and moral processing (though not with moral decisions *per se*).

Associations between psychopathic traits and measures of affect, empathy and morality

Pearson and Spearman's correlation coefficients and False Discovery Rate adjusted p-values between SRP dimensions and all measures used are reported in Table 2.3. Z and p-values of difference between regression coefficients are also presented. After correcting p-values for multiple comparisons, no significant associations between the dimensions of SRP and variables of Multimorph and Moral emotions tasks were found. Both SRP dimensions showed significant associations with less negative empathic responses to fearful faces and the affective-interpersonal dimension showed an additional significant association with less positive emotional responses to happy stories. Significantly different and opposite associations between the SRP dimensions and propensity to feel empathic concern were found. The affective-interpersonal dimension was negatively associated with the propensity to feel empathic concern, whilst lifestyle-antisocial dimension showed the opposite direction when the overlap between the two dimensions was accounted for. There were no significant associations between SRP dimensions and endorsement of actions on the moral dilemmas task, but both dimensions showed negative associations with perceived difficulty in making those decisions. However, the associations with lifestyle-antisocial dimension ceased to be significant when affective-interpersonal was kept constant.

Table 2.3. Correlations between SRP scores and criterion variables

SRP scale	*Total*	*Affective-Interpersonal (AI)*		*Lifestyle-Antisocial (LA)*	
Control variables	IQ	IQ	IQ & LA	IQ	IQ & AI
	r	*r*	*r*	*r*	*r*
Multimorph: Stage Scores[a]					
Sad Faces	-.02	.00	.03	-.04	-.05
Fearful Faces	.09	-.16	-.18	-.03	.09
Angry Faces	.10	.00	.10	-.12	-.16
Happy Faces	.01	.01	.01	-.01	-.01
SAM-Faces: Valence Ratings[a]					
Sad Faces	.18	.18	.13	.13	.02
Fearful Faces	.31*	.25*	.07	.32*	.22
Angry Faces	.20	.15	.02	.22	.16
Happy Faces	.03	.01	-.01	.04	.04
SAM-Stories: Valence Ratings[a]					
Sad Stories	.09	.12	.13	.02	-.06
Anger Stories	.10	.11	.08	.07	.00
Happy Stories	-.20	-.26*	-.26*†	-.09	.09†
IRI: Empathic Concern Scale[a]	-.27*	-.40**	-.46**†	-.06	.26*†
Moral Emotions Task: Ratings					
Compassion[a]	.09	.04	-.05	.13	.13
Guilt[b]	-.15	-.17	-.15	-.08	.03
Self-Anger[a]	.19	.22	.19	.12	-.02
Other-Anger[a]	.09	.13	.14	.04	-.06
Moral Dilemmas: Endorsement[b]					
Impersonal Dilemmas	-.04	-.06	-.07	-.01	.03
Personal Dilemmas	.09	.06	-.01	.11	.08
Moral Dilemmas: Difficulty Ratings[a]					
Impersonal Dilemmas	-.38**	-.39**	-.30*	-.28*	-.05
Personal Dilemmas	-.27*	-.28*	-.20	-.20	-.04

Notes:. [1] Pearson and [2] Spearman partial correlation coefficients are reported. (2-tailed); * $p < 0.05$, ** $p < 0.01$ (2-tailed; FDR corrected); † Significantly different correlations with criterion variables between SRP dimensions ($Z > 1.96$; $p < .05$; 2-tailed).

2.5. Discussion

This study examined the associations between multiple measures of affect, empathy and morality with different features of the psychopathic personality, in a community sample of males. Overall, our findings indicate that in the general population, both dimensions of psychopathy are associated with weaker empathic responses to fearful faces; but that there also appears to be some specificity between the two dimensions of psychopathy and domains of empathic and moral processing: the unique variance of the SRP affective-interpersonal dimension was associated with weaker empathic response to happy stories, lower propensity to feel empathic concern and less difficulty to make decisions in moral dilemmas; in contrast, the unique variance of the SRP lifestyle-antisocial dimension was associated with greater propensity to feel empathic concern.

Although difficulties in recognising sad and fearful facial affect have been reported in previous studies (e.g. Blair, et al., 2004; Montagne, et al., 2005), no significant correlations between the dimensions of the SRP and sensitivity to recognise facial affect survived correction for multiple comparisons in the present study. Previous research with a community sample has reported similar negative results (Del Gaizo & Falkenbach, 2008). It is possible that impairments in emotional recognition are present only in clinical cohorts of psychopathy, which would explain the lack of consistent findings in studies using community samples.

Similar to Ali et al. (2009), our findings indicated an association between psychopathic traits and less negative emotional responses to fearful faces in the SAM-Faces task. Both dimensions of psychopathy were related to less negative emotional responses to fearful faces. However, these associations ceased to be significant once the shared variance was removed, suggesting that the variance shared by the dimensions of psychopathy drives the reduced emotional response to fearful faces. On the other hand, only the affective-interpersonal dimension of the SRP was significantly correlated with less positive emotional responses to happy stories, even when the variance overlap with the lifestyle-antisocial dimension was accounted for. This finding might indicate that affective-interpersonal features of psychopathy are associated with diminished empathic responsiveness to positive, as well as negative emotions.

Although no significant correlations with the moral emotions task variables survived correction for multiple comparisons, we did find opposite significant correlations between both SRP dimensions and propensity to feel empathic concern. Empathic concern is considered to be a prototypical moral emotion (Eisenberg, 2000), and thus to function as a moral barometer motivating behaviour. The unique variance associated with affective-interpersonal features was correlated with lower propensity to feel concern for others, whereas the unique variance associated with lifestyle-antisocial was correlated with greater propensity to feel concern for the distress of others. Similar effects revealing opposing associations have been reported previously, with evidence from forensic and community samples suggesting that the two dimensions of psychopathy have opposite relationships with emotion and emotional reactivity. For example, previous studies have shown that after controlling for the overlap between the two dimensions, the affective-interpersonal dimension is negatively associated with constructs such as emotional distress, fearfulness, trait negative affect, whilst the impulsive-antisocial behaviour dimension is positively associated with these constructs (Hicks & Patrick, 2006).

Our results also indicate that neither SRP dimension is associated with increased endorsement of actions in the moral dilemmas task, replicating previous data from forensic (Cima, et al., 2010) and community samples (Glenn, Raine, Schug, et al., 2009). Nonetheless, affective-interpersonal features appear to diminish the level of difficulty that making these decisions represent. To our knowledge this is the first study exploring perceived difficulty in making decisions on moral dilemmas in relation to psychopathic traits. The perceived ease with which those individuals high on affective-interpersonal features made moral decisions could merely reflect a general ease in decision making, rather than anything circumscribed to moral decision making. But, it could also specifically reflect ease in making decisions about emotionally aversive dilemmas which, taken together with the other findings, suggest some level of emotional disengagement when making these kind of decisions. This later hypothesis would be in line with previous studies that indicate that this type of moral dilemmas evoke activity in the amygdala and other brain structures implicated in emotional processing (Greene et al., 2001) and that this activity is atypical in subjects scoring higher in psychopathy traits (Glenn, Raine, & Schug, 2009). Unfortunately, these alternative hypotheses cannot be tested with the current data.

Some limitations of this research should be noted. Although our results suggest that the different features of the psychopathy have at least partially divergent associations with certain domains of emotional, empathy and moral processing (as evidenced by statistically significant differences in the correlation coefficients), research on larger samples is required to reliably test the difference between the correlations of the SRP dimensions and the criterion variables. It should also be noted that a number of potentially interesting associations did not survive correction for multiple comparisons in these exploratory analyses. These negative results should be interpreted with caution due to restricted statistical power afforded by our sample. This was the first study to administer a large battery of affect, empathy, and morality tasks and relate these to different features of psychopathy. The preliminary findings from this study suggest that both dimensions of psychopathy make some distinct contributions to empathy and affective aspects of moral processing. Research on larger samples from community and forensic settings is required to probe the precise extent to which different features of psychopathy have distinct associations with particular empathic and moral features.

2.6. Conclusions

This chapter describes a behavioural study where we investigated how specific dimensions of empathy and morality were associated with psychopathic traits in the general population. We employed several paradigms probing emotional recognition ability, affective empathic response to different types of emotional facial expressions and emotional-eliciting stories, empathic concern and other moral emotions such as guilt and anger, and moral decision-making; conducted correlational analyses, correcting for multiple comparisons; and further tested whether the associations found were unique to any of the psychopathy facets. Our findings indicate that both core affective-interpersonal, as well as lifestyle-antisocial features of psychopathy are associated with weaker empathic responses to fearful faces. However, only the unique variance of the affective-interpersonal features is associated with weaker empathic response to happy stories, lower propensity to feel empathic concern and less difficulty in making decisions on moral dilemmas. In contrast, the unique variance of the lifestyle-antisocial features is associated with greater propensity to feel empathic concern. These preliminary findings extend previous research and suggest that, while the joint variance between affective-interpersonal and lifestyle-antisocial features might drive some deficits associated with psychopathy, there also appears also to be unique deficits associated with the core affective-interpersonal features, particularly in relation to affective aspects of moral cognition.

In the next chapter, Chapter 3, an extension of this study with a female sample will be presented to probe the consistency of these findings across genders.

CHAPTER 3: Behavioural correlates of empathy and morality in a sample of females from the general population

3.1. Chapter Introduction

In the previous chapter we presented a study where we identified associations between specific dimensions of empathy and morality and psychopathic traits in a sample of males from the general population. In the present chapter we extend the study of these associations to a sample of females from the general population.

Although a number of experimental studies to date has demonstrated that atypical empathic and moral processing are central features of psychopathic personality in males (e.g. Ali, Amorim, & Chamorro-Premuzic, 2009; Blair, 1999; Glenn, Raine, & Schug, 2009), and a growing number of studies has investigated psychopathic personality in females (e.g. Nicholls & Petrila, 2005; Rogstad & Rogers, 2008), we know very little about how individual differences in psychopathic traits in females are associated with variability in empathy and moral processing and whether these associations are similar or distinct to the ones found in males. Only one study to date has reported that females with higher levels of psychopathic traits show reduced empathic concern for others (Rutherford, Cacciola, Alterman, & McKay, 1996)

3.1.1. Dimensions of psychopathic personality

As described in the previous chapter, evidence from forensic and community male samples suggest that the two dimensions of psychopathy (affective-interpersonal and lifestyle-antisocial behavior) present distinct associations with various criterion measures of personality, emotionality and behavior, particularly when their shared variance is controlled for. For example, the affective-interpersonal dimension presents negative associations with emotional correlates such as fearfulness, distress, and empathic concern, whlist the lifestyle-antisocial dimension presents positive associations with these correlates (e.g. Hicks & Patrick, 2006; Uzieblo, et al., 2010). The two dimensions thus seem to present distinct contributions to psychopathy. Affective-interpersonal traits are hypothesized to represent the distinct personality traits defining psychopathy in that their presence distinguishes individuals who are psychopathic from those who manifest antisocial characteristics but who are not psychopathic (Blair, et al., 2005). Research so far indicates that emotional and personality correlates of psychopathy such as glibness, grandiosity, lack of empathic concern are akin across genders, but similarities in behavioural correlates, such as criminal behaviour and type of aggression, seem to be less consistent (see Verona & Vitale, 2006, for a review). It has been suggested that differences found across genders are mainly differential expressions of the same underlying construct (Nicholls & Petrila, 2005), and that the same personality traits may confer risk for different forms of behaviour for women versus men (Verona, Sprague, & Javdani, 2012).

3.1.2. Individual differences in empathic and moral processing

Past research with male samples has used a variety of paradigms to study how individual differences in psychopathic personality relate to individual differences in emotion recognition, empathy and morality. Some studies have reported that psychopathic individuals have a selective impairment in recognizing other people's fear and sadness (e.g. Blair et al., 2004; Blair et al., 2002); although similar findings have not been consistently replicated in community samples (e.g. Del Gaizo & Falkenbach, 2008). Psychopathy has also been associated with reduced autonomic response to distress in others (Blair, 1999; Blair, Jones, Clark, & Smith, 1997). Individuals with high levels of psychopathic traits also report blunted affective empathic responses to emotional displays of others (Ali et al., 2009). In respect to moral decision-making, while some studies have found psychopathy to be associated with more utilitarian responses in moral dilemmas (Koenigs et al., 2011), others have not found such different patterns of responses (Cima et al., 2010; Glenn, Raine, Schug, et al., 2009). In the previous chapter, we administered a wide battery of experimental tasks and questionnaires to thoroughly investigate which of the specific constructs considered above, i.e. emotional recognition, affective empathy, moral emotions and moral decision making, were associated with the two underlying dimensions of psychopathy. We found that both affective-interpersonal and lifestyle-antisocial dimensions of psychopathy were associated with weaker empathic responses to fearful faces. However, only the unique variance of the affective-interpersonal dimension was associated with weaker empathic response to happy stories, lower propensity to feel moral emotions (i.e. empathic concern) and less self-reported difficulty in making decisions on moral dilemmas. We also found that the lifestyle-antisocial dimension was uniquely associated with greater propensity to feel empathic concern, when controlling for the affective-interpersonal dimension. These preliminary findings suggested that, while the joint variance between affective-interpersonal and lifestyle-antisocial dimensions might drive some deficits associated with psychopathy, others appear to be uniquely associated with affective-interpersonal dimension.

3.1.3. The current study

In women, experimentally tested empathic and moral processing correlates have seldom been studied in relation to psychopathic traits. So far only diminished ability to categorize briefly presented sad faces (Eisenbarth, Alpers, Segrè, Calogero, & Angrilli, 2008) and feel empathic concern (Rutherford et al., 1996) have been reported in forensic samples of women (as compared with control participants). In the current study we employed the same battery of paradigms presented in the previous chapter to investigate how different dimensions of psychopathic personality traits in women relate to empathic and moral processing. A new set of data from a female sample was collected, and statistical tests were performed to verify whether the associations found in this new dataset were similar to the ones previously found in male data.

3.2. Material and Methods

3.2.1. Participants

One-hundred healthy adult females from western English speaking countries, with no history of psychiatric disorder, aged 18-56 (M=22.68; SD=6.64), and estimated IQ between 85 and 134 (M=112; SD=11), were further recruited from the community through the University College London Psychology Subject Pool. Participants provided written informed consent and were compensated with either one course credit or £6 for their time.

3.2.2. *Procedure*

All tasks and questionnaires were presented on a computer using Psytools software (Delosis Limited). All tasks were presented randomly across participants and were followed by the questionnaires. Further details of each task can be found in the previous chapter.

3.2.3. *Materials*

3.2.3.1. *Assessment of General ability*

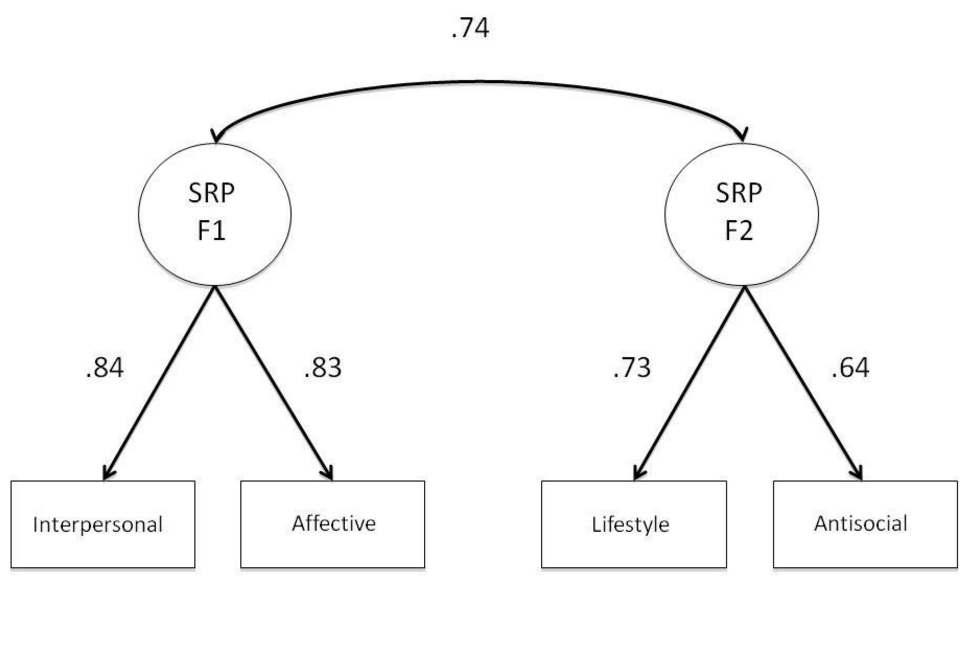
The *WASI (Wechsler, 1999)* Full-Scale IQ Two-Subtest (FSIQ-2) was used to produce an estimate of general cognitive ability.

3.2.3.2. *Assessment of psychopathic traits*

Psychopathic traits were assessed with the *Self-Report Psychopathy Scale 4 Short Form* (SRP-SF; Paulhus, Neumann, & Hare, in press), a 29-item scale designed to measure psychopathic attributes in non-institutionalized samples. The SRP-SF assesses psychopathic traits, organized in four facets – interpersonal, affective, lifestyle and antisocial – consistent with recent research on the PCL-R. Like the PCL-R, the four facets can be modeled in terms of the traditional two-factor dimensions.

To verify the scale integrity of the SRP in our sample, scale reliability analyses were conducted. Mean Inter-Item Correlations (MICs) for the SRP Interpersonal (.38), Affective (0.22), Lifestyle (0.25), and Antisocial (0.37) scales suggested scale homogeneity among these four SRP facets, indicating that they were unidimensional indicators of their respective SRP psychopathy factors. Alpha for the total SRP scale was good (0.87), and similarly for the items used to form composite facet scores of the traditional affective-interpersonal (0.84) and lifestyle-antisocial (0.75) dimensions. The MICs for the SRP total, affective-interpersonal, and lifestyle-antisocial scales were also good (0.22, 0.29 and 0.24, respectively). To verify the adequacy of the two-factor model, confirmatory factor analysis was conducted using Mplus, Version 6.1 (Muthen & Muthen, 1998-2010). Using the Interpersonal and Affective SRP scale scores as indicators of affective-interpersonal, and Lifestyle and Antisocial SRP scales as lifestyle-antisocial indicators, the 2-factor solution showed excellent model fit (Figure 3.1; Model fit: $X^2(1) = .76$, $p < 0.05$, CFI = 1.00, SRMR = 0.003), and fit significantly better than a one-factor scale-based model via a chi-square difference test between the two model ($x^2(1) = 6.65$, $p < 0.05$).

Figure 3.1. CFA model of the two-factor solution in our sample



Model fit: $X^2(1) = 0.09$, $p > .05$, CFI = 1.00, SRMR = .003, BIC = 2119

3.2.3.3. Measures of Affect, Empathy and Morality

Emotion Multimorph Task

The Emotion Multimorph, previously used by Blair et al. (2004), is a measure of sensitivity to recognize emotional facial expressions. This task consists of identities that gradually morph from a neutral affect expression into each prototypical emotional expression (sadness, fear, anger and happiness) in 20 stages. Mean expression recognition stage scores were computed following the procedure used in Blair et al. (2004) to characterize participants' sensitivity to recognize each emotional facial expression type.

Empathy for emotional facial expressions task (SAM-Faces)

Based on Ali et al. (2009), this task estimates participants' emotional response to emotional faces using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). Participants were asked to rate their affective state on the valence scale of the SAM when watching images depicting a person showing a sad, fearful, angry, happy or neutral expression. The valence scale ranges from a low-spirited manikin ('1') to a widely smiling one ('9'), going through a middle neutral stance ('5'); low scores thus represent negatively valenced affective responses and high scores represent positively valenced affective responses. This task includes realistic and naturalistic stimuli, and is thought to tap into the affective empathy construct as it not only estimates participants' vicarious response to emotional stimuli, but also comprises elements of self-awareness and self/other distinction.

Empathy-Eliciting Short Stories task (SAM-Stories)

The SAM-Stories described in the previous chapter was used to assess participants' emotional response to emotional short stories using the SAM valence scale. Participants were presented with 12 short stories portraying sadness, anger or happiness, and asked to rate their affective response on the SAM.

Affective Empathy Scale of the Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers, Corcoran, Drake, Shryane, & Völlm, 2011)

This scale was added to the battery of experimental tasks and questionnaires for this study as it was not yet published when the previous study was designed. The QCAE is a newly developed measure of empathy that assesses affective and cognitive components of empathy. In this study we used the affective component which is composed of three different scales: emotion contagion (e.g. "It worries me when others are worrying and panicky."); peripheral responsivity (e.g. "I often get deeply involved with the feelings of a character in a film, play, or novel"); and proximal responsivity (e.g. "I often get emotionally involved with my friends' problems").

Empathic Concern Scale of the Interpersonal Reactivity Index (IRI; Davis, 1980)

This scale assesses the tendency to experience feelings of sympathy and compassion for others (e.g. "I would describe myself as a pretty soft-hearted person.").

Moral emotions task

Adapted from Kédia et al. (2008), this task comprised the presentation of brief stories depicting prototypical moral situations, i.e. “an agent harms a victim”. Depending on whether the agent and the victim are the self or other, these stories elicit four kinds of moral emotions: Guilt, Compassion, Self-Anger and Other-Anger. The harmful action is performed unintentionally in all stories to prevent possible interferences from other cognitive processes likely involved in moral judgment. In the study described in the previous chapter, nine scenarios per emotion were presented to participants and each scenario was rated for all possible moral emotions. Based on participant feedback regarding that previous version, this task was shortened and simplified for the present study. The present task contained six scenarios per emotion and participants were asked to rate to what extent they would experience only the target emotion on a scale from 1 to 7 (1 = not at all; 4 = fairly; 7 = extremely).

Moral dilemmas task

Based on previous published work (e.g. Greene et al., 2001), this task is a scenario-based measure of moral decision. Participants were asked to make decisions on a series of 8 moral dilemmas portraying a choice of whether or not to sacrifice one person’s life in order to save the lives of a group of others, differing on whether there is direct physical contact with the victim (Personal) or not (Impersonal). Participants were asked to answer if they ‘Would do… in order to…?’ and to rate the difficulty of the decision on a 10-point scale.

3.3. Data analyses

Pearson and Spearman correlational analyses were conducted using SPSS 20 for Windows. Preliminary analyses indicated that estimated IQ was significantly correlated with some of the criterion variables. Therefore, two sets of analyses were conducted. First, to adjust for the influence of cognitive ability on the relationships between SRP scores and criterion variables, estimated IQ was entered as a control variable. Subsequently, to examine the influence of the unique variance of each SRP dimension on criterion variables, the other SRP dimension was entered as a second control variable. Benjamini and Hochberg False Discovery Rate (FDR; 1995) was used to control the probability of making a Type-I error on multiple comparisons. Corrected p-values are presented. Steiger's Z-tests (two-tailed) were conducted to assess the significance of the difference between associations of the two SRP dimensions and criterion variables. Fisher's Z-tests were conducted to assess the significance of the difference between the correlations in the present female sample and correlations in the male sample. Because of small alterations on the Moral emotions task, female *versus* male comparisons were not conducted on that task.

3.4. Results

Descriptive statistics are presented on Table 3.1. A complete correlational table for all experimental paradigms is also presented in Table 3.2 for illustrative purposes. A similar pattern of results as to the one found in the previous chapter was observe and therefore will not be further discussed.

Table 3.1. Participants' and criterion variables descriptive statistics.

	Mean	SD	Minimum	Maximum
Age	22.68	6.64	18	56
Estimated IQ	111.81	10.54	85	134
SRP-4-SF				
SRP Total	51.12	12.70	31	90
Affective-Interpersonal Dimension	25.46	8.23	14	50
Lifestyle-Antisocial Dimension	24.59	6.10	14	44
Multimorph: Recognition Stage				
Sad Stage Score	9.73	4.15	0	18
Fear Stage Score	11.84	2.78	1	17.67
Anger Stage Score	11.05	3.30	0	18
Happy Stage Score	13.97	3.74	1	19.33
SAM-Faces: Valence ratings				
Sad faces	18.03	7.32	8	46
Fearful faces	25.09	8.04	8	46
Angry faces	26.93	8.84	8	56
Happy faces	58.19	7.50	43	72
SAM-Stories: Valence ratings				
Sad stories	7.17	2.97	4	19
Anger stories	13.86	3.36	6	20
Happy stories	30.18	3.72	19	36
QCAE: Affective Empathy	36.60	5.66	17	48
IRI: Empathic Concern	20.60	4.84	2	28
Moral Emotions task: Ratings				
Compassion	30.45	5.65	13	41
Guilt	36.68	4.44	20	42
Self-Anger	30.50	6.17	14	42
Other-Anger	29.97	6.31	15	42
Moral Dilemmas: Action Endorsement				
Impersonal dilemmas	3.17	1.09	0	4
Personal dilemmas	0.92	0.85	0	4
Moral Dilemmas: Difficulty ratings				
Impersonal dilemmas	7.14	2.29	1	10.00
Personal dilemmas	6.09	2.08	1	10.00

Table 3.2. Correlations between all criterion variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Multimorph: Recognition Stage[b]																				
1. Sadness																				
2. Fear	.25*																			
3. Anger	.14	.29**																		
4. Happiness	.38**	.34**	.26**																	
SAM-Faces: Valence Ratings[a]																				
5. Sad faces	-.13	.03	.02	.04																
6. Fearful faces	-.07	.04	**.23***	.10	.68**															
7. Angry faces	.04	.13	.11	.10	.53**	.71**														
8. Happy faces	.11	-.04	-.12	.05	-.70**	-.62**	-.57**													
SAM-Stories: Valence ratings[a]																				
9. Sad stories	-.05	-.01	.16	-.11	**.45****	**.38****	**.30****	**-.46****												
10. Anger stories	.06	.17	**.37****	.08	**.28****	**.29****	**.25***	**-.32****	.52**											
11. Happy stories	.16	.00	-.08	.14	**-.40****	**-.44****	**-.30****	**.55****	-.53**	-.38**										
12. QCAE: Affective empathy[a]	**.23***	.07	.07	.17	**-.43****	**-.24***	-.18	**.33****	**-.34****	**-.23***	**.38****									
13. IRI: Empathic concern[a]	.11	**.22***	.11	.14	**-.23****	**-.20***	-.12	**.36****	**-.36****	-.16	**.37****	**.62****								
Moral Emotions task: Ratings																				
14. Compassion[a]	.09	**.20***	.02	.10	**-.38****	**-.26****	-.13	**.31****	**-.37****	**-.24***	**.20***	**.48****	**.49****							
15. Guilt[b]	**.25***	.07	-.01	.12	**-.20***	-.09	.00	**.22***	**-.23***	**-.31****	.09	**.31****	**.31****	.53**						
16. Self-Anger[a]	-.05	-.15	-.02	.11	-.12	-.10	-.07	.11	**-.24***	**-.28****	-.01	.14	.01	.19	.43**					
17. Other-Anger[a]	.00	**-.25***	-.12	-.12	-.14	-.09	-.07	.16	**-.20***	**-.30****	.05	.02	-.05	.15	.33**	.74**				
Moral dilemmas: Action endorsement[b]																				
18. Impersonal Dilemmas	.08	-.09	**-.22***	-.01	-.02	-.11	.07	.04	-.09	-.13	.06	-.10	-.08	.03	.02	.04	.14			
19. Personal Dilemmas	-.05	.02	.01	-.01	.02	-.03	-.02	-.05	.08	-.05	.03	-.03	-.07	-.05	.02	-.09	-.11	.19		
Moral dilemmas: Difficulty ratings[a]																				
20. Impersonal Dilemmas	.11	**.25***	.11	.09	-.18	-.08	-.19	.16	**-.27****	**-.21***	**.22***	**.32****	**.32****	**.40****	.17	.04	.13	-.07	-.07	
21. Personal Dilemmas	.12	.06	-.06	.08	**-.23***	-.12	-.19	**.25***	**-.42****	**-.26****	**.42****	**.30****	**.25***	**.26****	.13	.03	.07	.13	.26*	.62**

Notes: Correlations between all criterion variables. [1]Pearson correlation coefficients are reported; [2] Spearman correlation coefficients are reported; ***p<0.001, **0.001<p<0.01, *0.01<p<0.05 (2-tailed). Values in bold indicate significant associations across measures.

Associations between psychopathic traits and measures of affect, empathy and morality

Pearson and Spearman's correlation coefficients and FDR adjusted p-values between SRP dimensions and all measures used are reported in Table 3.3. No significant associations between the dimensions of SRP and variables of Multimorph were found. While none of the associations between the lifestyle-antisocial dimension and criterion variables survived FDR correction, the affective-interpersonal dimension was significantly correlated with several criterion variables. Higher scores on this dimension were associated with and lower scores of affective empathy in the QCAE and less negative emotional responses to sad and fearful faces, and sad stories; lower scores of empathic concern and compassion; higher utilitarian responses on personal dilemmas and lower difficulty in making decisions on impersonal dilemmas. Partialing out each SRP dimension from the other yielded similar findings.

Fisher's Z-tests indicated that the pattern of correlations observed in the present study and in our study with a male sample was extremely similar. Statistically significant differences between genders were only observed in the associations between the affective-interpersonal dimension and endorsement of personal moral dilemmas. Contrary to men, women presented positive associations between the affective-interpersonal dimension and endorsement of utilitarian responses to personal moral dilemmas (controlling for IQ: $Z=2.50$, $p<.05$; controlling for IQ & LA: $Z=2.47$, $p<.05$). An additional marginally significant difference was observed between the lifestyle-antisocial dimension and empathic response to fearful faces where, contrary to men, women did not present a significant association between these variables (controlling for IQ: $Z=1.92$, $p<.06$).

Table 3.3. Correlations between SRP scores and criterion variables

SRP scale	*Total*	*Affective-Interpersonal (AI)*		*Lifestyle-Antisocial (LA)*	
Control variables	IQ	IQ	IQ & LA	IQ	IQ & AI
	r	*r*	*r*	*r*	*r*
Multimorph: Stage Scores[a]					
Sad Faces	-.07	-.11	-.12	-.01	.06
Fearful Faces	-.02	-.02	-.02	-.01	-.00
Angry Faces	-.03	.05	.11	-.11	-.15
Happy Faces	-.05	.00	.05	-.08	-.09
SAM-Faces: Valence Ratings[a]					
Sad Faces	.26*	.25*	.14	.22	.12
Fearful Faces	.19	.25*	.25*	.07	-.08
Angry Faces	.13	.2	.23	-.01	-.13
Happy Faces	.16	-.19	-.18	-.07	.03
SAM-Stories: Valence Ratings[a]					
Sad Stories	.24*	.24**	.22	.15	.01
Anger Stories	-.02	-.02	-.02	-.01	.01
Happy Stories	-.09	-.17	-.23	.05	.16
QCAE: Affective Empathy[a]	-.28*	-.35**†	-.35**†	-.10†	.11†
IRI: Empathic Concern Scale[a]	-.28*	-.42**†	-.49**†	.00†	.28†
Moral Emotions Task: Ratings					
Compassion[a]	-.39**	-.43**†	-.37**†	-.22†	.00†
Guilt[b]	-.25*	-.22	-.14	-.21	-.12
Self-Anger[a]	-.2	-.09	.07	-.29	-.29
Other-Anger[a]	-.13	-.02	.12	-.24	-.26
Moral Dilemmas: Endorsement[b]					
Impersonal Dilemmas	-.01	.04	.09	-.08	-.12
Personal Dilemmas	.29*	.31*	.27*	.16	.00
Moral Dilemmas: Difficulty Ratings[a]					
Impersonal Dilemmas	-.21	-.24*	-.22	-.10	.03
Personal Dilemmas	-.12	-.15	-.15	-.05	.04

Notes: [a] Pearson partial correlation coefficients are reported; [b] Spearman partial correlation coefficients are reported; * $p < 0.05$, ** $p < 0.01$ (2-tailed; FDR corrected); † Significantly different correlations with criterion variables between SRP dimensions ($Z>1.96$; $p<.05$; 2-tailed).

3.5. Discussion

This study examined the associations between multiple measures empathic and moral processing with psychopathic traits in a community sample of females. Overall, our findings indicate that in females from the general population affective-interpersonal traits are associated with selective lower affective empathy to sadness and fear, lower propensity to feel other-oriented moral emotions, higher endorsement of utilitarian responses in dilemmas involving direct harm, and lower self-reported difficulty in making decisions in moral dilemmas involving indirect harm.

Although impairments in the ability to recognize emotional distress in others have been reported in clinical male and female samples (e.g. Blair et al., 2004; Eisenbarth et al., 2008) the existence of such impairments in community samples has not yet been confirmed (e.g. Del Gaizo & Falkenbach, 2008). In the present study, neither of the dimensions of psychopathy was associated with lower sensitivity to recognize emotional expressions. It is possible that impairments in emotional recognition are present only in clinical cohorts of psychopathy.

Our findings did however indicate a clear negative association between levels of affective-interpersonal traits and affective empathy as measured by the Questionnaire of Cognitive and Affective Empathy (Reniers et al., 2012). This association was further corroborated and specified by the results from the affective empathy tasks where participants indicated their feelings using the SAM, where higher levels of affective-interpersonal traits were selectively associated with less negative empathic responses to both observed and imagined displays of fear and sadness. Contrary to men, where lifestyle-antisocial traits were also associated with diminished empathic responses to fear, in women only the specific affective-interpersonal dimension was associated with it. However, the difference between genders in the associations of lifestyle-antisocial traits with empathic responses to fearful faces was only marginally significant and therefore the current data does not afford a strong interpretation with regard to gender differences. Nevertheless, the current findings suggest that this association could be explored further, possibly within clinical samples. Affective empathy is considered to be necessary for the development of moral emotions such as guilt and compassion. In fact, high levels of affective-interpersonal traits were not only associated with diminished affective response to sad and fear emotions in others, but also with diminished propensity to feel these moral emotions. The affective-interpersonal dimension was characterized by reduced ability to feel other-oriented moral emotions as demonstrated by its negative associations with the empathic concern scale, compassion and guilt ratings on the moral emotions task. These moral emotions are thought to function as moral barometers and motivate prosocial and inhibit antisocial behaviors. Impairments in processing such emotions might thus underlie a possible emotional disengagement in moral decision making that might be associated with high levels of affective-interpersonal psychopathic traits.

Affective-interpersonal psychopathic traits were indeed negatively associated with higher endorsement of highly emotional harmful actions to others and with less difficulty in making moral decisions. Females with higher levels of affective-interpersonal traits were more willing to endorse direct harm to a single victim in order to save the lives of many. This result is significantly different from our previous male sample where no such association was found. However, it is not yet clear whether in males psychopathy is associated with a different pattern of responses to these dilemmas or not. While most studies so far have reported negative findings (e.g. Cima et al., 2010; Glenn et al. 2009), one has reported higher utilitarian responses in personal dilemmas in a group of low-anxious psychopaths in comparison to controls (Koenigs et al., 2011). Similarly to Koenigs et al. (2011), in the present study, higher levels of affective-interpersonal traits were associated with higher endorsement of utilitarian responses in more extreme and emotional demanding scenarios where direct contact with the potential victim is necessary. A pattern of higher endorsement of personal dilemmas has also been reported in relation to individual differences in cognitive style, such as higher "need for cognition" and higher "working memory capacity", and it is thought that the endorsement of utilitarian responses in such dilemmas requires overdriving a strong, countervailing emotional response. Higher levels of affective-interpersonal traits were also associated with less difficulty in making decisions on impersonal moral dilemmas but not on personal ones (which are in general deemed less difficult in terms of decision making due to their extreme aversiveness). Taken together, our findings suggest that affective-interpersonal traits of psychopathy might be associated with some level of emotional disengagement and higher involvement of controlled cognition when processing moral decisions.

3.6. Conclusions

This chapter describes a behavioural study where we investigated whether the associations previously found in males between individual differences empathy and moral processing and individual differences in psychopathic traits would also be present in females. We employed the same battery of paradigms employed in the study describe in the previous chapter. This battery included paradigms probing emotional recognition ability, affective empathic response to different types of emotional facial expressions and emotional-eliciting stories, moral emotions, and moral decision-making. We conducted correlational analyses and further tested whether the associations found were unique to any of the psychopathy dimensions to investigate whether variability in these empathy and moral processing constructs was associated with individual differences in psychopathic traits in females; and further tested whether these associations were similar or distinct to the ones found in males.

To our knowledge, this was the first study to investigate how different dimensions of psychopathic personality in women are associated with distinct correlates of empathic and moral processing and further directly compare to results from a male sample. Overall, our findings suggest that, in women, psychopathic personality traits present the same underlying empathic and moral biases found in men. Furthermore, these biases were specific of the affective-interpersonal dimension of psychopathy, strengthening the views that the two dimensions of psychopathy encompass distinct contributions to emotional and moral processing; and that while psychopathy might be manifested differently in females and males, either due to gender-role socialization or biological differences (e.g. Nicholls & Petrila, 2005), its central characteristics appear to be similar. Future work with larger samples from community and forensic settings should further probe the generalizability of these important preliminary findings and the precise extent to which different components of psychopathy present distinct associations with particular empathic and moral processes.

In the present and previous chapter, we identified an association between empathic response to emotional faces and levels of affective and interpersonal psychopathic traits. In the next chapter, Chapter 4, a study designed to identify the neural structures involved in empathic responses to different types of emotional facial expressions will be presented. We adapted the SAM-Faces task to an event-related functional Magnetic Resonance Imaging (fMRI) design in order to verify whether the observed weakened response to other people's emotional facial expressions would also be apparent at the neural level.

CHAPTER 4: Neural correlates of affective empathy for facial expressions and associations with psychopathic traits in a sample of males from the general population

4.1. Chapter Introduction

In the previous chapters we describe two studies where we identified associations between specific dimensions of empathy and morality and psychopathic traits in the general population. We have found that individual differences in psychopathic traits in men and women are associated with weaker affective responses to emotional facial expressions, in particular to sad and fearful facial expressions. In the present chapter, a study conducted to identify the neural structures involved in empathic responses to emotional facial expressions is presented. Despite the extensive literature available on the neural basis of empathic response for pain and disgust, little is still known about the brain regions that subserve empathic response to other people's emotional facial expressions. The first aim of this study was thus to identify the brain regions that subserve affective response to different types of emotional facial expressions, and whether these include the neural structures that have been consistently associated with empathic responding to pain and disgust (i.e. AI, dACC and IFG) and with detecting emotional saliency (i.e. amygdala). The second aim of this study was to verify how the atypical response to other people's emotional facial expressions observed at the behavioural level for individuals with high levels of psychopathic traits, is also observed at the neural level.

4.1.1. Neural basis of affective empathy for emotional faces

Although theorists are not in complete agreement regarding the precise definition of empathy and its constitutive components (see Batson, 2009, for a comprehensive review), most agree that empathy is a multidimensional phenomenon, which involves the understanding of another person's experience through the sharing of their emotional states (Davis, 1983; Decety & Jackson, 2004; Eisenberg, 2000; Eisenberg & Eggum, 2009; Hoffman, 2000). As described in the general introduction of this thesis, at present, and mostly due to the critical contribution of social neuroscience (e.g. Adolphs, 1999; Blair, 2005; Decety, 2011; Decety & Jackson, 2004; Singer, 2006; Singer & Lamm, 2009), much of the empathy literature distinguishes between cognitive and emotional aspects of empathy and further distinguishes affective empathy from emotional contagion and empathic concern. Whilst cognitive empathy is regarded as the ability to understand other people’s intentions, desires or beliefs, through cognitive reasoning (Frith & Frith, 2003), affective empathy is generally understood as the experience of an affective or sensory state that is similar to that the one shown by another person, but where one is aware as that the source of the state is the other person. Although the observer’s emotional state is isomorphic with the other person’s, the subject is aware that his or her own affective state is elicited by the emotional state of the other person (de Vignemont & Singer, 2006). Affective empathy is distinct from emotional contagion, which denotes the predisposition to “catch” other people’s emotions (Hatfield et al., 2009) but without the elements of self-awareness and self-other distinction that are present in affective empathy; and from empathic concern, which refers to affective changes that are induced in the observer in response to the perceived or imagined affective state of another person, but which are not necessarily isomorphic with those experienced by the other.

In recent years, the field of social neuroscience has begun to shed light on the neural underpinnings of affective empathy. These studies suggest that observing or imagining another person in a particular emotional state automatically activates a representation of that state in the observer (e.g. Decety & Ickes, 2009; Decety & Jackson, 2004; Singer, 2006; Singer & Leiberg, 2009). However, it should be noted that these studies also suggest that the experience of empathy is not necessarily purely automatic and sensory-driven, but that top-down cognitive processes can also play a role in the empathic experience (e.g. Decety, 2011; Singer & Lamm, 2009b).

Recent meta-analyses (Fan et al., 2011; Lamm et al., 2011) indicate that empathy tasks systematically elicit robust activation in anterior insula (AI), extending into the inferior frontal gyrus (IFG) and dorsal anterior cingulate cortex / anterior medial cingulate cortex (dACC/aMCC). Although these regions are deemed to be involved in empathic responding to other people's affective states, and although previous studies have utilised a wide range of different experimental tasks and stimuli to probe the neural basis of empathy (see Fan, et al., 2011, for a comprehensive review), to our knowledge no study has used an experimental task probing empathic response to basic emotions, in particular emotional facial expressions. Yet, emotional facial expressions constitute important cues to others' emotional states. Facial expressions can be readily perceived and thus are fundamental to the empathic experience. Moreover, emotional facial expressions are thought to have specific communicatory functions, conveying specific information about the observed person to the observer (Blair, 2005). In that sense, it has been suggested that emotional empathy acts as the translation of the communication of the emotional expressions of the observed person by the observer (Blair & Fowler, 2008).

4.1.2. Individual differences in affective empathy

Identifying the neural substrates involved in the empathic response to emotional facial expressions is of particular interest for the understanding of psychopathic traits and antisocial behaviour. Psychopathy is deemed to be marked by profound impairments in empathy, in particular in affective empathy. It is thought that the absence of a robust empathic response to the distress cues of others leads to an impaired moral development, making individuals high in psychopathic traits more prone to engage in antisocial behaviour (Blair et al, 2005). Precursors of psychopathic traits in children (i.e. callous-unemotional traits) are associated with aberrant neural functioning in the amygdala, ventromedial prefrontal cortex (vmPFC), orbitofrontal cortex (OFC), anterior insula and caudate (Jones et al., 2009; Marsh et al., 2011; Marsh et al., 2008; Sebastian et al., 2012; Viding et al., 2012; White et al., 2012); brain areas that are involved in processing basic emotional salience, and emotion regulation. More specifically, children with high levels of callous-unemotional traits show reduced amygdala response to other's distress (e.g. Jones et al. 2009; Marsh et al. 2008; White et al. 2012), even when the stimuli are presented below conscious awareness (Viding, Sebastian et al., 2012) and reduced functional coupling between amygdala and OFC when viewing fearful facial expressions (Marsh et al. 2008). Two recent studies have also reported that, when observing pictures of others in pain, children with high levels of callous-unemotional traits present reduced neural response within regions associated with empathy for pain (Lockwood et al., 2013; Marsh et al., 2013), namely reduced response in AI (Lockwood et al., 2013), dACC (Lockwood et al, 2013; Marsh et al., 2013) and amygdala (Marsh et al., 2013).

In adults, while there is evidence that psychopathic traits are associated with atypical affective response to others' emotions at the behavioural level (as demonstrated in Chapters 2 and 3), there is so far less evidence of how this impairment is reflected at the neural level. Although a recent study has shown a negative association between psychopathic traits and amygdala reactivity to fearful faces (Carré et al., 2013), to our knowledge, only one other study has addressed empathic processing directly in adults with psychopathy. In that study, contrary to findings in children with high levels of callous traits (Lockwood et al. 2013; Marsh et al., 2013), Decety et al. (2013) found that, when observing body parts in painful situations and when observing facial expressions of pain, the neural activity of incarcerated men with high levels of psychopathy (score of >30 on the Psychopathy Checklist Revised (PCL-R; Hare, 2003) was significantly higher in a number of regions, including bilateral anterior insula, dACC and IFG, than the neural activity of incarcerated men with low levels of psychopathy (score >20 on the PCL-R). The increased activity in these regions was associated with both dimensions of psychopathy (affective-interpersonal and lifestyle-antisocial). The source of inconsistency between these studies remains to be investigated, but could reflect differences in developmental stage, task variables, as well as differences in samples (no healthy comparison group was included in the adult study).

4.1.3. The current study

Despite the role that empathic processing of emotional expressions is thought to have in psychopathic traits, to our knowledge, no study so far has investigated whether the atypical empathic response to distinct basic emotional facial expressions that is observed at the behavioural level is also reflected at the neural level. The current study had two main aims. The first aim was to identify the neural structures involved in empathic responses to emotional facial expressions, and whether these would include the neural structures that have been consistently associated with empathic responding in previous studies (i.e. AI, dACC and IFG). Although the amygdala has been less consistently reported in previous studies of empathy (Fan et al., 2011; Lamm et al., 2011), due to its putative role in detecting emotional saliency (Adolphs, 2010) and, more importantly, in the etiology of psychopathy (Blair, 2007, 2008b), we were also interested in exploring its involvement in affective responding to emotional facial expressions. To accomplish this aim, we adapted the *Empathy for emotional facial expressions task* introduced in the previous behavioural chapters. This task includes realistic and naturalistic stimuli, and is thought to tap into the affective empathy construct as it not only estimates participants' vicarious response to emotional stimuli, but also comprises elements of self-awareness (participants have to evaluate their emotional response) and self/other distinction (participants are asked how *the* stimulus makes them feel). Our second aim was to test whether variability in affective response to emotional faces would also relate to individual differences in psychopathic traits at the neural level, particularly in the above mentioned regions. In the studies described in the previous chapters, we have found that individual differences in psychopathic traits were associated with weaker self-reported affective responses to emotional facial expressions of others. We predicted that the atypical response to other people's emotional facial expressions observed at the behavioural level for individuals with high levels of psychopathic traits would also be observed at the neural level.

4.2. Materials and Methods

4.2.1. Participants

Thirty-one right-handed male participants with no reported history of psychiatric disorder were recruited for this study. Of these, one was excluded prior to fMRI analyses due to excessive response failure (>50%) and movement artefact. Following exclusion, data from 30 participants (mean age: 26.9, range: 20-40; mean estimated IQ: 110, range: 85-125) were analysed. All participants provided written informed consent according to the guidelines approved by UCL Division of Psychology and Language Sciences Ethics Committee who provided local ethics approval for this study.

4.2.2. Materials

4.2.2.1. Assessment of General ability

The Matrix Reasoning subscale of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) was administered to estimate level of general intellectual ability.

4.2.2.2. Assessment of psychopathic traits

Psychopathic traits were assessed with the *Self-Report Psychopathy Scale 4 Short Form* (SRP-SF; Paulhus, Neumann, & Hare, in press), a 29-item scale designed to measure psychopathic attributes in non-institutionalized samples. The SRP-SF assesses psychopathic traits, organized in four facets – interpersonal, affective, lifestyle and antisocial – consistent with recent research on the PCL-R. Like the PCL-R, the four facets can be modelled in terms of the traditional two-factor dimensions. The SRP has been shown to have clear latent structure, good construct validity in male and female samples (Neumann et al., 2012) and is strongly correlated with the PCL-R (Lilienfeld & Fowler, 2006; Paulhus et al., in press).

4.2.2.3. Assessment of Anxiety

Participants also completed the State-Trait Anxiety Index (STAI; Spielberger, Gorsuch, & Luschene, 1970). The STAI comprises two subscales, one for measurement of trait anxiety (STAI-T) and the other for measurement of state anxiety (STAI-S).

4.2.2.4. Empathy for emotional facial expressions task

For the present study, we adapted the SAM-Faces task introduced in the previous behavioural chapters. As described before, this task, based on Ali et al. (2009), estimates participants' emotional response to emotional faces using the Self-Assessment Manikin

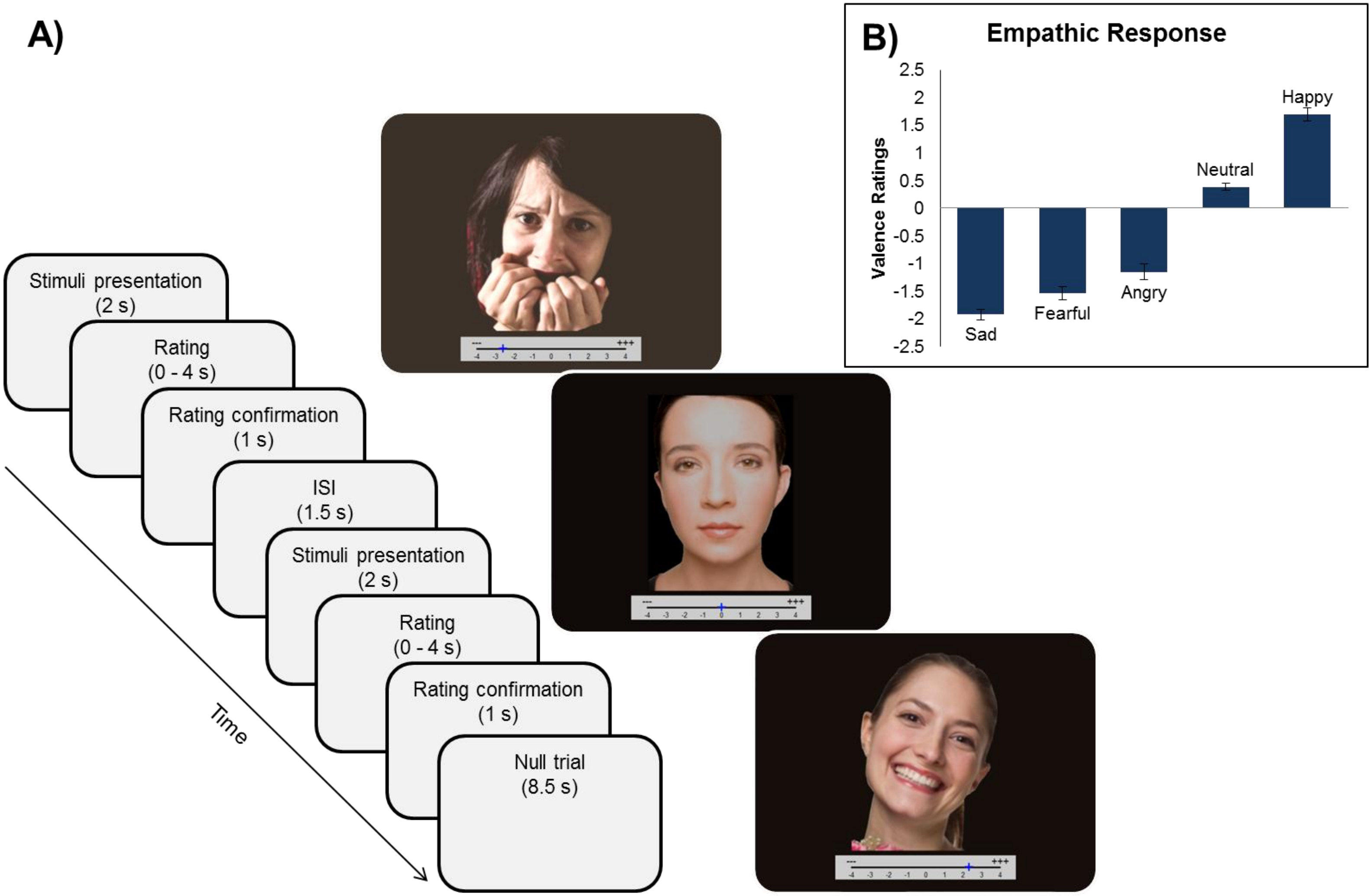
(SAM; Bradley & Lang, 1994). This task includes realistic and naturalistic stimuli, and is thought to tap into the affective empathy construct as it not only estimates participants' vicarious response to emotional stimuli, but also comprises elements of self-awareness (participants have to evaluate their emotional response) and self/other distinction (participants are asked how *the* stimulus makes them feel). Participants are asked to rate their affective state on the valence scale of the SAM when watching images depicting a person showing a sad, fearful, angry, happy or neutral expression. The valence scale ranges from a low-spirited manikin to a widely smiling one, going through a middle neutral stance. For the present study, we adapted this task to an event-related functional magnetic resonance imaging (fMRI) design. To prevent possible confounding effects at the neural level of presenting expressive manikins (that contain emotional facial expressions) alongside the emotional stimuli of interest (emotional facial expressions), the valence scale of the SAM was replaced by a sliding scale, ranging from -4 (---) to +4 (+++). We included the stimuli described in the previous chapters, i.e. 8 images per type of emotion (sadness, fear, anger, neutral, and happiness) depicting one person, whose face is the focal point of the image.

Immediately prior to scanning, participants were familiarised with the task and instructions. Stimuli used during practice were not used in the scanning session. Inside the scanner, before the beginning of the task, participants were reminded of the instructions for 14.875 s, corresponding to the 5 dummy scan volumes discarded prior to analysis (see below). Participants were presented with a total of 120 trials in two runs, corresponding to the 40 different stimuli repeated 3 times, and were instructed to rate how the picture made them feel on the sliding rating scale. Each trial started with the presentation of the stimuli.

After 2 s, the sliding scale appeared on the screen, below the stimuli. Participants made their ratings using three keys on a keypad. Two keys moved the cursor (initially positioned in the centre of the scale) to left or right on the sliding scale, and a third key ‘marked’ the answer. After marking their ratings, participants received visual confirmation of their answer for 1 s. Participants had a maximum of 4 s to make their ratings. If a rating was not made within that time, the trial was considered an error. A fixation cross appeared on the screen for 1.5 s before the next trial started. Twenty-four fixation cross null trials, with a duration of 8.5 s, were also included. Trials were presented in a pseudorandom order to prevent presentation of more than two consecutive trials of the same type and more than one consecutive null trial.

Examples of the stimuli used can be found in Appendix 2.

Figure 4.1. Affective empathy for emotional facial expressions task



Notes: A) Task timeline and examples of three trials (from fearful, neutral and happy conditions). Participants were presented with each trial over two screens consisting in the presentation of the stimuli for 2 s, followed by presentation of the sliding scale where they rated how the image made them feel (0-4 s); **B)** Manipulation check. All conditions elicited significantly different levels of emotional response ($F(1, 29) = 423.27$, $p < 0.001$; all pairwise comparisons $p < 0.03$, corrected).

4.2.3. Magnetic resonance imaging acquisition

Images were acquired using a Siemens Avanto 1.5 T MRI scanner at the Birkbeck-UCL Centre for Neuroimaging with a 32-channel headcoil. A 5.5 min 3D T1-weighted anatomical scan, and multislice T2*-weighted echo planar images (EPIs) with BOLD contrast were acquired. The T2* EPI sequence used the following acquisition parameters: 35 2 mm slices acquired in a descending trajectory with a 1 mm gap; echo time = 50 ms; repetition time = 2.975 s; slice tilt = -30^{o} (T > C); flip angle = 90^{o}; field of view = 192 mm; matrix size = 64 x 64. Functional data were acquired in a single run. Field maps (phase and magnitude images) were also acquired for use in the unwarping stage of data preprocessing. Stimulus presentation and response collection were presented in Cogent, running in Matlab 2011b (http://mathworks.com).

4.3. Data analyses

4.3.1. Behavioural analysis

All behavioural analyses were conducted with SPSS 20 for Windows. To confirm that the stimuli in the different types of experimental conditions elicited significantly stronger emotional responses than the stimuli in the neutral condition, we conducted a one-way ANOVA on valence ratings, as well as post-hoc pairwise comparisons, with Bonferroni correction for multiple comparisons. Pearson correlational analyses between valence ratings and dimensions of psychopathic traits were conducted to check the replicability of our previous findings at the behavioural level in the present sample. Two sets of analyses were conducted. First, we entered estimated IQ and anxiety as control variables to adjust for the influence these variables on the relationships between psychopathic traits and criterion variables. Second, the other SRP dimension was entered as an additional control variable to examine the influence of the unique variance of each SRP dimension on criterion variables.

4.3.2. Image processing and analyses

EPI data were analysed using SPM8 (www.fil.ion.ucl.ac.uk/spm). The first five volumes were discarded, and the data were realigned to the sixth volume, unwarped using a fieldmap, normalized to the Montreal Neurological Institute template resampling to a voxel size of 2x2x2 mm, and smoothed with an 8 mm full width at half-maximum Gaussian filter. Data were high-pass filtered at 128 s to remove low-frequency drifts, and the statistical model included an AR(1) autoregressive function to account for autocorrelations.

An initial set of event-related analyses was conducted to compare neural responses associated with each type of emotional facial expression in relation to neutral faces. Onsets of interest were time-locked to the presentation of the stimuli, and durations included the presentation of the stimuli and the duration of the rating on the sliding scale (2-6 s). Regressors of interest were created by convolution of these onsets with a canonical hemodynamic response function. Other regressors modelled in the analysis included null trials and errors (error rate > 5% for all participants). The six realignment parameters were modelled as parameters of no interest. For two participants, an extra regressor was included to model corrupted images resulting from excessive motion. These images were removed and the adjacent images interpolated in order to prevent distortion of the between-subjects mask. First-level contrast images were calculated by applying appropriate linear contrasts to the parameter estimates of regressors of interest and entered into second-level analyses. Second-level analyses were conducted by performing one-sample t-tests on each of these contrasts using the summary-statistics approach to random-effects analysis. Whole-brain analyses were conducted using a threshold of $p < 0.05$, FWE corrected at the voxel level, after applying an inclusive grey matter mask (segmented from the group average anatomical scan). Additional exploratory whole-brain analyses were conducted using a cluster forming threshold of $p < 0.001$ (uncorrected, cluster size > 20) after applying an inclusive grey matter mask (segmented from the group average anatomical scan), and clusters surviving FWE correction ($p<.05$) were considered statistically significant. ROI analysis in bilateral amygdala was conducted using the Pickatlas toolbox. A single ROI was anatomically defined using masks from the automated anatomical labelling (AAL) atlas. A cluster forming threshold of $p < 0.001$ (uncorrected) was applied and clusters surviving FWE correction ($p < 0.05$) were considered statistically significant.

To test whether individual differences in hemodynamic response in the brain areas previously implicated in empathic processing were associated with individual differences in psychopathic traits, we used the Marsbar toolbox (Brett, Anton, Valabregue, & Poline, 2002) to extract average contrast estimates from 8 mm spheres centred on activation peaks in the AI, dACC, IFG and amygdala (identified in the whole-brain and ROI analyses). Note that these correlation analyses were orthogonal to the contrast used to define the regions of interest. To ensure that our results were due to our personality constructs of interest (distinct dimensions of psychopathy), we ran partial-correlation analyses including estimated IQ and trait Anxiety as covariates to control for the influence of these variables. Subsequently, to examine the influence of the unique variance of each SRP dimension on criterion variables, the other SRP dimension was entered as a third control variable.

4.4. Results

Demographic and personality statistics are presented in Table 4.1.

Table 4.1. Participants' demographic and personality statistics

	Minimum	Maximum	Mean	S.D.
Age	20	40	26.90	5.99
WASI matrices	41	68	56.83	6.04
STAI Trait	22	58	39.00	9.64
SRP Total	31	109	58.07	18.18
SRP Affective-Interpersonal	14	61	29.23	10.89
SRP Lifestyle-Antisocial	15	47	27.70	8.73

4.4.1. Behavioural findings

Manipulation check

To confirm that the stimuli in the different types of experimental conditions elicited significantly stronger emotional responses than the stimuli in the neutral condition, we conducted a one-way ANOVA on valence ratings and found a main effect of valence ($F(1, 29) = 423.27$, $p < 0.001$). Post-hoc pairwise comparisons, with Bonferroni correction, confirmed that there were significant differences between valence ratings of all stimuli types (all p < 0.001, except for sad > fear: p < 0.03), with the pattern sad > fearful > angry > neutral > happy (Figure 4.1)

Relationship between psychopathic traits and affective response to emotional facial expressions

Pearson partial correlations controlling for trait anxiety and intelligence revealed that psychopathic traits, in particular affective-interpersonal traits, were significantly associated with less positive emotional responses to happy faces. The associations with other emotional expressions had correlation coefficients of similar magnitude to the ones reported in the previous chapters (i.e. less negative emotional responses to negative emotional facial expressions), but failed to reach significance likely due to the lower N of the imaging study (Table 4.2).

Table 4.2. Correlations between SRP scores and valence ratings of emotional response to facial expressions

SRP scale	*Total*	*Affective-Interpersonal (AI)*		*Lifestyle-Antisocial (LA)*	
Control variables	IQ & ANX	IQ & ANX	IQ, ANX & LA	IQ & ANX	IQ, ANX & AI
	r	*r*	*r*	*r*	*r*
Valence Ratings					
Sad Faces	.09	.16	.24	-.01	-.19
Fearful Faces	.25	.28	.25	.16	-.07
Angry Faces	.26	.30	.27	.17	-.09
Neutral Faces	-.16	-.13	-.02	-.16	-.10
Happy Faces	-.44*	-.47*	-.36	-.34	.02

Notes: Pearson correlation coefficients are reported. * p < 0.05 (2-tailed).

4.4.2. fMRI findings

Neural response to each type of emotional facial expression

At a conservative cluster forming threshold of $p < 0.05$, FWE corrected at voxel level, we identified a single significant cluster of activation within the lingual gyrus during the observation and rating of one's own affective response to fearful faces in comparison to neutral faces. At an initial threshold of $p < 0.001$ (uncorrected, cluster extent > 20 voxels), we identified significant clusters of activation (FWE cluster corrected) within the lingual gyrus during the observation and rating of one's own affective response to sad and fearful faces in comparison to neutral faces. No other clusters survived correction at the cluster level (Table 4.3). ROI analyses within the amygdala (bilaterally) did not identify significant cluster of activation for any type of emotional facial expression. It is possible that the lack of activation in areas that have been consistently reported in tasks involving affective and empathic processing is due to lack of power in our task to detect differential neural activation between emotional and neutral conditions. Alternatively, it is possible that the processing demands (reflecting on one's emotional state) in emotional and neutral conditions are similar and, therefore, no differential activity can be identified. These alternative explanations will be further discussed in the Discussion section. We conducted a second set of exploratory post-hoc analyses to identify neural activity associated with performing the task.

Table 4.3. Peak cluster activations during empathic response to emotional facial expressions in comparison to neutral facial expressions

	Peak						Cluster	
Brain regions	**L/R**	**x**	**y**	**z**	**t**	**Z**	**Extent (k)**	**p (FWE)**
Sad > Neutral								
Lingual gyrus	L	-12	-76	-11	5.72	4.64	105	.001
Middle temporal gyrus	R	-51	11	-32	4.96	4.19	37	.285
Inferior temporal gyrus	R	48	14	-35	4.89	4.14	64	.068
Posterior cingulate cortex	L	-9	-49	7	4.76	4.06	31	.392
Fear > Neutral								
Lingual gyrus	L	-21	-88	-14	6.50	5.06	153	.002
Parahippocampal gyrus	L	-27	-31	14	4.39	3.81	35	.350
Angry > Neutral								
Lingual gyrus	L	-18	-73	-11	4.06	3.58	22	.578
Happy > Neutral								
Thalamus	L	-15	-22	1	4.73	4.04	20	.668
Lingual gyrus	L	9	-79	-11	4.06	3.58	29	.434

Notes: Whole-brain analyses within grey matter mask, reported at a threshold level of $p < 0.001$ (uncorrected), cluster size > 20 voxels. Spatial coordinates (x, y, z) are in Montreal Neurological Institute space. R = Right; L = Left.

Post-hoc analyses

Neural response to emotional facial expressions task

A second set of exploratory post-hoc analyses was conducted in order to identify neural activity associated with performing the task. In this second set, we contrasted neural responses associated with all conditions in relation to null trials (fixation). Whole-brain analyses were conducted using a conservative cluster forming threshold of $p < 0.05$ (FWE corrected) after applying an inclusive grey matter mask (segmented from the group average anatomical scan).

Performing the task, i.e. explicitly resonating with others' facial expressions, evoked responses in regions that have been consistently identified to be associated with affective empathy: inferior frontal gyrus (IFG) extending to anterior insula (AI) bilaterally, and dorsal anterior cingulate cortex (dACC). Further activation was also observed in supramarginal gyrus (SMG), middle frontal gyrus (MFG), thalamus and cerebellum, extending to fusiform gyrus (Table 4.2, Figure 4.2). ROI analysis in bilateral amygdala identified two significant clusters of activation within the right and left amygdala (Table 4.3, Figure 4.2). No regions exhibited the opposite pattern of activity.

Table 4.4. Peak activations in brain regions during empathic response to faces

				Peak			Cluster	
Brain regions	**L/R**	**x**	**y**	**z**	**t**	**Z**	**Extent (k)**	**p (FWE)**
Inferior frontal gyrus, opercular part	R	54	11	7	13.63	7.56	659	< .001
Extending to Anterior insula	R	45	5	1	10.05	6.55		
Cerebellum	L	24	-49	-32	12.52	7.29	3583	< .001
Extending to Fusiform gyrus	L	39	-58	-14	12.01	7.15		
Thalamus	L	-12	-22	10	12.28	7.22	268	< .001
Inferior frontal gyrus, opercular part	L	-45	-25	16	12.22	7.21	1302	< .001
Extending. to Anterior insula	L	-42	-1	1	11.59	7.03		
Dorsal anterior cingulate cortex	R	-3	14	34	11.66	7.05	235	< .001
Dorsal anterior cingulate cortex	R	6	14	40	11.34	6.96	205	< .001
Supramarginal gyrus	L	45	-40	40	8.38	5.93	140	< .001
Middle frontal gyrus	R	36	41	25	8.22	5.86	176	< .001

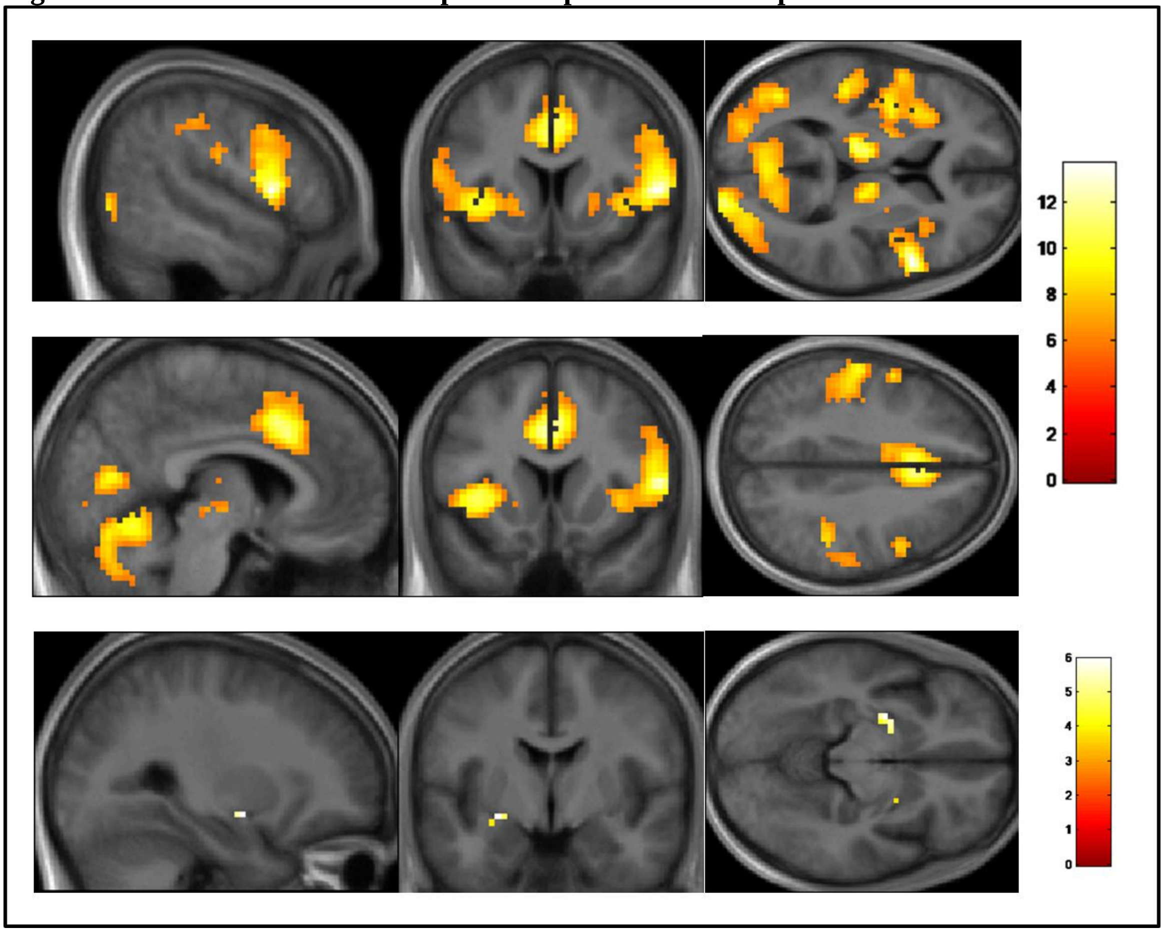
Notes: Whole-brain analysis within grey matter mask, reported at a threshold level of $p < 0.05$ (FWE corrected, cluster size > 20 voxels). Spatial coordinates (x, y, z) are in Montreal Neurological Institute space. R = Right; L = Left.

Table 4.5. Peak cluster activations in amygdala during empathic response to faces

				Peak				Cluster
Brain regions	**L/R**	**x**	**y**	**z**	**t**	**Z**	**p (FEW)**	**Extent (k)**
Amygdala	L	-27	-4	-17	5.95	4.77	.014	8
Amygdala	R	24	2	-11	3.62	3.26	.038	1

Notes: ROI analysis using AAL mask, reported at a threshold level of $p < 0.001$ (uncorrected). Spatial coordinates (x, y, z) are in Montreal Neurological Institute space. R = Right; L = Left.

Figure 4.2. Neural correlates of empathic response to facial expressions.

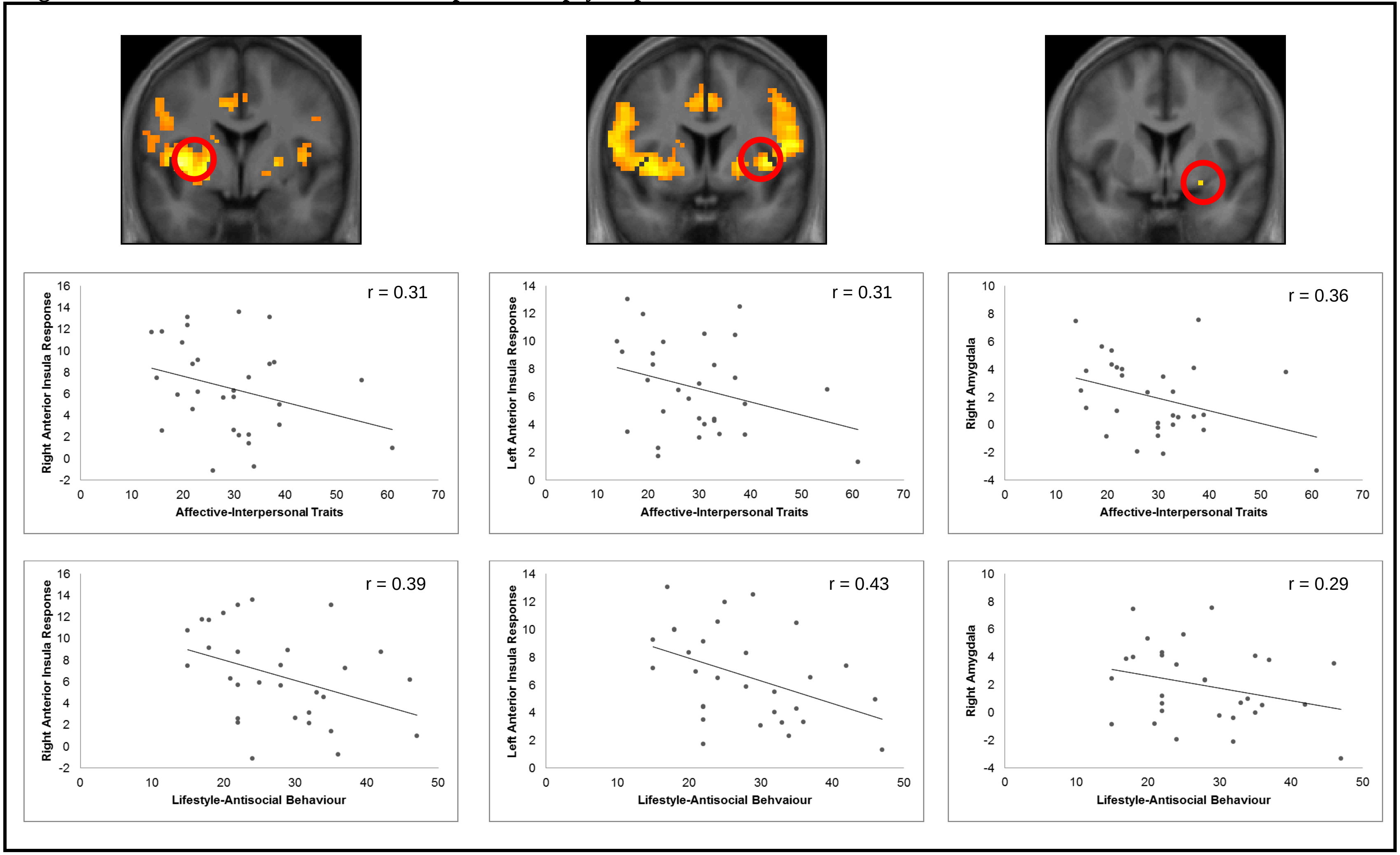


Notes: Results from whole-brain and amygdala ROI analyses illustrating clusters of voxels in IFG extending to anterior insula (top panel), dACC (middle panel) and amygdala (bottom panel). Overlays are displayed at $p < 0.05$ (FWE corrected) for whole brain analysis and at $p < 0.001$ (uncorrected) for amygdala ROI analysis.

Associations between neural responses and psychopathic traits

Next, we tested whether responses elicited during the performance of the task, i.e. all conditions relative to fixation, in IFG, AI, dACC and amygdala regions were associated with individual differences in psychopathic traits. During the performance of the task, the magnitude of neural response in the anterior insula, bilaterally, was significantly negatively associated with levels of lifestyle-antisocial psychopathic traits (Right AI: $r = -0.38$, $p = 0.05$; Left AI: $r = -0.43$, $p = 0.02$), and at trend with affective-interpersonal traits (Right AI: $r = -0.31$, $p = 0.10$; Left AI: $r = -0.33$, $p = 0.08$). The magnitude of response in right amygdala also presented significant negative associations with both affective-interpersonal traits ($r = -0.38$, $p = 0.03$) and lifestyle-antisocial behaviour ($r = -0.37$, $p = 0.05$). Partialing out each SRP dimension from the other, weakened correlation coefficients and increased p-values of these associations rendering them non-significant, indicating that the shared variance between psychopathy facets was responsible for the associations. We found no significant correlations between psychopathic traits and response in lingual gyrus during the observation and rating of one's own affective response to sad and fearful faces in comparison to neutral faces.

Figure 4.3. Association between neural response and psychopathic traits



Notes: Regression plots depicting associations between task elicited anterior insula (8 mm sphere centred at peak coordinates [45 5 1; -42 -1 1]) and amygdala (8 mm sphere centred at peak coordinates [24 2 -11]) response and levels of psychopathic traits. Raw scores are presented for illustrative purposes.

4.5. Discussion

The aims of the study described in this chapter were two-fold. First, we wanted to identify the neural structures that subserve empathic response to emotional facial expressions, and whether these include the neural structures that have been consistently associated with empathic responding to pain and disgust (i.e. AI, dACC and IFG). Second, we wanted to verify whether the atypical response to other people's emotional facial expressions observed at the behavioural level for individuals with high levels of psychopathic traits was also reflected at the neural level. Although we were not able to comprehensively identify neural substrates involved in empathic response to different types of emotions, we were able to confirm that the neural structures that are most consistently reported to be involved in empathy for pain and disgust (i.e. AI, dACC and IFG) and in detecting emotional saliency (i.e. amygdala) were robustly recruited during the performance of our task, i.e., when participants explicitly resonated with others' facial expressions. Moreover, we were able to confirm that variability in hemodynamic response in AI and amygdala during the performance of our task was negatively associated with individual differences in psychopathic traits.

Unfortunately, we were not able to disentangle possible distinct neural circuits involved in the affective response to different types of emotions. On reflection, we speculate that due to the limited number of trials per condition, and perhaps more importantly to the limited number of different stimuli per emotion type which might have caused repetition effects, this task was not optimally powered to obtain separate parameter estimates for all emotion types (each condition had 40 trials but these were comprised of 8 different stimuli repeated three times). Future improved versions of this task should include more trials per condition, and should not include stimuli repetitions in order to avoid habituation effects. Another possible explanation for the lack of differential neural activation between emotional and neutral conditions in our task would be that there are no differential processing demands between the conditions. That is, explicitly resonating with others' emotional or neutral facial expressions would recruit the same psychological processes and therefore would not elicit differential neural activation.

Nonetheless, our post-hoc analyses focusing on all trials vs. fixation baseline, allowed us to explore brain regions recruited during empathic response to facial expressions in general. When participants observed and rated their affective responses to facial expressions, BOLD response was observed in the IFG, AI and dACC, as well as in the amygdala. These regions are thought to play important roles in the experience of empathy. The amygdala is involved in detecting emotional saliency (Adolphs, 2010) and in experiencing emotional arousal in face of emotional stimuli (Decety, 2011); the AI is proposed to be critical for sensory integration (Critchley et al, 2004), and interoceptive awareness (Craig, 2009); and the dACC in emotional appraisal (Etkin, Egner, & Kalisch, 2011). These regions therefore play a crucial role in emotion awareness and understanding (Decety, 2011). The IFG, on the other hand, is thought to be important for emotion regulation (Ochsner & Gross, 2005; Wager, Davidson, Hughes, Lindquist, & Ochsner, 2008). Recent meta-analyses have shown that indeed empathy tasks systematically recruit robust activation in these regions (Fan et al., 2011; Lamm et al., 2011). However, though previous studies have employed a wide range of different experimental tasks and stimuli to probe the neural basis of empathy, to our knowledge, no study before had used an experimental task probing empathic response to different facial expressions. Although we can only make tentative conclusions based on our post-hoc analyses, our findings are in line with previous studies that implicate the amygdala, AI, IFG and dACC in affective empathic processing and suggest that these regions are recruited not only when we incidentally process other people's pain or disgust, but also when we actively observe and introspect our own affective responses to other people's emotions.

In the previous chapters we demonstrate that, in the general population, variability in self-reported empathic response to emotional faces is associated with individual differences of psychopathic traits. Now, our present findings suggest that this association is also apparent at the neural level. We found that activity in those regions that are thought to be responsible for detecting emotional saliency and generating emotional arousal (amygdala), and for sensory integration and interoceptive awareness (anterior insula) was negatively associated with both dimensions of psychopathic traits. To our knowledge, this is the first study suggesting that neural correlates of empathic processing for facial expressions are associated with levels of psychopathic traits. Three previous studies have investigated associations between neural correlates of empathy for pain and levels of psychopathic traits. Two of those studies report similar results to ours in children with differing levels of callous-unemotional traits: when observing others in pain, children with high levels of callous-unemotional traits present reduced neural response within AI (Lockwood et al., 2013; Marsh et al., 2013) and amygdala (Marsh et al., 2013). However, another study with adults (Decety et al., 2013) presented opposite results: when observing body parts in painful situations and facial expressions of pain, incarcerated men with high levels of psychopathy presented increased neural response within the AI when compared with incarcerated men with low levels of psychopathy. Although, the source of inconsistency between child and adult studies remains to be investigated, our results seem to indicate that these different findings are not a reflection of differences in developmental stage. Further studies are necessary to clarify these inconsistencies, for example where forensic groups can be compared with a healthy comparison group. Nonetheless, our findings provide further evidence that psychopathy is marked by profound impairments in empathy, and that atypical amygdala and AI function represent neural markers of disrupted emotional and empathic processing for individuals with high levels of these traits.

4.6. Conclusions

This chapter described an event-related fMRI study designed to identify brain regions involved in processing empathic response to emotional facial expressions and how activity in these structures are associated with individual differences in psychopathic traits. Unfortunately, we were not able to identify neural substrates involved in empathic response to different types of emotions, possibly due to design issues. Nonetheless, we were able to confirm that the neural structures that are most consistently reported to be involved in empathy for pain and disgust (i.e. AI, dACC and IFG) and in detecting emotional saliency (i.e. amygdala) are also robustly recruited when subjects are instructed to resonate with others' facial expressions.

We further tested whether individual differences in hemodynamic response in these regions were associated with levels of psychopathic traits. As described in the previous behavioural chapters, we have found that individual differences in psychopathic traits were associated with weaker affective responses to emotional facial expressions of others. Here we demonstrated that variability in affective response to emotional faces also mapped onto individual differences in psychopathic traits at the neural level, particularly in amygdala and anterior insula, regions that are thought to be responsible for detecting emotional saliency and generating emotional arousal, and for sensory integration and interoceptive awareness. Our findings are in line with previous theoretical and empirical work suggesting that psychopathy is marked by profound impairments in empathy, that atypical amygdala and AI function represents neural markers of disrupted emotional and empathic processing for individuals with high levels of these traits, and that subclinical levels of variability in psychopathic traits map onto behavioural and neural processes typically found to be dysfunctional in criminal psychopaths.

CHAPTER 5: Neural correlates of everyday moral processing and associations with psychopathic traits in a sample of males from the general population

5.1. Chapter Introduction

In the previous chapters we describe two studies where we identified associations between specific dimensions of empathy and morality and psychopathic traits in the general population, as well as a study designed to identify the neural structures and circuits involved in empathic responses to different types of emotional facial expressions. In the present chapter, we present a study conducted to identify the neural structures and circuits involved in processing everyday personal moral transgressions and how activity in these structures and circuits are associated with individual differences in psychopathic traits.

Despite recent advances in identifying the neural bases of human morality, relatively little is known about the neural substrates implicated in everyday and real-life moral cognitive processes. Delineating the neural circuitry implicated in everyday moral processing is essential if we are to further our understanding of individual differences in moral cognition and behaviour. Our aims were two-fold. First, we wanted to identify the neural structures that subserve moral cognition in everyday personal moral transgressions; and second, we wanted to test whether individual differences in neural responses specific to everyday moral processing (independent of emotional saliency and mentalising content) were associated with inter-individual variability in psychopathic traits in the general population.

5.1.1. Neural basis of everyday moral processing

The question of why humans engage in behaviour that harms others even when they know it is wrong has long preoccupied and intrigued philosophers (e.g. Descartes, 1649; Hume, 1739-1740; Smith, 1759). In the past decade numerous studies have reported on the neural correlates of human morality (Greene et al., 2004; Moll, Zahn, et al., 2005). These studies have advanced our understanding of the processes involved in moral cognition, and motivated a paradigm shift where human morality is no longer conceptualised as a product of pure logic but rather as emerging from an interaction of reasoning, emotion and motivation.

Despite recent advances in identifying the neural bases of human morality, relatively little is known about the neural substrates implicated in everyday and real-life moral cognitive processes. Extant studies have identified a consistent network of brain regions implicated in moral cognition, including prefrontal cortex (PFC), insular cortex, amygdala, posterior cingulate cortex (PCC), precuneus, temporo-parietal junction (TPJ) and posterior superior temporal sulcus (pSTS) (see Fumagalli & Priori, 2012; Young & Dungan, 2012, for recent reviews). These regions are engaged by emotional, social as well as cognitive information processes (Bzdok et al., 2012). Nonetheless, the majority of these studies have been limited in elucidating everyday moral processing of personal transgressions in at least three respects. First, they have typically employed extreme scenarios and/or a third-person perspective (e.g. Greene et al., 2004; Heekeren et al., 2003; Koenigs et al., 2007; Moll, De Oliveira-Souza, Bramati, et al., 2002), making it difficult to generalise findings to personal moral transgressions in everyday life. For example, we are seldom faced with the dilemma of sacrificing one person's life to save many. But we might be tempted to behave immorally when facing situations where doing what is morally correct comes at a cost to oneself, and inflicting harm to another person is necessary to achieve our desired goal. Second, even when more realistic first-person scenarios have been employed (for example to identify the neural correlates of personal transgressions and of moral guilt) these studies have been problematic to interpret either because the emotional content of experimental and control scenarios has not been equated (e.g. Sommer et al., 2010), or because the intention to transgress has not been clear – yet, intention is a key factor when judging the morality of an action (Cushman, 2008). Specifically, previous studies have utilised scripts comprising actions that are either unintentional (e.g. Kédia et al., 2008), or where the intent is difficult to ascertain unambiguously (e.g. Green et al., 2010; Moll et al., 2007; Takahashi et al., 2004). It is important to control for these factors if we are to disentangle neural substrates that are involved in moral cognition (Christensen & Gomila, 2012). Third, the structure of the tasks employed in these studies precludes the separation of different processes that are likely involved when we evaluate the morality of our actions. These include an initial appraisal phase during which we make meaning out of and understand the morality of a particular course of action; and subsequent processes involved in reflecting on feelings of moral guilt which are triggered by the realisation that we have intentionally caused harm to another person (e.g. Eisenberg, 2000). Addressing each of these limitations is essential if we are to characterise how the brain process personal moral transgressions in everyday life.

5.1.2. Individual differences in moral processing

Delineating the neural circuitry implicated in everyday moral processing is essential if we are to further our understanding of individual differences in moral cognition. In particular if we want to understand why some individuals routinely present with irresponsible and immoral behaviour. The study of psychopathic traits can be particularly helpful in this regard. As described in previous chapters, psychopathy is a personality disorder characterised by a constellation of personality and behavioural traits, including blunted affect and lack of remorse as well as marked irresponsible lifestyle and antisocial behaviour (e.g. R. D. Hare & Neumann, 2008). Evidence from both clinical and community samples has shown that individual differences in psychopathic personality traits are associated with atypical neural activity during moral judgement and moral decision making, especially in ventromedial prefrontal cortex (vmPFC) and amygdala (Glenn, Raine, & Schug, 2009; Harenski et al., 2010; Marsh & Cardinale, 2012; Marsh et al., 2012; Pujol et al., 2012). This atypical activity is thought to reflect the emotional and interpersonal impairments of the psychopathic personality (Glenn, Raine, & Schug, 2009; Harenski et al., 2010; Marsh et al., 2012; Marsh & Cardinale, 2012). However, these studies have either used visual stimuli comprising third person or abstract actions (Harenski et al., 2010; Marsh et al., 2012) or have been confounded by emotionality, with the scenario implicated in the moral transgression typically being characterised by higher levels of emotional content (Glenn, Raine & Schug, 2009; Marsh & Cardinale, 2012). It remains therefore unclear whether psychopathic traits are associated with atypical moral or atypical emotional processing when it comes to processing personal moral transgressions.

5.1.3. The current study

The current study had two main aims. The first aim was to identify the neural structures that subserve moral cognition in everyday personal moral transgressions. We developed a novel, more realistic and rigorously controlled task that comprised scripts of everyday moral scenarios, written in the second person. In the condition of interest (harm-to-other), these scripts described scenarios in which the protagonist achieved a personal goal, but harmed another person. To control for other cognitive processes that might be necessary for moral cognition but are not specific to it, we included control scripts (harm-to-self). These were matched for intentionality, causality, mentalising requirements, emotional valence and arousal, and entailed achieving the same goal as in the harm-to-other condition, but at a cost to the protagonist.

We predicted that by equating these confounding factors in our task design, we would observe a more circumscribed set of brain areas than those identified in previous studies. For example, we expected that regions such as the amygdala, which is thought to play a crucial role in detecting emotional saliency (Adolphs, 2010; Vuilleumier, 2005), and the right temporo-parietal junction, which is consistently engaged when we think about other people's intentions (Van Overwalle, 2009), would not be activated specifically during harm-to-other scenarios. We also predicted that we would observe partially separable and overlapping neural circuits recruited during the initial appraisal of the moral transgressions and during the later effortful reflection on feelings of guilt resulting from the transgression.

Our second aim was to test whether individual differences in neural responses specific to everyday moral (rather than emotional or mentalising) processing were associated with inter-individual variability in psychopathic traits in the general population. We further explored the associations found between the magnitude of neural response during everyday moral processing and individual differences in psychopathic traits, by conducting exploratory psychophysiological interaction (PPI) analyses. These analyses allowed us elucidate whether individual differences in psychopathic traits modulate the functional integration between brain regions (Friston et al., 1997) during processing of everyday moral transgressions.

5.2. Materials and Methods

5.2.1. Participants

Thirty-two right-handed male participants with no reported history of psychiatric disorder were recruited for this study. Of these, three were excluded prior to fMRI analyses: one for excessive response failure (>50%) and excessive MR signal artefact, one due to excessive MR signal artefact, and one for being identified as an univariate outlier on the Self-Report Psychopathy Scale Short-Form SRP-SF (SRP-SF; Paulhus et al., in press) and a multivariate outlier on analyses involving the SRP-SF. Following exclusions, data from 29 participants (mean age: 26.6, range: 20-40; mean estimated IQ: 110, range: 85-125) were analysed. All participants provided written informed consent according to the guidelines approved by UCL Division of Psychology and Language Sciences Ethics Committee who provided local ethics approval for this study.

5.2.2. Materials

5.2.2.1. Assessment of General ability

The Matrix Reasoning subscale of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) was administered to estimate level of general intellectual ability.

5.2.2.2. Assessment of psychopathic traits

Psychopathic traits were assessed with the *Self-Report Psychopathy Scale 4 Short Form* (SRP-SF; Paulhus, Neumann, & Hare, in press), a 29-item scale designed to measure psychopathic attributes in non-institutionalized samples. The SRP-SF assesses psychopathic traits, organized in four facets – interpersonal, affective, lifestyle and antisocial – consistent with recent research on the PCL-R. Like the PCL-R, the four facets can be modeled in terms of the traditional two-factor dimensions. The SRP has been shown to have clear latent structure, good construct validity in male and female samples (Neumann et al., 2012) and is strongly correlated with the PCL-R (Lilienfeld & Fowler, 2006; Paulhus et al., in press).

5.2.2.3. Assessment of Anxiety

Participants also completed the State-Trait Anxiety Index (STAI; Spielberger et al., 1970). The STAI comprises two subscales, one for measurement of trait anxiety (STAI-T) and the other for measurement of state anxiety (STAI-S).

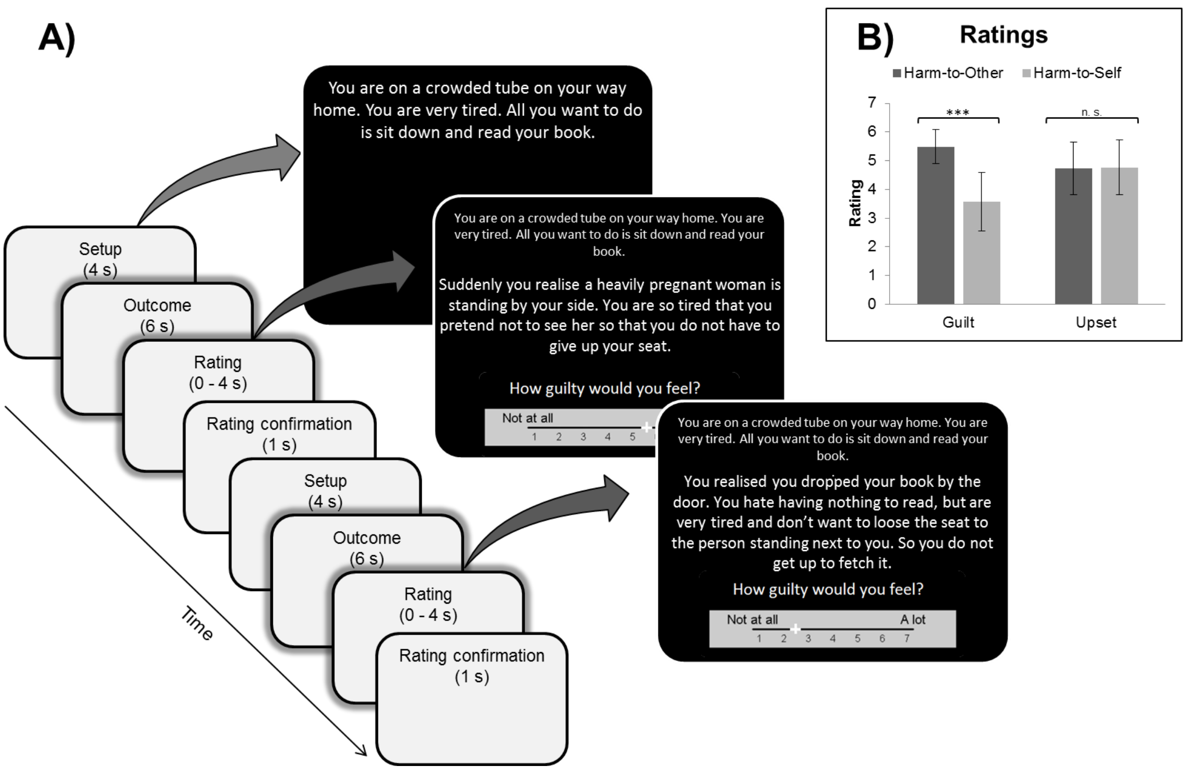
5.2.2.4. Moral Vignette task

To develop this task, we initially created twenty-eight scenarios with two possible endings. These scenarios comprised descriptions of a personal goal, each with two possible outcomes to achieve the goal: causing harm to another person; or harm to oneself. These two outcomes thus represented either a moral transgression or a morally neutral (but still unpleasant) situation respectively. The scenarios' outcomes were matched for a number of factors, including: participant perspective and consequent experience of agency; clarity about the intentionality and causality of the action in evaluation; recruitment of mentalising abilities (including number of characters); emotional arousal; order of presentation of relevant information; vocabulary (which can cause expression style and word framing effects); and word number. A two-phase pilot study was conducted to select the 15 best scenarios for the fMRI task. Forty participants read the stories and were asked to rate how guilty and how upset they would feel, and how morally wrong the action in the story was. The scenarios chosen were those in which the two possible outcomes were best matched for emotional valence and arousal (i.e. those with the least and no significant difference between means of upset ratings on the two possible outcomes), but only the moral transgression outcome would elicit guilt (i.e. those with the greatest difference between means of guilt ratings on the two possible outcomes). Additionally, the moral transgression outcome (harm-to-other) had to be judged as clearly morally wrong (i.e. with mean ratings above the median point of the moral judgement scale).

Immediately prior to scanning, participants were familiarised with the task and instructions. Scenarios used during practice were not used in the scanning session. Before the beginning of the task, participants were reminded of the instructions for 14,875 ms, corresponding to the 5 dummy scan volumes discarded prior to analysis (see below). Participants were presented with 30 trials, corresponding to 15 different scenarios, each with two outcomes, in which they were instructed to imagine themselves in each situation and rate how guilty they would feel. Trials comprised three stages: 1) presentation of the personal goal ('setup'; 4 s); 2) presentation of the outcome, i.e. harm to other (moral transgression) or harm to self (morally neutral) to achieve the goal ('outcome'; 6 s); and 3) rating of subjective guilt on a sliding scale from 1 ('Not at all') to 7 ('A lot') after a prompt question *'How guilty would you feel?'*. Participants made their ratings using three keys on a keypad. Two keys moved the cursor (initially positioned in the centre of the scale) to left or right on the sliding scale, and a third key 'marked' the answer. After marking their ratings, participants received visual confirmation of their answer for 1 s before the next trial started. Participants had a maximum 4 s to make their ratings. If a rating was not made within that time the trial was considered an error. Fifteen null trials, where the sentence 'This is a small break, please keep still' appeared on the screen for 10 s, were also included. Trials were presented in a pseudorandom order to prevent presentation of more than two consecutive trials of the same type and more than one consecutive null trial. After scanning, participants read the scenarios for a second time and rated how upset they would feel in the imagined situation.

Examples of the scenarios can be found in Appendix 4.

Figure 5.1. Moral vignettes task



Notes: A) Task timeline for two non-consecutive trials. Participants were presented with each scenario over three screens, representing each phase of the trial: 1) presentation of the personal goal ('Setup'; 4 s); 2) presentation of the outcome, i.e. harm-to-other or harm-to-self ('Outcome'; 6 s); 3) rating of subjective guilt on a sliding scale ('Rating', 0-4 s); **B)** Manipulation check results. Ratings of guilt and upset in harm-to-other and harm-to-self trials. Both types of scenarios elicited similar levels of negative emotional state ($t(28) = -0.09$; $p = 0.93$), but differed in terms of levels of guilt ($t(28) = 9.23$; $p < 0.001$).

5.2.3. Magnetic resonance imaging acquisition

Images were acquired using a Siemens Avanto 1.5 T MRI scanner at the Birkbeck-UCL Centre for Neuroimaging with a 32-channel headcoil. A 5.5 min 3D T1-weighted anatomical scan, and multislice T2*-weighted echo planar images (EPIs) with BOLD contrast were acquired. The T2* EPI sequence used the following acquisition parameters: 35 2 mm slices acquired in a descending trajectory with a 1 mm gap; echo time = 50 ms; repetition time = 2975 ms; slice tilt = -30^{o} (T > C); flip angle = 90^{o}; field of view = 192 mm; matrix size = 64 x 64. Functional data were acquired in a single run. Field maps (phase and magnitude images) were also acquired for use in the unwarping stage of data preprocessing. Stimulus presentation and response collection were presented in Cogent, running in Matlab 2011b (http://mathworks.com).

5.3. Data analyses

5.3.1. Behavioural analysis

All behavioural analyses were conducted with SPSS 20 for Windows. To confirm that the stimuli in the experimental (harm-to-other) condition elicited significantly stronger moral guilt than the stimuli in the neutral condition (harm-to-self); but that both conditions elicited a similar negative emotional state, one-sample t-tests were conducted. Multiple regression analyses were conducted to inspect associations between psychopathic traits and the intensity of subjective feelings of guilt during the harm-to-other scenarios. First, trait anxiety and intelligence were included as covariates to control for the influence of these variables on the relationships. Subsequently, to examine the influence of the unique variance of each dimension of psychopathic traits on subjective feelings of guilt, the other SRP dimension was entered as a third control variable.

5.3.2. Image processing and analysis

EPI data were analysed using SPM8 (www.fil.ion.ucl.ac.uk/spm). The first five volumes were discarded, and the data were realigned to the sixth volume, unwarped using a fieldmap, normalized to the Montreal Neurological Institute template resampling to a voxel size of 2x2x2 mm, and smoothed with an 8 mm full width at half-maximum Gaussian filter. Data were high-pass filtered at 128 s to remove low-frequency drifts, and the statistical model included an AR(1) autoregressive function to account for autocorrelations.

An event-related analysis was conducted to compare neural responses associated with moral transgression (harm-to-other) and morally neutral (harm-to-self) scenarios. Onsets of interest were time-locked to the appraisal phase of the trial and to the guilt-rating phase of the trial, for both harm-to-self and harm-to-other scenarios, with durations of 6 s for the appraisal phase and variable duration (0-4 s) for the guilt-rating phase. Regressors of interest were created by convolution of these onsets with a canonical hemodynamic response function. Other regressors modelled in the analysis included: goal presentation (pooled across all scenarios); null trials; and errors. The six realignment parameters were modelled as parameters of no interest in both analyses. For one participant, an extra regressor was included to model 3 corrupted images resulting from excessive motion.

These images were removed and the adjacent images interpolated in order to prevent distortion of the between-subjects mask. First-level contrast images were calculated by applying appropriate linear contrasts to the parameter estimates of regressors of interest and entered into second-level analyses. Second-level analyses were conducted by performing one-sample t-tests on each of these contrasts using the summary-statistics approach to random-effects analysis. Whole-brain analyses were conducted using a threshold of $p < 0.05$, FWE corrected at the voxel level, after applying an inclusive grey matter mask (segmented from the group average anatomical scan). To identify regions that were commonly active during the moral appraisal and guilt reflection, a mask was created at a liberal threshold of $p < .001$, uncorrected, for the two contrasts of interest (appraisal of harm to other>appraisal of harm to self (AHO > AHS), and reflection on guilt for harm to other>reflection on guilt for harm to self (RHO > RHS). We then ran each contrast using an inclusive mask derived from running the other contrast with a cluster-forming threshold of $p<.001$ (uncorrected), cluster size 20 voxels), using a threshold of $p<0.05$ corrected for multiple comparisons at the cluster-level within the mask.

To identify associations between individual differences in psychopathic traits and individual differences in hemodynamic response during moral and guilt processing, we used the Marsbar toolbox (Brett et al., 2009) to create regions of interest (ROIs) and extracted average contrast estimates across these ROIs based on significant peaks identified from the above whole-brain analyses (ROIs defined as 8 mm spheres with peaks of significant clusters as centre coordinates). Note that these correlation analyses are orthogonal to the contrast used to define the ROI. To ensure that our results were due to our personality constructs of interest (distinct dimensions of psychopathy), we ran multiple regression analyses including trait anxiety and intelligence as covariates to control for these variables. Subsequently, to examine the influence of the unique variance of each SRP dimension on criterion variables, the other SRP dimension was entered as a third control variable. Adjustment using the Benjamini and Hochberg False Discovery Rate procedure (FDR; Benjamini and Hochberg, 1995) was used to control the probability of making a Type-I error across multiple regions.

To further clarify the associations found between the magnitude of mOFC response during guilt reflection and psychopathy lifestyle and antisocial personality traits, we carried out a psychophysiological interaction (PPI) analysis, which can elucidate whether functional integration occurs between regions, as well as how this integration changes as a function of different psychological contexts (Friston et al., 1997). The PPI analysis consists of a design matrix with three regressors: the *psychological variable*, which represents the experimental task (here, the contrast RHO>RHS); the *physiological variable*, which represents the neural response in the seed region (here, the mOFC); and a third variable representing the interaction between the first and the second variables. The coordinates of the seed region corresponded to the peak activation within the mOFC cluster detected in RHO>RHS contrast. For each individual, the principal eigenvariate across the fMRI time-series was extracted from a sphere of 8 mm radius centred on the peak height coordinates (physiological variable). This was multiplied by the RHO>RHS contrast (psychological variable) to create a third variable representing the interaction between the time-series and the psychological variable (PPI variable). Following estimation, subject-specific contrast images were then entered into two random-effects analyses using one-sample t-tests: the first using the physiological variable to estimate the direction of the coupling of the mOFC seed region with other regions; and the second using the PPI variable to identify which regions had increased coupling with the mOFC during guilt reflection (RHO relative to RHS). Whole-brain analyses were conducted with a cluster-forming threshold of $p<.001$ (uncorrected) and cluster size of 20 voxels after applying an inclusive grey matter mask. Regions surviving FWE cluster level correction ($p<.05$) across the whole brain were considered statistically significant. To examine whether the increased coupling identified during RHO was associated with individual differences in psychopathic traits, we extracted PPI estimates using the Marsbar toolbox (Brett et al., 2002) as described above for the categorical fMRI analysis.

5.4. Results

Demographic and personality statistics are presented on Table 5.1.

Table 5.1. Participants' demographic and personality statistics

	Minimum	Maximum	Mean	S.D.
Age	20	40	26.31	5.51
WASI matrices	41	68	56.83	6.12
STAI Trait	22	58	39.79	9.49
SRP Total	31	80	55.24	14.09
SRP Affective-Interpersonal	14	39	27.38	7.75
SRP Lifestyle-Antisocial	15	46	26.72	7.85

5.4.1. Behavioural Findings

Manipulation check

Both types of scenarios (harm-to-other and harm-to-self to achieve a personal goal) elicited a negative emotional state: upset. Importantly upset ratings were similar between the conditions ($t(28) = -.09$; $p = .93$). By contrast, guilt was elicited significantly more strongly during moral transgression (i.e. the harm-to-other scenarios) compared with harm-to-self ($t(28)=9.23$; $p<.001$) (Figure 5.1).

Relationship between psychopathic traits and moral guilt feelings

Multiple regression analyses controlling for trait anxiety and intelligence revealed that the intensity of subjective guilty feeling during the harm-to-other scenarios was significantly negatively associated with individual differences in affective-interpersonal traits ($r = -0.41$; $p < 0.05$), and at trend with lifestyle-antisocial behaviour traits ($r = -0.35$; $p = 0.07$). After partialing out each psychopathic traits dimension from the other these associations became weaker and non-significant ($r = -0.26$; -0.16).

5.4.2. fMRI Findings

Separable neural circuits engaged during the appraisal of and guilt reflection on everyday moral transgressions

Our fMRI paradigm allowed us to distinguish between the processes involved in appraising the moral transgression (during the presentation of each scenario) and in reflecting on feelings of guilt elicited by that transgression (rated immediately after each scenario). We constructed a single statistical model in which the onsets of the regressors of interest were time-locked to (1) the appraisal phase of the trial and (2) to the guilt-rating phase of the trial. Appraising one's own moral transgression (harm- to-other scenario) relative to morally neutral scenarios (harm-to-self scenario), evoked responses in vmPFC (superior rostral gyrus and superior frontal gyrus, medial part) regions, dlPFC (superior frontal gyrus, lateral part), bilateral anterior insula and posterior cingulate cortex (Figure 5.2; Table 5.2), all of which survived whole-brain correction for multiple comparisons at the voxel level. No regions exhibited the opposite pattern of activity at this threshold, or at the more lenient threshold level of $p < .001$ (uncorrected), cluster size > 20 voxels. Guilt reflection during harm-to-other relative to harm-to-self scenarios evoked responses in posterior middle temporal gyrus (pMTG) and cerebellum, both of which survived whole-brain correction for multiple comparisons at the voxel level (Figure 2; Table 1). No regions exhibited the opposite pattern of activity at this threshold, or at the more lenient threshold level of $p < .001$ (uncorrected), cluster size > 20 voxels.

Table 5.2. Peak cluster activations in brain regions during appraisal of one's own moral transgression

Brain regions	Peak						Cluster	
	L/R	x	y	z	t	Z	Ext. (k)	p (FWE)
Appraisal moral transgression (AHO>AHS)								
Superior rostral gyrus	L	-9	53	10	7.89	5.68	1004	<.001
Superior frontal gyrus, lateral part	L	-27	47	31	7.47	5.5	248	<.001
Anterior insula	L	-30	-17	-14	6.62	5.09	294	<.001
Anterior insula	R	36	5	4	6.44	5.00	111	.006
Superior temporal gyrus	L	-57	-28	16	4.88	4.11	81	.025
Superior frontal gyrus	R	-9	49	16	5.89	4.71	50	.128
Thalamus	L	-15	-19	-2	5.3	4.37	29	.415
Middle frontal gyrus	R	-33	50	1	4.83	4.08	48	.143
Superior parietal lobule	L	66	-31	40	4.71	4.00	22	.596
Hippocampus	L	-27	-10	-20	4.7	4.00	21	.625
Supramarginal gyrus	L	-60	-28	-20	4.66	3.98	31	.372
Posterior cingulate gyrus	L	-6	-28	28	4.57	3.91	58	.082
Middle temporal gyrus	L	51	-58	7	4.13	3.62	27	.462
Supramarginal gyrus	L	48	-28	22	4.11	3.61	24	.54
Guilt reflection (RHO>RHS)								
Posterior middle temporal gyrus	R	51	-55	-8	6.74	5.15	67	.059
Cerebellum	L	-6	-55	-11	6.58	5.07	434	<.001
Medial orbital gyrus (mOFC)	L	-9	47	-8	5.26	4.35	102	<.001
Medial frontal gyrus	R	3	53	-5	4.92	4.14	64	.069
Putamen	R	-18	14	-2	4.59	3.93	43	.209

Notes: Whole-brain analyses within grey matter mask, reported at a threshold level of $p < 0.001$ (uncorrected), cluster size > 20 voxels for descriptive purposes. Spatial coordinates (x, y, z) are in Montreal Neurological Institute space. R = Right; L = Left. AHO = appraisal harm-to-other; AHS=appraisal harm-to-self; RHO = reflection harm-to-other; RHS=reflection harm-to-self.

Overlapping neural circuits during moral appraisal and guilt reflection

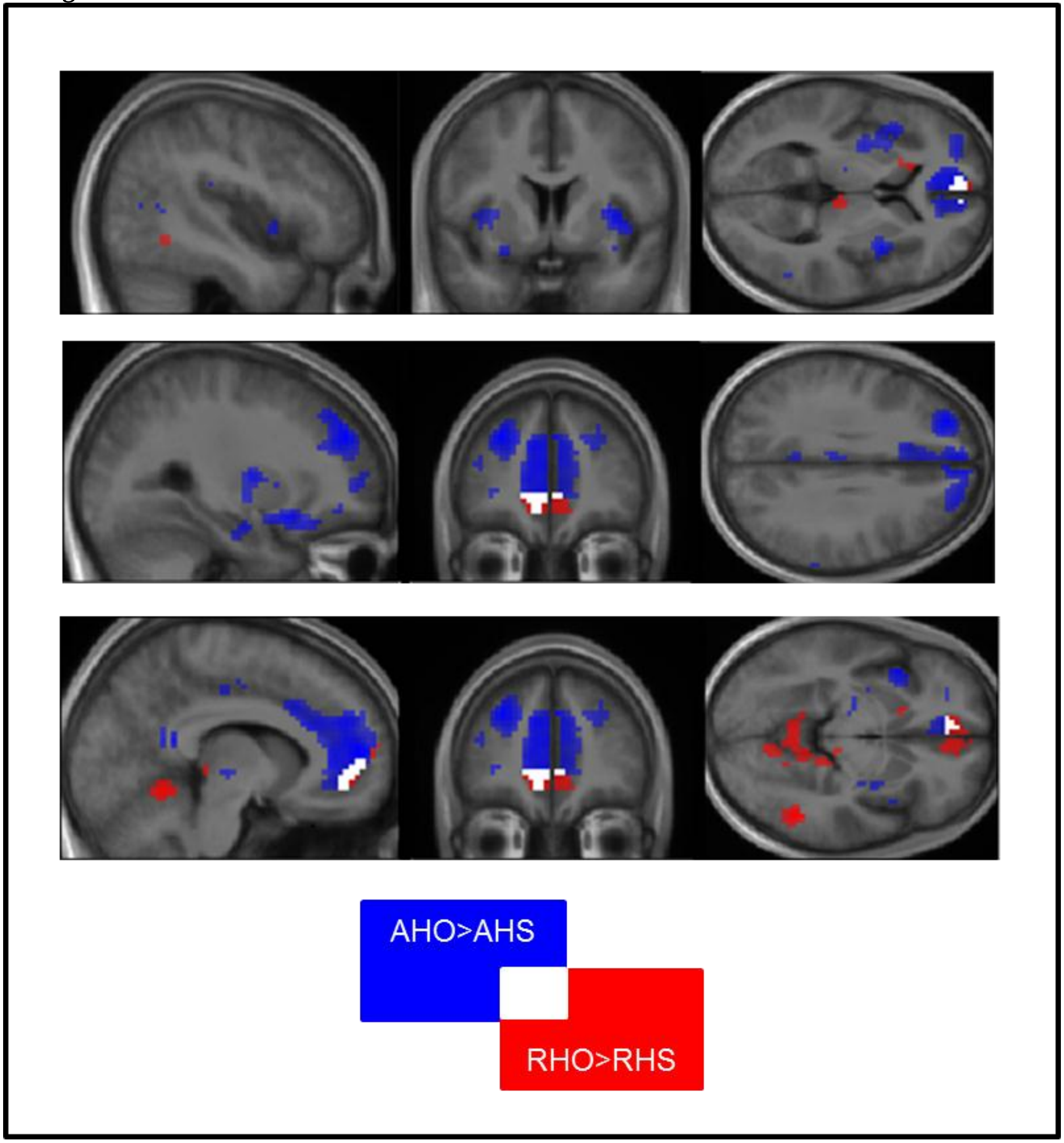
To identify regions that were active during both moral appraisal and guilt reflection we created two masks, each including all voxels activated in each contrast using a threshold of $p < .001$ (uncorrected). We then ran the appraisal contrast inside the reflection contrast mask and vice versa, correcting for multiple comparisons at the cluster level within the respective masks. These analyses revealed a common cluster of activation encompassing voxels within the vmPFC (superior rostral gyrus) and mOFC (Figure 5.2; Table 5.3).

Table 5.3. Commonly activated brain regions during appraisal of moral transgressions and reflection on guilt

	Peak						Cluster	
Brain regions	**L/R**	**x**	**y**	**z**	**t**	**Z**	**Ext. (k)**	**p (FWE)**
Appraisal moral transgression (AHO>AHS)								
Superior rostral gyrus	L	-6	53	7	7.54	5.53	67	.001
Guilt reflection (RHO>RHS)								
Medial orbital gyrus	L	-9	47	-8	5.26	4.35	67	.003

Notes: Analyses within the corresponding contrast activation mask; initial cluster-forming threshold of $p < 0.001$ (uncorrected), $k > 20$. Spatial coordinates (x, y, z) are in Montreal Neurological Institute space. R = right; L = left. AHO = Appraisal harm-to-other; AHS = Appraisal harm-to-self; RHO = Reflection harm-to-other; RHS = Reflection harm-to-self.

Figure 5.2. Neural correlates for the appraisal of and guilt reflection on everyday moral transgressions

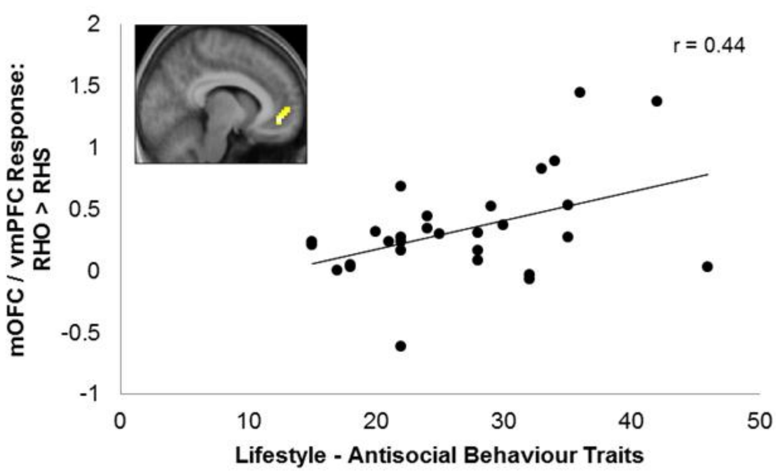


Notes: Results from whole-brain analyses illustrating clusters of voxels in anterior insula and dlPFC during moral appraisal (blue: AHO > AHS); and the common cluster of activation in mOFC/vmPFC during moral appraisal and guilt reflection (red: RHO > RHS; white: overlap). Overlays are displayed at $p < 0.001$ (uncorrected) for illustrative purposes.

Associations between neural responses and psychopathic traits

Next, we tested whether above described responses elicited by the appraisal of the personal moral transgression and by subsequent guilt reflection were associated with individual differences in psychopathic traits. After FDR correction for multiple regions, none of the responses elicited during the appraisal phase were associated with any of the psychopathic traits dimensions. However, the magnitude of neural response in the commonly activated mOFC region, during the reflection phase, was significantly positively associated with levels of lifestyle-antisocial behaviour (LA; $r = 0.50$; $p = 0.03$, corrected) (Figure 5.3; Table 5.5). Partialing out each SRP dimension from the other yielded similar findings and, although the association between response in mOFC and LA traits did not survive correction for multiple comparisons, it was nominally significant ($r = 0.48$, $p = 0.01$).

Figure 5.3. Association between neural response in vmPFC/mOFC and psychopathic traits



Notes: Regression plot depicting the association between guilt-elicited mOFC response and levels of lifestyle-antisocial behaviour traits. Raw scores are presented for illustrative purposes. RHO = Reflection Harm-to-Other; RHS = Reflection Harm-to-Self.

Table 5.4. Associations between neural response during moral appraisal and guilt reflection and psychopathic traits

Con.	Clusters' peak activations	SRP-AI	SRP-LA	Unique variance SRP-AI	Unique variance SRP-LA
AHO>AHS	*Whole brain*				
	Superior rostral gyrus	.37	.35	.21	.19
	Superior frontal gyrus, medial part	.30	.30	.16	.16
	SFGlp	.29	.42	.07	.31
	Left anterior insula	.33	.30	.19	.15
	Right anterior insula	.00	.17	-.13	.21
	Perigenual anterior cingulate	.31	.34	.14	.21
	Posterior cingulate	.21	.18	.14	.07
	Within RHO>RHS mask				
	Superior rostral gyrus	.29	.28	.16	.14
RHO>RHS	*Whole brain*				
	Posterior middle temporal gyrus	.46	.43	.28	.23
	Within AHO>AHS mask				
	Medial orbitofrontal cortex	.32	.55*	-.01	.48

Notes: Partial correlation values (after controlling for IQ and anxiety) and FDR corrected p-values are presented. * $p < 0.05$; AI = Affective-Interpersonal traits; LA = Lifestyle-Antisocial Behaviour traits; AHO = Appraisal Harm-to-Other; AHS = Appraisal Harm-to-Self; RHO = Reflection Harm-to-Other; RHS = Reflection Harm-to-Self.

Functional coupling of the mOFC during guilty reflection

To further clarify the associations between the magnitude of mOFC response during guilt reflection and psychopathy lifestyle and antisocial personality traits, we carried out a psychophysiological interaction (PPI) analysis, which can elucidate whether functional integration occurs between regions, as well as how this integration changes as a function of different psychological contexts (Friston et al., 1997). The mOFC seed region (8mm sphere centred at coordinate showing highest activation during moral reflection) was significantly (whole brain, cluster-level corrected) coupled with the posterior insula (peak coordinate: 39 -22 1; Z = 6.34; $p < 0.001$), pMTG (peak coordinate: -15 -67 7; Z = 6.83; $p < 0.001$) and inferior frontal gyrus, orbital part (peak coordinate: -30 50 4; Z = 5.74; $p < 0.001$) extending to lateral middle frontal gyrus, with increased coupling during guilt reflection in harm-to-other trials vs. harm-to-self trials (posterior insula: Z = 4.62; $p < 0.01$; pMTG: Z = 4.60, $p < .001$; inferior frontal gyrus: Z = 4.32; $p < 0.01$) (Table 5.5).

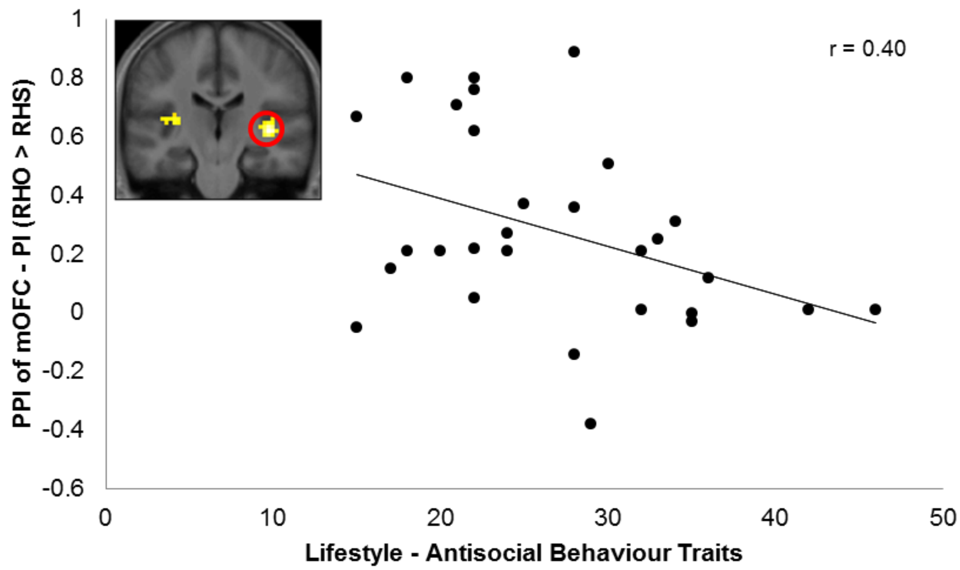
Table 5.5. Psychophysiological interaction analysis of mOFC region during guilt reflection

Brain regions	Peak						Cluster	
	L/R	x	y	z	t	Z	Ext. (k)	p (FWE)
Posterior insula	R	39	-22	1	5.73	4.62	103	.008
Posterior middle temporal gyrus	L	-15	-67	7	5.7	4.6	493	<.001
Inferior frontal gyrus, orbital part	L	-30	50	4	5.22	4.32	138	.002
Cerebellum	R	36	-49	-32	4.45	3.84	97	.011

Notes: Whole-brain analyses with grey matter mask; initial cluster-forming threshold of $p < 0.001$ (uncorrected), $k > 20$. Spatial coordinates (x, y, z) are in Montreal Neurological Institute space. R = Right; L = Left.

We then examined whether the increased coupling during harm-to-other trials was associated with individual differences in psychopathic traits, and found a negative association between the magnitude of modulation of mOFC coupling with posterior insula and levels of lifestyle-antisocial traits ($r = -0.46$; $p < 0.05$, corrected) (Figure 5.4). Partialing out each SRP dimension from the other yielded similar findings and, although the association between the magnitude of modulation of mOFC coupling with posterior insula and LA traits did not survive correction for multiple comparisons, it was nominally significant (r = -0.41, p = 0.04).

Figure 5.4. Association between mOFC-PI connectivity and psychopathic traits

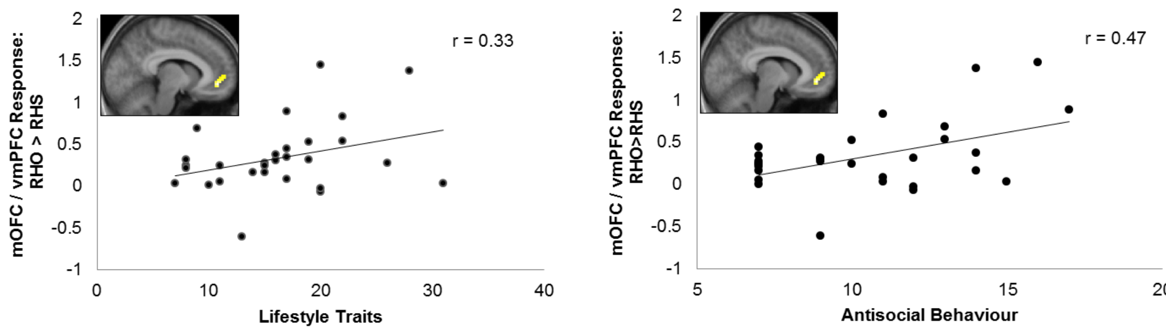


Notes: Regression plot depicting the negative association between the magnitude of modulation of mOFC coupling with posterior insula and levels of lifestyle-antisocial traits. Overlay is displayed at p < 0.001 (uncorrected), and raw scores are presented for illustrative purposes. RHO = Reflection Harm-to-Other; RHS=Reflection Harm-to-Self.

Post-Hoc Analyses

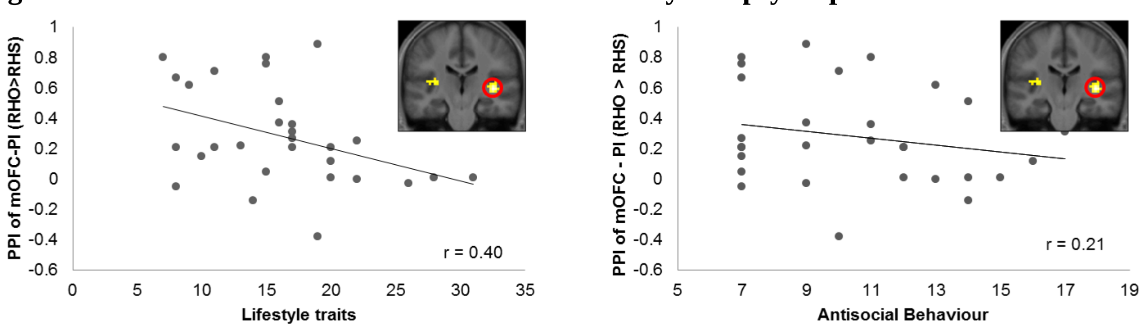
Finally, we wanted to probe whether the associations found between the mOFC response and connectivity during guilt reflection with lifestyle and antisocial traits were driven by lifestyle traits, by antisocial behaviour, or both. We conducted a new set of multiple regression analyses with these two facets, following the methods described for the initial analyses with the two dimensions (affective-interpersonal; lifestyle-antisocial). Both lifestyle (r = 0.41, p = 0.03) and antisocial (r = 0.54, p > 0.01) facets were significantly positively associated with mOFC response; whilst only the lifestyle facet was negatively associated with functional connectivity with posterior insula (r = -0.46, p = 0.02; antisocial behaviour: r = -0.23, p = 0.25) (Figures 5.5 and 5.6). Behaviourally, only the lifestyle facet was negatively associated with the intensity of subjective feelings of guilt during the harm-to-other scenarios (r = -.41; p = 0.03; antisocial behaviour: r = -0.27, p = 0.17).

Figure 5.5. Associations between neural response in vmPFC/mOFC and psychopathic traits



Notes: Regression plot depicting the association between guilt-elicited mOFC response and levels of lifestyle and antisocial behaviour traits. Raw scores are presented for illustrative purposes. RHO = Reflection Harm-to-Other; RHS=Reflection Harm-to-Self.

Figure 5.6. Associations between mOFC-PI connectivity and psychopathic traits



Notes: Regression plots depicting associations between the magnitude of modulation of mOFC coupling with posterior insula and levels of lifestyle and antisocial traits. Overlays are displayed at p<.001 (uncorrected) and raw scores are presented for illustrative purposes. RHO = Reflection Harm-to-Other; RHS=Reflection Harm-to-Self.

5.5. Discussion

The study described in this chapter had two main goals: 1) to identify the neural structures that subserve moral cognition in everyday personal moral transgressions; and 2) to test whether individual differences in neural responses specific to everyday moral processing (independent of emotional saliency and mentalising content) were associated with inter-individual variability in psychopathic traits in the general population. We were able to delineate a network of brain regions engaged when people envisage the kinds of personal moral transgressions that might be encountered in everyday life. We also disambiguated the initial *appraisal* of the scenario from subsequent *reflection* on feelings of guilt that arise following a moral transgression. While these processes were underpinned by two largely separable neural circuits, a cluster in the ventral prefrontal cortex (superior rostral gyrus and mOFC), was commonly activated across both. We also demonstrated associations between individual differences in psychopathic traits and neural response to *everyday* moral transgressions. Notably, mOFC response during guilt reflection was positively associated with individual differences in lifestyle traits antisocial behaviour. Additionally, weaker guilt-elicited functional coupling of mOFC and posterior insula was positively associated with lifestyle characteristics of psychopathic personality.

Our task design enabled us to disentangle neural circuits that are likely to be involved during different stages of moral processing. We identified partially separable and overlapping brain regions recruited during the initial appraisal of a transgression and the effortful reflection on subsequent feelings of moral guilt. Appraising one's own moral transgressions evoked activation in vmPFC, dlPFC, mOFC, anterior insula and posterior cingulate cortex. These regions have been reported to be involved in the cognitive and affective evaluation of self and others and in decision-making subserving moral judgement. For example, the anterior insula has been found to be involved not only in making negative judgments in economic, social and emotional contexts, but also in making negative (but not positive) moral judgments (Borg et al., 2008). The dlPFC has been functionally implicated in norm-related behaviour (Sanfey et al, 2003), and has been speculated to play a pivotal role in cost-benefit analyses (Greene et al, 2001). Finally, vmPFC is the area most consistently implicated in moral judgment and moral decision-making (e.g. Greene et al, 2001; Moll et al., 2002a; Fumagalli and Priori, 2012), and lesions to this region have been reported to result in deficits in social and moral behaviour (Damasio et al., 1994; Koenigs and Tranel, 2007; Koenigs et al., 2007). Reflecting on feelings of moral guilt elicited activity in the mOFC and in the right posterior middle temporal gyrus. While the mOFC has been previously reported to participate in moral emotion processing (Moll et al, 2005b), our task design enabled us to verify that activation in this region is indeed evoked by processing of moral guilt, rather than other possible negative emotional states that might result from unpleasant scenarios, but which do not unambiguously involve a moral transgression as they lack clear intentionality.

The processes of appraising a moral transgression and reflecting on subsequent guilt shared an overlapping neural substrate in vmPFC/mOFC, which have been consistently reported in studies of moral cognition, independent of task used (e.g. Greene et al., 2004; Moll et al., 2002a; Moll et al., 2002b). This part of the ventral PFC has also been hypothesised to integrate different types of neural information in order to influence decision-making (Wallis, 2007). In particular, it has been hypothesised to integrate positive and negative reward signals into a representation of the overall expected value or utility of a decision (Knutson et al., 2006; Wallis, 2007; Hare et al., 2010). This region is consistently recruited during economic decision-making, including the valuation of both appetitive and aversive goals (Plassman et al., 2010), and also during more complex social decisions, such as deciding to donate money to charities (Hare et al., 2010). More importantly, it has been found to be associated with the "expected moral value" of a decision on moral dilemmas where one has to consider sacrificing the life of one person to save the life of many (Shenhav et al., 2010). In our task a cluster within these regions was activated both during the appraisal of the moral transgression and during the reflection on resulting feelings of guilt. We speculate that this vmPFC/mOFC region subserves the integration of information from the other cognitive and emotional evaluative mechanisms, allowing the identification and assignment of value to a moral transgression, and thus enabling the experience of moral guilt.

Our study identified a relatively circumscribed set of brain areas; we did not, for example, observe activations in the amygdala, rTPJ and pSTS, regions that have been consistently reported to relate to moral processing (Fumagalli and Priori, 2012; Young and Dungan, 2012). We equated the emotional and mentalising demands between experimental conditions and this may explain the absence of differential activation in these regions. For example, the amygdala is known to respond to emotional stimuli and is thought to play a crucial role in detecting emotional saliency (Adolphs, 2005), while regions such as rTPJ are thought to play a central role in inferring and representing another people's beliefs and mental states (Schultz et al., 2005; Young et al., 2007). Regions such as rTPJ no doubt contribute to moral cognition (for example, to ascertain the intention of an action (Young and Saxe, 2009)), but may not play a specific role in processing moral content and, in particular, in processing personal transgressions.

We found a positive association between hemodynamic response in this same vmPFC/mOFC region during the reflection of feelings of guilt following one's own everyday moral transgressions and lifestyle and antisocial psychopathy traits. A previous study investigating social norm violations (Prehn et al., 2008) reported a similar negative association between response in an adjacent cluster and "moral judgement competence", measured by the Moral Judgment Test, which assesses the ability to apply moral orientations and principles in a consistent and differentiated manner in varying social situations (Lind, 2007). Taken together, these findings are consistent with an interpretation in terms of cortical efficiency (Rypma et al., 2006), i.e. that greater activation in vmPFC/mOFC reflects increased recruitment of less efficient neurocognitive resources for computing the moral value of a situation. In other words, the circuitry subserving the ability to reflect on moral choices, and compute the moral value of a situation, may operate less efficiently in individuals who are more prone to poor behavioural control and more likely to engage in antisocial behaviour. Alternatively, greater mOFC activity may not reflect reduced efficiency, but instead may reflect the additional recruitment of this region to make a value comparison (Rushworth et al., 2012, McNamee et al., 2013) between the simultaneously aversive and appetitive outcomes present in everyday moral scenarios. Morally charged situations are characterised by the conflict between opposing values. In our task, the outcome of the harm-to-other scenario has the reward of achieving a desired goal but also the cost of feeling guilt when faced with harm to another person. Perhaps, for individuals with high levels of lifestyle-antisocial traits, whose behaviour is often described as being driven by immediate or hedonistic goals, the comparison between these two values is more finely balanced, possibly necessitating increased mOFC recruitment to effect a value comparison. In either case, our results appear to be consistent with the hypothesis that atypical functioning in the vmPFC/mOFC plays a critical role in psychopathy/disruptive behaviour disorders (Blair, 2008a; White et al., 2013), and contributes to the disordered lifestyle and antisocial behaviour exhibited by individuals with high levels of these traits. However, it should be noted that fMRI is not able to establish a causal relationship between neural and questionnaire responses.

Our findings also indicate that lifestyle traits, but not antisocial behaviour, are negatively associated with self-reports of guilt following the moral transgressions, and with the coupling of the mOFC with a cluster in the posterior insula. Previous studies suggest that the posterior insula is activated during the processing of moral disgust (but not non-moral disgust) (Borg et al., 2008; Moll, De Oliveira-Souza, et al., 2005). One tentative explanation is that the posterior insula codes an automatic subjective emotion of disgust, or moral indignation, which calibrates the mOFC deliberative process of computing the value of an action. However, it is also plausible that a top-down process is in play where the computation of the value in the mOFC determines the subjective feeling of moral indignation coded in the posterior insula. In either case, it is conceivable that two processes are at play and contribute differentially to lifestyle and antisocial aspects of psychopathy. It is possible that a dysfunctional computation of the moral value of a situation contributes to higher levels of antisocial behaviour; whilst dysfunction of the computation of the moral value combined with weaker coding of moral disgust contributes to higher levels of irresponsible and impulsive lifestyle traits (and, in turn, to lower levels of feelings of guilt after a moral transgression).

5.6. Conclusions

This chapter describes an event-related fMRI study conducted to identify the neural structures and circuits involved in processing everyday personal moral transgressions and how activity in these structures and circuits are associated with individual differences in psychopathic traits. We developed a novel, more realistic and rigorously controlled task that comprised scripts of everyday moral scenarios, written in the second person. By equating emotional saliency and mentalising requirements, we were able to test whether individual differences in neural responses specific to everyday moral (rather than emotional or mentalising) processing were associated with inter-individual variability in psychopathic traits in the general population. We further explored the associations found between the magnitude of neural response during everyday moral processing and individual differences in psychopathic traits, by conducting exploratory psychophysiological interaction (PPI) analyses. These analyses allowed us elucidate whether individual differences in psychopathic traits modulate the functional integration that occurs between brain regions (Friston et al., 1997) during processing of everyday moral transgressions.

In this chapter, we demonstrated that the appraisal of personal everyday moral transgressions and reflection on subsequent feelings of guilt elicit responses in two partially separable neural circuits, while a portion of the vmPFC/mOFC cortex is commonly activated during both. We also identified associations between the neural correlates of moral reflection after everyday moral transgressions and individual differences in psychopathic traits. Importantly, our highly controlled task allowed us to show that these associations are not due to more general impairments in emotional or mentalising processes but are specific to moral cognition. It is possible that different aspects of moral processing are differentially affected by the various dimensions comprising psychopathic traits. While individuals high in psychopathic traits may in part show little concern for the needs of others because of reduced emotional responsivity, our findings suggest that dysfunction in circuits subserving the ability to reflect on moral choices may be equally important in accounting for antisocial and irresponsible patterns of behaviour in these individuals.

In the next chapter we will summarise the findings from the present and previous empirical chapters and will discuss the implications of these findings.

CHAPTER 6: General Discussion

6.1. Overview

Psychopathy is a personality disorder that can be defined by profound disturbances in empathic response to others and repeated engagement in immoral behaviour (Cleckley, 1976; Hare, 2003; Blair et al, 2005). However, empathy and morality are complex phenomena. They are ambiguous constructs, have numerous different definitions and conceptualizations, and are multidimensional in nature. Therefore, it is not only crucial to define these phenomena carefully if we are to better understand them, but also to systematically identify and isolate its distinct processes and components if we are to comprehend the role they play in other complex constructs such as psychopathic traits. Investigating individual differences in levels of psychopathic traits within the general population can be valuable for furthering our understanding of psychopathy and the underlying processing atypicalities that give rise to its constellation of personality traits and behaviour. At present, we still know little about how behavioural and neural substrates of distinct dimensions of empathy and morality are associated with variation of psychopathic traits. In this thesis, we have employed behavioural and neuroimaging methods to investigate how variability in correlates of distinct components of empathy and morality is reflected in psychopathic traits in the general population.

6.2. Research questions

The current thesis set out to investigate how variability in distinct components of empathy and morality are associated with individual differences in psychopathic traits in the general population. The research presented here endeavoured to answer to five outstanding research questions: 1) Given the complexity and multidimensionality of the constructs of empathy and morality, which specific dimensions of these constructs are associated with psychopathic traits at the behavioural level? 2) Are behavioural correlates of empathy and morality in psychopathic traits specifically associated with the affective-interpersonal dimension, with the lifestyle-antisocial dimension, or with both? 3) Are these associations consistent across genders? 4) Are associations between psychopathic traits and empathic processing reflected at the neural level? and, finally, 5) Are associations between psychopathic traits and moral processing reflected at the neural level? Each of these will be addressed in the sections below.

6.2.1. Which specific dimensions of these constructs are associated with psychopathic traits at the behavioural level?

In chapters 2 and 3 of this thesis, we described two behavioural studies where we employed several paradigms concurrently to investigate how variability in distinct components of empathy and morality are associated with variability in levels of psychopathic traits in the general population. Overall, our findings indicate that in the general population, individual differences in psychopathic traits are associated with variability in empathic responses to emotional facial expressions and emotional-eliciting stories; propensity to feel moral emotions such as empathic concern and guilt; and difficulty to make decisions in moral dilemmas.

Surprisingly, and contrary to previous studies reporting that psychopathic traits are associated with difficulties in recognising sad and fearful facial affect (Blair et al., 2004; Montagne et al., 2005), we found no significant associations between these traits and sensitivity to recognise emotional facial expressions. Previous research with a community sample has reported similar negative results (Del Gaizo & Falkenbach, 2008). It is possible that the measures used in ours and in previous studies to measure emotional recognition ability are not sensitive enough to capture what is possibly subtle variation in emotional recognition abilities in the general population. However, it is also possible that impairments in emotional recognition are present only in extreme cohorts of psychopathy, which would explain the lack of consistent findings in studies using community samples. Our results also indicate that variation in emotion recognition sensitivity is not consistently associated with other measures of affective empathy. This could again be due to lack of sensitivity of the measure used, but could also indicate that emotional recognition is a distinct process from affective empathy and, therefore, that caution should be used when using affect recognition as a proxy of affective empathy.

Our findings did however indicate a clear negative association between levels of psychopathic traits and variability in affective empathy, i.e. in experiencing an affective or sensory state that is similar to that of another person, but where one is aware that the source of the state is the other person. This association was patent in the results from the Affective Empathy scale of the Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011), and was further corroborated and specified by the results from the affective empathy tasks where participants indicated their feelings using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). In these tasks, higher levels of psychopathic traits were associated with less negative empathic responses to both observed and imagined displays of fear, sadness and happiness. These results are in line with and extend previous results from Ali et al (2009) where they found that psychopathic traits were associated with empathic response to fearful faces using the same methodology.

Appropriate affective empathic response to others' emotions is considered to be necessary for the normal development of moral emotions (i.e. emotions that are linked to the interests or welfare of the society or of persons other than the judge or agent) such as guilt and empathic concern (i.e. compassion). In fact, our results show that high levels of psychopathic traits were not only associated with diminished affective response to others' emotions, but also with diminished propensity to feel moral emotions. Higher levels of psychopathic traits were characterized by reduced ability to feel other-oriented moral emotions, as demonstrated by its negative associations with the Empathic Concern scale of the Interpersonal Reactivity Index (IRI; Davis, 1980), and with compassion and guilt ratings on the Moral Emotions task. These moral emotions are thought to function as 'moral barometers', motivating prosocial and inhibiting antisocial behaviours. Impairments in processing such emotions might thus underlie a possible emotional disengagement in moral judgement and decision-making in individuals with high levels of psychopathic traits which is translated into their (immoral) behaviour.

Finally, our studies did not indicate a clear association between levels of psychopathic traits and response to moral dilemmas. In the study described in chapter 2 we found no such association, whilst in the study described in chapter 3 we found that psychopathic traits were indeed negatively associated with higher endorsement of direct harm to a single victim in order to save the lives of many. The nature of this difference in results could lie in the characteristics of the samples (which will be discussed further in a following section), but could also be a reflection of other studies in the field which indicate that it is yet unclear whether psychopathic traits are associated with a different pattern of responses to these dilemmas or not. While two other studies using these dilemmas so far have reported negative findings (Cima et al., 2010; Glenn, Raine, Schug, et al., 2009), one study has reported higher utilitarian responses in personal dilemmas in a group of low-anxious psychopaths in comparison to controls (Koenigs et al., 2011). In spite of this inconsistent finding, our results show a clear link between higher levels of psychopathic traits and less difficulty in making decisions on these moral dilemmas. Taken together with the findings described in the previous paragraph, these results suggest that psychopathic traits might indeed be associated with some level of emotional disengagement when making moral decisions.

6.2.2. Are behavioural correlates of empathy and morality in psychopathic traits specific to the affective-interpersonal dimension, the lifestyle-antisocial dimension, or both?

As discussed in the general introduction, evidence from forensic and community samples suggest that the two dimensions of psychopathy (i.e. affective-interpersonal traits and lifestyle-antisocial behavior) present distinct associations with various criterion measures of personality, emotionality and behavior, particularly when their shared variance is controlled. For example, the affective-interpersonal dimension presents negative associations with emotional correlates such as fearfulness and distress, whilst the lifestyle-antisocial dimension presents positive associations with these correlates (e.g. Hicks & Patrick, 2006; Uzieblo et al., 2010). This suggests that, although co-occuring, the different dimensions of psychopathy might tap into two separable, distinctive underlying constructs (Patrick et al., 2007). Inspecting the variation of each dimension in association with criterion variables can thus be extremely important to provide a more comprehensive map of the psychopathy construct. Consistent with this, data from our behavioural chapters (Chapters 2 and 3), suggest that the two dimensions of psychopathy present some partially distinct associations with components of empathy and morality.

In respect to variance in affective empathy correlates, our findings indicate that variance in general affective empathy, as measured by the QCAE, is significantly associated with affective-interpersonal but not with lifestyle-antisocial traits. Moreover, this association remains significant after controlling for variance in lifestyle-antisocial, and the correlation coefficients of the two dimensions with this criterion variable are significantly different from each other. Likewise, we observe a similar pattern of associations with the variance of specific affective response to happy faces in males (chapter 2). In females, we also see a similar pattern of associations in relation to variation in response to fearful faces (chapter 3), although the correlation coefficients of the different dimensions with this variable are not significantly different. In contrast, in males, variation in affective responses to fearful faces is associated with both dimensions of psychopathic traits. These associations cease to be significant once we control for the shared variance between the two dimensions, suggesting that it is the shared variance of the two dimensions that drives the association between these responses and psychopathic traits. In females, we also observe a similar pattern of associations in relation to variance in affective response to sad faces (although the association with lifestyle-antisocial fails to reach significance after correction for multiple comparisons). Although these findings are not straightforward to interpret, and the nature of the causal direction of statistical associations is not possible to establish in cross-sectional studies, we speculate that whilst an overall weaker affective empathic response (including, for example, affective response to positive emotions) only contributes to the affective-interpersonal characteristics of the psychopathic personality, a weaker empathic response to sad and fearful faces might contribute to both affective-interpersonal and lifestyle-antisocial characteristics of the construct.

With regard to moral processing, our findings seem to indicate that it is the variance in affective-interpersonal traits that drives the associations between higher levels of psychopathy and lower propensity to feel empathic concern and less difficulty in making decisions in moral dilemmas (potentially due to lower affective engagement in making these decisions). In fact, we found significant correlations, but in opposite directions, between the two dimensions of psychopathy and the propensity to feel empathic concern once shared variance is removed. The unique variance of affective-interpersonal features was correlated with lower propensity to feel concern for others, whereas the unique variance of lifestyle-antisocial was correlated with greater propensity to feel concern for the distress of others. Previous studies from forensic and community samples also suggest that the two dimensions of psychopathy have opposite relationships with emotional reactivity. For example, when the overlap between the two dimensions is controlled for, the affective-interpersonal dimension is negatively associated with constructs such as emotional distress, fearfulness, and trait negative affect, whilst the lifestyle-antisocial behaviour dimension is positively associated with these constructs (Hicks & Patrick, 2006). Affective-interpersonal traits are associated with blunted affect (e.g. diminished emotional response to others' distress). In contrast, lifestyle-antisocial traits seem to encompass both low and high aspects of emotional reactivity (e.g. poor affective response to others' emotional facial expressions but high emotional reactivity in general), which might cancel each other out. When the variance in affective-interpersonal traits, which might contain only representations of blunted affect, is partialled out from lifestyle-antisocial traits, then variance in lifestyle-antisocial traits related to high emotional reactivity might be freed up thus revealing opposite associations.

In sum, while it appears that empathic deficits are driven by the joint variance between affective-interpersonal and lifestyle-antisocial facets, those related to affective aspects of moral cognition seem to be driven by the unique variance of affective-interpersonal facets. It should be noted though that, although the use of partial correlations is a powerful and informative technique to identify associations between different variables, in the context of personality research they pose some difficulties in the interpretation of results (Lynam, Hoyle, & Newman, 2006). The most important one is the difficulty in knowing exactly what construct is left once the variance of another highly correlated construct is removed (Lynam et al., 2006). Interpretations of unique associations need to be made carefully and with the support of theory. The replication of these findings using a group comparison approach, with groups being defined by differing levels of these traits, would provide important further validation and clarification of these results.

6.2.3. Are these associations consistent across genders?

Overall, our data from Chapters 2 and 3 suggest that psychopathic personality traits present the same underlying empathic and moral correlates in men and women, and formal statistical tests between the two samples indicate only two differences between their correlates. In women, we found that affective-interpersonal traits were negatively associated with higher endorsement of moral dilemmas implicating direct harm to a single victim in order to save the lives of many. This association is significantly different from the one found in the male sample, where we did not find such significant association. However, this difference should be interpreted with caution, as it is not yet clear whether psychopathic traits in males are associated with greater endorsement of utilitarian choices in these dilemmas. While most studies so far have reported negative findings (e.g. Cima et al., 2010; Glenn, Raine, Schug, et al., 2009), one has reported higher utilitarian responses in personal dilemmas in a group of low-anxious psychopaths in comparison to controls (Koenigs et al., 2011). We also found that contrary to men, where diminished empathic response to fear was associated with both affective-interpersonal and lifestyle-antisocial traits, in women diminished empathic response to fear was associated only with affective-interpersonal traits. However, the difference between genders in the associations of lifestyle-antisocial traits with empathic responses to fearful faces was only marginally significant and therefore the current data does not afford a strong interpretation with regard to gender differences.

In sum, our data suggests that while psychopathy might be manifested differently in females and males, either due to gender-role socialization or biological differences (e.g.

Nicholls & Petrila, 2005), its central characteristics appear to be similar. In women, psychopathic personality traits present the same underlying empathic and moral biases that are found in men with these traits, providing further validity to the hypothesis that processing atypicalities in empathy and morality processing are central to the construct of psychopathic personality. Furthermore, these biases seem to be more specific of the affective-interpersonal dimension of psychopathy, strengthening the views that the two dimensions of psychopathy encompass distinct contributions to variance in emotional and moral processing.

6.2.4. Are associations between psychopathic traits and empathic processing reflected at the neural level?

In chapter 4 of this thesis, we verified that the performance in our Empathy for Emotional Faces task, i.e. when participants explicitly resonate with others' facial expressions, robustly recruits the anterior insula, dorsal anterior cingulate, inferior frontal gyrus and amygdala. These regions are the most consistently reported to be recruited during empathy for pain and disgust (anterior insula, dorsal anterior cingulate and inferior frontal gyrus) and during detection of emotional saliency (amygdala). The results from this chapter, demonstrate that the association we found at the behavioural level between variability in empathic response to facial expressions and psychopathic traits is reflected at the neural level. More specifically, we found that activity in amygdala, which is involved in detecting emotional saliency (e.g. Adolphs, 2010) and in experiencing emotional arousal

(Decety, 2011), and anterior insula, which is proposed to be critical for sensory integration (Critchley et al., 2004), and interoceptive awareness (Craig, 2009), was negatively associated with both affective-interpersonal and lifestyle-antisocial psychopathic traits. Interestingly, these associations cease to be significant once we control for the shared variance between the two dimensions, suggesting that it is the shared variance of the two dimensions that drives the association between these responses and psychopathic traits. Unfortunately, it was not possible to disentangle whether these associations were driven by specific types of facial expressions. Future research, with improved task design, should try to unravel whether these associations are a reflection of atypical neural response when resonating with facial expressions in general or whether they are driven by atypical response to specific emotional expressions. Nonetheless, our findings are in line with previous theoretical and empirical work suggesting that psychopathy is marked by profound impairments in affective empathy, and provide further evidence that atypical amygdala and anterior insula function represent neural markers of disrupted emotional and empathic processing for individuals with high levels of these traits.

6.2.5. Are associations between psychopathic traits and moral processing reflected at the neural level?

In chapter 5, we demonstrated that the appraisal of personal everyday moral transgressions and reflection on subsequent feelings of guilt elicit responses in two partially separable neural circuits, while a portion of the vmPFC/mOFC cortex is commonly activated during both. We speculate that this vmPFC/mOFC region might subserve the integration of information from other cognitive and emotional evaluative mechanisms, which allows the identification and assignment of value to a moral transgression, and thus enables the experience of moral guilt. We also identified associations between the neural correlates of moral reflection after everyday moral transgressions and individual differences in psychopathic traits. We found a positive association between hemodynamic response in the commonly activated vmPFC/mOFC region during the reflection of feelings of guilt following one's own everyday moral transgressions and the lifestyle-antisocial behaviour dimension of psychopathy. It is possible that the circuitry subserving the ability to reflect on moral choices, and compute the moral value of a situation, may operate less efficiently in individuals who are more prone to poor behavioural control and more likely to engage in antisocial behaviour. Alternatively, it is possible that for individuals with high levels of lifestyle-antisocial traits, whose behaviour is often described as being driven by immediate or hedonistic goals, the value comparison necessary to compute the 'moral value' of a situation is more finely balanced due to increased reactivity to the reward element of achieving a desired goal (even if at the expense of another person's well-being). In any case, our results appear to be consistent with the hypothesis that atypical functioning of the vmPFC/mOFC plays a critical role in psychopathy and antisocial behaviour (Blair, 2008; White et al., 2013) and contributes to the disordered lifestyle and antisocial behaviour exhibited by individuals with high levels of these traits.

Our findings also indicate that lifestyle traits, but not antisocial behaviour, are negatively associated with self-reports of guilt following the moral transgressions, and with the coupling of the mOFC with a cluster in the posterior insula. We think that it is conceivable that two processes are at play during moral reflection and contribute differentially to lifestyle and antisocial aspects of psychopathy. It is possible that a dysfunctional computation of the moral value of a situation contributes to higher levels of antisocial behaviour; whilst dysfunction of the computation of the moral value combined with weaker coding of moral disgust contributes to higher levels of irresponsible and impulsive lifestyle traits (and, in turn, to lower levels of feelings of guilt after a moral transgression). However, it should be noted that fMRI is not able to establish a causal relationship between neural and questionnaire responses and more sophisticated experimental designs are necessary to probe the relationship between these atypicalities at the neural level and actual irresponsible lifestyle and antisocial manifestations.

Importantly, our highly controlled task allowed us to show that these associations are not due to more general impairments in emotional or mentalising processes but are specific to moral cognition. We think that our present findings contribute to a more comprehensive understanding of moral processing impairments that give rise to the immoral behaviour observed in individuals with high levels of psychopathic traits, suggesting that distinct aspects of moral behaviour are differentially affected by the different dimensions comprising psychopathic traits. Whilst the characteristic disregard of individuals with high levels of psychopathic traits might arise due to an overall reduced emotional responsivity; their irresponsible and antisocial behaviour might also be heightened by dysfunction in circuits subserving the ability to reflect on moral choices.

6.3. Implications and future research

Psychopathy is a personality construct that involves a constellation of personality and behavioural characteristics, including callousness, manipulativeness, impulsiveness, and repeated engagement in antisocial and immoral behaviour (Blair et al., 2005; Cleckley, 1941; R. D. Hare, 2003). The prevalence of psychopathy in the general population is approximately 1–2% in the United States (Neumann & Hare, 2008) and 1% in the United Kingdom (Coid, Yang, Ullrich, Roberts, & Hare, 2009). In spite of the low prevalence of psychopathy in the general population, data from the United States indicates that psychopaths commit more than 30% of violent crimes, representing a cost of an estimated $250–400 billion dollars each year (Kiehl and Buckholtz, 2010). Psychopathy creates considerable costs for society, not only as a consequence of criminal behaviour but also in terms of emotional and personal cost to the people who interact with individuals with high levels of these traits, be they friends, family and co-workers.

There is now good evidence that the structure of psychopathy is dimensional in nature and that psychopathic traits are best viewed as existing on a continuum (Hare and Neumann, 2008). Individual differences in psychopathy traits in community samples have the same predictive value, with respect to antisocial and criminal behaviour, as they do in forensic populations (DeMatteo, Heilbrun, & Marczyk, 2006; Neumann & Hare, 2008), and recent evidence suggests that individuals with high levels of psychopathic traits in college and community samples show some similar underlying deficits to psychopaths in incarcerated samples. The findings of our thesis contribute and strengthen this perspective. We have employed a battery of tasks concurrently and demonstrated that variability in psychopathic traits in the general population are associated with variability in empathic and moral processes, which are deemed to be dysfunctional in criminal psychopaths.

Studying the construct of psychopathy in non-forensic samples is therefore not only a valid approach (Salekin, Trobst, & Krioukova, 2001), but also has the potential advantage of ruling out possible effects of incarceration, recurrent institutionalization (Lilienfeld, 1994), as well as substance abuse and dependence and use of psychotropic medication, which can be high in forensic and clinical settings. The presence of these undesired effects may not only influence the assessment of psychopathic personality traits but also add significant confounds to the measurement of their correlates.

Investigating individual differences in levels of psychopathic traits within the general population can thus be valuable for furthering our understanding of psychopathy and the underlying processing atypicalities that give rise to psychopathic traits and behaviour. Such research can have important implications not only for theoretical and clinical reasons but also for the promotion of general societal well-being. For example, recent research on the impact of psychopathic traits on organizations (e.g. Akhtar, Ahmetoglu, & Chamorro-Premuzic, 2013; Babiak, Neumann, & Hare, 2010; Campbell, Hoffman, Campbell, & Marchisio, 2011; Mathieu, Hare, Jones, Babiak, & Neumann, 2013; Stevens, Deuling, & Armenakis, 2012) has highlighted how problematic these traits can be in a professional context. Psychopathic traits appear to be associated with poor management style, failure to act as team player, low responsibility, failure to adhere to rules, unethical decision making and poor general performance (Babiak et al., 2010; Stevens et al., 2012). In spite of this, individuals with high levels of these traits seem to be viewed as being charismatic and having leadership potential, possibly as result of the ability of these individuals to manipulate decision makers (Babiak et al., 2010). Understanding the specific deficits on the basis of these traits, and the biological vulnerabilities that contribute to them, is extremely important if we are to understand, prevent it and, potentially minimise their consequences.

In addition to specific limitations and future directions approached in the sections above, future work could also extend the data presented in this thesis in a number of ways. For example, it would be interesting to add psychophysiology measures to empathy tasks to better elucidate and probe the empathic and moral atypicalities observed in our studies. This would add a more clear evidence of bottom-up deficiencies in the experience of empathy and in the processing of affective aspects of morality for individuals with high levels of psychopathic traits. Likewise, it would be interesting to probe whether and, perhaps more importantly, which, top-down factors can inhibit or amplify these bottom-up affective deficits. If the experience of empathy, or moral behaviour, can be modifiable by context, for example, and if we can identify how this operates in relation to these traits, then ultimately we might be able to contribute with important clues for intervention in applied settings. For example, it is possible that perceiving a higher reward component of empathic and moral behaviour has an important effect in modulating prosocial behaviour and moral decision-making for these individuals. These could have important implications in, for example, promoting empathic and prosocial behaviour by focusing on individual gains of such behaviour.

It would also be important to generalise the present findings to developmental cohorts, ideally in longitudinal designs. These would allow a more precise identification of affective/cognitive processing styles, and of possible “neural biomarkers”, that predict future behavioural outcomes (Viding & McCrory, 2012).

Finally, on a more general note, future research on these topics should continue to be concerned with the development of carefully designed and ecologically valid tasks that are able to isolate the distinct processes and components that comprehend complex phenomena such as empathy and morality. Only with such tasks we are able to systematically identify and characterise its distinct components and understand the role they play in the emergence of psychopathic traits and behaviour.

6.4. Conclusions

In this thesis we have contributed to the identification of how behavioural and neural correlates of distinct components of empathy and morality are associated with psychopathic traits in the general population. The results from our comprehensive battery of experimental tasks and questionnaires demonstrate that individual differences in psychopathic traits are associated with variability in empathic responses to emotional facial expressions and emotional-eliciting stories; propensity to feel moral emotions such as empathic concern and guilt; and difficulty to make decisions in moral dilemmas. Our results also suggest that while empathic deficits are driven by the joint variance between affective-interpersonal and lifestyle-antisocial facets, those related to affective aspects of moral cognition seem to be driven by variance in affective-interpersonal facets. Furthermore, the same underlying empathic and moral biases seem to be similar in men and women, providing further validity to the hypothesis that processing atypicalities in empathy and morality processing are central to the construct of psychopathic personality and that the two dimensions of psychopathy encompass distinct contributions from variance in emotional and moral processing. We developed a novel fMRI design to identify neural correlates of affective empathy and their association with psychopathic traits. We demonstrate, for the first time, that affective empathy for faces, i.e. resonating with others' facial expressions, robustly elicits activation within the anterior insula, dorsal anterior cingulate, inferior frontal gyrus and amygdala. Importantly, we demonstrate that activity in amygdala, which is involved in detecting emotional saliency (e.g. Adolphs, 2010) and in experiencing emotional arousal (Decety, 2011), and anterior insula, which is proposed to be critical for sensory integration (Critchley et al., 2004), and interoceptive awareness (Craig, 2009), is negatively associated with psychopathic traits and that it appears to be the shared variance of the two dimensions that drives this association. These findings provide further evidence that atypical amygdala and anterior insula function represent neural markers of disrupted emotional and empathic processing for individuals with high levels of these traits. Finally, with our novel task probing the neural correlates of everyday moral processing, we demonstrate that the appraisal of personal everyday moral transgressions and reflection on subsequent feelings of guilt elicit responses in two partially separable neural circuits, while a portion of the vmPFC/mOFC cortex is commonly activated during both. Variance in neural response and connectivity in this region appears to be associated with variance in lifestyle and antisocial psychopathic traits. These results provide further evidence that that atypical functioning of the vmPFC/mOFC plays a critical role in psychopathy and antisocial behaviour (Blair, 2008, White et al., 2013), and contributes to the disordered lifestyle and antisocial behaviour exhibited by individuals with high levels of these traits. It is possible that distinct aspects of empathic and moral processing contribute to and/or are differentially affected by the different dimensions that co-occur in this personality construct. It appears that affective-interpersonal traits are associated with an overall reduced emotional responsivity, including empathic responsivity, which might explain the characteristic disregard for other's well-being in individuals high on these traits. It is also possible that dysfunction in circuits that subserve the ability to reflect on moral choices contributes to the irresponsible and antisocial behaviour characteristic of the psychopathic personality.

In sum, we consider that the findings of this thesis add important evidence for a more comprehensive understanding of the empathic and moral processing impairments that underlie psychopathic traits and give rise to the immoral behaviour normally associated with these traits.

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APPENDICES

Appendix 1: Self-Report Psychopathy Scale

Self-Report Psychopathy Scale Short-Form (Paulhus, Hemphill & Hare, in press)

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 official 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 any more.
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 cold-hearted.
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.

Appendix 2: Empathy for emotional facial expressions task

Stimuli examples:

Sad **Fearful** **Angry** **Neutral** **Happy**

Appendix 3: Empathy-eliciting short stories task

Stimuli examples:

Sad: “It was a harsh winter evening and Michael was driving home after picking up his youngest son, Tom, from school. It was raining heavily and the visibility was rather poor. Tom was in the back seat happily talking about his day at school: about what he had learnt in his History lesson and about a joke that he told on the playground that made everyone laugh. Suddenly, a huge truck came from nowhere and everything turned black. When Michael woke up he was in the hospital, his wife by his side crying. Help had arrived too late and Tom had died from his injuries.”

Anger: “Sam was stuck in traffic for more than half an hour. It was Friday evening and he was on his way out of the city, heading for the country for a weekend of peace and quiet. It seemed everyone else on the road had had the same idea. In half an hour he managed to move about 1 mile. It was absolutely unbelievable and things were not improving. To make matters worse, a driver behind Sam started to honk his horn to express his discontent. Soon everyone else was doing the same. Sam thought his eardrums would burst and there was no escape from the traffic.”

Happy: “It had been four years since Martin had last seen his brother Lawrence who lived abroad. Last week Lawrence finally came home. Martin went to pick him up at the airport. He could hardly wait for the flight to arrive. It had been such a long time and he really missed Lawrence. They were best friends and used to do things together all the time. When the flight finally arrived, and the passengers began to walk out to the airport arrival lounge, Martin saw Lawrence carrying his little girl; Martin’s niece who he had never met. Everyone hugged for a long time.”

Appendix 4: Moral Vignette task

Stimuli examples:

Tube

Setup: You are on a crowded tube on your way home. You are very tired. All you want to do is sit down and read your book. Fortunately you find an empty seat and sit down.

Harm-to-other: Suddenly you realise a heavily pregnant woman is standing by your side. You are so tired that you pretend not to see her so that you do not have to give up your seat.

Harm-to-self: You realise you dropped your book by the door. You hate having nothing to read, but are very tired and do not want to lose the seat to the person standing next to you so you do not get up to fetch it.

Manager

Setup: You are hoping for a promotion in your job. During a meeting, your team manager praises the team's work. He is very complimentary about a novel idea the team has introduced.

Harm-to-other: He says the idea was yours. You know it was not; it was your colleague's. But you don't say anything because you don't want to risk your promotion.

Harm-to-self: He says the idea was your colleague's. You know it was your idea but you don't say anything because you don't want to risk your promotion.

Station

Setup: You are running late to catch a train to see your favourite band in concert. The station is very crowded and there is a group of tourists blocking the entrance to the platform.

Harm-to-other: They don't seem to be moving. To get through, you shove the person in front of you and he falls to the ground.

Harm-to-self: They don’t seem to be moving. To get through, you try to go around the group but you trip on one of them and hurt your leg.

Girlfriend

Setup: You are on a holiday with your new girlfriend. There is a running competition on and you decide to enter it to impress her.

Harm-to-other: Another competitor looks to be in very good shape. To win the race you trip him up; he falls down and you win first place.

Harm-to-self: Another competitor looks to be in very good shape. You manage to overtake him, but push yourself too hard, end up with a strained hamstring, and need crutches for the rest of the holiday.

Deadline

Setup: It is late in the evening. You and your colleague are working late because you each have very important deadlines tonight.

Harm-to-other: You accidently spill your coffee and damage some keys on your keyboard. While your colleague takes a break you switch the keyboards so you won’t risk missing the deadline.

Harm-to-self: You accidently spill your coffee and damage some keys on your keyboard. You have to wait until your colleague finishes his work to use his keyboard so you won’t miss the deadline.

Parking

Setup: You have been driving for a long time looking for a place to park your car in the supermarket car park.

Harm-to-other: You finally find an empty space but there is someone in a car waiting already and giving a signal to park. You ignore him and cut in front of him to take the space.

Harm-to-self: You finally find an empty space and park. You are about to leave the car when you realise you forgot your wallet at home and need to go back to get it.

Induction

Setup: You want to join a private club at university. You are a first year student and are going through the “induction”. One of the senior students sets up a task.

Harm-to-other: You have to coerce another student to drink beer mixed with vodka until he throws up. You go along because you want to get into the club. He ends up passing out and needing his stomach pumped at the hospital.

Harm-to-self: You have to drink beer mixed with vodka until you throw up. You go along with this because you want to get into the club. You end up passing out and needing your stomach pumped at the hospital.