Antisocial Behaviour in Adolescents: Exploring and Improving Emotion Processing Deficits

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Summary of Thesis

Antisocial behaviour in childhood and adolescence is associated with a range of negative outcomes in later life, which are costly to both society and to the antisocial individual themselves. Because the effectiveness of current interventions appears to be limited, it has been argued that treatment efforts should focus more on designing interventions that target neuropsychological correlates of antisocial behaviour. Two important correlates are impaired facial emotion recognition and empathy; these deficits have been proposed to cause antisocial behaviour because they involve an inability to understand and appropriately respond to the distress of others.

This thesis aimed first to extend our understanding of emotion processing deficits associated with antisocial behaviour by examining empathy in a large sample of adolescent males with ADHD, who are at risk of developing antisocial behaviour. Secondly, it was examined whether emotion function could be enhanced using an emotion training programme and oxytocin.

Compared to participants with ADHD alone, participants with ADHD and Conduct Disorder displayed problems in affective empathy for sadness, fear and happiness. We also found that a facial emotion training programme improved facial emotion recognition in young offenders; this group also showed a reduction in crime severity in a six months follow-up period. Finally, we demonstrate that intranasal oxytocin reduces emotional face-processing time, selectively enhances affective empathy for fear, and increases attention to the eye-region in healthy males. Given these are key areas which appear to be deficient in those who show severe and/or persistent antisocial behaviour, the implications of these findings for developing future interventions for at-risk youths are discussed.

Taken together, this thesis' findings have valuable implications for practitioners working with antisocial youths and suggest that interventions targeting specific emotional deficits should be given further consideration.

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List of Abbreviations

The following abbreviations are used in this thesis.

ADHD	Attention Deficit Hyperactivity Disorder
AE	Affective Empathy
AOI	Area of Interest
APA	American Psychiatric Association
ASD	Autism Spectrum Disorders
ASPD	Antisocial Personality Disorder
CD	Conduct Disorder
CESS	Cardiff Empathy Scoring System
CON	Control group
CU	Callous and unemotional
DAAM	Differential Amygdala Activation Model
DAWBA	Development and Well Being Assessment
DBD	Disruptive Behaviour Disorders
DSM	Diagnostic and Statistical Manual of Mental Disorders
EC	Empathy Continuum
FAR	Facial Affect Recognition
FER	Facial Emotion Recognition
GBH	Grievous bodily harm
HR	Heart rate
ICD	International Classification of Diseases
IES	Integrated Emotion Systems
IQ	Intelligence Quotient
IU	International Units
MC	Matched Controls
NICE	The National Institute for Health and Care Excellence
ODD	Oppositional Defiant Disorder
OXT	Oxytocin
OXTR	Oxytocin receptor gene
PL	Placebo

SES	Socioeconomic Status
SCL	Skin conductance level
TR	Training group
TWOC	Taking [vehicle] without owner's consent
UK	United Kingdom
WASI	Wechsler Abbreviated Scale of Intelligence
YO	Young offender
YOS	Youth Offending Services
YPI	Youth psychopathic traits inventory

1 Chapter 1 - Introduction

The ability to function and communicate effectively within social contexts is essential for human survival. It is widely believed that emotions have evolved to serve an important communicative function (Darwin, 1871). As such, being able to detect, process and respond appropriately to the emotions of others is crucial for normal social interaction (Corden, Cristchley, Skuse & Dolan, 2006; Fridlund, 1991). Theory of mind – the capacity to attribute mental states to oneself and others – enables an understanding that others may have different thoughts, beliefs and intentions to ourselves (Premack & Woodruff, 1978). This insight allows us to explain, interpret and predict the behaviour of others and ultimately facilitates successful social interactions. In addition to this cognitive capacity, humans also possess an emotional parallel – empathy. Empathy refers to the ability to understand and share in another's emotional state or context (Eisenberg & Strayer, 1987). If the other is perceived to be in a negative state, empathic concern can motivate action and lead to prosocial behaviour (de Waal, 2008). Consequently, these abilities facilitate cooperation and helping behaviours and are considered important for appropriate moral development (Hoffman, 2000). Conversely, aggression and other forms of maladaptive antisocial behaviours may result from the failure to be appropriately guided by, and thus respond to, the social cues of others (Blair, 2005). While some evidence points towards specific impairments in processing distress-related cues - in particular fearful and sad expressions - in individuals with antisocial behaviour, others have suggested impairments are pervasive across emotions (Marsh & Blair, 2008; Dawel, O'Kearney, McKone & Palermo, 2012).

While there has been much research into deficient facial emotion recognition and empathy in relation to antisocial behaviour, overall findings are somewhat mixed. These discrepancies are, in part, due to differences in stimuli and methodologies across studies - this poses a particular problem for empathy research where there is no agreed and consistent way of measuring and constructing the concept of empathy, with previous measures appearing limited (see section 2.1 page 26 for a discussion of previous empathy measurements) - but they are also due to different sample populations. For example, research on antisocial behaviour often focuses on adults or incarcerated and

clinical samples. However, offending peaks during adolescence (Moffitt, 1993), highlighting the need for studies to explore risk factors in young people so that the developmental course of antisocial behaviour can be further understood. Moreover, despite a large body of evidence pointing towards an association between emotion processing impairments and antisocial behaviour, comparably fewer studies have considered ways in which to improve these skills. Accordingly, the focus of this thesis is on further investigating empathy in relation to antisocial behaviour and examining ways in which emotion processing abilities (namely facial emotion recognition and empathy) can be enhanced in adolescent offenders.

1.1 Studying Antisocial Behaviour in Adolescents

1.1.1 Why Study Antisocial Behaviour in Adolescents?

It is well established that antisocial behaviours peak during adolescence with the majority of juvenile delinquents desisting offending in early adulthood (Monahan, Steinberg, Cauffman & Mulvey, 2009). Nevertheless, 5-6% of individuals persistently offend throughout their lives and also commit a disproportional amount of crime – 50-60% (Farrington, Ohlin & Wilson, 1986). As well as predicting future antisocial behaviour (Fombonne, Wostear, Cooper, Harrignton & Rutter, 2001), persistent childhood and adolescent delinquency is associated with a range of negative outcomes. It predicts substance abuse and dependence in adulthood, early pregnancy in girls, persistent health problems, and psychiatric illness (Bardone *et al*., 1998; Fombonne *et al.,* 2001; Kazdin, 1995). These negative outcomes are costly to society, as well as to the individuals themselves (Scott, Knapp, Henderson & Maughan, 2001). Financially, the total costs through to adulthood incurred by individuals with antisocial behaviour problems are 10 times higher than those without these problems (Scott *et al.,* 2001). These are high costs not only because of the crimes committed, the extra educational provision required, the foster/residential care needed, and other state benefits during adolescence, but also due to the associated mental and physical health problems of antisocial behaviour in adulthood (Odgers *et al*., 2007). Antisocial behaviour in adolescence therefore poses a serious problem for the individuals involved as well as society as a whole. Given that the period of adolescence appears to play a fundamental role in the persistence and desistence of crime and is a time at which the brain is still

developing (Olesen, Westerberg & Klingberg, 2004), antisocial behaviour in adolescence is an important area for research (Dodge & Pettit, 2003) and for the development of interventions (van Goozen & Fairchild, 2008).

1.1.2 Operationalising and Assessing Antisocial Behaviour

Antisocial behaviour covers a broad spectrum of behaviours that can be defined and studied based on the legal concepts of criminality and delinquency or by clinical diagnoses of externalising disorders (Morgan & Lilienfeld, 2000).

1.1.2.1 Criminality and delinquency

Judicial definitions examine criminal and delinquent unlawful behaviours that bring people in contact with the criminal justice system (*e.g.*, arrest, conviction, and incarceration) (Morgan & Lilienfeld, 2000). The occurrence of these behaviours is usually examined using official records (*e.g.,* from youth offending databases) or self-report measures. Official records of criminal behaviour provide important information on antisocial behaviour, since, unlike self-reports, they are objective measures which cannot be fabricated. Nonetheless, it is important to note that it is likely that these records reflect only the tip of the iceberg in terms of the number of actual offences committed, whereas self-report measures can potentially assess behaviours that were not brought to the attention of the criminal justice system. Categorising antisocial behaviour based on crime figures indicates that childhood delinquency is associated with persistent adult offending, with 80% of crime in the UK being committed by offenders who displayed behavioural problems as children and adolescents (Sainsbury Centre for Mental Health, 2009). Moreover, 4% of young offenders are responsible for the majority of offences, with over 15 convictions each (Ministry of Justice, 2011).

1.1.2.2 Clinical diagnoses

When antisocial behaviour becomes persistent and affects individual functioning across various areas of life, a clinical disorder is often diagnosed. Clinical definitions of antisocial behaviour are defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) and include diagnoses of antisocial personality disorder (ASPD) in adults, and disruptive behaviour disorders - comprising conduct disorder (CD) and oppositional defiant disorder (ODD) – in

children and adolescents. Of particular importance to this thesis is the diagnosis of CD which is a childhood and adolescence disorder characterised by repetitive and persistent patterns of behaviour in which the basic rights of others or major age-appropriate societal norms or rules are violated (DSM-5; American Psychiatric Association, 2013). This definition encompasses oppositional and defiant behaviours and antisocial activities (*e.g.*, lying, stealing, running away, vandalism and physical violence). These diagnoses are closely linked together. Consequently, it is unsurprising that there is evidence to support a hierarchical structure in terms of their development. For example, it has been observed that 82-90% of ASPD cases met criteria for CD during adolescence, and of the individuals with ODD who progressed to an ASPD diagnosis, nearly all showed intermediate CD (Loeber, Burke & Lahey, 2002).

Since criminality and delinquency are significantly correlated with the clinical syndromes related to antisocial behaviour (Moffitt, 1988), it is appropriate to draw on literature from both perspectives when examining findings from the antisocial behaviour literature (Morgan & Lilienfeld, 2000).

1.1.3 Reducing Heterogeneity: The Role of Aggressive Behaviour, Psychopathy and Callous-unemotional Traits

Diagnoses of CD and ASPD have been criticised for focussing on antisocial behaviour (Blair, Peschardt, Budhani, Mitchell & Pine, 2006) which reflects a heterogeneous group in terms of prognosis and severity (Frick & Marsee, 2006). Accordingly, the diagnostic rate of CD can reach 16% of boys in mainstream education (American Psychiatric Association, 1994) while 97 - 100% of adolescent offenders meet criteria for a diagnosis of CD (*e.g.*, Salekin, 2006), and over 80% of adult offenders meet criteria for a diagnosis of ASPD (Hare, 1991). Distinguishing between different subtypes of antisocial behaviour is therefore essential in order to identify differential causes of diverse behaviour, and to find appropriate interventions based on different aetiologies (Moffitt, 2003).

In addition, to date, a large body of research has focussed on comparing clinical groups (*e.g.*, ADHD and CD), against controls using clear cut-offs (*e.g.*, Decety, Michalska Akitsuki & Lahey, 2009; Fairchild, Stobbe, van Goozen, Calder & Goodyer, 2010) which represents a categorical approach to measurements. Nevertheless, there are problems associated with this approach (Krueger, Watson & Barlow, *2005*). Not only is there extensive comorbidity among disorders, but also there is extensive heterogeneity within categorical classifications of disorders (Krueger *et al*., 2005). This means it is theoretically possible that two individuals with the same diagnosis share only one common feature, but that two individuals with different diagnoses share multiple traits. Given these issues, outcome measures based on categorical distinctions of psychopathology can sometimes be difficult to interpret (Krueger *et al.*, 2005). Accordingly, there has been an increasing move towards more dimensional ways of studying psychopathology, for example by using correlational and regression analyses, as well as examining between antisocial behaviour subgroups (see Fairchild, van Goozen, Calder, Strollery & Goodyer, 2009a; Fairchild *et al*., 2009b; Marsee, Silverthorn & Frick, 2005; Passamonti *et al*., 2010). This thesis aims to consider both categorical and dimensional approaches to explaining antisocial behaviour.

1.1.3.1 Aggressive behaviour

While not all antisocial acts are aggressive (*e.g.*, Dodge, Coie, & Lynam, 2006), aggressive behaviour is central to both clinical and legal definitions of antisocial behaviour (Rhee & Waldman, 2002). Indeed, aggression seems to show strong continuity throughout childhood and adulthood (Farrington, 1989) and appears to be a stable genetic trait, whereas non-aggressive antisocial behaviour appears to be less stable and more strongly influenced by environmental factors (Eley, Lichtenstein & Moffitt, 2003). Moreover, childhood aggression predicts adult health outcomes, psychosocial functioning and criminality (Huesmann, Eron, Lefkowitz & Walder, 1984; Loeber & Le Blanc, 1990; Pulkkinen & Pitkanen, 1993). Taken together, these findings suggest that research should consider aggression when examining risk factors for antisocial behaviour.

1.1.3.2 Psychopathic traits

Psychopathy is a severe and chronic personality disorder, characterised by affective and interpersonal traits such as impulsiveness, manipulativeness, shallow affect, and lack of empathy, guilt or remorse, with a prevalence of approximately 1% of the general population (Hare, 2003). In contrast to focussing purely on antisocial behaviour, the classification of psychopathy has been argued to be more informative when considering offender populations (Blair *et al.,* 2006) since it involves both affective-interpersonal components (*e.g.,* such as lack of empathy and guilt) and behavioural components (*e.g.*, criminal activity and poor behavioural controls) (Frick & Hare, 2001; Hare, 1991). In the DSM-IV revised the concept of ASPD was also known as psychopathy. However, the DSM-5 has revised this to consider psychopathic traits within personality disorders. The focus of 'traits' in the DSM-5 reflects criticism of the DSM-IV for using arbitrary symptoms and thresholds for diagnosing disorders and highlights the importance of characterising personality dimensionally along trait-dispositional continua.

More recently, the concept of child and adolescent psychopathy has become an important research topic, driven, in part, by the suggestion that psychopathic traits, in particular the hyperactive and antisocial components, may help to identify a more homogenous subgroup of adolescents that develops into the 5-6% of offenders who proceed to be chronic adult offenders (Lynam, 1996). The importance of considering psychopathic traits as opposed to psychopathy as a disorder is particularly important when considering adolescents since the construct of psychopathy is limited to adults.

The presence of psychopathic traits can be defined and measured using standardised inventories including the revised psychopathy checklist (PCL-R; Hare, 2003) in adults, and the youth psychopathic traits inventory (YPI; Andershed, Ker, Stattin & Levander, 2002) in children and adolescents (Frick, O'Brien, Wootton & McBurnett, 1994). Factor analyses of items from these inventories have indicated distinct factors: an emotion dysfunction factor comprising of emotional shallowness, and an antisocial behaviour factor that is defined by instrumental aggression and a variety of offence types. A high score on the antisocial behaviour factor is associated with CD and ASPD diagnoses (Frick *et al.,* 1994). On the other hand, a high score on the emotion dysfunction factor is less closely associated with DSM diagnoses and appears to reflect more closely the neurocognitive impairments that lead to the development of psychopathy (Blair, 2001)

and thus may be important to consider when examining risk factors for antisocial behaviour. Within this thesis, where the term 'psychopathy' has been used to describe participants or methods it is in reference to measuring psychopathic traits along a continuum and not to indicate the categorical presence of psychopathy as a disorder.

1.1.3.3 Callous and unemotional traits

A central component of the emotional dysfunction associated with adult psychopathy is callous and unemotional (CU) traits (Hare, 1993). This trait describes an individual who displays deficient affect, a lack of empathy and general disregard for others (Frick & White, 2008). Frick and Marsee (2006) argue that the interpersonal and affective factor of psychopathy contains unique information that is not contained in CD symptoms, and that this feature has additional prognostic value. Indeed, adolescents displaying antisocial behaviour including CU traits show a more severe, stable, and aggressive pattern of conduct problems and delinquency, with more police contact than those without CU traits (Scheepers, Buitelaar & Matthys, 2011). Moreover, antisocial behaviour appears to be strongly heritable in children with high CU traits, whereas antisocial behaviour with low CU traits appears to be driven by environmental factors (Viding, Jones, Frick, Moffitt & Plomin, 2008). Consequently, the presence of CU traits has now been added to the DSM-5 as a specifier of CD to identify a subgroup of adolescents who show severe, continuing, and aggressive antisocial behaviours and who are less responsive to traditional intervention strategies (*e.g.*, Dadds & Salmon, 2003).

It should be noted that age of onset is also a specifier within the diagnosis of CD. This is based on robust support of Moffitt's (1993) development trajectory of antisocial behaviour which posits that adolescent-limited offenders start offending as teenagers, committing developmentally normative antisocial behaviour but desist offending in adulthood, whereas life-course persistent offenders begin offending earlier in childhood and continue offending throughout the life course. Adolescent offending is believed to be related to mimicry of delinquent peers, whereas life-course offending is believed to be the result of neuropsychological (*e.g.*, verbal and executive) deficits interacting with chronic social problems such as neglect, poverty and absence of caregiver. Nevertheless, empirical evidence suggests Moffitt's account does not provide a full picture of antisocial behaviour in young people (Roisman, Monahan, Campbell, Steinberg & Cauffman, 2010). More recent work has suggested that seriousness of

antisocial behaviour, rather than age of onset might determine dysfunctional neurobiological systems (*e.g.*, Fairchild *et al.*, 2009a; Fairchild *et al.*, 2009b; Fairchild, van Goozen, Stollery & Goodyer, 2008; Passamonti *et al.*, 2010). These authors noted that in youths with serious antisocial behaviours, emotional and neuropsychological deficits were present regardless of whether CD was early-onset or adolescent-onset, suggesting that severity of antisocial behaviour should be considered as a subtype (Fairchild, van Goozen, Calder & Goodyer, 2013).

Within the literature the concepts of antisocial behaviour severity, psychopathic traits and CU traits generally appear to be positively related (*i.e.*, Frick, Stickle, Dandreaux, Farrell & Kimonis, 2005). Where appropriate, this thesis attempts to examine the role of antisocial behaviour severity and psychopathic traits, in particular CU traits, in helping to explain variations in behaviours and how these may affect possible intervention strategies.

1.2 The Importance of Emotion Processing in Understanding Antisocial Behaviour in Adolescents

1.2.1 What is the Link between Emotion Processing and Antisocial Behaviour?

The emotions we experience, express, detect and respond to, help us to form and maintain social relationships (Fischer & Manstead, 2008). Accordingly, proficient emotion processing is important to social survival. On the other hand, impairments in emotion processing can have consequences for both the impaired individual and for those with whom they are interacting. Given the communicatory function of emotion is to transmit information about the valence of objects and situations to conspecifics, a failure to appropriately respond to the emotions of others could therefore lead to atypical responding in social interactions (Blair, 2003) and plays a central role in explanations of antisocial behaviour (Baumeister & Lobbestael, 2011). In particular, facial emotion recognition - which is the ability to correctly identify an emotional state from a facial expression in others - is important for interpersonal behaviour and social interaction (Herba & Phillips, 2004). Furthermore, it has been suggested that impairments in emotion recognition prevent individuals from appropriately empathising with the emotions of others, particularly with the distress cues of others (*i.e.*, fear and

sadness) which may in turn lead to increases in antisocial behaviour (Marsh, Adams & Kleck, 2005). If these abilities can be improved, they may enhance future social interactions and help to inhibit subsequent antisocial behaviour (*e.g.*, Penton-Voak *et al*., 2013).

1.2.2 What Emotional Deficits are Evident in Antisocial Populations?

1.2.2.1 Facial emotion recognition

Abnormal facial emotion recognition is reported in different antisocial populations, including psychopathic adults (Blair *et al.,* 2004; Glass & Newman, 2006), children high in psychopathic traits (Blair, Colledge, Murray & Mitchell, 2001), adolescents with early-onset or adolescence-onset CD (Fairchild *et al.,* 2009a), adolescents with mental health problems (Leist & Dadds, 2009), and antisocial adolescents recruited from mainstream schools (Dadds *et al.,* 2006) or the community (Bowen, Morgan, Moore & van Goozen, 2014). From the studies reported above, it appears deficits in emotion recognition are specific to detecting fearful and sad expressions. Indeed, in a meta-analysis of 20 studies, Marsh and Blair (2008) found a robust link between antisocial behaviour and specific deficits in the recognition of fearful expressions. These impairments could not be explained exclusively by higher task difficulty associated with fear detection but instead suggest that antisocial individuals have a specific deficit in processing fearful facial expressions which the authors suggest is linked to amygdala dysfunction. These findings support Blair's (2005) Integrated Emotion Systems (IES) model account for the relationship between antisocial behaviour and impairments in facial emotion recognition. According to the IES model, distress cues, such as fear and sadness, serve to inhibit antisocial behaviour. Specifically, it has been proposed that the correct processing of others' distress-related cues elicits empathy that in turn results in learning to avoid aggressive acts that cause fear and sadness. Since the amygdala is involved in the formation of stimulus-reinforcement associations, it is hypothesised that amygdala dysfunction impairs the learning that typically results following distress cues. This prevents moral socialisation and increases the likelihood of antisocial behaviour (Blair, 2005). The role of amygdala dysfunction in relation to antisocial behaviour is further highlighted in findings that amygdala lesions are often associated with specific impairments in recognising fearful expressions (*e.g.,* Adolphs *et al.,* 2005) and have

been reported in a range of antisocial populations (*e.g.*, Fairchild *et al.*, 2011; Jones, Lauren, Herba, Barker & Viding, 2009; Marsh *et al.*, 2008b; Sterzer *et al.*, 2005).

Nevertheless, a more recent meta-analysis, examining emotion recognition across modalities (*i.e.*, facial and vocal expressions) in psychopathy found evidence for pervasive deficits for several emotions (*i.e.*, not only fear and sadness) for children, adolescents and adults (Dawel, *et al.*, 2012). Consistent with this view, there is evidence that both anger and disgust recognition is impaired in antisocial populations (*e.g.*, Kosson, Suchy, Mayer & Libby, 2002; Schonenberg, Louis, Mayer & Jusyte, 2013). Pervasive, as opposed to fear-specific impairments, appear to be at odds with theories linking amygdala dysfunction to antisocial behaviour - however, further evidence suggests that the amygdala not only responds to fear but to a range of facial expressions (Fitzgerald, Angstadt, Jelsone, Nathan, & Phan, 2006). Additionally, current theories suggest that the amygdala may play an important role in detecting salient and socially relevant information (*e.g.*, Adolphs, 2010) and therefore may contribute to pervasive emotion recognition impairments via this mechanism. For example, amygdala damage has been associated with abnormal processing of the eye-region of faces in both laboratory (Adolphs *et al.*, 2005) and real-life interactions (Spezio, Huang, Castelli & Adolphs, 2007). Taken together, these findings suggest that a more general dysfunction in attentional mechanisms may underlie the facial emotion recognition deficits in those who show antisocial behaviour (*e.g.*, Dadds *et al.*, 2006) and since the eye-region is particularly important for the recognition of fear, more so than other emotions, this may explain why fear recognition appears to be selectively impaired (Adolphs *et al.*, 2005). Importantly, reduced attention to the eye-region of faces has also been observed in children with high CU traits (Dadds Jambrak, Pasalich, Hawes & Brennan, 2011) and adolescents (Dadds, Masry, Wimalaweera & Guastella, 2008). If emotion recognition deficits associated with antisocial behaviour are indeed the result of attention dysfunction, then it may be possible to train individuals to pay more attention to socially relevant information and thus improve recognition. This will be considered in more detail in section 1.3.2.

1.2.2.2 Empathy

Empathy, or a lack of it, plays an important role in Blair's (2005) Integrated Emotions Systems model. It is believed that empathy may act as an inhibitor to aggressive behaviour through the vicarious experience of others' distress. That is, if a person directly experiences the distress their actions have caused to others, they will be less likely to continue the offending behaviour. Accordingly, empathy impairments have been observed in a range of antisocial populations including young offenders (Robinson, Roberts, Strayer & Koopman, 2007), adult offenders (Domes, Hollerbach, Vohs, Mokros & Habermeyer, 2013a) and adolescents with CD (*e.g.*, de Wied, Boxtel, Posthumus, Goudena & Matthys, 2009). More recent evidence suggests that empathy deficits associated with antisocial behaviour are specific to the affective component of empathy (*i.e.*, feeling what someone else feels) whilst cognitive empathy (*i.e.*, understanding what someone else feels) is unimpaired (Schwenck *et al*., 2012). In addition, it has been demonstrated that affective empathy deficits are specific to negative distress emotions, (*e.g.*, de Wied *et al.*, 2009) which is in line with Blair's IES model.

Despite extensive research into the empathy deficits associated with antisocial behaviour, little is known about how empathy deficits may differ when considering comorbidity with other disorders or subtypes within antisocial behaviour. To our knowledge, no study has examined empathy in relation to antisocial behaviour in a sample of adolescents who are at-risk for showing antisocial behaviour because of a diagnosis of Attention Deficit Hyperactivity Disorder (ADHD). Given ADHD and CD commonly co-occur often resulting in poorer clinical outcomes, it is important to understand how empathy abilities may differ between individuals with ADHD, with and without antisocial behaviour, to enable targeted interventions to be developed.

In terms of facial emotion recognition, it has previously been demonstrated that young offenders' levels of CD and psychopathic traits explain variation in sadness and disgust recognition, whereas offence severity appears to explain variation in anger recognition (Bowen *et al.*, 2014). To our knowledge, no study has yet considered CD severity and CU traits dimensionally in relation to empathy impairment.

1.3 Improving Emotion Processing

1.3.1 Why are Interventions Needed?

As previously discussed (section 1.1.1), antisocial behaviour in childhood is associated with a range of negative outcomes in later life which are costly to both society and to the antisocial individual (Scott *et al.,* 2001). In addition, evidence demonstrating a high persistence of childhood offending into adulthood offending highlights the need for intervention strategies and support for young people with antisocial behavioural problems in order to alter this offending trajectory. Although there is now evidence supporting the long-term effectiveness of some current treatments such as parental training (*e.g.,* Dretzke *et al.,* 2009; Farrington & Welsh. 2007) with children who display antisocial behaviours, reoffending data suggests they do not necessarily work for everyone. Furthermore, the effectiveness of intervention for at-risk groups (*i.e.,* children with ADHD) appears to be limited (Klein, *et al.,* 2012; Molina *et al.,* 2009) highlighting the importance of trialling new treatments in adolescents with antisocial behaviours and those at-risk. For these reasons it has been argued that treatments should focus on designing interventions that target specific neuropsychological and neurobiological correlates of antisocial behaviour (van Goozen & Fairchild, 2008). This thesis will focus on two well-replicated correlates of antisocial behaviour previously addressed; emotion recognition and empathy.

1.3.2 Emotion Training as an Intervention for Antisocial Behaviour

As previously discussed (section 1.2.2.1), deficits in recognising emotional facial expressions (whether general or specific) are related to antisocial behaviour. More recent evidence from studies suggesting that the amygdala is important for detecting socially relevant information, combined with findings that children and adolescents with high CU traits pay less attention to the eye-region of faces (Dadds *et al.,* 2011; Dadds *et al.,* 2008), has led to the proposition that a dysfunction in attentional mechanisms underlies the facial emotion recognition deficits in those who show antisocial behaviour (*e.g.* Dadds *et al.,* 2006). If this is the case then it raises the possibility that emotion recognition can be trained, which may then have positive effects on future behaviour.

Indeed, by simply instructing participants to look at the eyes, fear recognition deficits reduce in children with high CU traits and adolescents (Dadds *et al.*, 2006; Dadds *et al.*, 2008). In addition to directing focus explicitly to the eye-region, facial emotion recognition has also been modified using implicit methods. For example, Schonenberg and colleagues (2014) used a modified version of a dot probe task to implicitly train violent offenders to direct attention to the salient face regions whilst the intensity level of the facial expression increased. Not only did this training improve the recognition of the trained emotions but it also increased recognition of untrained emotions. Nevertheless, none of these studies addressed whether improvements in emotion recognition impacted upon antisocial behaviour *per se*.

Two recent studies indicate that emotion training could indeed impact behaviour. Dadds, Cauchi, Wimalaweera, Hawes and Brennan (2012) found no beneficial effect of emotion recognition training on parental reports of conduct problems six months after intervention in an offender group as a whole, however for those with high CU traits, affective empathy appeared to improve and conduct problems reduce. Penton-Voak *et al*. (2013) succeeded in modifying emotional cognitive biases of angry ambiguous expressions in aggressive youths, who subsequently self- and staff-reported fewer aggressive behaviours in the two weeks after intervention (see section 3.1 for a detailed discussion of these interventions). To our knowledge, no study has examined the effect of emotion training on objective official crime rates.

1.3.3 Oxytocin as an Intervention for Antisocial Behaviour

1.3.3.1 Oxytocin synthesis, receptors and administration

Oxytocin (OXT), a nine amino acid neuropeptide, acts both as a central neuromodulator and a peripheral hormone (Lee, Macbeth, Pagani & Young, 2009a). It is synthesised in the hypothalamus and projected to the pituitary gland - to enable peripheral release into the bloodstream - and to a variety of brain regions including the amygdala, hippocampus, striatum and brainstem, where it exerts central effects (Ludwig & Leng, 2006). Via the periphery, OXT is well known for its reproductive functions, facilitating child birth and lactation (Lee *et al*., 2009). However, most behaviour effects (*e.g.*, pair bonding and parental care) are believed to originate centrally and are not triggered

directly by pituitary gland secretion because of the blood-brain barrier (Ross *et al.*, 2009; Insel & Young, 2001).

In addition to its well-known reproductive functions, animal studies have helped highlight OXT as one of the most important chemical modulators of social behaviour (Donaldson & Young, 2008). In mice, rats, monkeys and sheep, OXT enhances social recognition, memory for peers, development of partner preference and bonding, and reduces aggression (Donaldson & Young, 2008) and as such may be important when considering antisocial behaviour. Nevertheless, until the last decade, the majority of OXT research was limited to animal research. This was due to complications administering OXT in a way which would enable it to pass through the blood-brain barrier to exert central effects. For example, only approximately 0.01% of the peptide has been found to cross the blood-brain barrier following intravenous administration, and using this technique peptides have a very brief half-life (Kendrick, Keverne, Hinton & Goode, 1991). Animal studies on the other hand could utilise administration techniques that go directly into the ventricles.

In their pioneering study, Born and colleagues (2002) demonstrated that peptides can bypass the blood-brain barrier via the nasal pathway and the olfactory nerves, resulting in peptide level increases in both plasma and cerebrospinal fluid. These increases started within 10 minutes of administration and remained elevated up to 80 minutes after administration. More recently, OXT nasal spray has been shown to increase peptide levels in blood, urine and saliva (*e.g.*, Dal Monte, Noble, Turchi, Cummines & Averbeck, 2014), with one study reporting that OXT levels remained elevated in saliva for up to 7 hours after administration of either 16 or 24 IU (Van IJzendoorn, Bhandari, Van der Veen, Grewen & Bakermans-Kranenburg, 2012). Combined, these studies clearly demonstrate the potential for intranasal administration of OXT within human participants.

1.3.3.2 Oxytocin and prosocial behaviour

The development of intranasal OXT has therefore spurred interest into the effects of administered OXT in humans. Using this technique, variations in OXT and its receptor (OXTR) have been linked to a variety of social behaviours in humans beyond the realm of reproduction, including social affiliation, social cognition and the suppression of

social anxiety (MacDonald & MacDonald, 2010). In combination, this research suggests that the OXT system may be a very general mechanism involved in the regulation of social behaviour (Ross & Young 2009; Goodson & Thompson, 2010).

1.3.3.2.1 Attachment

It has been demonstrated that plasma OXT levels during pregnancy and postpartum predict mother-infant (Feldman, Weller, Zagoory-Sharon, & Levine, 2007) and father-infant relationships (Gordon, Zagoory-Sharon, Leckman, & Feldman, 2010). There is also increasing evidence that OXT facilitates positive parenting behaviours (Feldman, Gordon, & Zagoory-Sharon, 2011). These studies, combined with evidence suggesting OXT is involved in partner bonding (*e.g.*, Holt-Lunstad, Birmingham, & Light, 2008), implicate OXT in the neurobiology underlying forming attachments in general.

1.3.3.2.2 Trust

In addition to building and maintaining normal social attachments, which facilitate approach behaviour, there is extensive evidence suggesting that OXT is associated with trusting others (Zak, Kurzban, & Matzner, 2005). For instance, it has been demonstrated that administered OXT increases the likelihood of participants to entrust others with money (Baumgartner, Heinrichs, Vonlanthen, Fischbacher, & Fehr, 2008; Kosfeld, Heinrichs, Zak, Fischbacher & Fehr, 2005) and with confidential information (Mikolajczak, Pinon, Lane, de Timary, & Luminet, 2010a). However, the effect of OXT on trust appears to depend on the context of the situation. For example, OXT appears to increase trust towards in-group members but not towards competing out-group members (De Dreu *et al.*, 2010). Moreover, Mikolajczak and colleagues (2010b) found that OXT did not lead to increased trust when the person to be trusted was perceived to be unreliable, suggesting OXT increases trust without increasing gullibility. These findings have led researchers to examine mechanisms by which OXT increases trust. OXT does not appear to elevate trust by generally increasing risky behaviours (Kosfeld *et al.*, 2005), instead OXT appears to reduce fear of betrayal (Baumgartner *et al.*, 2008). It has been demonstrated that the amygdala plays an important role in modulating OXT's effect on trust insofar as amygdala activation in response to betrayal appears to be reduced in participants who have received OXT (Baumgartner *et al.*, 2008). Taken together, these studies suggest that OXT fosters trust in contexts that are socially

adaptive, thus increasing cooperation and social relations and encouraging approach behaviour.

1.3.3.2.3 Emotion processing

Of particular importance to this thesis are consistent findings that OXT enhances facial emotion recognition (Shahrestani, Kemp & Guastella, 2013). However, while some studies have reported that OXT selectively improves the recognition of positive emotions relative to negative emotions (Marsh, Yu, Pine & Blair, 2010), others have found OXT facilitates recognition of negative emotions compared to positive emotions (Fischer-Shofty, Shamay-Tsoory, Harari & Levkovitz, 2010). On the other hand, it has been reported that OXT results in a general improvement in facial emotion recognition across emotions (Shahrestani *et al.,* 2013) or indeed it has been demonstrated that OXT does not enhance recognition accuracy but does improve the threshold at which emotions are recognised (Lischke *et al.,* 2012). Discrepancies across studies are, in part, attributable to differences in stimuli used. For example, studies differ in the use of static and dynamic stimuli, whole face and part faces and stimulus duration which will be discussed in greater detail in Chapter 4.

There has been considerably less research into the effects of OXT on empathy. Of the four behaviour studies to examine this, one found evidence to suggest OXT facilitated affective empathy whilst leaving cognitive empathy unaffected (Hurlemann *et al.,* 2010), two found no effect of OXT on empathy as measured by empathic concern or personal distress (Theodoridou, Rowe & Mohr, 2013) and subjective rating of empathy for partners' physical pain (Singer *et al.,* 2008) and a fourth found OXT improved empathic accuracy but only for less socially proficient individuals (Bartz *et al.,* 2010). Similar to studies investigating facial emotion recognition, the aforementioned studies differed greatly in stimuli used. Whereas some used emotional scenes to induce empathy experimentally, others used questionnaire measures. Additionally, no study has addressed the effects of OXT on empathy for discrete emotions, or used more ecologically valid stimuli such as dynamic clips. This will be discussed in greater detail in Chapter 5.

1.3.3.3 What are the mechanisms involved in OXT-induced enhancement?

It was originally believed that OXT-induced enhancement was specific to positive and prosocial behaviours. According to this hypothesis, OXT is involved in overcoming fear of betrayal (Baumgartner *et al.*, 2008), enhancing prosocial behaviour (Kosfeld *et al.*, 2005), and reinforcing altruism (Zak, Stanton & Ahmadi, 2007). Nevertheless, findings suggesting that OXT effects on trust are context-dependent suggest that this may be too simplistic. Other findings indicate that OXT may play a more complex role in social behaviour. For instance, OXT has also been implicated in a wider range of social behaviours such as defence against out-group members (De Dreu *et al.*, 2010) and increasing schadenfreude and envy towards rivals (Shamay-Tsoory *et al*., 2009a). These studies suggest that rather than OXT selectively enhancing positive behaviours, OXT is involved in enhancing social salience. The social salience hypothesis of OXT posits that OXT modulates social emotions by increasing the perceived salience of social cues and thus the attentional processing of the cues. According to this view, both pro- and antisocial behaviours are up-regulated by OXT, but the resulting positive or negative outcome is dependent on the specific context characterising the social interaction (Shamay-Tsoory *et al.*, 2009).

In support of the salience hypothesis, alongside evidence of improved emotional recognition, it has been suggested that these improvements are, at least in part, due to OXT altering eye-gaze towards socially relevant stimuli – in this case the eye-region. Evidence to support this explanation comes from studies which highlight the importance of the eye-region for facial emotion recognition (*e.g.*, Adolphs *et al.*, 2005) and studies which have found OXT directs eye-gaze to the eye-regions of neutral faces (Guastella, Mitchell, & Dadds, 2008). If OXT does indeed improve emotion processing by altering eye-gaze then this would support the social-salience hypothesis. However, the only study to examine this mechanism directly in relation to recognition accuracy found no evidence to support this claim (Lischke *et al.*, 2012) and no study has addressed this in relation to enhanced empathy. In order to fully understand the potential effects of OXT it is also important to consider the underlying mechanisms that facilitate improvement.

An alternative explanation states that the effects of OXT can be seen in terms of approach and withdrawal insofar as OXT up-regulates social approach motivation, and down-regulates social avoidance motivation (Kemp & Guastella, 2011). Thus improvements in facial emotion recognition, empathy and other social behaviours as a result of OXT are mediated by social approach motivation, whereas reduced aversion to angry faces is related to withdrawal (Evans, Shergill & Averbeck, 2010). Consistent with this hypothesis, Domes, Steiner, Porges and Heinrichs (2013b) demonstrated that OXT resulted in increased gaze to the eye-region for positive faces but decreased gaze to the eye-regions when viewing negative faces.

Inconsistencies between eye-tracking studies highlight the need to further examine the potential mechanism underlying OXT-induced improvement in order to better understand how OXT leads to behavioural change. This is particularly important within the context of this thesis since antisocial behaviour is associated with reduced attention to socially relevant stimuli (*e.g.,* Adolphs *et al.,* 2005; Dadds *et al.,* 2006).

In additional to attentional mechanisms that may underlie OXT's effects, evidence also suggests that intranasally administered OXT has anxiolytic effects in humans (Heinrichs Baumgartner, Kirschbaum & Ehlert, 2003; Guastella *et al.,* 2010; de Oliveira, Zuardi, Graeff, Queiroz & Crippa, 2012). For example, using the Trier Social Stress Test, which primarily consists of a public speaking task and mental arithmetic performed in front of an audience, Heinrichs *et al.* (2003) found intranasal OXT reduced anxiety. It is therefore possible that any increase in aforementioned approach behaviours are the result of OXT reducing anxiety and neuroendocrine stress responses.

Similarly, it has been suggested that the diverse psychosocial functions associated with OXT are, at least in part, mediated by the amygdala (*e.g.,* Domes *et al*., 2007b; Gamer Zurowski & Buchel, 2010; Kirsch *et al.,* 2005; Labuschagne *et al*., 2010). For instance, in humans, decreased amygdala activation following intranasal OXT has been shown in response to both social and non-social stimuli regardless of valence (Domes *et al.,* 2007b; Kirsch *et al.,* 2005). Taken together, these results suggest that OXT may play an important role in the development and persistence of anxiety disorders, which are characterised by an exaggerated fear of negative scrutiny, including an attentional bias towards critical/aversive faces and threatening social signals and a heightened activation

of the amygdala in response to social cues conveying threat (*e.g.*, fearful or angry faces). Indeed, using an fMRI randomised control trial comparing patients with social anxiety disorder and match controls, Labuschagne *et al.* (2010) found that OXT attenuated the heightened amygdala reactivity to fearful faces in the patient group, such that amygdala hyperactivity that was observed during the placebo session was no longer evident following OXT. These findings suggest that OXT has a specific effect on fear-related amygdala activity, particularly when the amygdala is hyperactive, such as with social anxiety.

The relationship between OXT, anxiety and the amygdala is particularly important to consider within the context of this thesis since youth with antisocial behaviour tend to display the opposite pattern of fear and amygdala responses compared to patients with anxiety disordered. For example, whereas patients with social anxiety show an emotional bias towards detecting fear in neutral faces, antisocial youths show impairments in detecting fear. Similarly, whereas patients with social anxiety experience amygdala hyperactivity in response to fearful faces and images, antisocial youths exhibit a dampened amygdala response. If OXT reduces anxiety by dampening the amygdala response to social scenes then it is possible that OXT could exacerbate the problems faced by adolescents who display antisocial behaviours. Nevertheless, despite numerous studies indicating OXT is associated with an attenuated amygdala response, behaviour results have contradicted these findings. For example, Fischer-softly *et al.* (2009) provide evidence that OXT selectively enhances emotional processing of fearful faces and evidence also suggests that OXT increases attention to the eye-region of faces (*e.g.*, Gamer *et al*., 2010) – both of which are behaviours associated with an increase in amygdala activity. Additionally, Domes *et al.* (2010) found evidence to suggest that the effect of OXT on the amygdala is sex-dependent with women showing increased amygdala response. Taken together, these studies suggest that the relationship between OXT and the amygdala is complex, and, as such, it would be premature to discount OXT as a possible intervention for antisocial behaviour before we fully understand the complexities of its effects.

1.3.3.4 Current Concerns in OXT Research

It is also important to consider that alongside the growing body of OXT research there has also been growing concerns relating to the quality and rigour of OXT studies.

Churchland and Winkielman (2002) raised concerns about the use of intranasal OXT as an effective method of administration, highlighting uncertainties about what happens when OXT is administered intranasally and questioning whether intranasal OXT does in fact reach the appropriate brain receptors and whether the effects of OXT are due to central or peripheral influences. Although the mechanism by which intranasal OXT affects both central and peripheral concentrations, directly and indirectly, is still not fully understood, the continuing interest in OXT research has driven researchers to investigate these concerns further. For example, Neumann, Maloumby, Beiderbeck, Lukas and Landgraf (2013) demonstrated that intranasal OXT can cross the blood-brain barrier and reach specific brain regions in rats and mice. More recently, Paloyelis *et al*. (2014) provided evidence that intranasal OXT can cross the blood brain barrier in human males, providing further support that intranasal OXT has direct effects on the brain. In addition, several studies have found that intranasal OXT leads to a significant increase in OXT concentrations in cerebrospinal fluid (CFS), blood plasma and saliva, which may also be indicative of intranasal OXT reaching the brain (Dal Monte *et al.*, 2014; Van IJzendoorn *et al.*, 2012). Nevertheless, these effects appear to be small and, in general, many previous studies have neglected to provide any measures or indicators of whether OXT concentrations have increased and instead rely solely on evidence of behaviour effects (Leng & Lugwig, 2016). For example, Daughters and colleagues (2015) note that of the 80 studies published in 2012 that used intranasal OXT only three examined the pattern of OXT concentrations in saliva in healthy adults. In light of the large variations in individual responsivity to saliva OXT concentration Daughters *et al*. observed, they argue measuring OXT concentrations in saliva is important to fully understand its effects. Moreover, Leng and Lugwig cite an example of a study which published no significant effects of intranasal OXT on CSF in one paper but in another paper claimed intranasal OXT resulted in behaviour effects, effectively ignoring the evidence indicating that OXT levels had not changed.

Despite past criticism of measuring OXT in saliva for artificially elevating OXT levels (see McCullough, Churchland & Mendez, 2013), recent improvements in the way OXT concentrations are measured from saliva have alleviated these concerns and made saliva analysis a more viable option. Given measuring OXT from saliva is relatively quick, easy and less distressing compared to measuring CSF, measuring saliva samples may represent a possible way of understanding the mechanisms involved. Nevertheless,

the relationship between central and peripheral concentrations of OXT is not fully understood, as such, there has been continued debate surrounding whether OXT concentrations in saliva and plasma are related to central OXT levels and whether these measures can be used as evidence that OXT levels have increased centrally (Leng & Ludwig, 2016; McCullough *et al.,* 2013). It is evident that further research is needed to fully understand the relationship between central and peripheral effects. As a starting point, if more studies provide measures or indicators of OXT levels after intranasal administration, OXT research will not only benefit from the increased rigour of study designs but also a better understanding of the underlying mechanisms may be developed.

Despite the continued uncertainty surrounding the exact mechanisms through which OXT exerts effects, researchers generally agreed that, similar to psychopharmacological cases where the precise mechanisms of action are not known but the behaviour improvements are evident (*e.g.,* selective serotonin reuptake inhibitors) (Quintana & Wooley, 2015), intranasal OXT research is a worthwhile and promising endeavor. Instead, concerns now focus on the quality and rigour of OXT research, with more recent reviews suggesting that the compelling evidence for the role of OXT in a range of complex social cognitive processes is, at least, in part, the product of publication bias and underpowered studies (Leng & Ludwig, 2015; Walum *et al.,* 2015). The criticisms of previous OXT studies centre around two main issues. Firstly, given the moderate effect sizes associated with OXT research the majority of studies appear to be underpowered. Secondly, it has been suggested that many studies are guilty of 'fishing' for significant results which has created a publication bias towards significant behavioural effects. It has therefore been suggested that previous significant results need to replicated in larger samples and that data should be openly available and primary outcome clearly stated in order to minimise the risk of publication bias (Leng & Ludwig, 2015; Walum *et al.,* 2015).

The current ethical stance in the United Kingdom on administering OXT to adolescents meant it was not possible to study the effect of intranasal OXT on young offenders in this thesis. Additionally, given there are still many unanswered questions within the OXT literature surrounding improvements in emotion processing, possible negative outcomes and the possible underlying mechanisms in which OXT exerts effects, it was

decided that further research is needed to clarify how OXT functions in healthy controls before examining how this may differ in adolescents with antisocial behaviour.

1.4 Goals and Hypotheses of the Thesis

1.4.1 Empathy

Currently research suggests that antisocial behaviour is associated with affective empathy deficits specific to negative emotions; however it is uncertain how these impairments may relate to severity of antisocial behaviour, psychopathic traits – more specifically CU traits and other comorbid disorders such as ADHD. Moreover, there is no agreed way in which to investigate empathy with previously used measures failing to adequately account for cognitive and affective empathy separately (*e.g.*, Strayer & Rossberg-Gempton, 1992). Chapter 2 will examine whether empathy abilities differ in a sample of male adolescents with ADHD who either do or do not have a joint diagnosis of CD, and what, if any, the added role of antisocial behaviour subtypes such as CU traits, and CD severity have in distinguishing empathy deficits. Furthermore, empathy will be induced using more ecologically valid dynamic stimuli, and a new method for scoring cognitive and affective empathy will be discussed.

1.4.2 Facial Emotion Training

Considerable empirical research suggests that emotion recognition can be improved using emotion training, more specifically by training individuals to look at the eye-region of faces. Although it has been demonstrated that these methods can improve recognition in antisocial populations there is limited evidence for how these improvements relate to antisocial behaviours. Where this has been addressed, studies have relied on subjective accounts of antisocial behaviour and only trained a limited number of emotions (*e.g.*, anger and happiness). Chapter 3 will examine whether an emotion recognition protocol which explicitly encourages participants to attend to the eye-region of faces, provides detailed characteristics of facial expression for four emotions (happiness, sadness, fear and anger) and requires participants to think about when they have experienced these emotions, can improve facial emotion recognition and impact upon future antisocial behaviour - as determined by official criminal offences - six months after the intervention.

1.4.3 Intranasal Oxytocin

Despite considerable research into the effects of intranasal administered OXT on facial emotion recognition, relatively little is known about the underlying mechanisms in which OXT may enhance performance with some studies supporting the idea that OXT alters eye-gazes but others finding that this does not result in improved recognition. Given antisocial behaviour has been linked to dysfunctional attention to socially relevant cues (*e.g.,* Adolphs *et al.,* 2005; Dadds *et al.,* 2006) it is important when considering the possible role of OXT as a therapeutic intervention to establish whether OXT indeed enhances recognition, whether this is a general or specific effect, and whether this happens through changes in eye-gaze. Chapter 4 will use a within-subjects double-blind randomised control trial to examine the effect of OXT on emotion recognition and will also track participants' eye-gaze to see if any improvements in recognition are the result of increased attention to the eye-region.

While there are strong theoretical grounds for training empathy amongst antisocial populations, a recent review of empathy training concluded that there is insufficient evidence to suggest that empathy-promoting interventions with violent offenders are effective (Day, Casey & Gerace, 2010). Furthermore, it has been demonstrated that psychopaths can increase empathic responses when being told to empathise more (Meffert, Gazzola, den Boer, Bartels & Keysers, 2013). This suggests that they are consciously able to manipulate their empathy - which may add to the manipulative characteristics of the disorder - and suggests the need to consider interventions which automatically increase empathy rather than priming participants to respond to it. Intranasal OXT may represent one way in which to do this, however to date there has been considerably less empirical research exploring the effect of OXT on empathy and where this has been examined the results are inconsistent. Inconsistencies may, in part, be due to the variety of methods used to measure empathy which have tended to lack ecological validity and have not always considered the multi-component nature of empathy (*e.g.,* affective and cognitive components and empathy for different emotions). Moreover, to our knowledge no study has considered the underlying mechanisms in which OXT may enhance empathy. Chapter 5 therefore aims to examine the effect of OXT on cognitive and affective empathy for different emotions (*e.g.,* pain, sadness,

happiness and fear) using the same study design as Chapter 4. In addition, empathy will be measured using ecologically valid dynamic clips and participants' eye-gaze will be analysed to examine whether any improvements in empathy are related to altered eye-gaze.

1.4.4 Hypotheses and Research Questions

The thesis consists of four empirical chapters. Chapter 2 is part of a study investigating cognitive and emotional impairments in a large sample of clinically referred males. The sample consisted of 204 adolescents with ADHD, half of who had a joint diagnosis of CD. Chapter 3 utilised a sample of 50 young offenders aged 11-19 who were under the supervision of the local youth offending team. Chapter 4 and Chapter 5 are part of the same double-blind within subjects randomised control trial, investigating the effect of intranasal OXT on a range of social behaviours in a sample of 40 male undergraduates. These experimental chapters are currently submitted or in preparation to be submitted as journal papers. They have therefore been presented in paper format. Because of this there may be some repetition in the introduction and methods; however, the hypotheses and results are unique to the chapters.

It was hypothesised that:

(1) Adolescent males with ADHD and CD would show reduced empathy compared to those with ADHD alone. More specifically, they would display:
    a. Reduced affective empathy for negative valence emotions (pain, sadness and fear)
    b. But normal cognitive empathy abilities
(2) There was no specific hypothesis relating to the contributions of CD severity, CU traits and ADHD symptoms to any empathy impairments as this was more exploratory.
(3) Young offenders who received an emotion training programme in addition to their statutory treatment would show improved facial emotion recognition and reduce subsequent antisocial behaviour compared to a matched control group who received the statutory treatment only.

(4) Intranasal OXT would enhance prosocial behaviours. More specifically, OXT would result in:
    a. Improve facial emotion recognition accuracy across emotions.
    b. Enhanced cognitive and affective empathy across emotions.
    c. Altered eye-gaze towards the eye-region of faces which would be related to any improvements in emotion recognition and empathy.

By integrating the findings across the four empirical chapters this thesis also aims to answer the following research questions:

(1) Is antisocial behaviour linked with general or specific emotion problems?
(2) Does antisocial behaviour severity and CU traits explain deficits in emotion processing?
(3) Why is antisocial behaviour associated with deficient recognition of emotion but intact cognitive empathy?
(4) Can intranasal OXT improve emotion processing in healthy males?
(5) Is intranasal OXT involved in enhancing social salience?
(6) Can emotion processing be improved in young offenders?
(7) Is intranasal OXT a potential intervention for antisocial behaviour?

2 Chapter 2: Empathy impairments in adolescent males with ADHD and Conduct Disorder

Accepted paper

This chapter is based on Van Goozen, S.H.M., Langley, K., Northover, C., Hubble, K., Rubia, K., Schepman, K., O'Donovan, M.C., & Thapar, T. (2015). Identifying mechanisms that underlie links between COMT genotype and aggression in young people with ADHD. *Journal of Child Psychology and Psychiatry, Manuscript accepted.*

2.1 Introduction

The ability to understand and share in another's emotional state or context, referred to as empathy (Eisenberg & Strayer, 1987), is essential in developing and sustaining successful reciprocal social relationships (Dziobek *et al.*, 2008). Despite extensive research, the construct of empathy has been difficult to quantify owing to variations in definitions and measurements (Preston & de Waal, 2002). In particular, the relative contributions between the affective and cognitive components of empathy have posed continuing problems for researchers. Broadly, affective empathy involves the vicarious experience of emotions consistent with those of another, whereas cognitive empathy is the ability to understand what another person is thinking or feeling (Shamay-Tsoory, 2009). In general, empathy is thought to trigger a number of prosocial behaviours intended to benefit others. If the other is perceived to be in a negative state, empathic concern can motivate action and lead to prosocial behaviour (de Waal, 2008). Consequently, these abilities facilitate cooperation and helping behaviours and are considered important for appropriate moral development (Hoffman, 2000). Conversely, deficient emotion processing is an important risk factor associated with antisocial behaviour that requires further investigation (Blair, Mitchell & Blair, 2005; Raine, 1997; Van Goozen, Fairchild, Snoek & Harold, 2007).

Empathy is an aspect of emotional functioning that is impaired in children and adolescents with Conduct Disorder (Cohen & Strayer, 1996) - a childhood and adolescence disorder characterised by repetitive and persistent patterns of serious aggressive and antisocial behaviour (American Psychiatric Association, 1994). It has also been found to be deficient in young offenders (Robinson *et al.*, 2007) and adult offenders (Domes *et al.*, 2013a). Questionnaires have traditionally been employed in empathy research to provide a measure of trait or general empathic abilities. Nevertheless, there is now a large body of evidence that suggests empathic abilities may differ across situations; for example, they may differ depending on the emotion that is to be empathised with (*e.g.*, Eisenberg *et al.*, 2001; de Wied *et al.*, 2009). As a result, empathy research has adapted multi-method approaches to measuring empathy. By employing these methods empathy deficits have been observed in individuals with CD in terms of self-reported responses (Robinson *et al.*, 2007), altered physiology (heart rate [HR] and facial electromyography; de Wied *et al.*, 2009) and by atypical anterior

insular and anterior cingulate cortex functioning (Sterzer, Stadler, Poustka & Kleinschmidt, 2007; Decety, *et al*., 2009; Lockwood *et al.*, 2013).

Despite extensive research into the empathy deficits associated with CD, little is known about how empathy deficits may differ when considering comorbidity with other disorders. Research consistently suggests that CD and Attention Deficit Hyperactivity Disorder (ADHD) commonly co-occur (*e.g.,* Thapar, van den Bree, Fowler, Langley & Whittinger, 2006) with approximately 20-50% of children with ADHD developing CD (Kutcher *et al.,* 2004). Although both disorders separately are associated with poor social and emotional outcomes, a combined diagnosis of ADHD and CD leads to poorer outcomes than either disorder alone. For instance, genetic studies indicate that the combination of ADHD and CD is a more severe subtype in terms of genetic loading and clinical severity (Thapar, Harrington & McGuffin, 2008).

Studies on empathy in CD have neglected to consider the effect of a combined diagnosis of ADHD, and there has been relatively little interest in empathy among adolescents with ADHD alone. One study found that boys with ADHD empathised less with characters in picture stories compared to boys without ADHD (Braaten & Rosen, 2000), but the potential combined effect of CD on empathic abilities was not considered. One study that did consider this, found that children with ADHD and clinical levels of conduct problems showed more empathy problems than children with ADHD with no conduct problems or controls (Marton, Wiener, Rogers, Moore and Tannock, 2008). A limitation of this study however, was that it relied on parent-reported measures of trait empathy.

It is believed that empathy may act as an inhibitor of aggressive behaviour through the vicarious experience of others' distress (Decety & Jackson, 2004). That is, if a person directly experiences the distress their actions have caused another, they will be less likely to continue that behaviour. The tendency for aggressive behaviour has therefore been hypothesised to reflect an impaired empathic response to others' distress (Blair & Blair, 2009). This is supported by findings suggesting CD is associated with intact cognitive empathy but deficient affective empathy (Schwenck *et al.*, 2012) which seems to be specific to negative emotional situations (de Wied *et al.,* 2009). It has been suggested that these impairments may be the result of a lack of arousal induced by

seeing others suffer (Raine, 1997). In support of this it has also been observed that adolescents with disruptive behaviour disorders (DBD) show reduced HR reactivity to documentary scenes of people experiencing sadness (de Wied *et al.,* 2009). Nevertheless, another study found normal HR and skin conductance levels in boys with DBD while watching a sad movie scene (Marsh, Beauchaine & Williams, 2008a).

It has long been recognised that adolescents who display persistent antisocial behaviours reflect a heterogeneous group in terms of prognosis and severity (Frick & Marsee, 2006). One distinction recently added to the DSM-5 is between adolescents with CD who do or do not display high levels of callous and unemotional traits (*e.g.*, deficient affect, lack of empathy and general disregard for others [Frick & White, 2008]) (American Psychiatric Association, 2013). Adolescents displaying antisocial behaviour including CU traits show a more severe, stable, and aggressive pattern of conduct problems and delinquency, with more police contact than those without CU traits (Scheepers, Buitelaar & Matthys, 2011). Moreover, antisocial behaviour appears to be strongly heritable in children with high CU traits, whereas antisocial behaviour with low CU traits appears to be driven by environmental factors (Viding, Jones, Frick, Moffitt & Plomin, 2008). It has been suggested that the presence of CU traits may explain some of the inconsistent findings mentioned above (Lorber, 2004), with a subgroup of adolescents with CD and CU traits appearing to show reduced arousal and lacking normal emotionality compared to those without CU traits (Bons *et al.,* 2013). These findings highlight the importance of considering other factors within CD, which may play an important role in disorder severity and emotion dysfunction.

Another line of research has suggested that the seriousness or severity of antisocial behaviour, may determine dysfunctional neurobiological systems in individuals with CD (*e.g.,* Fairchild *et al.,* 2009a; Fairchild *et al.,* 2009b; Fairchild *et al.,* 2008; Passamonti *et al.,* 2010). These authors noted that in youths with serious antisocial behaviour, emotional and neuropsychological deficits were present regardless of the age of onset of CD. Similarly, CD sysmptoms of greater severity predict poorer outcomes for example worse substance use outcome (Crowley, Mikulich, MacDonald, Young & Zerbe, 1998) suggesting that CD severity is also important to consider when examining risk factors associated with CD (Fairchild, van Goozen, Calder & Goodyer, 2013). To our knowledge no study has yet considered ADHD symptom severity, CD symptom

severity and CU traits dimensionally in relation to empathy. A key next step is therefore to identify whether specific empathy deficits are driven by variations in these variables.

In addition, there is currently no agreed way of measuring empathy. Typically, studies which have measured self-reported responses to empathy-inducing stimuli have used correct target emotion recognition as a measure of cognitive empathy, however understanding another's emotion arguably goes beyond facial emotion recognition. Similarly, affective empathy has often been measured based solely on the intensity at which participants rate feeling aroused by a specific target emotion, effectively ignoring similar emotions that may still indicate an empathic reaction. Strayer and Rossberg-Gempton's (1992) Empathy Continuum attempts to address these issues by considering participants cognitive understanding of emotions and categorises this into seven levels of understanding. Affective empathy depends on the intensity match between the main character and participant's emotions but also considers other similar emotions. Despite its wide use, the level of cognitive empathy awarded is dependent on participants' understanding of the reasons for their own emotions and not for their understanding of the main character's emotions. This means a participant cannot score highly on cognitive empathy unless they have reported personally feeling the target emotion. Consequently, scores of cognitive empathy are dependent on affective empathy which is in contradiction to the notion that cognitive and affective empathy are separate constructs and may be dissociated (*e.g.*, Blair, 2005; Shamay-Tsoory, 2009). Schwenck *et al.* (2012) attempted to address these pitfalls by using participants' explanations for the main character's emotion to score cognitive empathy. However, this was on a scale from 0-2, providing little variation in scores. Additionally, affective empathy addressed how emotionally affected the participants were, but ignored specific emotions. The limitations associated with previous scoring systems highlights the need to develop a new scoring system.

A first goal of this study was to test whether adolescents with ADHD and CD or ADHD alone differ in empathic abilities. A second aim was to address the contributions of ADHD symptoms, CD symptom severity and CU traits to empathy impairments. In order to achieve these aims, participants completed a dynamic empathy task that used four short film clips to depict the emotions of pain, sadness, happiness and fear in the main character. Despite not representing one of the basic emotions, pain was included in

the study since it is related to distress and suffering of others and is often inflicted by antisocial adolescents. After each clip participants were asked to identify (a) the main character's emotions and intensities, (b) their own emotions and intensities, and (c) the reasons for their own and the main character's emotions. These responses were coded using the Cardiff Empathy Scoring System (CESS). Reliability measures were carried out on a cross-section of the data to ensure the reliability and validity of this new measure.

It was hypothesised that adolescents with ADHD and CD would display affective empathy impairments specific to distress cues (pain, sadness and fear) compared to those with ADHD alone. We did not predict any differences in cognitive empathy. In terms of dimensional variations within the sample, we predicted that CD symptom severity and levels of CU traits would contribute to more affective empathy impairments.

2.2 Method

2.2.1 Participants

Participants were eligible for inclusion if they were boys aged 10-17 years with a clinical DSM-IV ADHD or ICD-10 diagnosed Hyperkinetic Disorder (met full criteria during childhood), which was confirmed by a research diagnostic interview, and willing to participate in laboratory-based cognitive and physiological research. The sample was recruited from community child and adolescent mental health clinics or child health clinics in Wales and most had participated in a previous genetic study (n= 174) (see Stergiakouli *et al.*, 2012). In total, 204 adolescent males (mean age = 13.9 years) attended the laboratory-based assessments. The majority of families were of UK White origin (*n*=202). One hundred and eighty-four participants completed all parts of the empathy task. One participant was excluded as no CD diagnosis was available for analysis, resulting in a final sample of 183 (ADHD = 86, ADHD+CD = 97). All the participants came from community clinics and had previous experience with stimulant medication. Participants who continued to take stimulant medication were asked to come off medication 24 hours prior to testing.

2.2.2 Ethical Statement

Ethical approval was obtained from the Wales Multicentre Research Ethics Committee. Informed written consent was obtained for all accompanying parents and adolescents aged over 16 years. Written assent was obtained for younger adolescents.

2.2.3 Measures and Materials

2.2.3.1 Clinical measures

All participants had a clinical diagnosis of ADHD. Additional, child psychopathology measured were assessed using the Development and Well Being Assessment (DAWBA) structured interview using parents and children as informants (Goodman, Ford, Richards, Gatward & Meltzer, 2000). Parents completed the ADHD and CD sections and children the CD section. All interviews were administered by trained psychologists, supervised by an experienced clinician. Symptom scores and diagnoses were generated from the DAWBA according to DSM-IV criteria. CD symptoms were counted as present when endorsed by either the parent or child. These were summed and used to sub-divide participants into two groups: ADHD (ADHD) and comorbid ADHD and CD (ADHD+CD) based on a research diagnosis of DSM-IV criteria for a CD diagnosis. The number of CD symptoms, and ADHD symptoms from the parent reports, were also used as a continuous measure of CD and ADHD symptom severity. It was not known how many of the participants had an official clinical diagnosis of CD, only which participants met research diagnostic criteria.

2.2.3.2 Callous-unemotional (CU) traits

CU traits were measured using the Youth Psychopathy Inventory (YPI; Andershed *et al,* 2002). The YPI is a 50-item validated youth self-report questionnaire that assesses general psychopathic tendencies. The YPI is scored on a 1 - 4 Likert scale, giving a sum score between 50 - 200. A higher score is indicative of higher levels of psychopathic traits. The YPI is made up of four subscales. Given the relevance of CU traits in antisocial behaviour we also examined the Callous and Unemotional subscale separately. The CU subscale has 15 items, and each item is answered on a 4-point Likert scale (score range 15 – 60). These 15 items were summed to achieve a CU trait score.

The reliability and validity of the YPI have been established (Andershed, Hodgins, & Tengstrom, 2007).

2.2.3.3 IQ

Cognitive ability was assessed using the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999) – 2-subset form (vocabulary and matrix reasoning).

2.2.3.4 Empathy Task: Emotion-eliciting Film Clips

Four clips depicting the target emotions of pain, sadness, happiness and fear, were edited from cinematic films. Each clip was matched with a pair of target emotions based on ratings obtained in a previous study. The primary emotions of the main character in the video clip were therefore pain/hurt, sadness/upset, fear/scared or happy/cheerful although these will be referred to as pain, sadness, happiness and fear clips (see van Rijn, Barendse, van Goozen & Swaab, 2014). To reduce the effects of fatigue and habituation clips were edited to be between one and three minutes in duration (Rottenberg, Ray & Gross, 2007). The four clips selected were: 127 hours – Pain (94s) – a male rockclimber falls resulting in his arm becoming trapped between rocks which he attempts to free; The Champ – Sad (94s) – A young boy is shown crying over the body of a dead boxer who he was obviously close to; Racing Stripes – Happy (80s) – a young girl wins a horserace whilst riding a zebra and is shown celebrating with her father; and Jaws 2 – Fear (104s) – a young girl watches a friend being attacked by a shark and is left on her own in a boat in the middle of the sea after the shark kills her friend. Film clips were shown to participants using Windows Media Player on a 15" screen computer. Participants were simply asked to watch each clip and were not provided with any other information or instructions until the end of the clip.

2.2.3.5 Explicit empathy test

After each clip participants completed two questionnaires, one concerning the emotions of the main character and the other concerning their own emotions while viewing the clip. By placing a cross on a continuous line of 10 cm participants were asked to indicate how strongly they or the main character felt on a range of 10 emotions (labelled as follows: anger, sad, pain, upset, fearful, happy, scared, cheerful, surprised and hurt). Participants were next asked to give the reason for the emotion they identified in the main character and in themselves. Typically the experimenter went through each

emotion that was identified as being present and asked the participant "what happened in the clip to make you (or the main character) feel (insert emotion)?" These responses were coded for cognitive and affective empathy using the Cardiff Empathy Scoring System. This took into consideration four elements of empathy: (1) whether the target emotion was correctly identified; (2) whether other similar emotions were identified; (3) the intensity of the emotion (-s) identified and (4) the explanation for the causes of the emotion. Cognitive empathy scores ranged from 0-9 whereas affective empathy scores ranged from 0-6 (see Table 2.1 for scoring guidelines). For all scales a higher score was indicative of greater empathy.

Participants' previous experience of the film clip was checked after each clip by informing the participants of which film the clip was taken from and asking whether or not they had seen the film before. The effect of film familiarity was checked before analysis to examine whether previous experience with a film affected the intensity of the emotions observed in the main character or experienced by the participant. Between-subject *t*-tests revealed that there were no significant differences in emotional intensity experienced by the participants or observed in the main character (all *p*'s <.05); consequently film familiarity was not included in the main analysis.

2.2.3.6 Cognitive empathy

Cognitive empathy was calculated for each clip based on participants' ratings and explanations for the main character's emotions. Participants could score 0-2 depending on whether they correctly recognised the target emotion in the main character. A score of 0 was awarded if the target emotion was not identified, 1 if it was recognised but was rated at a low intensity, and 2 if the emotion was rated at a high intensity. A score of 1-2 (depending on intensity) was also awarded if participants correctly identified a similar relevant emotion in the main character. A score of 0 was awarded if another relevant emotion was not identified. Typically these consisted of emotions of the same valence to the target emotion (*e.g.,* fear during the pain clip). For both of these scores an emotional intensity rating less than three was indicative of low intensity (scoring 1) whereas a score greater than three was considered to be high intensity (scoring 2). Finally, 0-5 points could be awarded based on how participants explained the causes of

the main character's emotions. If the explanation was incorrect or inappropriate a score of 0 was awarded. Participants could score between 1-5 depending on the quality of the explanation in terms of the factual content and a deeper understanding of the main character's situation by reflecting on possible consequences for the main character (see table 2.1 for full scoring).

2.2.3.7 Affective empathy

Affective empathy was calculated using a similar system but used participant's ratings of their own emotions and their explanations for these. Participants could score 0-2 using the same criteria and cut-offs for intensity as outlined above, but based on whether they reported feeling the target emotion personally. They could also score 0-2 if they identified feeling a similar relevant emotion themselves. Finally, participants could score 0-2 depending on their explanation and attributions of their own emotions. An irrelevant attribution scored 0, an attribution based on factual information scored 1 and an attribution based on the emotion of the main character or evidence of the participant transposing themselves into the main character's situation scored 2.

The highest scoring attribution explanation was always selected regardless of which emotion was explained (as long as it was a relevant emotion). Attributions that were considered to reflect more sympathy than empathy, for example, "I felt sad *for* him" were awarded a zero unless the participant advanced on this accordingly. Thus the maximum score for a sympathy response was four, consistent with Strayer's (1993) suggestion that sympathy is a product of empathy and therefore should still be recognised as reflecting some empathic skills. Inter-rater reliabilities for both measures were confirmed between two blind raters using a subset of the data (10%) across the four film clips. Cronbach's alphas ranged from .74 (cognitive) to .82 (affective). Internal consistency for cognitive and affective empathy was .62 and .79 respectively. The procedure took approximately 45 minutes.

Table 2.1:
The Cardiff Empathy Scoring System for cognitive and affective empathy

Cognitive Empathy
Target emotion
0 = Target emotion not identified in main character 1= Target emotion identified at a low intensity 2= Target emotion identified at a high intensity
Similar relevant emotion
0 = Similar relevant emotion not identified in main character 1= Similar relevant emotion identified at a low intensity 2= Similar relevant emotion identified at a high intensity
Explanation of emotion
0= Incorrect or irrelevant explanation of emotion *e.g.,* "The girl was fearful because she was scared". 1= Explanation provides <u>one</u> factual reason for emotion *e.g.,* "The girl was fearful because there was a shark". 2 = Explanation provides <u>more than one</u> factual reason for emotion *e.g.,* "there was a shark <u>and</u> the boat got knocked" OR provides <u>one</u> consequence of the event *e.g.,* "she thought she might die". 3= Explanation provided <u>one</u> piece of factual information AND took into consideration the consequence of the event for the main character *e.g.,* "There was a shark in the water and she thought it might kill her". 4 = Explanation provided <u>more than one</u> piece of factual information AND took into consideration the consequence of the event for the main character *e.g.,* "there was a shark, her boyfriend fell in the water and she thought she might die". 5= Explanation provided a thorough account of the main character situation providing multiple factual reasons for their emotions and elaborating on the possible consequences of the situation *e.g.,* "There was a shark in the water and it had already killed her boyfriend. She was on her own and would be worried that it might come back for her and kill her as well".
Affective Empathy
Target emotion
0 = Target emotion not identified in self 1= Target emotion identified at a low intensity

2= Target emotion identified at a high intensity
Similar relevant emotion
0 = Similar relevant emotion not identified in self 1= Similar relevant emotion identified at a low intensity 2= Similar relevant emotion identified at a high intensity
Explanation of emotion
0= Incorrect or irrelevant explanation of emotion e.g., "I felt happy because I like seeing people die". 1= Explanation based on factual information e.g., "I felt sad because the man died". 2= Explanation based on main characters emotions or involved participant transposing themselves into main characters situation e.g., "I felt sad because I thought about that happening to me".

2.2.4 Data Analyses

Mixed method ANOVAs were used where Group (ADHD or ADHD+CD) was the between- subject factor and Emotion (pain, sadness, fear and happiness) was the within-subject factor. Two separate analyses were carried out on the dependent variables of cognitive and affective empathy. Where the assumption of sphericity was violated, the Greenhouse-Geisser correction was used. Where follow-up tests were required, Bonferonni correction was used. Effect sizes were calculated as eta squared (η^2; small≥.01, medium≥.06, large≥.14; Cohen, 1988). Multiple regression analyses were carried out to assess the relative contribution of personality and behavioural measures in explaining any between-group differences in empathic abilities. Analyses were carried out using SPSS 20 (SPSS Inc., Chicago, Illinois).

2.3 Results

2.3.1 Demographic Characteristics

Table 2.2 shows the demographic characteristics of the sample. One-way ANOVAs revealed no significant differences between the groups in terms of age, F [1, 182] = 1.5, p =.22. Compared to the ADHD group, the ADHD+CD group had a significantly lower estimated IQ score, F [1,176] = 11.1, p =.001, marginally more ADHD symptoms, F [1,

176] = 3.7, p =.06, higher levels of CU traits, F [1, 181] = 23.4, p <.001 and more CD symptoms F (1, 182) = 301.25, p <.001.

Table 2.2:
Demographic characteristics of adolescents

Variable	**ADHD**		**ADHD+CD**	
	M	*(SD)*	*M*	*(SD)*
Age (years)	13.8	*(1.9)*	14.1	*(1.7)*
IQ	91.2	*(12.0)*	85.8	*(9.8)*
ADHD symptoms	11.7	*(5)*	13.0	*(4.2)*
CU Traits	31.1	*(6.0)*	35.8	*(7.0)*
CD symptoms	1.0	*(0.7)*	5.69	*(2.4)*

ADHD Attention Deficit Hyperactivity Disorder, CD Conduct Disorder, IQ Intelligence Quotient, CU Callous and Unemotional.

Pearson's correlation analysis revealed that neither IQ nor ADHD symptoms were significantly related to cognitive or affective empathy scores (all *ps* >.05), and it was therefore decided not to enter these in subsequent analyses. CU traits and CD symptom severity correlated with affective empathy (Table 2), but not with cognitive empathy (all *ps* >.05).

2.3.2 Cognitive Empathy

Figure 2.1 illustrates cognitive empathy scores for the ADHD and ADHD+CD groups across the four emotional film clips. There was a significant main effect of Emotion, F [2.82, 510.4] = 45.2, p <.001, η^2 =.20. Follow-up analysis revealed that, regardless of Group, the happiness clip resulted in poorer cognitive empathy whereas the pain clip resulted in greater (all *ps*<.05). There was no difference in cognitive empathy scores between the sadness and fear clips (p=.06).There was no main effect of Group, F [1,181] = 0.06, p = .81, η^2=.00, and no interaction between Emotion and Group, F [2.82, 510.4] = 0.16, p =.91, η^2=.00.

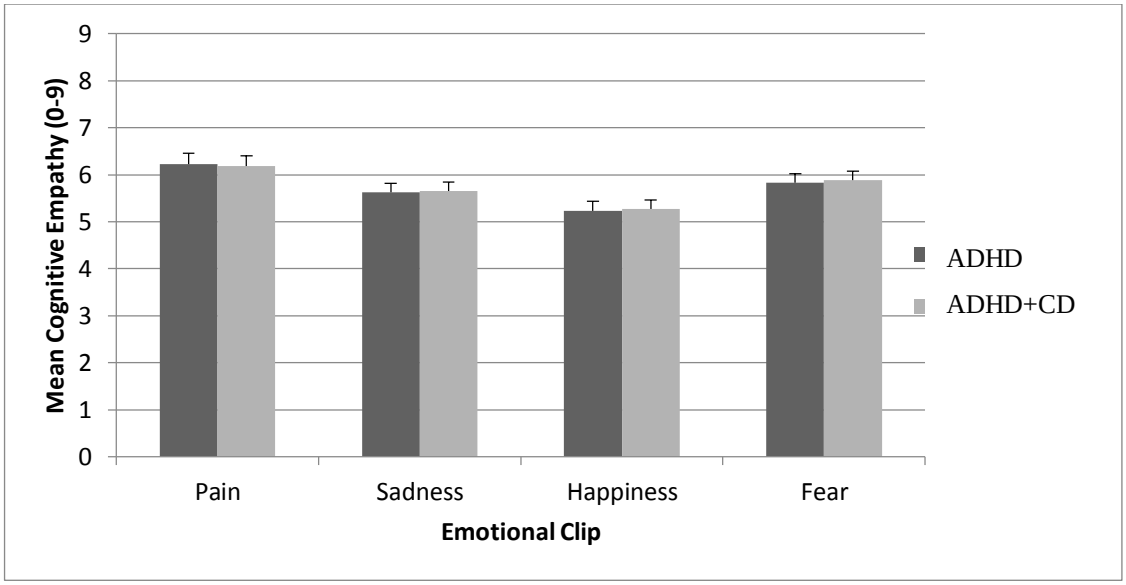

Figure 2.1: Cognitive empathy scores as a function of ADHD type. Error bars show +2 SE.

2.3.3 Affective Empathy

Affective empathy scores are presented in Figure 2.2. Results revealed a significant main effect of Group, F [1, 181] =5.00, p =.03, η^2=.03, indicating the ADHD group (M=2.74, SD =2.25) in general reported greater affective empathy compared to the ADHD+CD group (M=2.23, SD=2.11). There was also a main effect of Emotion, F [3, 543] =25.9, p <.001, η^2=.12, indicating affective empathy was greatest for happiness (M =2.87, SD=1.88) followed by that of sadness (M=2.86, SD=2.12), pain (M=2.49, SD=1.96) and fear (M=1.73, SD=2.01). The interaction between Emotion and Group was also significant, F [3, 543] = 4.9, p = .002, η^2=.02. Follow-up tests revealed that the ADHD+CD group reported significantly less affective empathy during the sadness (p=.045), happiness (p=.001) and fear (p=.02) clips.

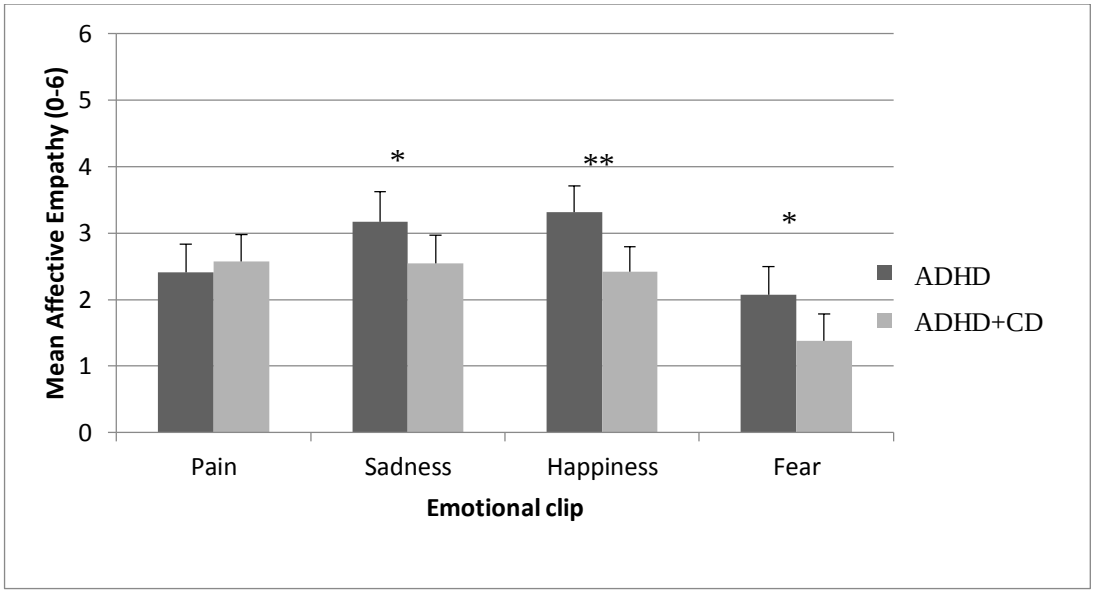

Figure 2.2: Affective empathy score as a function of ADHD type. Error bars show +2SE. *p<.05, **p<.01

2.3.4 Correlates of Affective Empathy

Table 2.3 displays the correlation coefficients for affective empathy scores and demographic variables. CD symptom severity correlated negatively with affective empathy for fear, sadness and happiness; CU traits correlated negatively with affective empathy for sadness and fear only. In addition, CD symptom severity and CU traits were positively correlated.

Table 2.3:
Inter-correlations between key variables. Pearson's R.

	1	2	3	4	5	6
1. Pain AE	-					
2. Sadness AE	.51**	-				
3. Happiness AE	.41**	.44**	-			
4. Fear AE	.54**	.54**	.42**	-		
5. CD severity	-.09	-.28**	-.31**	-.28**	-	
6. CU traits	.02	-.18*	-.11	-.19*	.42**	-

AE Affective Empathy, CD Conduct Disorder, CU Callous and Unemotional, *p<.05, **p<.01

In order to establish which factor(s) were driving the affective empathy deficits, a stepwise regression model was used containing CU traits and CD symptom severity both entered into the analysis at the same time. Since affective empathy differed

between the emotions a regression model was computed for each emotional clip in which group differences were found (*i.e.*, sadness, happiness and fear).

Table 2.3 shows that CU traits and CD symptom severity were both significantly inversely correlated with affective empathy. However, only CD severity significantly predicted variance in affective empathy (Table 2.4). CU traits did not enter the equation at Step 2 of the analyses (Sadness, t (181) = .98, p =.33; Happiness, t (181)=0.26, p =.80 and Fear t (181) = 1.09, p =.28).

Table 2.4.
Summary of simple regression analyses for variables predicting affective empathy for sadness, happiness and fear.

Variable	Sadness			Happiness			Fear		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Step 1 (Constant)	3.54	.23		3.53	.20		2.35	.22	
CD severity	-.20	.05	-.28**	-.20	.04	-.31**	-.19	.05	-.28**
R^2		.08			.10			.08	
F		15.19			19.39			15.32	

*Notes: *p<.05, ** p <.001.*

2.3.5 Cardiff Empathy Scoring System Validity

In addition to confirming the inter-rater reliability and internal consistency of the newly developed scoring criteria it was also necessary to assess the correlational validity of CESS with previously used measures. To this end, a subset of the data (10%) was scored using both the Empathy Continuum (Strayer & Rossberg-Gempton, 1992) and Schwenck *et al.'s* (2012) measures and compared to the CESS. Pearson's correlation coefficient was calculated and averaged across the four film clips to compare total cognitive and affective empathy scores (see Table 2.5).

Table 2.5:
Correlational validity between measures of empathy. Pearson's R.

Measure		CESS		EC		Schwenck *et al.*	
	Type of Empathy	Cognitive	Affective	Cognitive	Affective	Cognitive	Affective
CESS	Cognitive	-					
	Affective	.205	-				
EC	Cognitive	.257	.727**	-			
	Affective	.191	.612*	.464*	-		
Schwenck *et al.*	Cognitive	.766*	.116	.271	.07	-	
	Affective	.343	.544*	.510*	.424*	.161	-

*Notes: CESS – Cardiff Empathy Scoring System, EC – Empathy Continuum, *p<.05, ** p <.001.*

Results revealed that the CESS correlated strongly with Schwenck *et al.'s* (2012) measures for both empathy components. The affective scale also correlated strongly with the Empathy Continuum affective scale. The Empathy Continuum cognitive empathy scales did not correlate well with Schwenck *et al.'s* or the CESS but did correlate strongly with the respective affective empathy scales. Neither the CESS nor Schwenck *et al.'s* measures correlated significantly with each other however cognitive and affective empathy measures from the Empathy Continuum were highly correlated.

2.4 Discussion

This study sought to compare cognitive and affective empathy in a large sample of adolescent males with ADHD and ADHD+CD, a previously under-researched group. Our results confirm our hypothesis that there are no differences in cognitive empathy between adolescent males with ADHD with and without comorbid CD. Conversely, adolescents with ADHD and CD showed reduced affective empathic responses compared to those with ADHD alone. These results support previous findings in those with CD alone and support the notion that CD is associated with reduced affective empathy but intact cognitive empathy abilities (*e.g.*, Schwenck *et al.*, 2012). These results are particularly interesting since they are from a large clinical sample of males all of whom had a diagnosis of ADHD and are therefore at risk for developing antisocial behaviour (Thapar *et al.*, 2006). To our knowledge this is the first study to demonstrate reduced affective empathy in adolescents with CD in the context of ADHD. This allows

us to further previous research by concluding that affective empathy impairments previously observed in males with CD are also evident in adolescents with a combined diagnosis of ADHD and CD. It is worth reiterating here that all participants had a clinical diagnosis of ADHD but CD diagnosis was based on a research and not a clinical diagnosis. Given the high comorbidity between the two disorders these findings are particularly important since it is possible that the participants who made up our ADHD and CD group and who showed affective empathy impairments may not have known they met the requirements for CD and thus may not be receiving the appropriate support. Our results suggest that the clinical implications of not diagnosing a comorbid disorder may have consequences for the treatment and prognosis of ADHD and CD.

Contrary to our hypothesis, reduced empathy was not specific to the distress cues (sadness and fear), but also evident in affective empathy for happiness. This is inconsistent with previous studies (*e.g.,* de Wied *et al.,* 2009) that suggest affective empathy impairments associated with CD are specific to negative emotions. One explanation for the discrepancy in findings involves the way in which affective empathy was measured. Rather than focussing purely on the intensity of the emotion(s) identified in the participants, our scoring system also took into consideration why participants felt the emotions they did. We believe this is particularly important for the emotion of happiness since watching film clips is generally considered to be an enjoyable experience. Indeed, some participants reported feeling happy, not because of empathy for the main character's situation, but because they enjoyed watching the clip. This response would receive a lower affective empathy score in our system. If we had employed measures similar to previous studies (*e.g.,* Strayer & Rossberg-Gempton, 1992) there would have been no qualitative difference between the two responses. Consequently, this raises the question as to whether adolescents with ADHD and CD have generally reduced affective empathy or a negative emotion specific one. Indeed, a recent meta-analysis suggests emotional impairments associated with psychopathy are not distress-specific but pervasive across emotion processing (Dawel, O'Kearney, McKone & Palermo, 2012). In support of this view it has been found that individuals high in psychopathic traits showed reduced activation compared to controls in the fusiform gyrus, inferior frontal gyrus, orbitofrontal cortex, and ventromedial prefrontal cortex across pain, sadness, happiness and fearful stimuli (Decety, Skelly, Yoder &

Kiehl, 2014). Nevertheless, the results from our pain data suggest this is not the case in CD insofar as adolescents with ADHD and CD and ADHD alone did not differ in affective empathy for pain. Given that pain could be considered a distress cue, one may expect to observe a reduced affective empathic response to pain as well. Neuroimaging studies suggest that empathy for pain may be processed differently from other negative emotions. Decety *et al.* (2009) found enhanced amygdala response to images of people experiencing pain in aggressive adolescents with CD and therefore no deficit in neural activity. Conversely, other neuroimaging studies have reported reduced amygdala response in adolescents with CD during the viewing of negative valence pictures (Marsh *et al.*, 2008; Sterzer, Stadler, Krebs, Kleinschmidt & Poutska, 2005). Taken together, neuroimaging studies indicate that adolescents with CD are responsive to the pain of others, but less responsive to negative valence emotions such as fear, which mirrors our findings. Given that our study employed film clips which are dynamic and reflect realistic social interactions (Karrow & Connors, 2003) one should be careful in drawing parallels with results from imaging studies using static imagery. We recommend that future research should re-examine empathy for pain in individuals with CD by employing more ecologically valid stimuli.

A second aim of our study was to explore whether clinical variations within our sample of adolescents with ADHD may help explain empathy impairments. We demonstrated that neither cognitive nor affective empathy was related to ADHD symptoms, suggesting empathy impairments are not associated with ADHD *per se.* Instead, a reduced affective empathic response appeared to be consistently associated with more severe CD. Findings were somewhat mixed in terms of CU traits, which were found to be associated with less affective empathy for fear and sadness, but not happiness. Regression analyses confirmed that CD symptom severity uniquely predicted affective empathy impairments greater than that of CU traits. These findings support the idea that a reduced affective empathic response is related to more severe antisocial behaviour through an impaired response to the distress cues of others. This is clinically important insofar as the results suggest that impairments in affective empathy for sadness, happiness and fear may be a risk factor for committing more severe antisocial behaviours. Additionally, it is important to note that CU traits did not explain any additional variance in affective empathy above that of CD symptom severity.

A strength of our study was that we also employed a newly developed scoring system to help overcome problems associated with existing measures. A final aim of this study was to validate the CESS with previous measures of empathy used in similar samples. To achieve this, a subset of the data was scored using the criteria set out in the Empathy Continuum (Strayer & Rossberg-Gempton, 1992) and Schwenck *et al.* (2012) and compared to the CESS. As hoped the CESS showed strong correlation with both empathy measures used by Schwenck *et al.*, suggesting good validity. The affective subscale of the CESS also correlated strongly with the affective scale of the Empathy Continuum however this was not the case for the cognitive empathy measure. Examining this further it was found that the measure of cognitive empathy from the Empathy Continuum correlated highly with the affective empathy subscale of the CESS, Schwenck *et al.* and with its own affective empathy subscale. These results support our original concern that Empathy Continuum's cognitive empathy measure is too dependent on affective empathy and thus has poor construct validity. Taken together, these results suggest the CESS has good validity when compared to Schwenck *et al*., and justifies the decision to develop a new scoring system to improve upon that of the commonly adapted criteria set out by Strayer and Rossberg-Gempton (1992).

2.4.1 Limitations

An important limitation to address is the lack of a control group with no clinical diagnoses to examine more effectively how adolescents with both ADHD and CD and ADHD alone compare to typically developing peers in terms of cognitive and affective empathy. A previous study has suggested adolescents with ADHD show empathy impairments compared to controls (*e.g.*, Braaten & Rosen, 2000); however, since this study did not control for comorbid CD it is not known whether these deficits were linked to ADHD *per se* or to a possible comorbid diagnosis of CD. We found no relationship between ADHD severity and empathy impairments within our ADHD sample, suggesting empathy is not associated with ADHD *per se*; nevertheless since we do not have a normal healthy control group we cannot confidently comment on whether adolescents with ADHD alone exhibit normal empathy or whether they just have better empathy compared to those with comorbid CD. Furthermore, a control group would also allow us to determine whether differences in empathy for pain are due to the

ADHD+CD group performing better for this emotion or the ADHD group performing worse.

A strength of our study compared to some previous studies (*e.g.*, Braaten & Rosen, 2000; Marton *et al.*, 2008) is that we used more ecologically valid, dynamic film clips to induce empathy. By using film clips we can more accurately represent how social interactions take place in everyday life and provide a more realistic setting in which participants can respond (Karrow & Connors, 2003). Nevertheless, the use of film clips represents posed emotions as opposed to naturally expressed emotions. Bons *et al.* (2013) noted that discrepancies in empathic abilities apparent across studies (*i.e.*, de Wied, van Boxtel, Zaalberg, Goudena & Matthys, 2006; de Wied *et al.*, 2009) may be due to naturally expressed emotions triggering a stronger response in healthy individuals, resulting in significant differences between groups compared to responses to posed expressions. With this in mind we recommend that future studies focus on expressed emotions since they represent more realistic emotional situations and may trigger a greater empathic response providing an opportunity to better compare group differences.

General limitations of the study lie in the demographics of the participants. Due to lower prevalence rates of ADHD and CD in females, we only included males in our study. Since sex differences in empathic abilities are evident in adults and children as young as 6 (Baron-Cohen & Wheelwright, 2004; Chapman *et al.*, 2006), males and females with ADHD and CD should be compared in future studies to assess possible differences in this clinical group.

Given that adolescents, especially antisocial adolescents, may have difficulties in verbalising their personal thoughts and feelings (Quiggle, Garber, Panak & Dodge, 1992) future research should employ physiological measures to further examine differences between those with ADHD and ADHD+CD. Similarly, it would be interesting to examine why affective empathy is reduced in those with ADHD and CD. It has been suggested that impaired emotion function is related to reduced attention to key facial features, particularly the eye-region (Klin, Jones, Schultz, Volkmar, & Cohen, 2002), and interventions developed to train and improve these skills appear to be successful (Guastella *et al.*, 2009). Similarly, it has been demonstrated that children

high in CU traits show impaired eye contact with attachment figures (Dadds *et al*., 2014a). A key next step would be to examine eye-gaze patterns in adolescents with ADHD and CD whilst viewing empathy-inducing stimuli, to explore whether a similar mechanism exists. If this proves to be the case, interventions that specifically target affective empathy impairments in adolescents with ADHD and CD can be developed and tested.

2.4.2 Conclusions and Clinical Implication

Despite some of the limitations noted above, we provide evidence for the first time that affective empathy impairments associated with CD are also evident in adolescents with a joint diagnosis of ADHD and CD. This is clinically important given the high comorbidity between the two disorders. Specifically, we have demonstrated that male adolescents with a combined diagnosis of ADHD and CD display affective empathy impairments for sadness, fear and happiness when compared to individuals with ADHD alone. We further demonstrated that these impairments were not related to ADHD symptoms but instead CD symptom severity was shown to be the best predictor of reduced affective empathy greater than that of CU traits. These findings highlight the importance of considering ADHD as a heterogeneous disorder by taking into consideration CD diagnosis and severity, and CU traits when examining associated behaviours. This is clinically important since current treatments for those with ADHD focus on alleviating the primary symptoms of inattention and hyperactivity and do not consider additional impairments that might vary across individuals. Our findings suggest that deficient affective empathy might explain why some adolescents with ADHD are at greater risk for antisocial behaviour. Consequently, these findings have implications for practitioners and policy makers since they indicate that therapeutic interventions commonly used with individuals with social communicative disorders should be adapted to specifically target empathy deficits to help individuals with ADHD and CD. Moreover, since our sample used a research diagnosis of CD our results also highlight the importance of successfully diagnosing CD in the presence of ADHD. Finally, we have developed a new empathy scoring system which we believe is an improvement upon previous methods and can be implemented within future studies to provide a more reliable account of cognitive and affective empathy.

3 Chapter 3: Improving negative emotion recognition in young offenders reduces subsequent crime

Published paper

This is chapter is based on Hubble, K., Bowen, K.L., Moore, S.C. & Van Goozen, S.H.M. (2015). Improving negative emotion recognition in young offenders reduces subsequent crime. *PLoS ONE, 10*(6) (10.1371/journal.pone.0132035)

3.1 Introduction

Antisocial behaviour in childhood and adolescence is associated with a range of negative outcomes in adulthood. It predicts future antisocial behaviour (arrests, severity of crimes, conviction rates and length of prison sentences) (Huesmann, Eron & Dubow, 2002), substance abuse and dependence in adulthood, early pregnancy in girls, persistent health problems, and psychiatric illness (Bardone *et al*., 1998; Fombonne *et al.*, 2001). These negative outcomes are costly to society, as well as to the individuals themselves (Scott *et al.,* 2001); there are high costs not only because of the crimes committed, the extra educational provision required, the foster/residential care needed, and other state benefits during adolescence, but also because of the associated mental and physical health problems of antisocial behaviour in adulthood (Odgers *et al*., 2007). For these reasons intervention strategies and support for young people with antisocial behavioural problems are highly desirable.

The short- and long-term effectiveness of individual-focused preventions (*e.g.,* child skills training) and family-focused preventions (*e.g.,* Multi-Systemic Therapy) in reducing antisocial behaviours has been demonstrated (Farrington & Welsh, 2007). Most of the evidence for the effectiveness of interventions comes from the USA; evidence from the UK has been criticised for being less robust in terms of both the quantity and quality of interventions tested (Ross, Duckworth, Smith, Wyness & Schoon, 2011). Given that statutory Youth Offending Services (YOS) in the UK are arguably more supportive than those in the USA (Butler, Baruch, Hickey & Fonagy, 2011), it is important that the effectiveness of interventions is tested within the context of current provisions. Similarly, whilst some interventions are successful, reoffending data also show that they do not work for everyone. For example, family-focused interventions are highly intensive and require involvement of family members, which is often problematic in young offenders (Losel & Beelmann, 2003). In addition, some young offenders may experience specific problems that are not targeted by standard interventions. The high persistence and poor prognosis associated with childhood antisocial behaviour, coupled with the limited effectiveness of current treatments, are the main reasons why the neuropsychological and neurobiological correlates of antisocial behaviour in childhood should be given more attention in terms of designing targeted interventions (van Goozen & Fairchild, 2008).

One of the best-replicated findings is that individuals who exhibit inappropriate interpersonal and antisocial behaviour have problems in facial emotion recognition, particularly fear and sadness (Marsh & Blair, 2008). According to Blair's (2005) IES model amygdala dysfunctions can impair the ability to correctly process others' distress related cues and thereby contribute to antisocial behaviour. Thus, if a person cannot correctly identify the distress they are causing to another person, they are more likely to continue with the behaviour that is causing the harm. Consistent with this theory empirical studies have found specific fear and sadness recognition impairments among clinical and community samples of antisocial individuals, including psychopathic adults (Blair *et al*., 2004; Glass & Newman, 2006), children high in psychopathic traits (Blair, Colledge, Murray & Mitchell, 2001), adolescents with conduct disorder (Fairchild *et al.*, 2009a), adolescents with mental health problems (Leist & Dadds, 2009), and antisocial adolescents recruited from mainstream schools (Dadds *et al*., 2006) or the community (Bowen *et al.,* 2014). Nevertheless, a recent meta-analysis indicates that a more general facial emotion recognition impairment is evident in psychopathy (Dawel *et al.,* 2012). Indeed, problems with disgust (Kosson *et al.,* 2002) and anger have also been observed (Schonenberg *et al*., 2013), with impairments in anger recognition in particular being reported in adolescents who display antisocial behaviour (Leist & Dadds, 2009), adolescents with early-onset conduct disorder (Fairchild *et al.,* 2009a), and juvenile offenders (Bowen *et al*., 2014). Evidence of pervasive deficits, combined with evidence suggesting boys with conduct problems show impairments in allocating attention to emotionally salient stimuli (Dadds, Jambrak, Pasalich, Hawes & Brennan, 2011), has led to the proposition that a more general dysfunction in attentional mechanisms underlies the facial emotion recognition deficits in those who show antisocial behaviour (*e.g.* Dadds *et al*., 2006).

Finally, it has been shown that delinquents are more likely than non-delinquents to misinterpret expression of disgust as anger (Sato, Uono, Matsuura & Toichi, 2009), and ambiguous or neutral expressions as negative (Best, Williams & Coccaro, 2002). A bias towards anger (*i.e.,* a hostility bias), as opposed to a deficit in anger recognition, may lead one to expect more dangerous and threatening situations, and thus contribute to antisocial behaviour. A recent study in young offenders suggests that both accounts may be true. Bowen *et al.* (2014) found evidence to suggest than young offenders were better

than controls in detecting high intensity angry faces, but were impaired in detecting low intensity ones. Since angry faces serve as warning signals of social punishment, young offenders may be less sensitive to low intensity or early warning signals and thus continue to behave in socially unacceptable ways. Targeted emotion recognition interventions (Tracy, Klonsky & Proudfit, 2014) could reduce these biases and also improve the ability to detect more subtle emotional expressions. This approach might contribute towards reducing antisocial behaviour.

Training programs that teach participants to pay more attention to important facial features using explicit methods (Golan *et al*., 2010; Neumann, Babbage, Zupan & Willer, 2014) – which specifically remind participants to look at key facial areas – or implicit methods (Schonenberg *et al*., 2013) – which do not explicitly mention key facial areas, but train participants to examine these areas by following a dot probe - demonstrate that facial emotion recognition can be modified. Two recent studies indicate that emotion training could also be effective in young people with behavioural problems. In a randomised control trial of 195 children with emotional and behavioural problems, Dadds and colleagues (2012) compared the effect of treatment-as-usual with and without an emotion recognition training programme. The training programme consisted of daily parent-child interactional exercises using a MindReading programme that aimed to train children to accurately perceive and interpret human emotions. While the emotional training has no beneficial effect on parent and teacher reported conduct problems in an offender group as a whole, behaviour of those with CU traits (even without a diagnosis of CD) was judged to have improved. However, since the training involved close parent-child interactions which were not mirrored in the treatment-as-usual group, it is not known whether any benefits in training were due to improvements in relationships.

Penton-Voak and colleagues (2013) were successful in modifying emotional cognitive biases of angry ambiguous expressions in aggressive youths, who subsequently reported fewer self- and staff-reported aggressive behaviour in the two weeks after intervention. The addition of staff-reported aggressive behaviour is particularly useful given the accuracy and honesty of self-reported behaviour is questionable. Nevertheless, staff could only report on behaviour during weekdays leaving the behaviour of participants in the evenings and weekends when they are away from the context of social support and

more able to commit official offences, unaccounted for. To our knowledge, no study has examined the effect of emotion training on objective official crime rates or included information about the type or severity of behaviours. Since increased aggression and offence severity are related, this last point may be particularly beneficial to include given the link between deficits in recognising distress cues and continued aggressive behaviour proposed by the IES model (Blair, 2005).

If young offenders' facial emotion recognition of key distress emotions like fear and sadness can be improved through training, then according to the IES model such interventions could alter how young offenders respond and interact with potential victims. Similarly, by improving the detection of anger, young offenders may pick up early warning signals of social punishment more effectively and refrain from continuing their negative actions. On the other hand, an improved ability to detect anger may reduce misinterpretation of other emotions, such as disgust, and lead to less threatening responses in otherwise non-threatening situations. Consequently, the training of these emotions could have positive effects on future antisocial behaviour, ultimately leading to a reduction in crime. We therefore decided to use an emotional training programme that aimed to improve the recognition of emotions - as opposed to a programme similar to that used by Penton-Voak *et al*. that aimed to modify behaviour by altering biases in emotions. Similarly, given the emotion recognition training employed by Dadds *et al.* did not show strong effects when CU traits were not considered we also wanted to include more than solely recognition training. Consequently, we decided to train emotion recognition using the Facial Affect Recognition (FAR) intervention (Neumann *et al*., 2014) which has previously been shown to improve emotion recognition in patients with chronic post-traumatic brain injury. This programme not only trained participants to recognise different emotional expressions but also linked these facial expressions to emotional situations. This also allowed us to examine a range of emotions (happiness, sadness, fear and anger) separately rather than focusing on a single emotion (Penton-voak *et al.*, 2013). This is particularly important given the findings from Chapter 2 which suggested that emotion processing deficits associated with antisocial behaviour are not consistent across emotions but may be specific to certain emotions.

The current study therefore assessed facial affect recognition and objectively recorded crime levels in a group of juvenile male offenders prior to and after completion of an emotion recognition training intervention and compared their data to those of juvenile male offenders who did not complete the training intervention. We expected (a) that the training would result in a significant improvement in the recognition of those negative emotions that were trained (fear, sadness, anger), and (b) that offenders in the training condition would show a greater reduction in reoffending levels compared to those receiving the usual treatment up to six months post training.

Whereas Chapter 2 was focused on furthering our knowledge of empathy deficits associated with antisocial behaviour, Chapter 3 took a different pathway aiming to examine whether improvements in already known deficits could improve antisocial behaviour. As such, Chapter 2 and Chapter 3 were conducted concurrently using different stimuli to reflect the different areas of emotion processing being examined. Since one of the main aims of Chapter 3 was to examine the effects of an emotional intervention on subsequent crime it was necessary to recruit a sample of participants with whom this information was available. In addition, since the training required multiple testing-days over a set timeframe it would not have been feasible to recruit from the same pool of participants recruited in Chapter 2 who traveled some distance to attend experiment sessions. Instead we recruited from two Youth offending teams where we had access to official crime data associated with each participant and had a setting where we could timetable in the timeslots required for testing. Additional measures were kept consistent across these two chapters for example the YPI and WASI.

3.2 Method

3.2.1 Participants

Male young offenders (YOs) aged 12–18 years (mean = 16.21) took part and were recruited from the Cardiff and Vale of Glamorgan Youth Offending Services (YOS). Young offenders were recruited with the help of YOS caseworkers who recommended suitable participants. All participants completed the emotion recognition test twice (average time between tests = 23 days). YOs were eligible to participate if they had

been convicted of an offence and received a court order to attend the YOS. To be included in the analyses participants were required to have completed the pre- and post-facial recognition measures in the required time frame without incarceration; however, later incarceration was not a reason for exclusion. All participants met these eligibility requirements and no participants dropped out from the study. A group of 24 offenders (Training group) completed the emotion training in the interval between the first and second emotion recognition test; another group of 26 offenders (Control group) was tested twice during the same time period, but did not receive the emotion training. Group allocation was strongly influenced by the opportunity and availability of the offenders to attend the YOS offices, where testing took place, for the required number of sessions. This was discussed with caseworkers before participants were officially approached about the study. Participants were specifically asked to take part in the Training group or the Control group, and were not given the option to choose between conditions. All parts of the study were completed at YOS offices and conducted by trained researchers. Sample size (n = 50) was based on a previous study comparing YOs and non-offending matched controls (Bowen *et al*., 2014).

3.2.2 Ethical Statement

The study was approved by the School of Psychology Research Ethics Committee at Cardiff University. All participants (n = 50) and their parents/guardians provided written informed consent.

3.2.3 Measures and Materials

3.2.3.1 Crime data

Data on the number and severity of offences that YOs had committed and which had led to criminal prosecutions by a court were compiled from YOS databases after the completion of the emotion recognition/training study. For each offender we collected crime data covering three time periods: (1) lifetime crime data; these covered all known crimes ever committed up to 12 months ago; (2) pretest crime data; all known crimes committed in the 6 months leading up to the first emotion recognition test, and (3) posttest crime data; all known crimes committed in the 6 months following the second emotion recognition test. From these time periods we examined: (a) the total number of

known offences; (b) the mean severity score for all known offences, and (c) the severity score for most severe offence known to have been committed. Juvenile offenders had been involved in the following types of offence: aggravated burglary, aggravated taking, arson, assault, attempted robbery, attempted theft, breach of order, burglary, public order (harassment, affray), public order (common assault), criminal damage, motor/traffic offences, obstructing police, drug offences, robbery, shoplifting, theft, public order (threatening, abusive), trespassing, TWOC (taking [vehicle] without owner's consent), wounding with intent to do GBH (grievous bodily harm; i.e., assault). The YOS also assigns each offence a severity score ranging from 1 (*e.g.*, minor public order offences) to 8 (*e.g.*, murder). In case of multiple offences, the highest severity score (the most serious crime committed) was recorded. The mean number of known offences in our sample before the start of our study (lifetime offence rate) was 6.68 (*SD* = 8.75; range 1-49), the mean severity score was 3.20 (*SD* = 1.09; range 1-6), and the mean score of the most severe offence committed was 4.82 (*SD* = 1.66; range 1-7).

3.2.3.2 SES and IQ

Many of the offenders were not in statutory full time education, but received some form of education provided by the YOS. Because of this it was considered to be more appropriate to use measures of IQ to assess educational ability. The two-subset form of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) was used to provide an estimated IQ score (see section 2.2.3). Twenty offenders in the training group and 17 in the control group provided IQ data. Socio-economic status (SES) was estimated using the National Statistics estimates of average household total weekly income based on each participant's postcode (Low = £0 - £520; Middle = £521 - £670; High = £671+).

3.2.3.3 Personality measures

The Youth Psychopathy Inventory (YPI: Andershed *et al.*, 2002) was used to provide an overall indicator of psychopathic tendencies and a subscale score for CU traits (see section 2.2.3 for more details) For CU traits a subscale score was calculated, which could range between 15 - 60 with a higher score being indicative of higher CU traits. Forty-two young offenders completed this measure (Training = 22; Control = 20); eight participants were unable or unwilling to complete the questionnaire.

3.2.3.4 Facial emotion recognition measure

The Facial Emotion Recognition (FER; see Bowen *et al*., 2014 for details) measure consists of a series of 150 slides, taken from the Ekman and Friesen (1975) facial affect battery, presented on a laptop. Six target faces – three male and three female – were used. Each target displays a neutral expression or one of five basic emotions (happy, sad, anger, fear or disgust); emotional expressions were morphed with their corresponding neutral expression (0% emotion) to display faces at 25%, 50%, 75% and 100% emotional intensity. The hair and background of the image had been blacked out so that only the facial features remained (see Figure 3.1 for example face stimuli).

The question "What emotion is this person showing?" accompanied the target image, which was displayed on a computer screen alongside a list of numbered options. The options were (from 1 to 6) "happiness", "sadness", "fear", "anger", "disgust" and "neutral". Participants were required to register their responses on the computer using the appropriate key press (*i.e.* 1 = happiness). Information regarding which key to press for each emotion was displayed on the screen throughout the duration of each trial. Percentage correct recognition scores for each emotion were calculated.

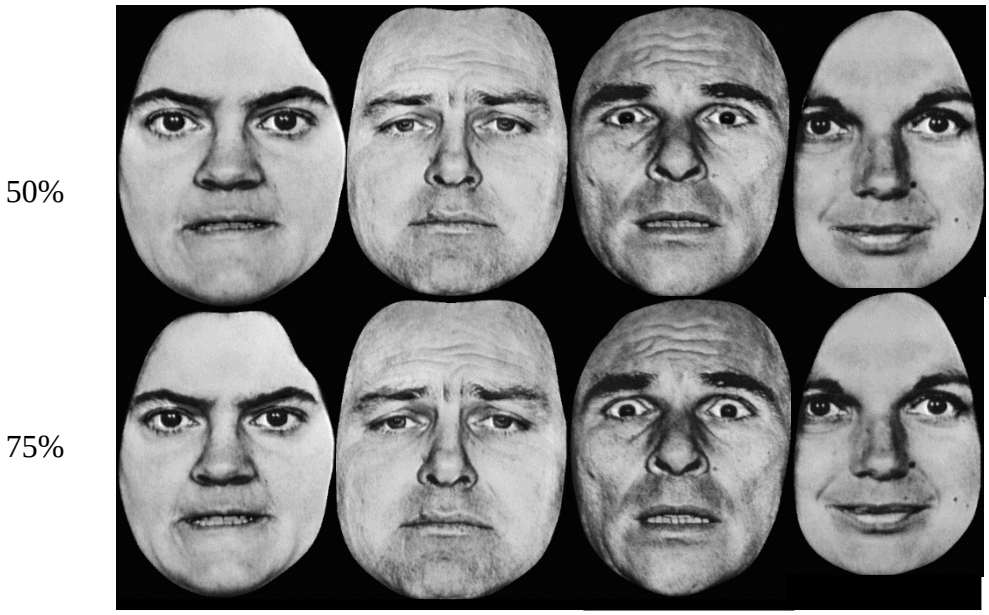

Figure 3.1: Example stimuli selected from Bowen *et al*., (2014).

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3.2.3.5 YOS intervention

Participants were known to the YOS, had their own caseworker and continued to receive their statutory interventions and allocated contact time with the YOS for the duration of the study (including the 6 months follow-up). The type of intervention and amount of contact with the caseworker varied between offenders depending on the court order received and their risk of reoffending.

Ten YOs (training = 4; control = 6) belonged to preventative or early intervention programmes. Offenders on these orders are considered at low level of risk of reoffending and are seen less regularly. Thirty-four participants had a Youth Rehabilitation Order (training = 16; control = 18), which is the standard community sentence for the majority of offenders. The specific requirements of the order and the amount of contact with the YOS follow an individual risk- and needs-based approach. Six participants were on probation after a custodial sentence or on bail (training = 4, control = 2). Offenders on these orders are considered at high risk and are seen 3-5 times a week. Although all interventions are tailored to each individual, most orders encourage engagement with statutory education and will work with the young person to put this in place if it is not currently happening (for example, through training, work placements, apprenticeships and college), as well as with health, substance misuse and family support services, and focus on restorative justice and encourage victim work.

3.2.3.6 Emotion Training

We used an adapted version of the Facial Affect Recognition (FAR) intervention (Neumann *et al*., 2014) which has previously been shown to improve facial emotion recognition in participants with chronic post–traumatic brain injury. The protocol-based computerised intervention was designed to train participants to identify the emotional expressions of happiness, sadness, fear and anger. The FAR consists of several levels of emotion tasks. For example, tasks require participants to identify the emotional expression of a face, to describe an event that has made them feel that emotion, and mimic the emotion using a mirror. Tasks also require participants to focus on specified features of an emotional face and select the correct description of that feature from

several options. Difficulty in correctly identifying the emotional expression gradually increases throughout the intervention by using lower intensity facial expressions and by using fewer cues to guide participants' attention. All elements of the FAR were completed, however the delivery time was adapted to take into consideration that YOs generally completed the intervention much faster than participants in previous studies (Neumann *et al.*, 2014), and could only been seen once a week. Participants completed the tasks within two to three sessions over a 2-week period. Total training time was approximately 2 hours.

3.2.4 Data Analyses

The FER variables are mean correct recognition scores for happy, sad, fearful, disgust and angry expressions, at both pre- and post-test. A mixed-design ANOVA was used with emotion (5 levels), and time (2 levels) as within-subject factors, and group (Training vs. Control) as between-subject factors. Where the assumption of sphericity was violated the Huynh-Feldt correction was used. Planned follow-up tests explored the effect of training on each emotion separately and used the Bonferonni correction. One-way ANOVAs examined differences in age, IQ, SES and personality measures between the experimental groups. Time to reoffend was analysed using the Cox (1972) Proportional Hazards Model. To compare mean offence rates of the training and control group and their severity scores 6 months after the training, general linear models were used. To adjust for the possibility of regression to the mean, baseline scores were subtracted from mean posttest scores and included as a covariate (Barnett, van der Pols & Dobson, 2004). To explore count data such as the total number of offences committed, negative binomial regression was used.

3.3 Results

Chi-square analysis revealed no differences between the Control and Training groups with respect to type of orders and interventions received, $\chi^2(2) = 1.1$, $p = .58$, and no differences in the amount of contact participants had with the YOS for the duration of the study, $\chi^2(2) = 3.63$, $p = .16$.

3.3.1 Demographic Characteristics and Pre-training Crime Data

Table 3.1 shows the demographic characteristics and the offence data for both groups. Chi-squared analysis revealed the groups did not differ in socio-economic status, $\chi^2(2) = 2.03$, $p = 0.36$. One-way ANOVAs indicated that the Training and Control groups did not differ in age, $F[1, 49] = 0.59$, $p = .45$, IQ, $F[1, 35] = 0.96$, $p = .33$, psychopathic traits, $F[1, 41] = 3.04$, $p = .09$, CU traits, $F[1, 41] = 0.33$, $p = .57$, age of first offence, $F[1, 48] = 3.58$, $p = .07$, or lifetime offending rate, $F[1, 49] = 0.04$, $p = .84$. Although the groups did not differ in offending rate, $F[1, 49] = 2.74$, $p = .10$, or crime severity, $F[1, 49] = 2.06$, $p = .16$, in the 6 months leading up to the emotion recognition study, they differed in terms of their most severe offence, with YOs in the Training group committing marginally more serious offences, $F[1, 49] = 3.88$, $p = .055$; $\eta^2 = .08$.

Table 3.1:

Demographic characteristics and offending data of young offenders

Variable	**Training**	**Control**
Age (years)	16.08 (1.2)	16.35 (1.2)
IQ	80.89 (9.64)	83.77 (7.64)
SES (mean)	1.3 (0.62)	1.6 (0.86)
Low (= 1)	79% (19)	65% (17)
Middle (= 2)	13% (3)	12% (3)
High (= 3)	8% (2)	23% (6)
YPI	115.2 (16.5)	125.8 (22.8)
CU traits	34.2 (6.6)	35.5 (8.4)
Age at first offence	14.17 (1.7)	13.24 (1.7)
Lifetime offence rate	6.42 (6.24)	6.92 (10.68)
Pretest offence rate (6m pretest)	3.63 (4.95)	1.92 (1.67)
Pretest offence most severe (6m pretest)	3.75 (2.23)	2.62 (1.84)
Pretest offence mean severity (6m pretest)	2.92 (1.82)	2.24 (1.53)

Re-offence rate (6m posttest)	1.67 (2.58)	0.92 (1.44)
Re-offence most severe (6m posttest)	2.08 (2.28)	1.85 (2.53)
Re-offence mean severity (6m posttest)	1.76 (1.89)	1.57 (2.11)

Table entries show mean values (standard deviations in parentheses), or % of group (with numbers in parentheses); IQ = intelligence quotient; SES = socio-economic status; YPI = Youth Psychopathy Inventory; CU = Callous and Unemotional.

3.3.2 Emotion Recognition: Training and Control Group Comparisons

Figure 3.2 shows pretest and retest scores on fear, anger, sadness, happiness and disgust for the Training and Control groups. The three-way interaction between group, emotion and time was significant, $F[4,164] = 2.44$, $p = .05$, $\eta^2 = .01$. We therefore next examined the effect of time and condition on each emotion separately.

3.3.2.1 Fear

There was a significant time by group interaction, $F[1, 48] = 13.00$, $p = .001$, $\eta^2 = .17$. Simple effects tests revealed fear scores did not differ between groups at pretest, $F[1, 48] = 0.24$, $p = .63$, $\eta^2 = .00$; however, at posttest the Training group performed significantly better, $F[1, 48] = 20.46$, $p < .001$, $\eta^2 = .30$. The Training group significantly improved from pre- to posttest, $F[1, 48] = 25.91$, $p < .001$, $\eta^2 = .35$, whereas there was no difference as a function of time in the Control group, $F[1, 48] = 0.09$, $p = .93$, $\eta^2 = .00$.

3.3.2.2 Sadness

There was a significant time by group interaction, $F[1, 48] = 14.30$, $p < .001$, $\eta^2 = .23$. Simple effects tests revealed that sadness scores did not differ between the groups at pretest, $F[1, 48] = 0.09$, $p = .77$, $\eta^2 = .00$, but the Training group performed significantly better at posttest, $F[1, 48] = 8.89$, $p = .004$, $\eta^2 = .16$. The Training group significantly improved from pre- to posttest, $F[1, 48] = 10.93$, $p = .002$, $\eta^2 = .19$, whereas the Control group performed worse over time; $F[1, 48] = 4.07$, $p = .049$, $\eta^2 = .08$.

3.3.2.3 Anger

There was a significant time by group interaction, $F[1, 48] = 10.13$, $p = .003$, $\eta^2 = .17$. Follow-up tests indicated that the Training group showed a significant improvement in

the recognition of anger after training, F[1, 48] =10.16, p = .003, η^2 = .18; the Control group did not differ between pre- and posttest, F[1, 48] = 1.63, p = .21, η^2 = .03. At posttest the Training group recognized significantly more angry expressions than the Control group, F[1,48] = 19.22, p <.001, η^2 = .286, although there was no difference at pretest, F[1, 48] = .609, p = .439, η^2 = .013.

3.3.2.4 Happiness

There was a significant main effect of group, F[1, 48] = 4.99, p = .030, η^2 = .094, with the Training group recognising more happy faces. However, there was no effect of time, F[1, 48] = 0.75, p = .391, η^2= .01, and no interaction between time and group, F[1, 48] = 1.87, p = .178, η^2 = .04. This shows that the groups did not improve significantly over time.

3.3.2.5 Disgust

There was no main effect of time, F[1,41] = 0.88, p= .35, η^2 = .02, or group, F[1,41] = 0.00, p =.97, η^2 = .00, and no significant interaction between time and group, F[1,41] = 0.39, p =.54, η^2 = .01.

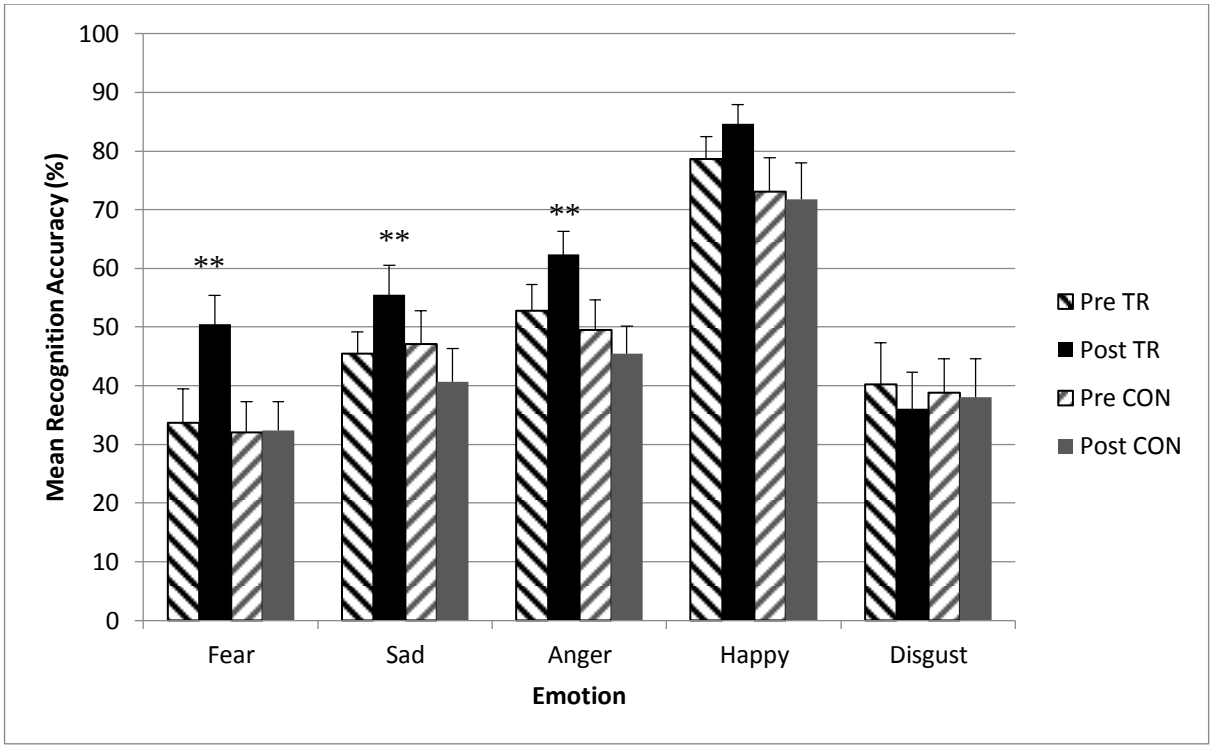

Figure 3.2: Mean fear, sadness, anger, happiness and disgust recognition scores for young offenders in the Training (TR) or Control (CON) group at pretest (Pre) and retest (Post). Error bars show +2 SE. *p<.05, **p<.01.

3.3.3 Reoffending Data 6 Months After Testing

Posttest reoffending data are shown in Table 1. In the 6 months after the training 12 offenders in the Training group and 10 offenders in the Control group reoffended. There were no differences between the groups in offence frequency (z = 1.02, p = .31) or severity, F[1, 49] = 0.12, p = .73. A random effects negative binomial model revealed a significant reduction in offence rates from the pre- to post-training 6-month periods for both groups (z = -3.45, p < .01). However, paired samples t-tests and general linear models adjusting for baseline differences from the mean only showed significant reductions in reoffending severity for the Training group (re-offence mean severity: t(23) = 2.17, p = .04; re-offence most severe: t(23) = 2.82, p = .01; B = -0.35, z = -2.07, p = .04; see Figure 3.3). There was no difference between groups in the time it took to reoffend (z = 0.70, p = .48), accounting for right side censoring and time in custody. Eleven offenders were in custody in the 12 months of the assessment period, three in the six months period before (2 Training, 1 Control) and eight in the 6 months follow-up period (4 Training, 4 Control). These subgroups did not differ in the number of days

spent in custody, and nor was being in custody associated with the number or severity of crimes committed (*p*s > .05).

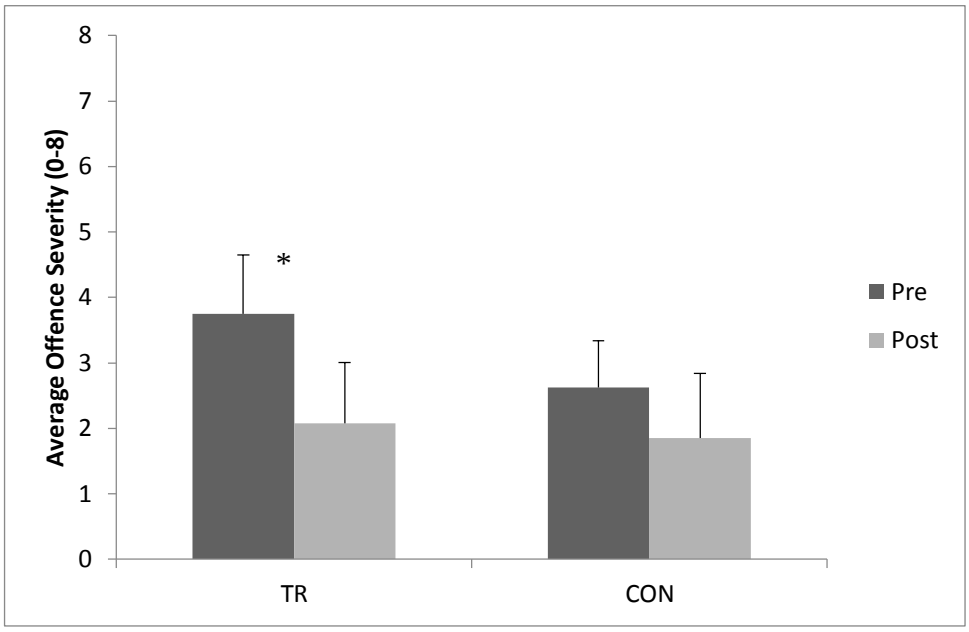

Figure 3.3: Effect of emotion training on crime: Offence severity 6 months before (pre) and 6 months after (post) for young offenders in the Training (TR) or Control (CON) group. Error bars show +2 SE. **p*<.05.

3.4 Discussion

The present study sought to establish whether emotion recognition abilities could be improved in young offenders, a group that has been found to have particular problems in recognising negative emotions (Bowen *et al.,* 2014). An intervention that has been shown to improve emotion recognition in individuals with acquired brain injury (Neumann *et al*., 2014) was used and emotion recognition performance of offenders receiving emotion training was compared to a matched control group of offenders not receiving training. This study is the first to investigate whether emotion training can positively affect subsequent reoffending as assessed through objectively recorded crime data.

The findings show that juvenile offenders in the Training and Control groups displayed statistically equivalent recognition abilities at pretest and confirm previous findings of poor recognition of negative emotions in offenders. Bowen *et al.* (2014) compared young offenders (YO) to matched controls (MC) and reported the following recognition rates: Fear: YO = 35%, MC = 39%; Sadness: YO = 46%, MC = 52% Anger: YO =

50%; MC = 55%. Happiness: YO = 81%; MC = 81%. We also demonstrated that the emotion training had a significant positive effect on emotion recognition scores in the subgroup of offenders that received the training. There was a significant improvement in the recognition of fear and sadness, two emotions known to be difficult to recognise in antisocial individuals, as well as in anger, with recent evidence suggesting that young offenders may particularly struggle to detect lower intensity angry faces (Bowen *et al*., 2014). Importantly, these improvements were specific to the Training group and not due to repeated testing, because offenders in the Control group showed either no improvement (fear, anger) or got worse (sadness) in recognising these emotions. It is not surprising that there was no significant improvement in happiness recognition since young offenders generally do not show impairments in detecting this emotion, also confirming previous results (Blair *et al*., 2001; Best *et al*., 2002).

Previous studies have found disgust recognition impairments in antisocial children (Fairchild *et al*., 2009a) and our results did show impaired disgust recognition at pretest. However, disgust did not form part of the training and no improvement was observed over time. Our results therefore indicate that improvement in emotion recognition was specific to those emotions that were trained. This finding is in contrast to Schonenberg *et al*. (2013), who found that the implicit training of violent offenders to attend to the eye areas of fearful faces, which gradually decreased in intensity, led to a better detection of fear but also improved sensitivity to other basic emotions. We suggest a number of subtle differences in the design of the two studies, which may account for these differing results. Firstly, we measured facial emotion recognition using still images of varying intensities and recorded percentages of correct responses, whereas Schonenberg *et al*. measured emotion recognition using dynamic emotion expressions. Secondly, our sample included young offenders in general, whereas Schonenberg *et al.* utilised a sample of violent offenders high in psychopathic traits whose impairments may be qualitatively different. Finally, Schonenberg *et al.* found that only an implicit task, which gradually decreased in intensity led to improvements whereas training to increase attention to the eye without decreases in intensity did not improve facial recognition. This highlights important differences in training designs. Since our training was explicit in teaching young offenders how to identify key facial features belonging to certain emotional expressions, and not just to (only) pay attention to the eye-regions, it is may be not surprising that our training effects did not spillover to different,

untaught emotions. We believe this difference could be qualitatively important and may result in more prolonged learning and therefore have a greater impact on behaviour than any method that only focuses on implicit learning. Nonetheless future studies comparing improvements associated with different training techniques would be beneficial to clarify these differences.

Turning to the crime data, we found that offenders in the Training and Control groups were similar with respect to lifetime crime data (as well as age, IQ, SES and CU traits) before the study, but differed in offence severity in the 6 months before the training, with those who went on to take part in the emotion training having committed more severe offences (d = 0.55). When we examined crime data in the 6 months following the training, we found that both groups exhibited significant reductions in reoffending rates. Given that all juvenile offenders continued to be closely monitored and to receive their 'treatment as usual' by the YOS during this period, it is unsurprising that both groups of offenders showed a reduction in offending rates. However, we found that only young offenders who participated in the emotion training showed a significant reduction in the severity of the crimes they committed. Taking Blair's (2005) theory into account, it is not surprising that the improvements relate specifically to offence severity. High severity crimes generally involve more physically aggressive behaviour and more interpersonal violence compared to less severe crimes that typically include theft and criminal damage. It is possible that the improvements in the recognition of angry, sadness and fear in others as a result of the training resulted in a better understanding of the emotions of potential victims and thus a reduction in physical aggression and the commitment of severe offences.

3.4.1 Limitations

It should be noted that the observed effects, in terms of offences severity, were relatively small and of moderate effect size. This is understandable in a sample as small and complex as the current one. Most of the young offenders were persistent offenders (see Table 1 for lifetime crime data) and therefore by definition those whose offending trajectory is resistant to change. In addition, the training time was relatively short. We consider this to be a major benefit of the program, demonstrating how a short, quick and easy to administer intervention can have positive results. Nevertheless, a previous study

using the same intervention in a sample of patients with severe traumatic brain injury (Neumann *et al*., 2014) allocated significantly more time to complete the training (9 hours). The nature of that sample may be responsible for the longer duration. However, it may also be that in order to obtain larger effects, a longer and more advanced program could be beneficial in young offenders. This could include the training of additional emotions such as disgust, that have been shown to be related to antisocial behaviour, and the training of how to respond to others who are afraid, sad, and angry.

The intervention was not randomised. Because of logistical issues within the YOS it was not possible to randomly allocate offenders to group; consequently, a quasi-experimental design was used based on the availability of young offenders to attend the YOS offices. With the help of caseworkers it was decided in advance whether offenders would be able to attend for the number of sessions required to complete training. Those who were unlikely to be able to attend all sessions formed the control group. It could be argued that this could have biased the sample; however, we have shown that the two groups did not differ on a number of key variables suggesting the groups were equal. It should be noted that there are other possible confounding variables, which we did not control for and that could have impacted upon our data, such as substance use, self-reported aggression, opportunity, and maltreatment. Our findings should therefore be interpreted with this caveat in mind. Despite the drawback of non-randomised designs, evidence suggests that there are no differences in magnitude of effect sizes between randomised control trials and quasi-experimental designs (de Vries, Hoeve, Assink, Stams & Asscher, 2015) Furthermore, according to The Maryland Scientific Methods Scale (Farrington, Gottfredson, Sherman & Welsh, 2002), the current intervention reflects a Level 3 intervention program to the extent that we measured of crime before and after the training programme, using a comparable control group, whilst controlling for other variables that influence crime. A supportive Level 3 evaluation provides evidence that an intervention is promising. Future research will need to confirm these results within a randomised control trial framework. Finally, our study does not explain why the emotion training improved expression recognition and reduced reoffending severity. Future research should employ techniques like eye-tracking methodologies to establish why and how improvement is achieved. This may also help to clarify whether the recognition impairments in offenders are caused by abnormal attention or scanning patterns.

3.4.2 Conclusions and Clinical Implications

We have shown that emotion recognition can be improved in youths who come into contact with the police for a wide range of different types of antisocial behaviour problems by administering a relatively brief, targeted intervention. Importantly, the training subsequently had a positive effect on criminal behaviour by reducing reoffence severity. This suggests that interventions that target neurobiological impairments are not only relatively easily achievable, but also have a beneficial impact on the lives of young people and their communities.

Within the autism literature compensatory changes in neural activity, measured by fMRI, have been observed alongside improved recognition in those with autism trained to attend and interpret emotional faces (Bolte *et al*., 2006). It is therefore possible that targeted trainings such as the one implemented here affect the neural processes involved in emotion recognition and thereby achieve long-term behavioural change, particularly in a young sample in which the brain is still developing (Olesen *et al*., 2004). If this training can alter young offenders' neural activity and produce improvement in recognition, it would provide a cost-effective and relatively quick way of managing a population of individuals whose combined offending produces the majority of harm in their communities.

4 Chapter 4: Oxytocin improves facial emotion recognition efficiency but leaves accuracy and eye-gaze unaffected

Paper in preparation

This chapter is based on Hubble, K., Daughters, K., Manstead, A.S.R., Rees, A., Thapar, A., & van Goozen, S.H.M. (2015). Oxytocin improves facial emotion recognition efficiency but leaves accuracy and eye-gaze unaffected. *Paper in preparation.*

4.1 Introduction

The ability to accurately recognise emotional facial expressions facilitates our understanding of the intentions, feelings, and reactions of others which is necessary for adaptive social functioning in interpersonal situations (Carr & Lutjemeier, 2005). Proficiency in recognising emotions has been linked to altruistic helping behaviour (Marsh, Kozak & Ambady, 2007). Conversely, deficits in emotion recognition have been associated with antisocial behaviour and psychopathy (Marsh & Blair, 2008). Thus, improving the ability to recognise emotional facial expressions may have the potential to improve social functioning in healthy and clinical samples. Indeed, evidence from Chapter 3 suggests that training participants to attend to important facial features improves emotion recognition and reduces the severity of subsequent crimes. The current Chapter aims to further these findings by establishing whether the neuropeptide oxytocin (OXT) can also improve facial emotion recognition.

The neuropeptide OXT has been found to play a central role in the regulation of social behaviour and social cognition (Heinrich, von Dawan & Domes, 2009) and has generally been associated with a range of prosocial behaviours including increased trust (Kosfeld *et al.,* 2005), and generosity (Zak *et al.,* 2007). Since the ability to decode another's facial expressions is necessary for social interaction, it is not surprising that OXT has been shown to improve the recognition of emotional facial expressions (for review see Shahrestani *et al.,* 2013). Nevertheless, there appear to be inconsistencies across studies. While some studies have reported that OXT selectively improves the recognition of certain emotions, for example happiness (Marsh *et al*., 2010) and fear (Fischer-Shofty *et al.,* 2010), others report that OXT results in a general improvement in facial emotion recognition across emotions (Shahrestani *et al.,* 2013), or indeed OXT does not enhance recognition accuracy but improves the threshold at which emotions are recognised (Lischke *et al.*, 2012).

To better understand the mechanisms through which OXT may promote facial emotion recognition improvement it is useful to examine evidence from clinical populations who show impairments in emotion recognition. It has been suggested that recognition impairments associated with individuals with autism spectrum disorders (ASD) are due, in part, to a lack of spontaneous attention to the eye-region of faces. For example, individuals with ASD who viewed actors interacting during an emotional scene were

found to fixate upon the mouth region twice as long as non-clinical controls and to the eye-region for half as long (Klin *et al.*, 2002). Based on this, it seems plausible that OXT might improve emotion recognition by altering eye-gaze towards the eye-region of faces.

A study, conducted by Guastella and colleagues (2008) found that participants who received OXT spent more time fixating upon the eye-region of neutral faces and returned more frequently to this area compared to participants receiving placebo. Although this study did not consider different emotions, Guastella *et al.* suggest that OXT has a direct influence on the ability to understand the emotions of others. It has also been shown that OXT enhances the ability to infer emotions from subtle cues around the eye-region (Domes, Heinrichs, Michel, Berger & Herpertz, 2007a) and alters eye-gaze towards the eye-region of faces in individuals with ASD (Andari *et al.*, 2010). While these studies did not assess the link between eye-gaze and emotion recognition explicitly, they support the idea that OXT may improve emotion recognition by increasing attention to socially relevant stimuli, in this case, the eye-region. Nevertheless, in the only study to our knowledge to assess this link directly, Lischke *et al.* (2012) found that whilst OXT improved the threshold for recognition (participants on OXT recognised emotions at lower intensities), eye-gaze and overall accuracy were unaffected. This study was conducted using dynamic faces, changing from low to high intensity. The authors suggest that the eye-region may be less salient in dynamic faces compared to static faces and that attention may be captured more by the eyes in static faces since the eyes are assumed to be the most informative part of the face (Adolphs, Baron-Cohen & Tranel, 2002). Indeed, it has been shown that the relative importance of the eyes reduces when using dynamic faces (*e.g.*, Vo, Smith, Mital & Henderson, 2012). A key next step would therefore be to determine whether OXT alters eye-gaze to static emotional faces. Furthermore, in the only study to previously examine the link between eye-gaze and emotion recognition a between subjects design was used (Lischke *et al.*, 2012). Given the large variations in individual responsivity to OXT across participants (Daughters *et al.*, 2015), it is important to explore the effects of OXT using within-subjects designs.

To this end, we compared facial emotion recognition across the six basic emotions, using a double-blind within-subjects randomised control trial of intranasal OXT. The

robustness of this design was chosen to improve on some of the limitations discussed in Chapter 3 associated with non-random assignment and enabled us to control for extraneous variables such as individual differences in response to OXT. An additional aim was to explore the mechanism by which OXT may affect facial emotion recognition by measuring eye-gaze. In order to achieve these aims participants completed a facial emotion recognition task similar to that used in Chapter 3 using medium intensity, whole, static faces with the additional improvement of incorporating an eye-tracker into the design of the emotion recognition task to enable eye movements to be tracked. Saliva samples were collected throughout each session to provide an indicator of OXT levels. Unfortunately, due to ethical restrictions this study could not be undertaken in a similar sample to those utilised in Chapters 2 and 3. Instead healthy male undergraduates were recruited; how this relates to the overall topic of adolescent antisocial behaviour is discussed in section 6.1.9.

In line with evidence suggesting OXT enhances prosocial behaviour and consistent with evidence from Shahrestani *et al.* (2013) we hypothesised that OXT would enhance facial emotion recognition across the basic emotions. We further expected OXT to increase attention to the eye-region of faces and that this would be related to improvements in facial emotion recognition.

4.2 Method

4.2.1 Participants

Forty healthy male students (M_{age} = 20.98; *SD* = 4.55) from Cardiff University participated in this experiment in return for course credit or £40. Participants took part in two 3-hour study sessions, with a 2 week interval between each session (for practical reasons seven participants had to be tested at later dates; the longest interval between the two sessions was 35 days). The order in which they received OXT or placebo nasal spray was randomised and counterbalanced with both the researchers and the participants remaining blind to this.

4.2.2 Ethical Statement

The study was approved by both the School of Psychology Ethics Committee at Cardiff University, and by the Research and Development Office at Cardiff and Vale University

Health Board. All participants gave written, informed consent at both testing sessions, and were fully debriefed after their second sessions. All participants completed medical pre-screening forms and signed statements of health before leaving each testing session, and were cleared to participate in the study by a medical professional. All participants had normal or corrected-to-normal vision, and did not report a history of neurological disease or severe allergic reactions. Participants were also asked to refrain from alcohol in the 24 hours prior to each study session and from cigarettes or caffeine two hours prior to each study session.

4.2.3 Measures and Materials

4.2.3.1 Emotion recognition

Emotion recognition was tested using a shortened version of the Facial Emotion Recognition (FER) task (Bowen *et al.*, 2014). The shortened test consisted of 96 slides representing the six basic emotions (happiness, anger, fear, sadness, disgust and surprise) at medium intensities (50% and 75%) and neutral faces (see section 3.2.3.4 for more details). The decision was made to only examine medium intensity facial expressions in order to reduce the chances of obtaining ceiling and floor effects associated with high (100%) and low (25%) intensity facial expressions. This was particularly important for the current Chapter since this sample involved healthy participants whereas Chapter 3 used a sample known to be deficient in emotion recognition so ceiling effects were less of a concern.

The question "What emotion is this person showing?" accompanied the target image, which was displayed on a computer screen alongside a list of numbered options. The options were (from 1 to 7) "happiness", "sadness", "fear", "anger", "disgust", "surprise", and "neutral". Participants were required to say their choice of emotion out loud for the experimenter to record before pressing the space bar to move on to the next face stimulus Percentage correct recognition scores for each emotion at each intensity level were produced.

4.2.3.2 Eye-tracking

Participants were positioned approximately 60-65 cm from the laptop and a 9-point calibration was performed. The quality of calibration was checked; if there were no data for one or more points, or if calibration quality was poor, calibration at those points was repeated. Calibration was followed immediately by the facial stimuli. Eye movements were recorded with a portable Tobii X2-60 compact eye- tracker sampling at 60Hz with a screen resolution of 1920 x 1080. This equipment is robust to changes in head position; negating the need for a chin rest. An I-VT fixation filter with a minimum fixation criterion of 60 milliseconds sampled the average raw data of both eyes to produce information on eye positions and duration. Eye-gaze validity was checked using a sample rate percentage that gives a rough estimate of the quality of the eye-tracking in a recording. Three participants whose validity fell below 70% were excluded from the final analysis (range = 14 - 44%). For the remaining participants, validity ranged from 73 - 96% (*M* = 90%). Successful fixations to the fixation cross prior to each face stimulus were also viewed in order to confirm calibration accuracy. Where this could not be confirmed, individual recordings were analysed further. This resulted in the exclusion of a further seven participants' eye-tracking data since the accuracy of the calibration did not appear to be sufficient.

4.2.3.3 Saliva samples

Participants produced four saliva samples during each session: at baseline, and 30, 60, 90 minutes after OXT/placebo administration. These were analysed to measure saliva OXT at each of these time points. Saliva analyses revealed the OXT nasal sprays were successful in increasing OXT levels (see Daughters *et al.*, 2015).

4.2.4 Procedure

Participants self-administered 24 IU (three 4IU puffs per nostril) of synthetic OXT or an independently manufactured placebo nasal spray (PL) that chemically matched the OXT spray for all compounds, except OXT. Both sprays were manufactured by St Mary's Pharmaceutical Unit, Cardiff (http://www.wales.nhs.uk/sites3/home.cfm?orgid=828). A doctor was present during administration, and for the subsequent 15 minutes. After a 30-minute wait period to allow the drug to take effect, participants completed the FER task. The FER, as described above, was presented immediately after calibration. Each

face was presented in a set of three slides. The first was a noise screen that was used to prevent any visual carryover effects from the previous slide. The second contained a fixation cross to control for participants' starting eye position, and finally the face stimulus. The noise and fixation cross screens were displayed for one second each. The face stimuli did not have a time restraint but lasted for as long as it took participants to select the emotion they judged the face to be showing. Once this was selected the next set of three slides were presented. After completing all tasks, participants were debriefed about the aims of the study and were asked which spray they thought they had during which session and how confident they were of this. Participants could not accurately tell during which session they received OXT or PL, where the correct order was detected confidence rating revealed these responses were guesses.

4.2.5 Data Analyses

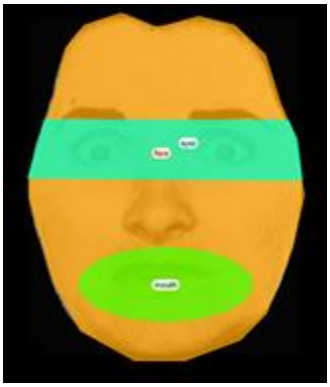

Figure 4.1. Example AOI showing the eyes, mouth and rest of the face AOIs.

Tobii analysis software was used to analyse eye movements, which allowed areas of interest (AOI) to be created and a variety of summary reports generated. The eyes were grouped into one area. A second AOI was created around the mouth and a third around the face as a whole to allow for analysis to be generated purely on when participants were looking at the face (for an example, see Figure 4.1). Eye-gaze was analysed for the period when participants were fixated on the face (as opposed to the response choices) between stimulus onset and response for each trial. Percentage dwell-time (the sum of the duration of all fixations to an area of interest divided by the total duration of time spent looking at the face) for each AOI was calculated. The percentage of time spent looking at the eye and mouth regions was subtracted from that of the whole face to produce a percentage of time spent looking at the rest of the face. Since each face stimulus was presented alongside the emotional response options the mean time spent looking at each face was also recorded (as oppose to the whole time participants were attending to a stimulus screen) as a measure of the time spent examining a face before a response was made (Face Processing Time).

Within-subject ANOVAs were used where Drug (OXT or PL) and Emotion (happiness, sadness, fear, anger, disgust and surprise) were within-subject factors. Two separate analyses were carried out on the dependent variables of recognition accuracy and response time. Where the assumption of sphericity was violated, the Greenhouse-Geisser correction was used. Where follow-up tests were required, the Bonferonni correction was used. Effect sizes were calculated as eta squared (η^2; small≥.01, medium≥.06, large≥.14; Cohen, 1988). Analyses were carried out using SPSS 20 (SPSS Inc., Chicago, Illinois).

4.3 Results

4.3.1 Recognition Accuracy

Recognition accuracy scores for six emotions during OXT or placebo are presented in Figure 4.2. There was a significant main effect of Emotion, F [3.86, 150.6] =48.35, p < .001, η^2=.30; the recognition of happiness was the most accurate (M = 94%, SD = 7), followed by the recognition of surprise (M = 84%, SD = 8), sadness (M = 75%, SD = 15), anger (M = 70%, SD = 14) and disgust (M = 64%, SD = 16); the recognition of fear (M = 61%, SD = 15) was least accurate. There was no significant effect of Drug, F [1, 39]=0.11, p = .74, η^2=.00, and no interaction between Drug and Emotion, F [3.99, 155.7] =0.93, p = .45, η^2=.00.

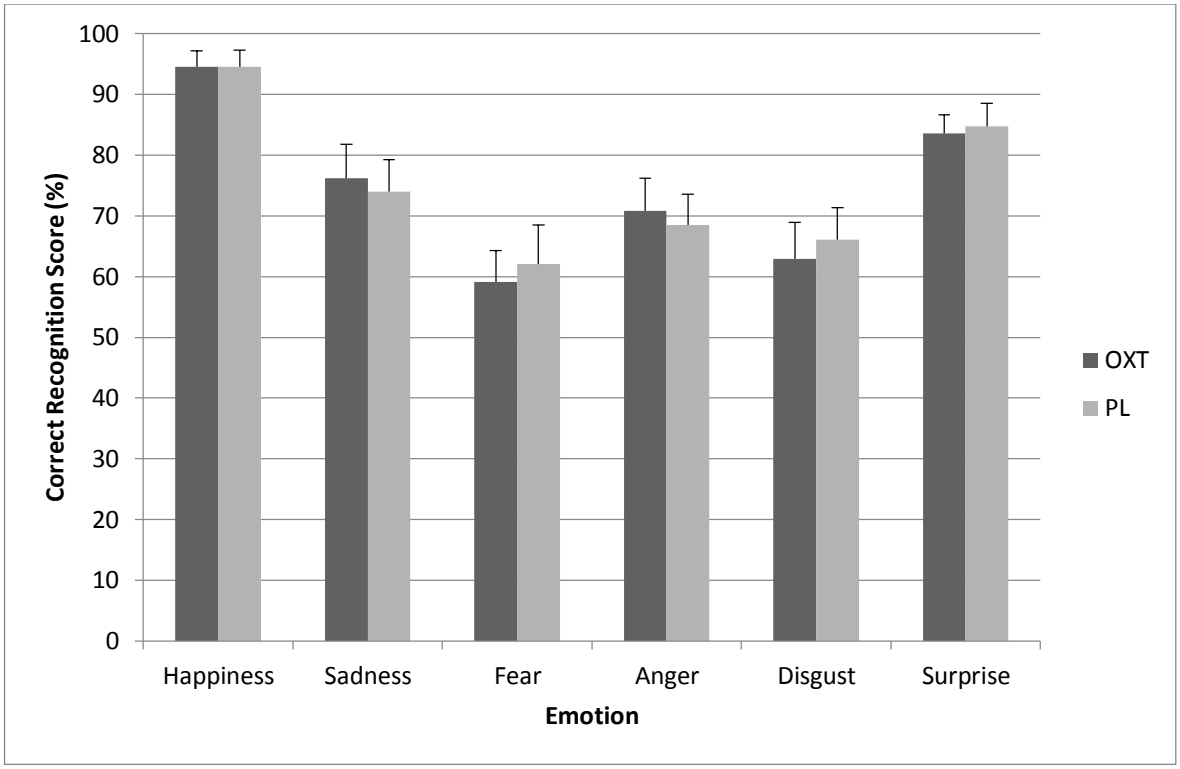

Figure 4.2: Mean recognition accuracy scores as a function of Emotion and Drug. Error bars indicate +2 SE.

4.3.2 Face Processing Time

The effect of OXT administration on face processing time is presented in Figure 4.3. There was a main effect of Emotion, F [5, 145] = 7.58, $p < .001$, η^2=.05, indicating that happy faces required the least face processing time (M = 1.64, SD = 0.9), followed by disgust (M = 1.85, SD = 0.6), surprise (M = 1.88, SD = 0.8) and sadness (M = 2.01, SD = 1.0). The emotions which required the most face processing time before recognition were fearful (M = 2.12, SD = 1.0) and angry faces (M = 2.12, SD = 0.9). There was a marginally significant main effect of Drug, F [1, 29] = 3.70, p = .06, η^2=.04, with OXT administration leading to less time processing the face (OXT: M = 1.78, SD = 0.6; PL: M = 2.09, SD = 1.2), but there was no interaction between Drug and Emotion, F [2.37, 68.72] =0.56, p = .60, η^2=.00.

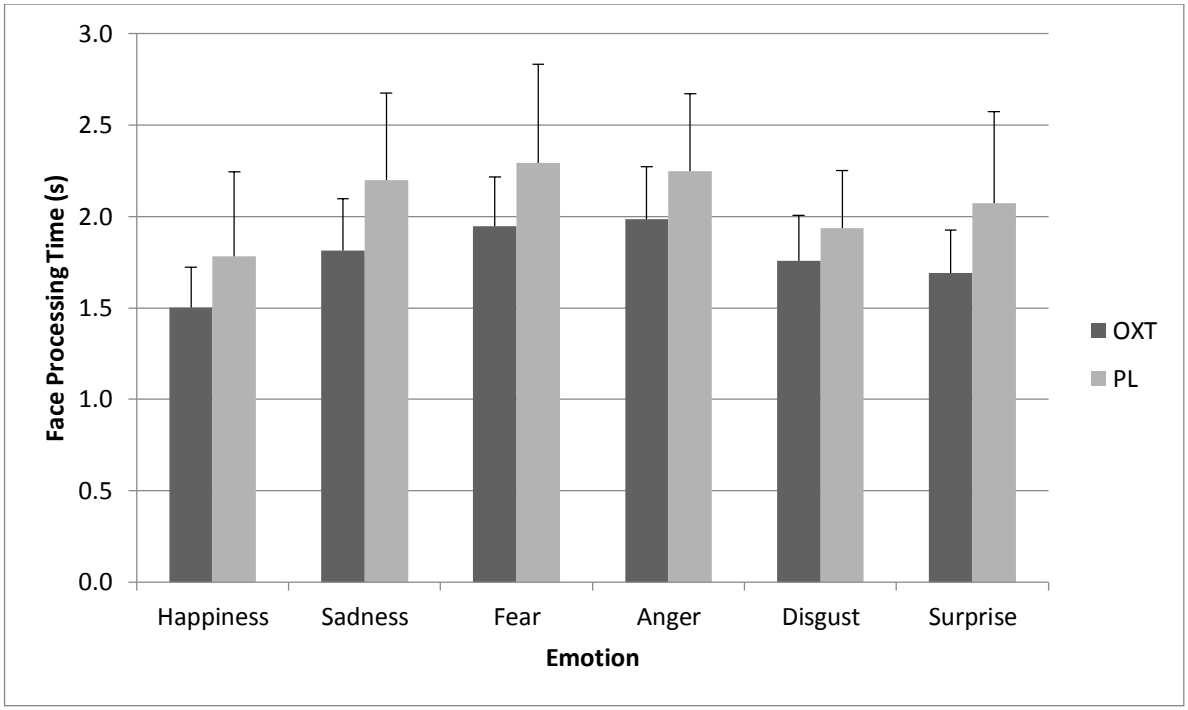

Figure 4.3: Mean Face Processing Time as a function of Emotion and Drug. Error bars indicate +2 SE.

4.3.3 Eye-gaze

Eye-gaze data are presented in Figure 4.4. To examine the effect of OXT administration on visual attention, a three-way repeated measures ANOVA was conducted (Drug x Emotion x AOI). This analysis revealed that the overall dwell-time to the eye or mouth regions was unaffected by OXT administration (main effect Drug: F [1, 29] =2.84, p = .10, η^2=.00; interaction Drug x Emotion: F [2.94, 85.19] =2.18, p = .10, η^2=.00; interaction Drug x AOI: F [1, 29] =0.51, p = .48, η^2=.00; three-way interaction Drug x Emotion x AOI: F [2.62, 76] =0.85, p = .46, η^2=.00). A significant Emotion x AOI interaction, F [3.37, 97.68] =18.86, p < .001, η^2=.01, revealed participants spent proportionally more time fixating upon the eye-regions of sad (M = 66%, SD = 20) and fearful faces (M = 66%, SD = 19), followed by that of surprised (M = 62%, SD = 16), disgusted (M = 61%, SD = 20) and angry faces (M = 59%, SD = 20). Percentage of time fixating upon the eye-region was lowest for happy faces (M = 55%, SD = 19). Conversely, participants spent a greater proportion of time fixating upon the mouth region of happy faces (M = 12%, SD = 13) followed by that of angry (M = 11%, SD = 10), fearful (M = 7%, SD = 8), surprised (M = 6%, SD = 6) and disgusted faces (M = 6%, SD = 6). Percentage of time spent fixating upon the mouth region was lowest for sad faces (M = 5%, SD = 6). The main effect of AOI, F [1, 29] =165.2, p < .001, η^2=.44,

revealed participants spent significantly more time looking at the eye-region (*M* = 61.64%, *SD* = 18) compared to the mouth region (*M* = 7.85%, *SD* = 7)

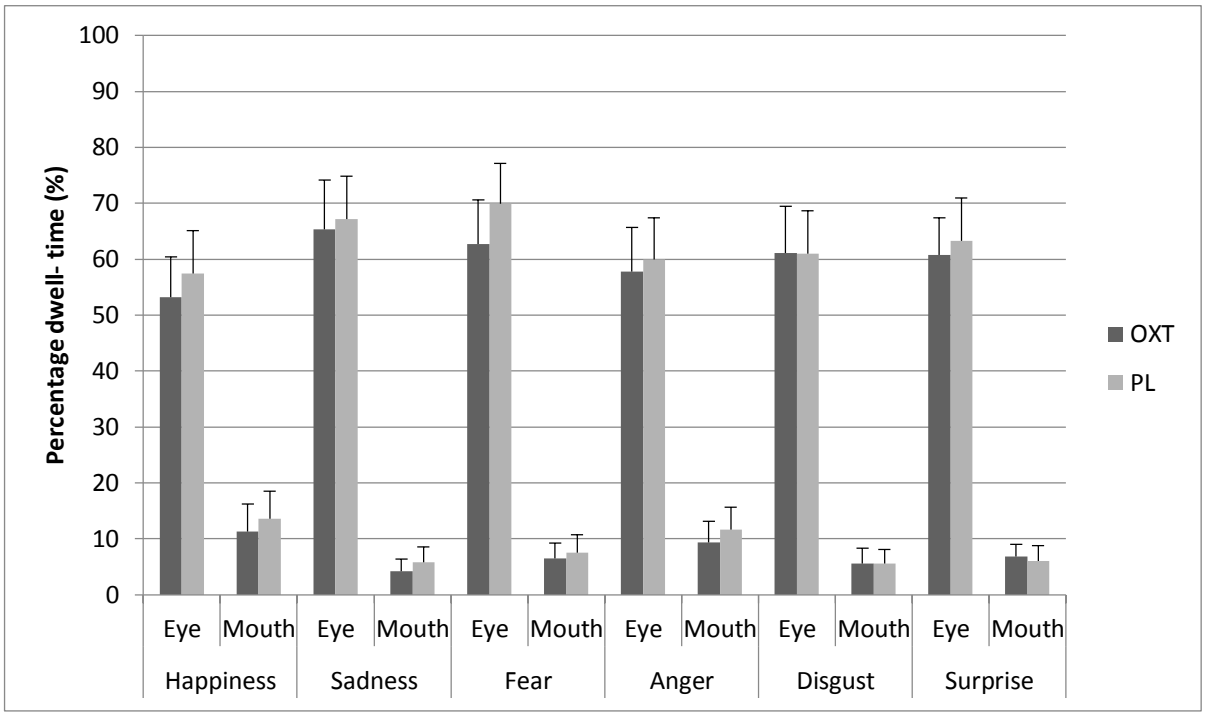

Figure 4.4: Mean percentage dwell-time as a function of Emotion, AOI and Drug. Error bars indicate +2 SE.

4.3.4 Association between Gaze to the Eye-Region, Emotion Recognition and Face Processing Time

We ran separate Pearson's correlation analyses for the different facial expressions. We found no evidence to suggest an association between dwell-time to the eye-region and emotion recognition, or between face processing time and emotion recognition performance or gaze towards the eyes in either the OXT or PL condition (all *ps* < .05)

4.4 Discussion

This study sought to establish whether OXT affects facial emotion recognition and, if so, whether improvements are related to altered eye-gaze to socially relevant stimuli in static images. Using medium intensity emotional faces our results demonstrated that OXT did not improve facial emotion recognition accuracy across emotions. This is contrary to our hypothesis that OXT would enhance emotion recognition across emotion and is also inconsistent with previous research (*e.g.* Shahrestani *et al.*, 2013).

Despite disagreement in previous studies as to whether OXT selectively enhances recognition accuracy for specific emotions (*i.e.,* fear or happiness) or whether it improves detection in general, studies have typically found that OXT does result in some improvement in recognition accuracy. Indeed, in a recent meta-analysis Shahrestani *et al.* (2013) concluded that OXT enhances the recognition accuracy of basic emotions, with specific effects for the recognition of happiness and fear. The paper went on to discuss the effect of OXT in specific situations, which may help explain the discrepant findings in this study. For example, additional findings from the meta-analysis suggest that different stimulus exposure times may explain discrepancies. Results showed that under implicit recognition conditions (<300ms), OXT enhances recognition of happy and angry expressions. Given these expressions are generally recognised faster and more efficiently (Leppänen & Hietanen, 2004; Fox *et al*, 2000), it is rational that OXT exerts stronger effects at shorter stimulus durations and not with longer exposure times where ceiling effects may occur. Conversely, for fearful expressions that tend to require more time to recognise and are generally harder to detect, OXT administration appears to have greater enhancing effects under longer durations of exposure (>300ms). Since our study had no limit on exposure time and was determined by the participant, it is therefore perhaps not surprising, that instead of finding improved recognition accuracy, we observed marginal evidence to suggest that OXT facilitated the time spent processing the face. Although this analysis was only marginally significant, the effect size was moderate. Importantly, there was no relationship between face processing time and recognition, which suggests that OXT enhanced the speed at which participants examined and recognised emotions without compromising accuracy.

This finding is similar to that of Lischkes *et al.* (2012) who demonstrated that OXT enhanced the threshold at which participants recognised an emotion rather than enhancing the accuracy *per se.* Conversely, Fischer-Shofty *et al.* (2010) found no effect of OXT on response time, but instead a selective effect of OXT on the enhancement of fear recognition. Given both the current study and Lischkes *et al.* used whole face stimuli, which have been shown to result in greater recognition accuracy compared to eyes-only stimuli (Valla, Maendel, Ganzel, Barsky & Belmonte, 2013) employed by Fischer-Shofty *et al.,* it is possible that OXT enhances recognition when task difficulty is high, but enhances efficiency when difficulty is low. Domes *et al.* (2007a) previously

demonstrated that OXT improved facial emotion recognition performance, but only for difficult and not easy test items; nevertheless, how this relates to efficiency is unknown. Future studies should address how accuracy and face processing speed interact across tasks of varying difficulty.

It has previously been suggested that improvements in facial emotion recognition associated with OXT are related to increased attention to the eye-regions of faces. However, in the only study so far to address this issue explicitly, there was no effect of OXT on eye-gaze (Lischkes *et al.,* 2012). The authors suggested this may have been due to the eye-region being less salient in the dynamic stimulus used in their study. Nevertheless, we observed similar results using static images. Specifically, we found that OXT did not result in increased preference to the eye-region of faces across emotions. This is in contrast to previous studies which suggest OXT is associated with greater dwell-time to the eyes (Guestella *et al.,* 2008; Andari *et al.,* 2010). As previously mentioned, Lischkes *et al.* suggested it is possible their discrepant findings were due to the use of dynamic stimuli whereas Guestella *et al.* (2008) and Andari *et al.* (2010) both employed static faces. Our findings suggest this is not the case. Interestingly, another difference between studies is that Guestella *et al.* and Andari *et al.* both examined eye-gaze in response to passive viewing, whereas both Lischkes *et al.* and the current study examined eye-gaze whilst participants were making emotional judgments. It is therefore possible that OXT has differential effects based on the type of viewing employed. Since the eye-region affords important information during emotional judgments, participants are likely to already have a preference for this area, whereas during passive viewing, where there is less practical benefit in viewing the eye-region, OXT may have more of an influence on where people look. As a caveat it should also be noted that Gamer *et al.* (2010) found evidence that OXT altered eye-gaze during an emotional judgment task, but this was specifically in relation to OXT increasing the number of times participants shifted their gaze toward the eye-region and not percentage dwell-time to the region. Given Gamer *et al*. presented stimuli for 150ms, these findings suggest that OXT is involved in the initial allocation of attentional resources, with the effect of OXT on eye-gaze becoming less relevant as stimulus exposure time increases. We recommend that future studies examine initial eye-gaze to stimuli presented for shorter durations to examine whether percentage dwell-time to the eyes differs at lower exposure times. It is also worth noting that

attending to the eyes may not be the optimal viewing strategy for all emotions. For example, for happy and surprise facial expressions the central region for successful recognition is the mouth area (Smith, Cottrell, Gosselin & Schyns, 2005). Consequently, an increase in attention to the eye region will not necessarily result in improved emotion detection for all emotional expressions. This highlights the importance of examining the effects of OXT on specific emotions and suggests future studies should consider grouping emotions into those which involve examing either the eye or mouth regions more. If the social saliency hypothesis is indeed correct, we would expect to observe an increase in attention to the eye-region for eye-dominant emotions such as sadness, but an increase the the mouth area for mouth-dominant emotions such as happiness.

In addition, a recent study suggests that rather than OXT increasing visual attention to the eye-regions, enhanced recognition could be related to changes in pupil dilation - which can be used as a sensitive and reliable indicator for cognitive resource allocation and emotional arousal (Bradley, Miccoli, Escrig, & Lang, 2008). Specifically, better emotion recognition after OXT administration was accompanied by increased pupil dilation across emotions, which the authors attribute to indicating an increased recruitment of attentional resources. This is consistent with OXT increasing attention towards socially relevant stimuli (Prehn *et al.*, 2013). Nevertheless, the authors failed to address other possible explanations for the increase in pupil dilation. For instance, pupil dilation not only represents a measure of attentional resources but also of increased arousal, in particular sexual arousal (Rieger & Savin-Williams, 2012). It has been previously demonstrated that OXT increases perceived attractiveness of faces (Theodoridou, Rowe, Penton-Voak & Rogers, 2009). Taken together, these findings suggest it is possible that any increased task-related pupil dilation observed in Prehn *et al.'s* study was in fact related to increased perceived attractiveness of the stimuli and not attentional resources.

Leknes *et al.* (2012) found similar results in a study examining evaluations of explicit and hidden happy and angry expressions. They demonstrated that administered OXT enhanced evaluations of facial expressions and led to greater pupil dilation during the identification of subtle and hidden emotional expressions. Although this study only examined angry and happy faces, it controlled for the attractiveness of faces, thereby

eliminating this as a possible explanation for the changes in pupil response. Moreover, Leknes *et al.* found that participants with lower emotional sensitivity and poorer baseline performance showed greater OXT-induced recognition improvement in addition to a larger change in pupil dilation. In contrast, when emotional sensitivity was already high, OXT resulted in little or no improvement. Along similar lines, Bartz *et al.* (2010) found that OXT improved empathic accuracy but only for participants who rated themselves as less socially proficient as measured by the Autism Spectrum Quotient. The authors suggested that administered OXT increases the salience of social cues and benefits individuals who are generally less tuned to social information, but does not benefit socially adept individuals.

Findings from Chapter 3 have shown that training young offenders to attend to informative facial feature improves emotion recognition accuracy. The current findings provide preliminary evidence to suggest that OXT may also improve emotion recognition through reducing the time needed to process an emotion. Given the current study was conducted with male undergraduates who arguably represent more socially adept individuals it is possible that the current findings related to accuracy are affected by the general higher social skills of the sample. The findings are particularly interesting in the context of using OXT as a potential treatment for clinical disorders characterised by reduced emotionality. Indeed, early investigations have provided some evidence that administered OXT could be an effective treatment for individuals with schizophrenia (Feifel, MacDonald, Cobb & Minassian, 2012) and ASD (Guestella *et al.*, 2009) – two disorders associated with impaired emotion recognition. Impaired emotion recognition is also associated with antisocial behaviour in general (Marsh & Blair, 2008) and has been shown to play a central role in children and adolescents with conduct disorder (CD) (Fairchild *et al.*, 2009a). Taken together, the above findings suggest OXT may indeed provide possible therapeutic benefits for adolescents with CD. Nonetheless, to date there have been no randomised control trials of the effect of OXT in antisocial individuals.

4.4.1 Limitations

It should be noted that we used only stimuli with emotional-social content, and face processing time was generally faster in all emotions in the OXT condition. Therefore, it

is presently unclear whether OXT has an emotional-specific advantage or affects processing speed in general. To disentangle this, we recommend that future studies examine response times in relation to non-social and non-emotional tasks, whilst also considering traits such as confidence and risk taking. Given that we have demonstrated that facial emotion accuracy was not compromised as a result of faster face processing times, it is unlikely that an increase in impulsivity as a result of OXT can explain the findings. However, a decrease in face processing time may be explained by OXT increasing participants' confidence in their decisions or resulting in them taking more risks and thus responding faster. Both possibilities should be explored further.

It should also be noted that we examined the effect of OXT in a male-only sample. This was due to practical and ethical complications in administering OXT to women. Evidence suggests that sex differences exist in the recognition of emotions and that OXT modulates the neural circuitry involved in face processing in men and women differentially. For example, while it has been demonstrated that OXT decreases amygdala activity in response to fear in men (Kirsch *et al.,* 2005), it appears to increase amygdala activity to similar stimulus in women (Domes *et al.,* 2010). Additionally, women are more accurate than men in recognising medium intensity facial expressions (Hoffmann, Kessler, Eppel, Rukavina & Traue, 2010). Consequently, our results may not be generalisable to women.

4.4.2 Conclusion and Clinical Implications

In summary, our study in a high functioning healthy male sample provides preliminary evidence that OXT reduces the time required to process emotional expressions but does not lead to improved accuracy of emotion recognition. In addition, we replicated previous findings with dynamic stimuli that suggest OXT does not alter eye-gaze when making emotional judgments about static emotional faces. Taken alongside previous findings, these results suggest that OXT may affect eye-gaze differentially depending on task requirements. When participants are required to make emotional judgments about faces, visual attention to the eye-region is unaffected by OXT, whereas when participants passively view faces, OXT appears to increase attention to the eyes. These findings highlight the need for research to further explore the differential effects OXT

appears to have in different situations. Given this study was conducted in relatively socially adept individuals the results may also have interesting implications for antisocial individuals who have problems recognising the emotions of others.

5 Chapter 5: In the Face of Fear: Oxytocin increases attention to the eyes and selectively enhances affective empathy for fear

Paper under review, *Emotion.*

This chapter is based on Hubble, K., Daughters, K., Manstead, A.S.R., Rees, A., Thapar, A., & van Goozen, S.H.M. (2015). Oxytocin Increases Attention to the Eyes and Selectively Enhances Affective Empathy for Fear, *Emotion, under review.*

5.1 Introduction

The neuropeptide oxytocin (OXT) has been found to play a significant role in several areas of prosocial behaviour and social cognition. For example, OXT has been found to increase trust (Kosfeld, Heinrichs, Zak, Fischbacher & Fehr, 2005), generosity (Zak *et al*., 2007), accuracy in mental-state attribution (Domes *et al.*, 2007a) and facial emotion recognition (Domes *et al.*, 2007b). These findings have spurred interest in the potential of OXT to reduce social deficits associated with a number of disorders such as autism spectrum disorders (ASD) and social phobia (Bartz & Hollander, 2006; Guastella *et al.*, 2009; Kosfeld *et al.*, 2005). Chapter 3 demonstrated that emotional processing abilities in young offenders can be improved using targeted emotional training programmes and Chapter 4 provided preliminary evidence to suggest OXT can improve the recognition of emotions by reducing the time required to process an emotion. The current chapter was ran contemporaneously to Chapter 4 and aimed to further explore the link between OXT, eye-gaze and improved emotional processing by examining the effect of OXT on additional measures of emotional processing, namely empathy.

Impairment in the ability to understand and share another's emotional state and context is a social deficit that has been shown to play an important role in a range of mental health disorders such as ASD (Baron-Cohen & Wheelwright, 2004) and conduct disorder (CD) (Sterzer *et al.*, 2007) (for a full review refer to Chapter 2). More specifically, individuals with ASD show impairments in cognitive empathy (*i.e.*, understanding what someone else feels) whilst displaying normal affective empathy (*i.e.*, actually feeling what someone else feels), whereas for individuals with CD the reverse pattern seems to hold (*e.g.*, Schwenck *et al.*, 2012, Chapter 2). These deficits have been shown to play an important role in the social communicative difficulties experienced by individuals with these conditions and have been linked to more severe forms of antisocial behaviour within CD (see section 2.3). Given the apparent implications of empathy deficits in these disorders it seems logical to examine whether OXT has an impact upon these abilities.

Using a between-subjects design with 48 healthy male participants, Hurlemann *et al.* (2010) examined cognitive and affective empathy using static pictures that showed people in emotionally charged situations. They found that intranasal OXT increased affective, but not cognitive, empathy in response to both positively and negatively

valenced stimuli. However, other studies have found less clear-cut results. In a within-subjects study examining empathy for a partner's experience of physical pain, Singer and colleagues (2008) found that OXT neither enhanced subjective empathy nor increased activation in empathy-relevant brain areas such as the anterior insula and anterior cingulate cortex. Similarly, Theodoridou and colleagues (2013) found that self-reported personal distress and empathic concern, both of which are considered to be components of affective empathy, were unaffected by the administration of OXT. Nevertheless, the authors also demonstrated that performance on a more implicit measure of perspective-taking – which is associated with cognitive empathy – was enhanced following OXT. Theodoridou *et al*. proposed that these results show that self-report measures of empathy may be less sensitive to OXT than more implicit measures and that future studies should therefore focus on more implicit measures. Finally, Bartz *et al*. (2010) found that OXT improved empathic accuracy – as reflected in a time-series correlation between a participant's ratings of a target's affect and the target's own ratings of their affect – reflecting the cognitive component of empathy, but only for participants who rated themselves as less socially proficient. Similarly, Feeser and colleagues (2015) found performance on the Reading the Mind in the Eye Test was enhanced by OXT but only for harder items and for participants who display lower baseline trait empathy scores.

Given the large variations in stimuli and methodology in the aforementioned studies it is not surprising that previous results concerning the effect of OXT on empathy are inconsistent. Many researchers now employ a range of methods to measure empathy in order to obtain a complete picture. These include physiological measures, such as heart rate and skin conductance, alongside traditional empathy-inducing tasks using videos, still images and self-report questionnaires. A more recent development is the use of eye-tracking that can provide a measure of visual attention allocation, as well as an index of arousal through pupil dilation. Using this technique Cowan, Vanman and Nielsen (2014) found a positive relationship between empathy and eye-gaze such that the greater participants' trait affective empathy, the more they fixated on the eye-region of an actor recounting a fictional sad event. Moreover, OXT has been shown to increase gaze toward the eye-region of neutral faces (Guastella, Mitchell, & Dadds, 2008), and also to increase attention to objects that are the gaze targets of static faces (Tollenaar, Chatzimanoli, van der Wee, & Putman, 2013). Such findings have led to the suggestion

that OXT may improve prosocial behaviour by increasing attention to socially relevant cues (Guastella *et al.*, 2008). If the administration of OXT alters eye-gaze to meaningful social information then it is possible that any improvement in prosocial behaviour is via this route. Indeed, within the ASD literature there is now evidence (*e.g.*, Andari *et al.*, 2010) that improved facial emotion recognition is due, in part, to participants spending more time looking at the eye area of faces. Nevertheless, evidence to support this in healthy participants is mixed, with one study suggesting that OXT results in increased gaze to eye areas for positive faces but decreased gaze to the eyes for negative faces (Domes *et al.*, 2013b), and others suggesting that improvements in facial emotion recognition are unaffected by eye-gaze (Chapter 4), but instead relate to pupil dilation (Lischke *et al.*, 2012; Prehn *et al.*, 2013).

To our knowledge, no study to date has examined the effect of OXT on eye-gaze in relation to empathic responses. Furthermore, the use of dynamic stimuli showing characters experiencing emotions and responding to emotional events are now generally considered to provide a more realistic situation in which to measure emotional reactions (Karrow & Connors, 2003). None of the previous studies examining OXT and empathy used dynamic stimuli. Similarly, to date the effect of OXT on empathy has only been considered for positive or negative valenced emotions (Hurlemann *et al.*, 2010), with the exception of pain (Singer *et al., 2008*). Given OXT appears to have differential effects in different contexts (*e.g.*, De Dreu et al., 2010) it is important to consider the effect of OXT on empathy for different discrete emotions. A further point is that the majority of OXT studies have used between-subjects designs. Given the large variations in individual responsivity to OXT across participants (Daughters *et al.*, 2015), it is important to explore the effects of OXT using within-subjects designs.

To address these issues, we aimed to measure cognitive and affective empathy for different emotions in the same double-blind within-subject randomised control trial of intranasally administered OXT that was discussed in Chapter 4. We also explored the mechanism by which OXT may affect empathy by measuring eye-gaze. To achieve these aims participants completed a dynamic empathy task that aimed to evoke empathy experimentally using four short video clips inducing the emotions of pain, sadness, happiness and fear, during which participants' eye-gaze was tracked. This task was based on the dynamic empathy task used in Chapter 2 but was further developed based

on the limitations associated with using posed as opposed to expressed emotions (see 2.4.1). As such, new clips were produced which showed main characters experiencing real emotions. Saliva samples were collected throughout each session to provide an indicator of OXT levels.

Consistent with the hypothesised prosocial effects of OXT, we predicted that OXT would enhance both cognitive and affective empathy across emotions. We further expected OXT to increase attention to the eye-region of faces and that this would be related to an improvement in empathy.

5.2 Method

5.2.1 Participants

See section 4.2.1.

5.2.2 Ethical Statement

See section 4.2.2.

5.2.3 Measures and Materials

5.2.3.1 Empathy task: emotion-eliciting video clips

We used eight clips depicting main characters feeling pain/hurt, sad/upset, fearful/scared or happy/cheerful; these will be referred to as the pain, sadness, fear and happiness clips, respectively (see van Rijn, Barendse, van Goozen, & Swaab, 2014). The clips were edited from commercially available films or videos to have a duration of approximately 120 seconds. Where possible these clips showed real people experiencing real emotions in real situations (this applied to the clips depicting pain, sadness, happiness). Each target emotion was represented by two clips that were matched for duration, content and intensity. The eight clips selected were: Pain (1) – a male footballer is in hospital with a dislocated knee; (2) a male is at the dentist having an emergency procedure carried out; Sad - a man (1) and woman (2) relive their memories of 9/11; Happy - A man (2) and woman (1) are seen celebrating after winning an Olympic gold; Fear – (1) a women is chased in the dark by a man with a gun, and (2) a woman is on a rope over a gorge when her harness breaks. Participants watched

one set of four emotional clips during the first visit and the other four clips on the second visit, and the order was counterbalanced across participants. Clips were shown to participants using Tobii Studio software on a Dell Precision M4700 laptop with a 15.6 inch screen.

5.2.3.2 Explicit empathy test

After each clip participants completed an explicit empathy test (for full details see Chapter 2 section 2.2.3). The measures had satisfactory internal consistency (Cronbach's alphas: cognitive empathy = 0.70; affective empathy = 0.83).

5.2.3.3 Eye-tracking

For information on eye-tracker set-up refer to section 4.2.3.2. Eye-gaze validity was checked using a sample rate percentage that provides an estimate of the quality of the eye tracking in a recording. One participant for whom this validity fell below 70% was excluded from the final analysis. For the remaining participants the validity ranged from 70-97%. Successful fixations to the fixation cross prior to each clip were also viewed in order to confirm calibration accuracy. Where this could not be confirmed individual recordings were further analysed. This resulted in the exclusion of data from a further six participants on the grounds that calibration accuracy was insufficient.

5.2.3.4 Saliva samples

See section 4.2.3.3.

5.2.4 Procedure

For drug administration procedure refer to section 4.2.4. After a 30-min wait period to allow the drug to take effect, participants completed a 15-min task unrelated to the empathy paradigm. The empathy task started approximately 45 minutes after OXT administration and lasted approximately 30 minutes. Each video clip was followed immediately by the corresponding empathy questionnaire. After completing all task in the second session, participants were debriefed about the aims of the study and were asked if they could guess which spray they had taken during the session.

5.2.5 Data Analyses

Tobii analysis software was used to analyse eye movements, which allowed areas of interest (AOI) to be created and a variety of summary reports generated. The eyes were grouped into one area. A second AOI was created around the mouth. A third AOI was around the face as a whole to allow for analysis of when participants were looking at the face. Eye-gaze was analysed during a 4-sec segment that was judged to have included the highest emotional content in each clip. Percentage dwell time (the sum of the duration of all fixations to an AOI divided by the total duration of the segment) for each AOI was calculated. The percentage of time spent looking at the eye and mouth regions was subtracted from that of the whole face to produce a percentage of time spent looking at the rest of the face.

Analyses were carried out using SPSS 20 (SPSS Inc., Chicago, IL). The principal analyses reported below are analyses of variance. Where the assumption of sphericity was violated, the Greenhouse-Geisser correction was used. Where follow-up tests were required, Bonferroni correction was used. Effect sizes were calculated as eta squared (η^2; small $\geq .01$, medium $\geq .06$, large $\geq .14$; Cohen, 1988).

5.3 Results

Within-subjects ANOVAs were used with Drug (OXT or PL) and Emotion (pain, sadness, fear and happiness) as the within-subject factors. Separate analyses were carried out on the dependent variables of cognitive empathy score and affective empathy score.

5.3.1 Cognitive Empathy

Mean cognitive empathy scores are shown in Figure 5.1. Results revealed a significant main effect of Emotion, $F[3, 117] = 12.93$, $p < .001$, $\eta^2 = .12$, but no main effect of Drug, $F[1, 39] = 0.04$, $p = .84$, $\eta^2 = .00$, and no interaction between Drug and Emotion, $F[3, 117] = 2.14$, $p = .10$, $\eta^2 = .02$. Follow-up analyses revealed that there was no difference in cognitive empathy for pain ($M = 6.4$, $SD = 0.7$) and fear ($M = 6.5$, $SD = 0.9$), or between sadness ($M = 5.9$, $SD = 0.7$) and happiness ($M = 5.9$, $SD = 0.8$), but

cognitive empathy was significantly greater for pain and fear compared to sadness and happiness (*p*s < .05).

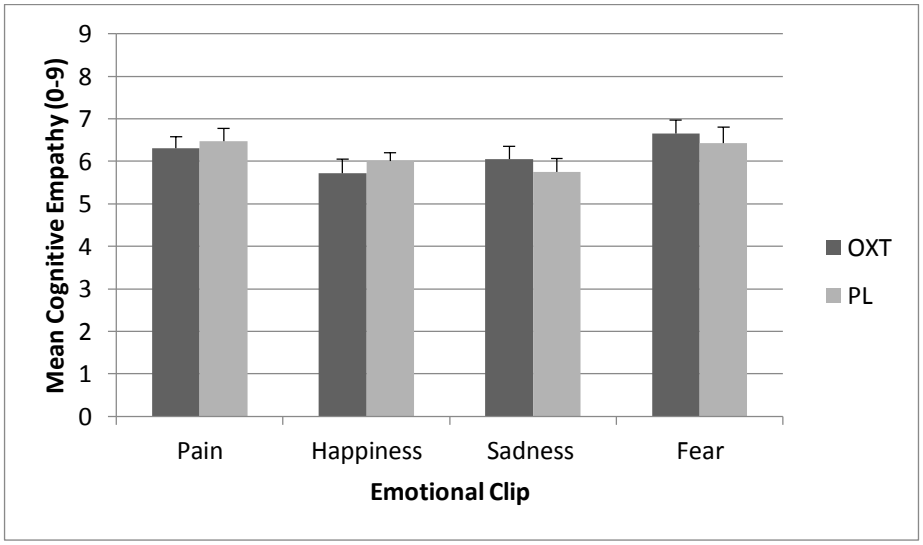

Figure5.1: Cognitive empathy as a function of Emotional clip and Drug. Error bars show +2 SE.

5.3.2 Affective Empathy

Mean affective empathy scores are shown in Figure 5.2. There was a main effect of Emotion, $F[3, 117] = 16.03$, $p < .001$, $\eta^2 = .18$, reflecting the fact that affective empathy was greatest for sadness ($M = 4.6$, $SD = 0.9$) (all *ps* < .001). There were no significant differences in affective empathy between fear ($M = 3.5$, $SD = 1.6$), pain ($M = 3.4$, $SD = 1.3$) and happiness ($M = 3.5$, $SD = 1.0$) (all *p s*> .05). There was no main effect of Drug, $F[1, 39] = 0.13$, $p = .73$, $\eta^2 = .00$, but there was a significant interaction between Emotion and Drug, $F[3, 117] = 2.77$, $p = .045$, $\eta^2 = .02$. Follow-up tests revealed that during the fear clip participants in the OXT condition rated feeling significantly ($p = .02$) more affective empathy ($M = 3.9$, $SD = 1.7$) than when they were in the PL condition ($M = 3.2$, $SD = 1.8$). The corresponding differences were not significant for pain ($p = 1.00$), happiness ($p = .25$) or sadness ($p = .35$).

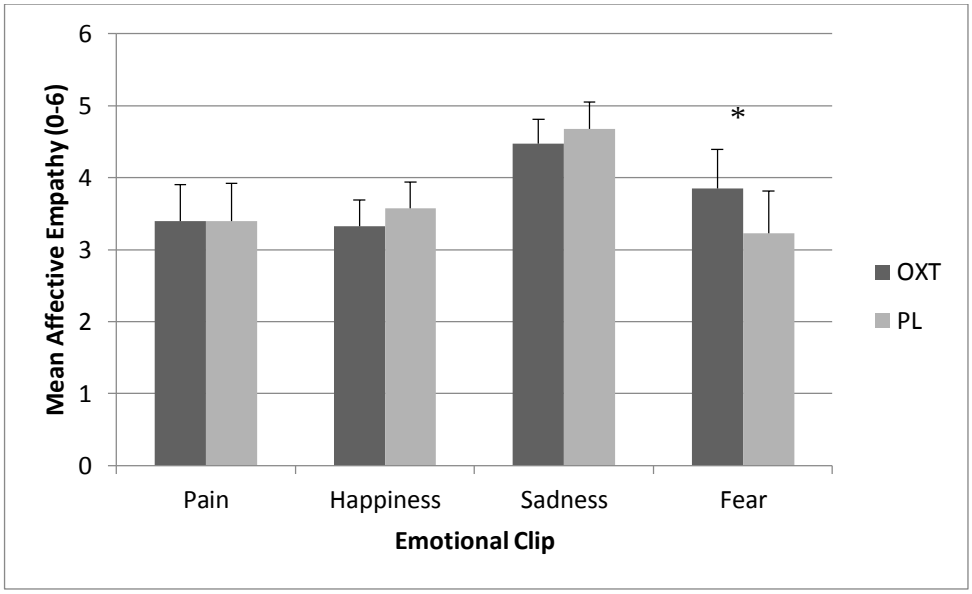

Figure 5.2. Affective empathy as a function of Emotional clip and Drug. Error bars show +2 SE. *p<.05.

5.3.3 Eye-gaze Patterns

An ANOVA was conducted with three within-subjects factors: Drug (OXT vs. PL), Emotional Clip (Pain, Happiness, Sadness, or Fear) and AOI (Eye, Mouth, or Rest of face). There was a main effect of AOI, F[1.31, 41.95] = 35.58, p < .001, η^2 = .19, reflecting the fact that percentage dwell time to the eye-region was greatest (M = 36%, SD=15.1), followed by that of the rest of the face area (M = 29%, SD = 7.6); dwell time to the mouth region was significantly lower than to both the eye-region (p < .001) and the rest of the face (p < .001) (M = 11%, SD = 8.2). Dwell time to the eye-region and rest of the face did not significantly differ (p = .13). A significant main effect of Emotion, F[2.49, 79.6] = 25.81, p < .001, η^2 = .02, showed that participants spent significantly more time looking at the face of the main character during the sadness clip (M = 30%, SD = 4.3) compared to the happiness (M = 26%, SD = 4.3) pain (M = 24%, SD = 5.2) and fear clip (M = 21.2%, SD = 5.5) (all p's < .05). There was no significant difference in dwell time to the face between the happiness and pain clip (p=.33) but during the fear clip participants spent significantly less time looking at the face compared to the other clips (all p's>.05). The Emotion by Drug interaction, F [2.29, 73.2] = .05, p = .99, η^2 = .00, and main effect of Drug, F [1, 32] = 3.76, p = .06, η^2 = .00, were non-significant.

The three-way interaction between Drug, Emotion and AOI was not significant, F[4.53, 144.79] = 0.68, p = .62, η^2 = .00, but there were significant interactions between Drug and AOI, F[2, 64] = 10.71, p <.001, η^2 = .02, and between Emotion and AOI, F[3.72, 118.96] = 20.2, p <.001, η^2 = .11. Means relevant to the Drug by AOI interaction are presented in Figure 5.3. Follow-up tests revealed that OXT resulted in a greater proportion of time fixating upon the eye-region, F[2, 96] = 11.33, p = .002, η^2 = .26; given this, it is not surprising that OXT also led to less time spent looking at the mouth, F[2, 96] =3.73, p = .06, η^2=.10, and the rest of the face, F[2, 96] = 12.86, p = .001, η^2 = .29. An illustration of eye-gaze patterns in both groups is presented in Figure 5.4.

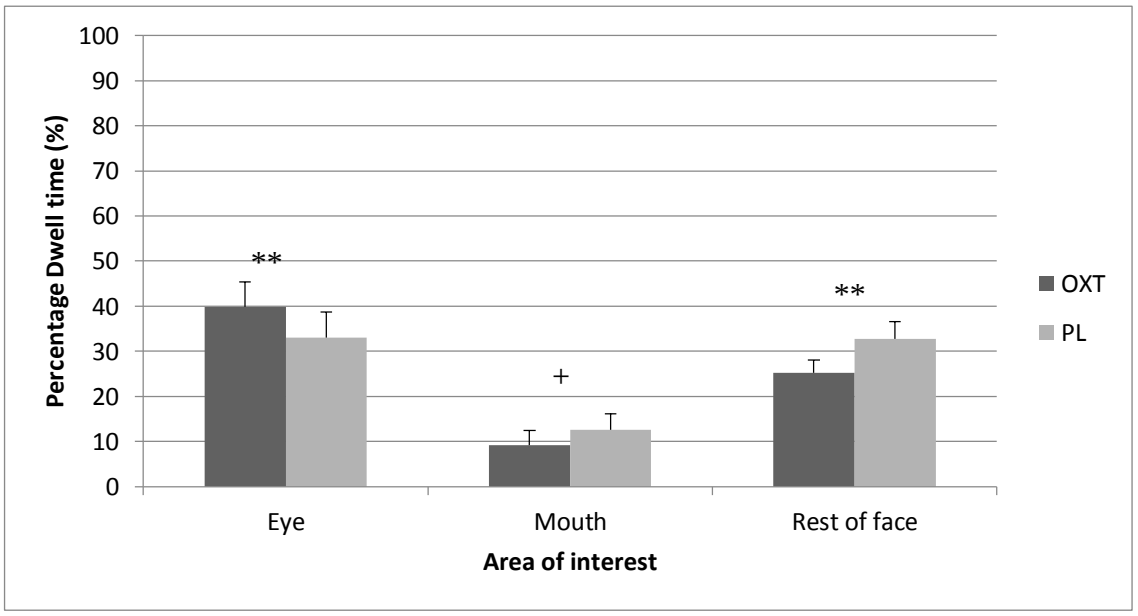

Figure 5.3: Percentage dwell time as a function of AOI and Drug. Error bars show +2 SE. +p=.06, *p<.05, **p<.01.

Figure 5.4. Heat maps of the OXT condition and the PL condition reflecting total fixation duration in a scene showing an athlete speaking after winning Olympic gold, illustrating the group differences in visual fixation towards the eyes. Red is indicative of a greater number of fixations.

Means relevant to the Emotion by AOI interaction are shown in Figure 5.5. Follow-up tests revealed that there were significant differences in the proportion of time spent fixating upon the eyes, $F[4, 119] = 34.05$, $p < .001$, $\eta^2 = .77$, and mouth, $F[4, 119] = 21.29$, $p < .001$, $\eta^2 = .68$. Further analyses revealed that participants spent a significantly greater proportion of time fixating upon the eyes during the sadness clip compared to the happiness, fear and pain clips (all *p*s < .05). Whereas a significantly greater proportion of time was spent looking at the mouth during the pain clip compared to the happiness, sadness and fear clips (all *p*s < .05). There were no differences between clips in respect to the amount of time spent fixating upon the rest of the face, $F[4, 119] = 0.98$, $p = .41$, $\eta^2 = .09$.

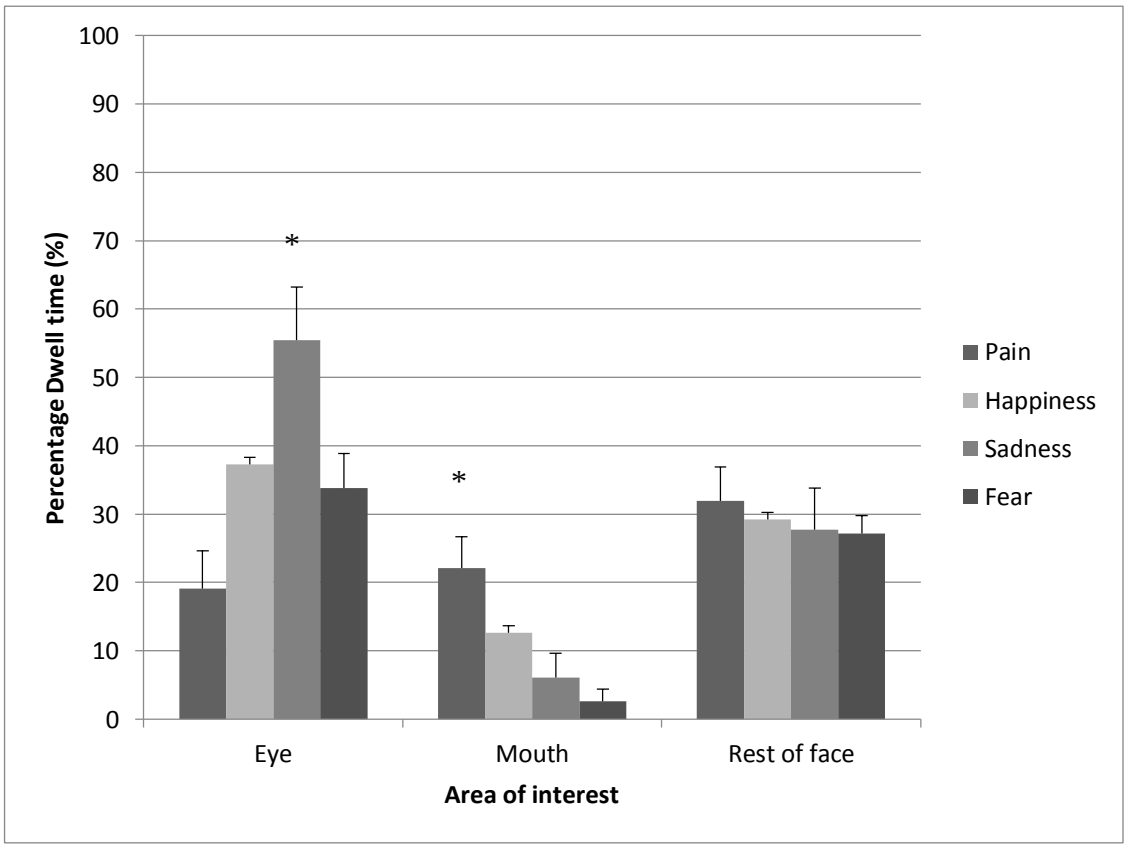

Figure 5.5: Percentage dwell time as a function of AOI and Emotion. Error bars show +2 SE. *p<.05.

5.3.4 Comparing Empathy and AOI

In order to explore the relationship between empathy and eye-gaze within the OXT condition, Pearson's R was calculated between cognitive and affective empathy scores for each emotional clip and average dwell time to the eye-region within each emotional clip. Results revealed there were no significant correlations between empathy scores and dwell time to the eye (all *p*'s<.05)

Table 5.1:
Relationship between eye-gaze and empathy (Pearson's R)

	Cognitive Empathy				Affective Empathy			
	Pain	Happiness	Sadness	Fear	Pain	Happiness	Sadness	Fear
Eyes dwell-time	-.03	-.07	.08	-.09	-.10	.12	.12	-.04

Notes: *$p<.05$

5.4 Discussion

We set out to establish whether OXT affects empathy and whether any improvements in empathy result from altered eye-gaze to socially relevant stimuli. In contrast to our hypotheses, which predicted that OXT would result in enhanced cognitive and affective empathy across emotions, our results demonstrate for the first time that a single dose of OXT administered to healthy males enhanced their ability to empathise affectively with a fearful protagonist, but not with a protagonist displaying pain, sadness or happiness. This is partly consistent with evidence from Hurlemann *et al.* (2010), who found that OXT increased affective but not cognitive empathy. However, Hurlemann *et al.* found improvements in response to both positively and negatively valenced stimuli. A possible reason for this discrepancy in findings is that the empathy-inducing stimuli differed between the two studies. Hurlemann *et al*. used static photos whereas we used dynamic clips that are arguably of greater ecological validity in that they reflect more closely the kind of everyday interpersonal interaction in which an empathic response could be aroused (Karrow & Connors, 2003). An additional strength of the present study is the use of a within-subjects design, which controls for the sizeable individual differences that can arise in response to intranasally administered OXT (Daughters *et al.*, 2015).

The selective effect of OXT on fear is consistent with findings from research exploring the effect of OXT on facial emotion recognition. Although Domes *et al.* (2007b), using static emotional facial expressions, found that OXT led to an improvement in facial emotion recognition for a range of emotions, Fischer-Shofty *et al.* (2010), employing dynamic video clips of emotional facial expressions, found that OXT selectively enhanced recognition for fearful faces only. Interestingly, neuroimaging evidences suggest that administration of OXT inhibits amygdala activation (Domes *et al*., 2007b; Kirsch *et al.*, 2005; Singer *et al.*, 2008), thereby dampening the fear response, which

appears to be in contradiction with the improvement in fear recognition observed by Fischer-Shofty *et al*. (2010) and greater affective empathy for fear demonstrated in the present findings. Given that there are a number of brain areas associated with the processing of fearful stimuli and affective empathy, and that OXT binding sites have been observed in different areas of the rats brain that are involved in emotion processing (Febo, Numan & Ferris, 2005; Ferris, 2008; Smeltzer, Cutis, Aragona & Wang, 2006), it is possible that OXT modulates different cortical regions that are important for processing threatening stimuli, and thereby improves affective empathy for fear (Fischer-Shofty *et al*., 2010).

A strength of the present study is our use of eye-tracking technology to investigate whether any improvement in empathy due to OXT is matched by an increase in attention to socially relevant stimuli. We found that OXT led to a general increase in the amount of time participants fixated on the eye-region of the face for four different types of emotion. These results contrast with those reported by Lischke *et al.* (2012) and our own findings in Chapter 4, which found no evidence to support the notion that OXT alters eye-gaze in healthy participants. Nevertheless, our results are consistent with evidence from ASD literature, suggesting that OXT increases attention to socially relevant stimuli, and specifically for the eye-region (*e.g.*, Andari *et al.*, 2010). ASD researchers have argued that improvements in facial emotion recognition associated with OXT administration result from increased attention to the eye-region. With respect to empathy research, no prior study has examined eye-gaze as a possible mediator of improved empathic abilities, although some evidence exists to suggest that there is positive relationship between trait empathy and attention to the eye region of sad faces (Cowan, Vanman & Nielsen, 2014). In the event, we found no evidence that empathy was related to eye-gaze, more specifically there was no evidence in the OXT condition that greater affective empathy for fear was related to the amount of time participants spent attending to the socially relevant eye-region of the protagonist's face. A possible explanation for the discrepancy between the current findings and ASD research concerns the stimuli used. Evidence for a link between emotion recognition and eye-gaze has typically been found in studies using facial images, where the only basis for judgments is provided by facial features. The emotional clips used in the current study depicted people experiencing emotions in affective situations. Participants therefore had access to cues such as tone of voice, gestures and contextual information. This

potentially may have rendered information from the face less important. However, we do not regard this as a limitation of the study, because dynamic stimuli showing people experiencing emotional situations is surely a strength; instead the results suggests that eye-gaze may be less important in normal everyday interactions than studies simply investigating responses to facial images suggest.

A final point in relation to the eye-gaze findings is that they revealed differential attention to facial regions as a function of type of emotional clip. Greater attention to the eyes was observed during sadness clips than during pain happiness or fear clips, and greater attention to the mouth was observed during happiness clips than during sadness clips. This is consistent with findings from studies using static images (Eisenbarth & Alpers, 2011). We also found that there was greater fixation on the mouth when the protagonist was experiencing pain.

Impairments in affective empathy, particularly for distress emotions, have been associated with antisocial behaviour in general (Blair, 2005). It is argued that affective empathy acts as an inhibitor of aggressive behaviour through the vicarious experience of others' distress (Decety & Jackson, 2004). Enhancement in affective empathy for fear is therefore consistent with the notion that OXT increases prosocial approach behaviour. Our results therefore potentially have implications for interventions aimed at treating psychiatric disorders characterised by fear processing impairments. For example, Chapter 2 demonstrated that adolescents with ADHD and Conduct Disorder (CD) show reduced affective empathy for sadness, happiness and fear compared to peers with ADHD alone. In addition, antisocial behaviour has been linked to variations in the OXT receptor gene (Prichard, Mackinnon, Jorm & Easteal, 2007), OXT antibodies (Fetissov *et al.*, 2006), and lower central and peripheral OXT levels as measured in cerebrospinal fluid (Lee, Ferris, Van de Kar & Coccaro, 2009b). This suggests that, administration of OXT might help to promote social understanding and behaviour by increasing empathy for the emotions of others, particularly fear.

5.4.1 Limitations

A possible reason for the absence of relationship between eye-gaze and empathy concerns when the measures were taken. Affective empathy was measured after each

clip, requiring participants to aggregate their emotional experiences during the 2-min stimulus into a single score, whereas the eye-gaze data were collected during a 4-sec segment of each clip that was judged to contain the highest level of expressed emotion. These segments were typically near the end of each clip. It is therefore possible that participants had already empathised affectively with the main character before the eye-tracking data were collected. Comparing strictly contemporaneous eye-gaze and empathy data might reveal a closer relationship between them, although this would be very difficult to implement, given that providing continuous ratings of emotions (one's own or another's) would interfere with eye-tracking analysis. Physiological measures might therefore offer a better way of comparing eye-gaze and empathy continuously but they are affected by other issues (*e.g.*, they measure arousal but are relatively insensitive to valence; Lang, Greenwald, Bradley & Hamm, 1993). Given the evidence that OXT may be especially involved in the initial allocation of attentional resources (Gamer *et al.*, 2010), future studies should consider whether monitoring early fixations would result in a closer relation between eye-gaze and empathy.

We examined the effects of OXT in a male-only sample. This was due to the practical and ethical complications entailed in administering OXT to women. Evidence suggests that there are sex differences in empathic abilities (*e.g.*, Baron-Cohen & Wheelwright, 2004) and that OXT differentially modulates the neural circuitry involved in face processing in men and women. For example, while it has been demonstrated that OXT decreases amygdala activity in response to fear in men (Kirsch *et al.*, 2005), it appears to increase amygdala activity to similar stimulus in women (Domes *et al.*, 2010). Additionally, women typically report higher levels of affective empathy than men (Hurlemann *et al.*, 2010; Theodoridou *et al.*, 2013). Consequently, our results may not be generalisable to women. In addition, given that our sample were all undergraduates who tend to perform reasonably well in these types of tasks, it is possible that our results may not be generalisable to populations who find these tasks more challenging. Indeed, it has been found that OXT has stronger effects when task difficulty is higher (Domes *et al.*, 2007a, Feeser *et al.*, 2015), suggesting the effect of OXT on empathy may be greater in populations showing empathy impairments (Feeser *et al.*, 2015).

5.4.2 Conclusions and Clinical Implications

In conclusion, our results demonstrate that the administration of OXT selectively enhanced affective empathy for fear whilst leaving cognitive empathy and affective empathy for sadness, happiness and pain unaffected. Furthermore, OXT significantly increased eye-gaze towards the eye-region of faces across the four emotions studied here. Importantly, dwell time to the eyes and affective empathy for fear were not correlated, raising the possibility that the greater affective empathy for fear in the OXT condition did not result from increased attention to socially relevant stimuli. The selective effect of OXT on affective empathy for fear has clinical implications for interventions with antisocial individuals who display impairments in the ability to appropriately respond to others' distress cues.

6 Chapter 6 – Discussion

The main aims of this thesis were to improve the understanding of emotion processing deficits associated with antisocial behaviour and to explore whether interventions can help improve these skills. More specifically, this thesis investigated (1) empathy impairments as a risk factor for comorbid ADHD and CD; (2) whether targeted emotion training could improve facial emotion recognition and reduce subsequent crime in young offenders; and (3) whether nasal spray administration of the neuropeptide oxytocin (OXT) can improve emotion processing (namely facial emotion recognition and empathy) and thus be a potential treatment option for adolescents who display antisocial behaviour. This chapter describes, discusses and integrates the main findings of this research and identifies suggestions for future study.

6.1 Overall findings

6.1.1 Understanding Empathy in Adolescents with ADHD and CD

Chapter 2 aimed to explore empathic abilities in a large sample of adolescent males with ADHD and CD, an under-researched group. Although there is a relatively large body of research examining empathy in individuals with CD (*e.g.,* de Wied *et al.*, 2009; Schwenck *et al.,* 2012; Sterzer *et al.*, 2007), little is known about how this relates to a joint diagnosis of ADHD. Consequently, we measured and compared cognitive and affective empathy between adolescents with ADHD and CD and those with ADHD alone. We also examined the effects of ADHD and CD symptom severity and CU traits dimensionally. In addition, this chapter aimed to validate a new empathy scoring system which was developed to improve upon limitations associated with previous methods (*e.g.,* Strayer & Rossberg-Gempton, 1992).

Results of this study (see section 2.3) indicate that adolescent males with a joint diagnosis of ADHD and CD reported reduced affective empathy for sadness, happiness and fear compared to adolescents with ADHD alone. There were no differences in cognitive empathy between groups. This is consistent with previous research

highlighting that children with CD display affective empathy deficits, but relatively intact cognitive empathy skills (Schwenck *et al.*, 2012). Our results further these findings to adolescents with a joint diagnosis of ADHD and CD which is clinically important given the high comorbidity between the two disorders. We also demonstrated for the first time in a sample of adolescents with ADHD, that ADHD symptom severity was not related to empathy. Although, CU traits were related to lower affective empathy for sadness and fear, CD symptom severity was the best predictor of affective empathy impairments. Taken together these findings suggest that deficient affective empathy might explain why some adolescents with ADHD are at greater risk for antisocial behaviour.

In addition, Chapter 2 highlighted that the Cardiff Empathy Scoring System (CESS) has strong external validity with previous measures (*e.g.,* Schwenck *et al*., 2012) and internal and inter-rater reliability. This system was subsequently used in Chapter 5 to score empathy in relation to OXT. Although Chapter 5 used different emotion-inducing stimuli the CESS continued to demonstrate strong internal reliability across emotions.

6.1.2 Improving Emotion Processing

Given the high persistence and poor prognosis associated with childhood antisocial behaviour, combined with the limited effectiveness of current treatments, it has been suggested that neuropsychological and neurobiological correlates of antisocial behaviour in childhood and adolescence should be given more attention in terms of designing targeted interventions (van Goozen & Fairchild, 2008). While Chapter 2 aimed to further investigate our understanding of emotion processing in relation to antisocial behaviour by examining empathic skills, Chapters 3 – 5 aimed to explore whether interventions can help improve known emotion processing deficits associated with antisocial behaviour.

6.1.2.1 Targeted emotion recognition training in young offenders

Chapter 3 aimed to investigate whether a targeted emotion training programme could improve facial emotion recognition in a community sample of young offenders. Whilst all young offenders received their statutory interventions, a subgroup of offenders also

took part in a facial affect training programme. Our results demonstrated that fear, sadness and anger recognition improved significantly in offenders in the training group, indicating that emotion recognition can be relatively easily improved in youths who engage in serious antisocial and criminal behaviour (see section 3.3). Furthermore, we aimed to investigate for the first time whether any improvements as a result of the training would have an impact on subsequent offending behaviour as measured by official offence rates. We found that offenders who received the emotion training showed a significant reduction in the severity of crimes committed in the six months after the intervention whereas offenders who did not complete the training did not show a reduction in crime severity. Given we found no evidence to suggest the intervention impacted upon the number of crimes committed we suggest that improved emotion recognition may reduce the severity of reoffending. This is consistent with the idea that improvements in the recognition of angry, sadness and fear in others as a result of the training resulted in a better understanding of the emotions of potential victims and thus a reduction in both physical aggression and the commitment of more severe offences (Blair, 2005).

6.1.2.2 Pharmaceutical intervention

Both Chapters 4 and 5 examined the effects of administered intranasal OXT on emotion processing. Due to a number of ethical and logistical restraints it was not possible to examine OXT in adolescent young offenders. Instead, these chapters used a sample of male undergraduates to explore the possible enhancing effects of OXT in a double-blind within-subject randomised control trial. How this may relate to treating adolescents who display antisocial behaviour will be addressed in section 6.1.8.

6.1.2.2.1 Oxytocin and emotion recognition

Chapter 4 examined the effects of intranasal administered OXT on the accuracy of facial emotion recognition and face processing time. Our results demonstrated that while OXT had no effect on the accuracy at which participants detected facial emotions we found a marginally significant effect of OXT on face processing time with those receiving OXT spending less time attending to the emotional stimuli across the six emotions (see section 4.3). Furthermore, we aimed to investigate whether any improvements in recognition were related to OXT altering eye-gaze towards more

socially salient information - in this case the eye-region of the face. We did not observe any differences in the amount of time participants spent looking at the eye-region of faces when receiving OXT compared to the placebo. In addition, there was no relationship between recognition accuracy or face processing time and dwell time towards the eyes.

6.1.2.2.2 Oxytocin and empathy

Chapter 5 examined the effect of OXT on cognitive and affective empathy in response to empathy-inducing video clips. This used the same task as that of Chapter 2 with the exception that the video clips were updated in response to limitations associated with posed as opposed to expressed emotions. To this end, where possible, Chapter 5 used video clips of people experiencing real-life situations and emotions rather than actors expressing emotions in film clips. Our results demonstrated that OXT selectively enhanced affective empathy for fear whilst leaving cognitive empathy and affective empathy for pain, happiness and sadness unaffected (see section 5.3). We further demonstrated that OXT resulted in greater dwell time on the eye-region across emotions but that this was not related to empathy.

6.1.3 What is the Evidence that Antisocial Behaviour is linked with General or Specific Emotion Problems?

Drawing on the findings from Chapters 2 and 3 together, we have demonstrated that antisocial behaviour is associated with specific emotion processing deficits rather than a general impairment. Analyses in Chapter 2 revealed that adolescents with ADHD and CD showed reduced affective empathy but comparable cognitive empathy skills to those with ADHD alone suggesting that antisocial behaviour is not related to general empathy deficits but instead is specific to problems with affective empathy. Although this supports the idea that emotion problems in antisocial youths are specific the results from Chapter 2 are not necessarily consistent with the predicted specific deficits suggested by Blair's (2005) Integrated Emotion Systems (IES) model. According to this framework antisocial behaviour is associated with specific problems in processing distress cues. In relation to Chapter 2 this would have predicted that adolescents with ADHD and CD would show empathy impairments for pain, sadness and fear, all of which indicate

distress, but not for happiness. We observed a different pattern of results with adolescents with ADHD and CD showing reduced affective empathy for sadness, fear and happiness but comparable empathic abilities to those with ADHD alone when observing someone experiencing pain.

Blair (2005) suggests that distress cues, such as fear and sadness, serve to inhibit antisocial behaviour. He proposes that this occurs by an individual learning to avoid hostile acts that can cause distress to others, which is underpinned by effective amygdala functioning. Amygdala dysfunctions affect the recognition of fear and sadness (Adolphs & Tranel, 2004; Blair *et al.*, 1999; Calder, 1996), and are widely reported in antisocial samples (*e.g.*, Fairchild *et al.*, 2011; Jones *et al.*, 2009; Marsh *et al.*, 2008b; Sterzer *et al.*, 2005). Conversely, Decety *et al.* (2009) found no evidence of amygdala dysfunction in response to images of people experiencing pain in aggressive adolescents with CD which may explain why we found no evidence of reduce affective empathy for pain even though it could be considered an indicator of distress in a victim.

Our finding that happiness may be impaired is also contrary to previous findings (*e.g.*, de Wied *et al.*, 2009). We have suggested that a possible explanation for this discrepancy involves the way in which affective empathy was measured. We believe affective empathy should include more than merely a measure of how intensely an emotion is felt and should also consider why people believe they feel the emotions they do as this can have important implications for how individuals respond to the emotions of others. As such, we believe more research is needed into the potential emotion processing impairments associated with positive emotions to fully understand the specific problems antisocial youths display.

Although Chapter 3 did not explicitly examine deficits in emotion processing the results from the intervention provide support against the notion that deficits are general across emotions. Support for a pervasive emotion impairment has come, in part, from studies which suggest that emotion impairments are the result of antisocial individuals failing to attend to the eye-region of faces (Dadds *et al.*, 2008; Dadds *et al.*, 2011). According to this view, a lack of attention to the eyes causes general emotion recognition deficits across emotions but since the eyes play a more important role in detecting fearful expressions, deficits in fear are often more pronounced (Adolphs *et al.*, 2005). If this

were the case then one would expect the emotion training programme used in Chapter 3 - which amongst other things trained participants to look more at the eye-region of the face - to improve the recognition of untrained as well as trained emotions. Since the analyses in Chapter 3 revealed that the intervention did not have a spill-over effect to disgust (an untrained emotion), then this implies that the intervention was not successful purely because it trained participants to look at the eye-region of faces, suggesting that other mechanisms specific to certain emotions may be partially responsible for emotion recognition deficits. Nevertheless the current study was unable to use eye-tracking technology to fully explore these relationships. Future studies are therefore needed to explore the effects of emotion training programmes in combination with eye-tracking data to explore the mechanisms responsible for specific improvements. The findings from Chapters 2 and 3 therefore emphasise the need to focus on assessing specific domains of emotion processing that can identify strengths as well as deficiencies in abilities, which could be used to further develop targeted interventions.

6.1.4 What is the Evidence that the Severity of Antisocial Behaviour and CU traits explain Deficits in Emotion Processing?

Antisocial behaviour covers a broad spectrum of behaviours. We know that a relatively large proportion of young people engage in antisocial behaviour, and that there is much heterogeneity in terms of prevalence, type and severity of antisocial behaviour (Moffitt, 1993). Distinguishing between different subtypes of antisocial behaviour is therefore essential in order to identify differential causes of diverse behaviour, and to find appropriate interventions based on different aetiologies (Moffitt, 2003). To date, a large body of research has focussed on a categorical approach by comparing clinical groups (*e.g.,* ADHD and CD), against controls using clear cut-offs (*e.g.,* Decety *et al*., 2009; Fairchild *et al.,* 2010). Dimensional approaches can help to overcome some of the problems associated with categorical measures and enable us to examine between antisocial behaviour subgroups.

Using this approach recent evidence suggests that levels of CD and psychopathic traits explain variation in sadness and disgust recognition in young offenders, whereas offence severity appears to explain variation in anger recognition (Bowen *et al.,* 2014).

We have added to this literature in Chapter 2 by exploring the role of CD severity and CU traits in empathy in adolescents with ADHD. As well as being highly correlated with one another, we demonstrated that both CD severity and CU traits were inversely related to affective empathy for sadness and fear, but only CD severity was inversely related to affective empathy for happiness. Regression analyses revealed that CD severity explained the most variance in affective empathy and that CU traits did not significantly explain any additional variance. This is consistent with the notion that affective empathy inhibits aggressive behaviour through the vicarious experience of distress, since adolescents who demonstrated the least severe CD scored the higher levels of affective empathy. Furthermore, these findings support Blair's (2005) IES model of antisocial behaviour which states that observing fear and sadness in others elicits affective responses, such as empathy and remorse, and reduces the likelihood of continued aggression against the victim. Interestingly, neither CD severity nor CU traits significantly explained affective empathy for pain, which is inconsistent with previous brain imaging studies that have found CU traits to be inversely related, and aggressive acts to be positively correlated, to neural responses whilst viewing others experiencing pain (Decety *et al.,* 2009; Lockwood *et al*., 2013). As discussed in section 2.4 the discrepancy between our findings and those of previous studies are likely to be due to the different stimuli, methods and populations employed suggesting further research is needed into the relationship between CU traits and severity of antisocial behaviour and affective empathy for pain in participants with ADHD.

A callous and unemotional personality type was associated with reduced affective empathy towards people experiencing sadness and fear but was not related to impairments in empathising with happiness. This suggests that individuals high in CU traits have specific impairments in empathising with the distress cues of others and further highlights the importance of considering a range of measures which may help reduce heterogeneity of disorders. That said, CU traits did not add any unique variance in explaining affective empathy for fear and sadness above that of CD severity. As such, these results highlight the importance for clinicians to consider not just the categorical cut off of CD but also the severity of symptoms dimensionally when working with individuals with comorbid ADHD, or indeed any disorder, in order to be able to effectively treat and provide targeted interventions.

Interestingly, Chapter 3 also demonstrated that when emotion processing was improved, despite both groups showing a reduction in the number of crimes committed, only the training groups showed a reduction in the severity of crimes committed. More specifically, before the intervention participants in the training condition had a mean crime severity score of four, whereas after the intervention the mean crime severity score was two. It was not possible to complete an analysis of the individual types of crimes which were committed due to low frequency of individual crimes; nevertheless, from the YOS data we can get an idea of the type of crimes committed. For example, a severity score of four commonly included crimes such as actual bodily harm, causing affray, breaching an order and burglary of a non-dwelling, whereas a severity score of two included such things as criminal damage, possession of class C drugs, threatening behaviour and absconding. Although we could not look at aggressive behaviours *per se* in the analysis we can see from the severity scores (see Appendix 1) that as the aggression involved in the antisocial act increases so does the severity score. Consequently, we suggest that emotion training may have the potential to reduce the severity of offences and thus the severity of antisocial behaviour. These findings also support Blair's (2005) IES model since they suggest that improving the ability to detect sadness, fear and anger reduces the likelihood of continued aggressive antisocial behaviour.

6.1.5 Why is Antisocial Behaviour Associated with Deficient Recognition of Emotion but Intact Cognitive Empathy?

The recognition scores from young offenders in Chapter 3 are comparable to previously examined young offender samples, indicating impairments in emotion recognition associated with antisocial behaviour. Similarly, results from Chapter 2 are consistent with previous studies suggesting antisocial behaviour is associated with intact cognitive empathy abilities. This seems counterintuitive given models of empathy generally assume a three stage approach (*e.g.*, Blair, 2005; Marshall Hudson, Jones & Fernandez, 1995; Marshall & Marshall, 2011). According to these models, the first stage includes recognising the emotion of the other. Next, the observation of the other's emotion is enhanced by taking the perspective of the other person. In the third stage, emotion

recognition and perspective taking enable the observer to feel an emotional response. Since emotion recognition is a prerequisite for cognitive empathy one would expect problems with recognising emotions to have a knock-on effect. Nevertheless, facial emotion recognition is just one component of cognitive empathy (Decety & Jackson, 2004). Typically, cognitive empathy tasks such as those employed in Chapter 2 and Chapter 5 require participants to judge the emotion of - and show understanding for - the situation of a character in a particular social context using vignettes and pictures, or more recently video clips. These stimuli afford additional emotional cues above that of facial expressions to aid the understanding of others, such as body language, gestures, background scenery and social context. Since attending to the eye-region is relatively more important when judging emotional faces compared to completing cognitive empathy tasks which have these additional cues (Hurlemann *et al.*, 2010) and that antisocial behaviour is associated with reduced automatic gaze towards the eyes (Dadds *et al.*, 2006; Dadds *et al.*, 2008), it is possible that antisocial behaviour is associated with emotion recognition impairments due to dysfunctional attention to the eyes but relatively intact cognitive empathy skills where other cues are available. Unfortunately, the design of the cognitive empathy task in Chapter 2 does not allow us to detangle this further. Instead, to fully understand the specific deficits associated with antisocial behaviour it would be appropriate to further examine cognitive empathy using deconstructed video clips in order to detect where impairments lie. For example, the same video clips could be shown in an audio only condition; a no audio condition; only the main character's face condition; and a masked main character's face condition to determine which information antisocial youths utilise in order to cognitively empathise.

A related issue concerns the theoretical notion that intact cognitive empathy should lead to intact affective empathy. Our results from Chapter 2 indicate that this is not always the case since participants with CD displayed intact cognitive empathy bur deficient affective empathy compared to participants without CD. Instead, evidence seems to suggest that facial emotion recognition is related to affective empathy but not cognitive empathy (*e.g.*, Gery, Miljkovitch, Berthoz & Soussignan, 2009). The link between emotion recognition and affective empathy is supported by psychophysiological and cognitive neuroscience research, which has suggested that the association stems from an automatic perception–action mechanism leading to emotional contagion (Decety & Lamm, 2006). For example, when unconsciously viewing happy and angry facial

expressions, participants responded with facial muscular actions corresponding to these emotions (Dimberg, Thunberg & Elmehed, 2000). Accumulating evidence from neuroimaging studies also suggests that the same cerebral network is activated when perceiving emotional expressions of another and when feeling these emotions ourselves (for a review see Decety & Lamm, 2006). For instance, observing people expressing disgusted faces and experiencing disgust oneself activated the same brain areas (*e.g.*, anterior insula and anterior cingulate cortex) (Wicker *et al.*, 2003). Nevertheless, evidence also suggests that adopting a self-perspective when observing others in pain results in stronger feelings of personal distress at the expense of empathic concern towards the 'in pain' individual (Decety & Lamm, 2006). Conversely, when participants take the other's perspective, there is less overlap between the neural circuits involved in the processing of first-hand experience of pain, and participants report more feelings of empathic concern which is more likely to motivate prosocial action (Williams, O'Driscoll & Moore, 2014). This highlights the importance of cognitive empathy for enhancing prosocial responses to the distress of others.

In addition, neuroimaging data also suggest that cognitive and affective empathy involve different brain regions (Shamay-Tsoory *et al.*, 2009b). For example, cognitive empathy is more related to social cognition such as perspective taking and theory of mind and has been shown to be associated with neural responses in the classic theory of mind network (bilateral posterior superior temporal sulcus at the temporoparietal junction, precuneus and temporal poles) as well as to prefrontal regions such as the medial and ventromedial prefrontal cortex (Sebastian *et al.*, 2012). On the other hand, affective empathy and facial emotion recognition appear to activate the amygdala and other limbic areas more (Mummenmaa, Hirvonen, Parkkola & Hietanen, 2008; Vollm *et al.*, 2006). If, indeed, antisocial behaviour is associated with reduced amygdala activation then these results suggest affective empathy and facial emotion recognition would be more impaired than cognitive empathy which is not as amygdala-dependent. Taken together, these findings suggest that facial emotion recognition is a prerequisite for affective empathy but cognitive empathy is important for effectively responding to the emotions of others. Nevertheless, to our knowledge, no study to date has examined the relationship between facial emotion recognition, cognitive empathy and affective empathy in the same sample of young offenders. Unfortunately, since Chapter 2 and Chapter 3 were not carried out in a similar sample we could not explore these

relationships in the current thesis. Future research is therefore needed to compare these components whilst also considering attention towards the eye-region since this may shed light on why emotion recognition and cognitive empathy are not as related as first thought.

6.1.6 What is the Evidence that Intranasal OXT Improves Emotion Processing in Healthy Males?

Drawing on our findings from Chapters 4 and 5, we have demonstrated that in certain contexts intranasal OXT does appear to improve emotion processing in healthy males; nevertheless, these improvements were not consistent across different areas of emotion processing. In combination with previous studies our findings provide some evidence to suggest that OXT can improve emotion processing, but that both the strength and specificity of these effects are context dependent and by no means ubiquitous. The analyses in Chapter 4 demonstrated that OXT did not improve the accuracy at which emotions were detected but did have a marginal effect on time participants spent processing the face, such that participants under the influence of OXT spent less time attending to the face stimulus before making an emotional response. The analyses in Chapter 5 reinforced this finding by further demonstrating OXT did not affect cognitive empathy (an ability which includes identifying emotions). Taken together the results from Chapter 4 and Chapter 5 suggest that OXT does not enhance the correct detection or understanding of other emotions in healthy male participants.

The results from Chapter 4 are consistent with Lischkes *et al.* who found OXT resulted in participants recognising emotions at a lower intensity but did not improve detection accuracy *per se.* Nevertheless, other studies have found OXT improves accuracy in general (*e.g.*, Shahrestani *et al.,* 2013) and for specific emotions (*e.g.*, Fischer-Shofty *et al.,* 2010; Marsh *et al.,* 2010). A recent meta-analysis suggests that these differences could be due, in part, to the duration that stimuli are presented (Shahrestani *et al.,* 2013). For example, at shorter exposure times OXT appears to enhance the recognition of emotions that are generally recognised faster (*i.e.,* happy and angry expressions), whereas, for emotions that are harder to detect OXT administration appears to have

greater enhancing effects under longer durations of exposure (*i.e.*, fearful expressions). Additionally, other differences in stimuli, for example the use of eye-only images (*e.g.*, Fischer-Shofty *et al*., 2010) as opposed to whole faces or static versus dynamic stimuli, are likely to make detection more difficult and thus pronounce any OXT-induced improvements (Domes *et al.,* 2007a). Indeed, consistent with the results of Chapter 5 Hurlemann *et al*. (2010) found no effect of OXT on cognitive empathy. They suggested that the discrepancy between their finding and studies which found OXT improves the ability to infer emotional states of others is due to cognitive empathy tasks typically providing more information (*i.e.,* body language, social context) which makes the reliance of attending to the correct information in the face (*i.e.,* the eyes) less important. Since it has been speculated that improved emotion recognition is due to OXT altering eye-gaze to the eye-region and this is less important for cognitive empathy tasks then this implies OXT would not have such an effect when the importance of the eyes is lower.

The analyses in Chapter 5 also demonstrated that OXT selectively improved affective empathy for fear but did not result in any improvements in affective empathy for pain, sadness or happiness. This is the first study to examine the effect of OXT on empathy for discrete emotions, and although one other study has demonstrated that OXT enhances affective empathy (Hurlemann *et al.,* 2010) more research is needed into empathy for different emotions to fully understand the different contexts that result in enhanced affective empathy. Nevertheless, similar to our findings, Fischer-Shofty *et al.* (2010) found evidence for a selective effect of OXT on emotion recognition for fear. These results are particularly interesting in the context of antisocial behaviour where fear processing appears to be deficient. This will be discussed in more detail in section 6.1.8.

Taking the findings from Chapters 4 and 5 together, we have provided some evidence to suggest that OXT can lead to improvements in emotion processing in healthy males. Nevertheless, it is clear from these Chapters and previous findings that OXT does not always result in improved emotion processing and that further research is needed to fully understand the context in which improvements are observed.

6.1.7 What is the Evidence that Intranasal OXT is involved in Enhancing Social Salience?

Chapter 4 examined eye-gaze towards static faces depicting the six basic emotions whilst participants performed an emotional judgement task. Consistent with Lischkes *et al.* (2012) we found no evidence to suggest OXT resulted in increased attention to the eyes. These results are however contrary to other findings which demonstrated that OXT altered eye-gaze towards the eye-region of neutral faces (Guestella *et al.,* 2008; Andari *et al.,* 2010). Lischkes *et al*. suggested that the differences observed in their study compared to previous findings could have been due to their use of dynamic stimuli which may have reduced the importance of the eye-region; nevertheless, Chapter 4 utilised static images. Another notable difference in stimuli is that both Chapter 4 and Lischkes *et al*. examined eye-gaze in relation to emotional faces whereas both Guestella *et al*. and Andari *et al*. employed neutral expressions suggesting that altered eye-gaze may be specific to observing neutral faces. Nevertheless, the findings from Chapter 5 directly counter this possibility.

Chapter 5 examined eye-gaze towards dynamic stimuli across four emotions. Consistent with findings from Guestella *et al.* and Andari *et al*., we demonstrated that OXT significantly increased attention towards the eye-region of faces across the four emotions. Taken together the discrepancy in results between Chapters 4 and 5 is particularly interesting given these studies were conducted in the same participants, effectively removing any individual differences as a possible explanation for the results and thereby suggesting the differences were manifest within the tasks.

Another difference between the studies that have found evidence for altered eye-gaze and those that have not is that the studies that have found altered eye-gaze as a result of OXT used a passive viewing task whereas both Chapter 4 and Lischkes *et al*. required participants to make an emotional judgement about the stimuli. A typical underlying assumption in the eye-movements literature is that when an observer is not engaged in a specified task (*i.e.,* passive viewing) his or her eye movements will be directed to areas of high saliency (Foulsham & Underwood, 2008; Parkhurst, Law & Niebur, 2002) (*i.e.*, the eyes). Nevertheless, a recent study examining the predictive ability of salience

models to predict the location of fixations whilst viewing images suggests that other factors influence gaze during passive viewing and that gaze towards salient features is not as high as during goal directed tasks (*i.e.*, emotional judgements) (Koehler, Guo, Zhang & Eckstein, 2014). This suggests that in healthy participants eye-gaze to the salient eye-region would be comparatively greater during the emotional judgement task where the eyes afford valuable goal-directed information. Although the video stimulus used in Chapter 5 did not require direct ongoing emotional judgements to be made, participants were aware that they were being asked to rate emotions at the end of each clip. Consequently, the task used in Chapter 5 cannot be fully described as passive viewing and therefore we cannot effectively conclude whether the effects of OXT on eye-gaze are related to task demands. Nonetheless, another key difference between the face stimuli used in Chapter 4 and the video stimuli used in Chapter 5 involves the complexity of the stimuli. The video stimuli contained more information than purely the face (*i.e.,* body language, background scenery and social context) which may have reduced the necessity to attend to the eyes. Indeed, data from Chapters 4 and 5 demonstrates the higher preference to the eye-region during the static faces (62%) compared to film clips (36%). Taken together, we argue that the eye-tracking results from Chapters 4 and 5 can be best explained by OXT altering eye-gaze towards the eye-region of faces during complex emotional scenes when other useful information may render attending to the eye-region less pivotal. It should be noted that these conclusions are only generalisable to healthy participants who do not show impairments in the ability to automatically attend to the eye-region of faces. For disorders where the automatic preference to the eyes is reduced, OXT may indeed alter eye-gaze during less complex scenes as well. Future research should further explore the effect of scene complexity as well as the possibility that the type of task demands may impact upon OXT-induced effects.

To conclude these findings, the above discussion suggests OXT enhances social salience (in this case the eye-region) and it appears to do this across emotions. Given the emotions used in Chapter 5 were not clearly either approach-related behaviour or avoidance-related behaviour (*e.g.,* fear can be both approach and avoidance) we cannot comment on whether the effects of OXT are best explained simply in terms of social salience or whether OXT serves to increase approach-related behaviours while decreasing withdrawal-related behaviours. Future research would need to consider a

range of emotions differing in approach and avoidance behaviours in order to fully answer this question.

6.1.8 What is the Evidence that Emotion Processing can be improved in Young Offenders?

One of the main aims of this thesis was to examine whether known neuropsychological deficits in young offenders can be improved using targeted interventions. The analyses from Chapter 3 clearly demonstrate that the detections of fearful, angry and sad expressions can be improved in young offenders using an emotion training programme. These findings are consistent with numerous studies that have found evidence to suggest targeted emotion training can improve facial emotion recognition in offending youths (*e.g.,* Schonenberg *et al.*, 2013). Penton-Voak *et al.* (2013) previously demonstrated that emotion training in young offenders can improve self- and staff-reported behaviour for 2 weeks after an intervention. Our results further these findings using more objective official offence rates and suggest that a relatively quick and easy intervention can promote behaviour improvements for up to six months following training. Further research is now needed to explore the duration of these effects and determine whether a more intense training package may result in stronger effects.

Although Chapters 4 and 5 did not examine young offenders specifically it is worth considering whether the results from these chapters can provide insight into whether OXT has the potential to enhance emotion processing in antisocial individuals. As such, the next section will provide a discussion of evidence for and against this.

6.1.9 What is the Evidence that Intranasal OXT may be a Potential Intervention for Antisocial Behaviour?

Evidence highlighting OXT as one of the most important chemical modulators of social behaviour has generated increased interest in the potential therapeutic effects of intranasal OXT in a range of social and affective disorders (for reviews see Liu, McErlean & Dadds, 2012; Striepens, Kendrick, Maier & Hurlemann, 2011). Although

in its infancy, preliminary findings suggest that administered OXT may alleviate symptoms of autism and social phobia (Liu *et al.*, 2012). Given many of the social deficits associated with antisocial behaviour fall in the same domain as the social effects of OXT, it is feasible that intranasal OXT may be able to alleviate some of these deficits (*e.g.*, by increasing eye contact and improving how young offenders respond to the emotions of others).

Drawing on the findings from Chapters 4 and 5, we have demonstrated that OXT can, in certain situations, improve emotion processing in healthy males, but how does this relate to antisocial behaviour specifically? To answer this question it is worth considering the results from Chapters 4 and 5 in combination with previous findings related to task difficulty and individual differences.

The analyses in Chapter 4 provided some evidence to such that OXT can decrease the time required to process an emotional face in healthy males but not the accuracy *per se*. However, both Domes *et al.* (2007a) and Feeser *et al*., (2015) have demonstrated that OXT has greater effects when the emotional judgment task is more difficult. Given the emotion recognition task in Chapter 4 had no time constraint it could be considered an easier task compared to when stimuli are presented for a fixed period of time. Along similar lines, it has been demonstrated that the effect of OXT is moderated by individual differences. For example, the effect of OXT appears to be more pronounced in participants who are less emotionally sensitive, show poorer baseline performance, are less socially proficient and have lower baseline empathy (Bartz *et al.*, 2010; Fessrer *et al*., 2015; Leknes *et al.*, 2012). These findings have led to the suggestion that administered OXT increases the salience of social cues and benefits individuals who are generally less tuned to social information, but does not benefit socially adept individuals. Given the participants in Chapter 4 are likely to reflect more socially adept individuals, and we know antisocial behaviour is associated with poorer baseline recognition levels and reduced emotion sensitivity (*e.g.*, Bowen *et al.*, 2014), combined with evidence that OXT improves emotion recognition performance in male youths with a diagnosis of ASD (Guastella *et al.*, 2010), there is good reason to believe OXT would improve facial emotion recognition accuracy, as opposed to solely efficiency, in antisocial individuals.

In terms of empathy, the findings from Chapter 5, which highlight that OXT selectively enhances affective empathy for fear, are particularly interesting in the context of antisocial behaviour. Chapter 2 demonstrated that adolescents with ADHD and CD show reduced affective empathy for fear compared to peers with ADHD alone, and that impairments in affective empathy for fear can be explained by CD severity. In addition, numerous studies have demonstrated that impairments in processing fear are particularly pronounced in antisocial behaviour (*e.g.,* Marsh & Blair, 2008). Consequently, dysfunctional fear processing is considered the basis of antisocial behaviour in Blair's (2005) IES model. According to this model, if a person directly experiences the fear their actions have caused another, they will be less likely to continue the offending behaviour and associative learning will then enable them to associate their actions to a negative feeling and thus inhibit subsequent antisocial behaviour. Taken together, the results from Chapter 5 suggest that OXT has the potential to selectively enhance one of the core deficiencies associated with continued aggressive and antisocial behaviour which may ultimately result in improved prosocial behaviour.

As previously discussed in section 6.1.1 Chapters 4 and 5 found no evidence to suggest that altered eye-gaze is related to emotion processing. Nevertheless, Chapter 5 provided evidence that OXT can alter eye-gaze towards socially relevant information in healthy participants. Similarly, it has been demonstrated that OXT increases gaze-time to the eye-region of faces in adults with ASD (Andari *et al.,* 2010), a skill which is deficient in individuals with antisocial behaviour. These findings are particularly interesting given that increasing attention to the eye-region of faces has been shown to reverse emotional recognition impairments in boys with high CU traits (Dadds *et al.,* 2006). Taken together, in combination with the findings already discussed concerning the greater effect of OXT when baseline recognition levels are lower, the evidence from the eye-tracking analyses further suggests that OXT may have the potential to alleviate known deficiencies associated with antisocial behaviour.

The possibility that administered OXT may have potential therapeutic effects for adolescents with antisocial behaviour is further supported by observations that, similar to ASD, antisocial behaviour is related to variations in the OXT receptor gene (OXTR) (Prichard *et al.,* 2007), OXT antibodies (Fetissov *et al.,* 2006) and lower central and peripheral OXT levels as measured in cerebrospinal fluid (Lee *et al.,* 2009b). Similarly,

a significant relationship had been demonstrated between polymorphisms of the OXT receptor gene and CU traits in children (Beitchman *et al.,* 2012). While there is a theoretical basis for the potential use of OXT as a therapeutic intervention for antisocial behaviour, there has been no published study on whether OXT can alleviate symptoms in individuals with CD or psychopathy.

A potential caveat to be considered here is the role of intergroup relations in moderating the effect of OXT. A body of evidence suggests that OXT may not in all situations be as prosocial as first believed. Although findings point to a range of positive benefits to in-group members, recent findings suggest OXT may in fact lead to an increase in negative behaviours towards out-group members. For example, using a Prisoner Dilemma paradigm in which the level of threat from an out-group member was manipulated, De Dreu *et al.* (2010) found that variations in out-group threat interacted with OXT. When out-group threat was low, OXT had no effect on non-cooperation towards the out-group; however, when out-group threat was high, participants in the OXT condition were significantly more non-cooperative towards the out-group compared to those in the PL condition. This suggests that OXT motivates humans to be non-cooperative with rivalling out-groups, especially when the out-group represents a threat to the in-group. This is particularly important when considering OXT as a potential intervention for psychiatric patients (De Dreu & Kret, 2015). For example, gang related group crimes appear to be on the increase in the UK (HM Government, 2011) and the possibility that OXT could have a negative effect on relations with out-group members, but a positive effect on those with in-group members, may have consequences for antisocial youths. Theoretically, it could potentially enhance the bond between gang members but at the same time increase negative feelings and behaviours towards rival gang members or the police. Neither Chapter 4 nor Chapter 5 examined whether participants identified with the characters in the video clips or facial stimuli, or considered them to be representative of in-group or out-group members. Future studies could explore the effect of OXT on empathy and emotion recognition for different group members.

Another caveat that needs to be addressed is the effect of OXT on the amygdala. Throughout this thesis we have drawn upon evidence that consistently links antisocial behaviour to deficient fear processing that is associated with a dysfunctional amygdala

response (Blair, 2005). We have also demonstrated in healthy males that OXT selectively enhances affective empathy for fear and increases attention to the eye-region, two processes both associated with prosocial behaviour and increased amygdala response (Adolphs *et al.*, 2005; Spezio, Huang, Castelli & Adolphs, 2007). Nevertheless, in direct contrast to these findings, animal studies have demonstrated that OXT has an impact upon fear conditioning and extinction (McCarthy, McDonald, Brooks, & Goldman, 1996), and dampens a range of fear responses in rodents (Windle, Shanks, Lightman, & Ingram, 1997). These findings have been replicated and extended in human participants where OXT has been shown to enhance the decline of skin conductance responses in the extinction of conditioned fear (Eckstein *et al.*, 2015), to attenuate amygdala response to social and non-social fearful stimuli (Kirsch *et al*., 2005) and supresses the stress response (Heinrich *et al.*, 2003). The fact that OXT appears to both enhance the processing of fearful emotional stimuli and dampens brain activity in response to fearful emotional stimuli presents an inherent contradiction.

Moul, Killcross and Dadds (2012) suggest that divergent findings regarding amygdala activation are likely to be due to researchers ignoring the complex structure of the amygdala and highlight the importance of considering specific sub-regions within the amygdala. Accordingly, Bickart, Dicerson and Barrett (2014) describe three partially distinct brain networks anchored in the amygdala that each support unique functions that are important for building and maintaining social relationships. They propose that social perception is anchored by the ventrolateral sector of the amygdala, social affiliation by the medial sector and social aversion by the rostrodorsal sector. In the context of OXT-induced effects recent evidence suggests that differential OXT - amygdala effects appear to be mediated by different sub-regions of the amygdala (Gamer *et al.*, 2010). For example, OXT-enhanced ventrolateral amygdala function is related to the shift of attention towards the eyes (Gamer *et al*., 2010), suggesting that OXT plays a role in the amygdala network supporting social perception. On the other hand, OXT decreases activity in the rostral amygdala in response to fearful faces (Gamer *et al.*, 2010) suggesting OXT is important in the amygdala network supporting social aversion. OXT also potentiates amygdala-dependent socially reinforced learning and emotional empathy (Hurlemann *et al.*, 2010) suggesting OXT also plays a role in the network supporting social affiliation. These findings suggest a complex interplay between OXT, social behaviours and the amygdala which is further compounded by

evidence suggesting OXT-related amygdala function is gender dependent (Domes *et al.*, 2010).

Along similar lines the Differential Amygdala Activation Model (DAAM; Moul *et al.*, 2009) of psychopathy, proposes that the amygdala is not uniformly dysfunctional in psychopathy but instead that cognitive and emotional deficits found in psychopathy are due to underactivity in the basolateral amygdala (comprising of lateral, basal and accessory basal nuclei) and average to above average activity of the central amygdala (comprising of central and medial nuclei) further highlighting the need to consider sub-regions of the amygdala.

Taken together, the studies discussed above and in combination with the behavioural findings from Chapters 4 and 5 suggest that there is still much to learn about the effect of OXT on specific sub-regions of the amygdala and the conditions that determine the direction of any effect. Given that severe and persistent antisocial behaviour is associated with amygdala dysfunction (Blair, 2005) and fearlessness (Raine, 1993) further research is needed to clarify in which situations OXT results in enhanced fear processing, which may be valuable for individuals with antisocial behaviour, and in which it supresses fear processing, which may exacerbate already existing problem behaviours.

6.2 Strengths, Limitations and Future Directions

A key strength of this thesis is the focus on examining ways in which to improve known emotion processing deficits associated with antisocial behaviour. Previous research has clearly demonstrated deficits in facial emotion recognition and empathy in antisocial individuals. This thesis extends and contributes to the literature by exploring whether these abilities can be improved using targeted interventions. Not only have we demonstrated that emotion processing can be easily enhanced using targeted emotion training or OXT, but we also provide evidence that these improvements can reduce the severity of future antisocial behaviour which can have important implications for the treatment of (adolescent) offenders. To achieve this we employed a robust within-subjects randomised control trial to compare the effect of OXT and placebo on emotion

processing and also utilised eye-tracking technologies which are novel in their use for exploring the effect of OXT on empathy.

Particularly in relation to Chapter 2, and where appropriate, we have considered categorical and dimensional aspects of antisocial behaviour and related personality measures giving us a greater understanding of affective empathy problems in individuals with antisocial behaviour. Chapter 2 also benefitted from a very large sample of clinical patients, who can typically be challenging to recruit and test.

Finally, by developing the Cardiff Empathy Scoring System we have improved upon previous scoring systems by allowing us to consider cognitive and affective empathy as separate concepts and by taking into consideration intensity and attributions associated with both the target emotion and other similar emotions which may still indicate empathy. We also used ecologically valid dynamic video clips, showing people in emotionally laden situations to induce empathy experimentally and developed this further in Chapter 5 by using real life video showing people experiencing real emotions (as opposed to using posed emotions in acted-out film clips) providing more realistic stimuli. Despite these clear strengths it should be noted that passively viewing an emotional situation – which, whilst being more ecologically valid than viewing static pictures or listening to stories – is not as realistic as everyday interactions and experiences. As such, recent research has begun to consider using more realistic interactions (for a review see Pfeiffer, Vogeley & Schilbach, 2013) such as skype interviews (Auyeung *et al.*, 2015). The growing area of computational emotion research, which among other things can program avatars to respond to and interact with participants, may provide an exciting future direction for social emotion researchers interested in creating more socially realistic experimental interactions (Gratch, 2014; Marsella, Gratch & Petta, 2010).

There is a number of additional limitations in this thesis that need to be discussed. In relation to the strength of employing eye-tracking technology in Chapters 4 and 5 it should be noted that unfortunately, this equipment was not available during data collection for Chapters 2 and 3. Future research is therefore needed to further explore eye-gaze in relation to empathy in adolescents with CD (Bons *et al.*, 2013) and to ascertain whether emotion recognition improvements after training were associated with

increased attention to the eye-region. We are currently in the process of extending the study used in Chapter 2, by sampling adolescents with ADHD and examining empathy whilst monitoring participant eye movements.

Another key limitation is the lack of a consistent sample of young offenders throughout the chapters to enable more comparisons to be drawn across findings. This was due to a combination of logistical and ethical reasons. For example, participants from Chapter 2 were already recruited as part of a larger study into ADHD and CD and were therefore available to take part in the relatively short empathy task. However, participants tended to travel from far away making it logistically impossible to recruit the same participants for an intervention study that required multiple visits (Chapter 3). Furthermore, since we were particularly interested in examining subsequent offending using official crime data it was imperative to use a sample of offenders known to the local YOT, for whom we could access this information. For Chapters 4 and 5 ethical constraints prevented us from recruiting adolescent participants (the clinical research facility where the study was carried out would only allow participants over the age of 18). This limitation by no means takes away from the main findings of the thesis, but obviously a key next step would be to investigate the effects of OXT in an adolescent offender sample that displays emotion processing deficits. Not only would this enable a true evaluation of the possible utility of OXT as a treatment for antisocial behaviour but, if carried out in a sample of young offenders, would also allow for a comparison to be made between the relative effectiveness of a pharmaceutical intervention and an emotion training programme. Future research, therefore, not only needs to examine OXT in a sample of offending youths, but should also aim to compare the effectiveness of different interventions in a similar sample.

Another notable issue relating to the sample is the sole use of male participants throughout the thesis. We know that there are not only sex differences in emotion processing (Fischer, Mosquero, van Vianen & Manstead, 2004). - usually showing a female advantage (*e.g.*, Baron-Cohen & Wheelwright, 2004; Donges, Kersting & Suslow, *2012*) - but disorders such as ADHD and CD also manifest themselves differently in females and are often associated with different comorbid disorders (*e.g.*, Hermens, Kohn, Clarke, Gordon & Williams, 2005; Loeber, Burke, Lahey, Winters & Zera, 2000). Moreover, males and females differ in some developmental factors

associated with antisocial behaviour (*e.g.*, Lewin, Davis, & Hops, 1999; van Lier, Vitaro, Wanner, Vuijk, & Crijnen, 2005) and OXT appears to have differential effects on males and females (Domes *et al*., 2010). It is therefore important for consistency to compare like with like and not necessarily include males and females in the same analysis (without first checking for gender differences). It was not within the scope of this thesis to collect the additional number of participants required to examine data by gender. Consequently, it was decided to exclude female participants from the study for a number of reasons. Firstly, the prevalence of ADHD and CD, and the percentage of offenders in the youth justice system are higher in males than females (Cauffman, Grisso, Sickmund & Hodgdon, 2009; Ford, Goodman & Meltzer, 2003; Soothill, Ackerley & Francis, 2003). Not only does recruiting males therefore provide a larger pool of participants making testing quicker and more straightforward, but these statistics also highlight a group of individuals who are, for whatever reason, at a greater risk of antisocial behaviour and arguably in greater need for targeted interventions. In addition, for logistical (controlling for menstrual cycle) and ethical reasons (concerning pregnancy testing and the effect of administering OXT on an unborn baby) we were unable to recruit female participants for the tasks discussed in Chapters 4 and 5. Consequently, the results from the thesis are not necessarily generalisable to females. Future research needs to consider the similarities and differences in antisocial behaviour and emotion processing across the sexes to establish whether effective interventions for males would also be beneficial for females. This is particularly important given the number of female offenders appears to be on the rise (Cauffman *et al.*, 2009 Accordingly, we are now recruiting female participants with ADHD and CD to examine whether, and if so how, empathy deficits differ in this subgroup (using the same protocol as Chapter 2).

Another limitation relevant to Chapters 2 and 5 is the sole use of self-reported affective empathy. Relying solely on participants to self-report their own emotional states can be problematic in general since they appear to be confounded by factors such as cognitive development (Hoffman, 1982) and verbal skills (Strayer & Roberts, 1997). This may be particularly problematic for antisocial children who may have difficulties verbalising their thoughts and feelings (Quiggle, Garber, Panak, & Dodge, 1992). Since estimates of IQ (which included a measure of verbal skills) were not related to measures of empathy in Chapter 2 we believe this particular issue was not a problem with using self-

reported affective empathy in this thesis. Nevertheless, self-reported emotional states are also confounded by conscious awareness of the response (Chisholm & Strayer, 1995) or even the willingness to report this response (Bryant, 1982). They are also vulnerable to demand characteristics and social desirability (*e.g.*, Eisenberg-Berg & Hand, 1979; Eisenberg *et al.*, 1989b). Consequently, self-reports might not necessarily reflect how one has actually felt, but rather indicate one's knowledge of how other people expect one to feel. Physiological measurements, such as the measurement of heart rate (HR) or skin conductance (SCL), do not fall prey to such concerns and as such have been used to examine affective empathy in aggressive populations (*e.g.*, de Wied *et al*., 2009). Nonetheless, physiological measurements of affective empathy have also been criticised since measures such as SCL only measure arousal and are not sensitive to discrete emotions (Mauss & Robinson, 2009). Since we were interested in empathy for discrete emotions skin conductance would not have allowed us to differentiate whether a clear arousal response was due to a participant enjoying the distress they were seeing or actually feeling distress themselves. Facial responsivity measures would allow for this differentiation, however they too are susceptible to faking and social desirability effects (Cacioppo, Petty, Losch & Kim, 1986). Moreover, it is unclear whether non-verbal indices sufficiently distinguish between empathy, sympathy, and personal distress (Zhou, Valiente & Eisenberg, 2003) – which self-reported scoring systems can attempt to do.

It is clear from the limitations associated with specific measures of affective empathy that none of these measurements are perfect tools. Evidence from studies examining the convergence between measures of affective empathy suggest some measurements correlate with each other, for example self-report measures and facial responsiveness, and facial responsiveness and physiological measures (Anastassiou-Hadjicharalambous & Warden, 2007), suggesting there are common underlying themes being tapped into by each measurement. This highlights the importance of measuring affective empathy using a multi-method approach to examine which specific areas of affective empathy adolescent offenders show impairments in and indeed whether OXT enhances differential elements of affective empathy. This by no means takes away from the conclusions of this thesis, but does suggest that future research should extend these findings related to affective empathy (Chapters 2 and 5) to examine whether similar results are observed when physiological measures are employed. In relation to Chapter

5, to our knowledge, no study to date has examined the effect of OXT on physiological measures of empathy. Concerning Chapter 2, previous studies have demonstrated affective empathy impairments for negative valence emotions in adolescents with CD using, SCL, HR and facial responsivity (*e.g.*, de Wied *et al*., 2009); however, how this relates to ADHD (a disorder associated with abnormal physiological arousal [*e.g.*, Musser *et al.*, 2011; Musser, Galloway-Long, Frick & Nigg, 2013) and CD severity is currently unknown.

Interestingly, a new area of research gaining attention involves measuring changes in pupil dilation as an indicator of emotional response. Pupillary changes during picture viewing appear to co-vary with SCL change, suggesting that the pupil's response during affective picture viewing reflects emotional arousal associated with increased sympathetic activity (Bradley *et al.*, 2008). Using this technique it has been observed that children with ASD show abnormal emotional processing with reduced pupillary activity compared with controls to subliminally presented emotions (Nuske *et al.*, 2014) and to fear expressed by unfamiliar people (Nuske, Vivanti & Dissanayake, 2014), and pupil constriction when viewing children's faces (Anderson, Colombo & Shaddy, 2006). This method appears to be harder to fake or consciously control compared to facial responsivity measures and is quicker, easier and less intrusive to set up than SCL and HR - particularly if collected using the same equipment as eye-gaze data - (Nuske, Vivanti, Hudry & Dissanayake, 2014) making it an attractive alternative for testing adolescents with behavioural problems. Furthermore, it has been suggested that changes in pupil dilation may underlie OXT-induced emotion recognition improvements (Prehn *et al.*, 2013) suggesting this is a mechanism worth exploring in relation to emotional processing deficits in offending youths. Nevertheless, pupillary changes have also been shown to reflect attentional resources and task demands. Future research is needed to investigate whether examining pupil dilation in young offenders can help to explain emotion processing deficits with the caveat that careful planning and analysis would be needed to determine exactly what any differences in pupillary response may represent (reduced emotional response or reduced attention).

Finally, specifically in relation to Chapters 4 and 5, it is worth considering that OXT interacts with a variety of hormones, for example testosterone and cortisol have been shown to increase and decrease respectively after administration of intranasal OXT

(*e.g.*, Ditzen *et al.*, 2009; Weismann, Zagoory-Sharon & Feldman, 2014). The interaction of OXT with testosterone and cortisol is particularly noteworthy given their own relationships with antisocial behaviour and emotion processing. In terms of antisocial behaviour, a meta-analysis of correlational studies reported a statistically significant correlation between testosterone and aggression in males (Book, Starzyk & Quinsey, 2001) and more recently testosterone has been found to be related to nonaggressive CD symptoms in boys with deviant peers (Rowe, Maughan, Worthman, Costello & Angold, 2003). Similarly, low levels of cortisol predict aggression five years later (Shoal, Giancola & Kirillova, 2003) and have been shown to be related to aggression for disruptive behaviour disorder (McBurnett, Lahey, Rathouz & Loeber, 2000). In terms of emotion processing, evidence suggests a negative relationship between foetal testosterone and empathy (Chapman *et al.*, 2006) and foetal testosterone and attention to the eyes (Lutchmaya, Baron-Cohen & Raggatt, 2002) and more recently Derntl *et al*. (2009) found a significant positive correlation in healthy men between testosterone and amygdala response to fearful and angry facial expressions, but no correlation with non-threatening expressions such as sadness and happiness. Although cortisol does not appear to affect emotion recognition there is evidence to suggest it influences the experience of emotion through increased feelings of arousal (Sudheimer, 2009). Since OXT, testosterone and cortisol are inter-related and all appear to have an effect on antisocial behaviour and emotion processing it may be too simple to assume any emotional improvement after OXT administration is due solely to increased levels of OXT. Due to the additional costs and time needed to complete additional hormone analysis it was not feasible in this thesis to measure concentrations of testosterone and cortisol. Future studies should address these concerns by examining the effect of testosterone and cortisol in relation to OXT-enhanced emotion recognition and empathy. The fact that OXT appears to reduce the cortisol stress response is particularly important to consider in a sample of antisocial individuals who already show a blunted stress response (Fairchild *et al.*, 2008) as it is theoretically possible that OXT can exacerbate already existing dysfunctions.

6.3 Implication and Conclusions

These results have important implications for clinicians and practitioners working with adolescents at risk of offending. According to the NICE guidelines for ADHD treatment, intervention options differ depending on the severity of ADHD symptoms. For young people with moderate ADHD group-based parent-training and education programmes are the preferred first treatment choice whereas for severe ADHD drug intervention is recommended (NICE, 2008). Given evidence suggests that a joint diagnosis of ADHD and CD is associated with poorer clinical outcomes than ADHD alone and that our findings indicate that impairments in affective empathy may be a risk factor for comorbid ADHD and CD, we suggest that clinicians need to consider more than ADHD symptom severity in isolation when choosing intervention options. Considering CD symptom severity may help to reduce the heterogeneity associated within ADHD and help lead to more targeted interventions, for example by specifically targeting emotional impairments in adolescents with a joint diagnosis of CD. In addition, our findings highlight the importance for clinicians to consider CD dimensionally since affective empathy deficits were associated with greater CD symptom severity.

Findings confirming affective empathy impairments in relation to antisocial behaviour are also relevant to youth offending policy makers. At present, the criminal justice system focusses heavily on the use of restorative justice where victims are encouraged to explain the impact an offence has caused (Ministry of Justice, 2014). However, we have demonstrated that youths who display more antisocial behaviours (CD symptom severity) have problems empathising with others' distress, and are therefore likely to have problems responding appropriately to victims. It is therefore important to examine individual risk factors for antisocial behaviour as it can provide avenues for more effective and potentially tailored intervention (van Goozen & Fairchild, 2008). Clearly, intervention programmes that train and improve emotion recognition, such as the one outlined in Chapter 3, should be considered on an individual basis to be included prior to any restorative justice programme. If successful, improved emotion recognition may enhance affective empathy towards the victim and improve engagement and ultimately the success of restorative justice schemes. As well as having the potential to improve relationships with victims and support staff our evidence has also shown that this can

directly impact future antisocial behaviour, further promoting the positive impact of the intervention.

Despite the possible controversy surrounding the use of a pharmaceutical intervention to help control problem behaviours and the lack of evidence supporting its long-term use (Dadds *et al*., 2014b) the evidence surrounding the positive effects of OXT on areas of key deficiencies associated with antisocial behaviour highlights the importance of examining the effect of OXT in antisocial individuals. If this is demonstrated then we may potentially see radical changes in the ways in which antisocial behaviour is treated.

To conclude, we have demonstrated that affective empathy deficits evident in adolescent with CD are also observed in adolescents with ADHD and CD and that these appear to be driven by CD symptom severity. We have shown that the administration of intranasal OXT enhances affective empathy for fear and increases attention to the eyes across emotions during complex emotional scenes in healthy males and that this may have the potential to improve emotion processing deficits in antisocial individuals. Finally, we have demonstrated that not only can we improve emotion recognition in young offenders, but that emotion training also results in a reduction in the severity of future antisocial behaviour. Taken together these results suggest that emotion processing deficits in antisocial individuals can be improved and that this has the potential to lead to positive behaviour change.

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Appendix 1 - Offence severity scores

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
01	VIOLENCE AGAINST THE PERSON		
0101	**Abduction/Kidnapping**	7	
	Abduction of female by force		Serious
	Child abduction		
	False imprisonment		Serious
	Hijacking		Serious
	Kidnapping		Serious
0102	**Assault police officer (common assault)***	3	
	Assault with intent to resist arrest or assaulting a person assisting a police constable		
0103	**Common assault***	3	
	Assault & battery		
	Assault by beating		
0104	**Grievous Bodily Harm (wound or inflict)***	6	
0105	**Manslaughter***	8	Serious
	Child destruction, infanticide or manslaughter due to diminished responsibility		
0106	**Murder***	8	Serious
	Attempted murder		
0107	**Indictable firearms offences**	5	
	Possessing a real or imitation firearm at the time of committing or being arrested for an offence specified in Schedule 1 of the Firearms Act 1968		
	Possession of real or imitation firearms/explosives with intent to commit an indictable offence – including resisting arrest		Serious
	Possession of real or imitation firearms/explosives with intent to cause violence		
0108	**Other wounding***	4	
	Administering poison with intent to injure or annoy		
	Assault occasioning actual bodily harm (ABH)		
0109	**Possession of an offensive weapon**	3	
	Having an article with a blade or point in a public place		
0110	**Threatening, abusive or insulting words or behaviour**	3	
0111	**Threat or conspiracy to Murder**	5	Serious
	Soliciting to commit murder		
0112	**Wounding or other act endangering life***	7	
	Attempting to choke, suffocate with intent to commit an indictable offence (garrotting)		Serious
	Burning or maiming by explosion		
	Creating danger by causing anything to be on the road, or interfering with a vehicle or traffic equipment		
	Causing explosions or casting corrosive fluids with intent to do grievous bodily harm		Serious
	Endangering life or causing harm by administering poison		
	Endangering railway passengers (by placing anything on railway, taking up rails, changing points and signals or by throwing anything at railway carriages)		Serious
	Causing danger to road users (throwing stones etc.)		
	Possession of firearms with intent to endanger life or injure property		Serious
	Using chloroform to commit or assist in committing an indictable offence		Serious
	Using firearms or imitation firearms with intent to resist arrest		Serious
0113	**Wounding with intent to cause grievous bodily harm (section 18)***	7	Serious

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
0114	Other/unspecified violence against the person	4	
02	SEXUAL OFFENCES		
0201	Buggery*	7	Serious
0202	Gross indecency with a child*	5	
0203	Incest*	7	
	Incest with a female under 13		Serious
	Inciting a girl under 16 to have incestuous sexual intercourse		
0204	Indecent Assault*	5	
0205	Indecent behaviour/exposure	4	
0206	Rape*	8	Serious
	Assault with intent to commit rape or buggery		
	Attempted rape		
	Conspiracy to rape		
0207	Unlawful sexual intercourse with female under 13*	4	Serious
0208	Unlawful sexual intercourse with female under 16*	3	
0209	Other/unspecified sexual offences*	5	
03	DEATH OR INJURY BY DANGEROUS DRIVING		
0301	Death by dangerous driving*	8	Serious
	Causing death by aggravated vehicle taking		
	Causing death by dangerous driving when under the influence of drink or drugs		
0302	Injury by dangerous driving*	5	
	Causing injury by aggravated vehicle taking		
	Causing injury by dangerous driving when under the influence of drink or drugs		
04	MOTORING OFFENCES		
0401	Dangerous Driving	5	
0402	Driving under the influence of drinks/drugs	3	
0403	Driving whilst disqualified	5	
0404	Interfering with a motor vehicle	3	
0405	Refusing to give breath test	4	
0406	Road traffic/Additional Offences	2	
	Driving without due care and attention		
	Driving on a footpath or/and common land		
	Driving defective motor vehicle		
	Exceeding speed limit		
	Failure to wear a seatbelt		
	Failure to comply with a road traffic sign		
	Failure to give particulars after an accident		

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
	Failure to produce documents		
	Failure to report an accident		
	Failure to stop when requested by a constable		
	Failure to stop after an accident		
	Forge vehicle records/licence		
	No insurance		
	No L plates		
	No licence		
	No MOT		
	Not wearing protective headgear		
	Not well maintained indicators/stop/hazard and light reflectors		
	Pedal cycle offences		
0407	Other/unspecified Motoring offences	3	
05	ROBBERY		
0501	Robbery*	6	Serious
	Assault with intent to rob		
	Conspiracy to rob		
06	DOMESTIC BURGLARY		
0601	Aggravated burglary of a dwelling*	7	Serious
	Burglary with violence or threat of violence		
0602	Burglary in a dwelling	6	Serious
	Conspiracy to commit burglary of a dwelling		
0603	Other/unspecified domestic burglary	6	
07	NON-DOMESTIC BURGLARY		
0701	Aggravated burglary of a non-dwelling*	7	Serious
	Burglary with violence or threat of violence		
0702	Burglary in a non-dwelling	4	
	Burglary with intent		
	Conspiracy to commit burglary of a non-dwelling		
0703	Found on enclosed premises	3	
0704	Other/unspecified non-domestic burglary	4	
08	VEHICLE THEFT/UNAUTHORISED TAKING		
0801	Aggravated vehicle taking*	5	
	Injury to person, damage to property or car		
0802	Being carried*	3	
	Being carried (aggravated)	4	
0803	Vehicle taking	4	
	Theft of motor vehicle		
	Unauthorised vehicle taking (TWOC/TADA)		
0804	Other/unspecified vehicle theft/taking	4	

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
09	THEFT AND HANDLING STOLEN GOODS		
0901	**Handling stolen goods**	3	**Serious**
	Receiving stolen goods		
	Undertaking or assisting in the retention, removal, disposal or realisation of stolen goods, or arranging to do so		
0902	**Theft**	3	
	Extracting electricity		
	Making off without payment		
	Going equipped for stealing		
	Intent to steal		
0903	**Other/unspecified theft & handling**	3	
10	FRAUD AND FORGERY		
1001	**Forgery**	3	
	Forgery, or use, of false prescription		
1002	**Fraud**	3	
	Acting as a peddler without certificate		
	Counterfeiting		
	Conspiracy to defraud		
	Fraudulent use of documents		
	Obtaining pecuniary advantage by deception		
	Obtaining property by deception		
1003	**Public/private service vehicle and rail fare evasion**	1	
1004	**Other/unspecified fraud and forgery**	2	
11	ARSON		
1101	**Arson endangering life**	6	**Serious**
	Arson reckless as to whether life is in danger		
1102	**Arson not endangering life**	5	**Serious**
1103	**Other/unspecified arson**	5	
12	CRIMINAL DAMAGE		
1201	**Criminal damage endangering life**	6	**Serious**
1202	**Other Criminal Damage Over £2000**	3	
	Equipped with intent to commit criminal damage		
	Threat to commit criminal damage		
1203	**Other Criminal Damage Under £2000**	2	
	Equipped with intent to commit criminal damage		
	Threat to commit criminal damage		
1204	**Other/unspecified criminal damage**	3	
13	DRUGS		
1301	**Permitting use of premises for use of Class B or Class C drug**	3	**Serious**

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
1302	**Possession – Class A drug**	3	
1303	**Possession – Class B drug**	2	
1304	**Possession – Class C drugs**	2	
1305	**Supply – Class A drug**	6	Serious
	Possessing a class A drug with intent to supply		
	Offering to supply a class A drug		
1306	**Supply – Class B drug**	4	Serious
	Possessing a class B drug with intent to supply		
	Offering to supply a class B drug		
1307	**Supply – Class C drug**	4	
	Cultivation of cannabis		Serious
	Possessing a class C drug with intent to supply		
	Offering to supply a class C drug		
1308	**Unlawful importation or exportation of a controlled drug**	5	Serious
1309	**Other/unspecified drug offence**	2	
14	PUBLIC ORDER		
1401	**Affray**	4	
1402	**Bomb Hoax**	5	
	Supplying false information about the presence of bombs		
	Dispatching articles to create a bomb hoax		
1403	**Breach of the Peace**	2	
	Behaviour likely to cause breach of the peace		
1404	**Drunk and Disorderly**	1	
1405	**Other Public Order Act offences**	2	
	Section 4 Public Order Act 1986 (fear or provocation of violence)		
	Section 4a Public Order Act 1986 (intentional harassment, alarm or distress)		
	Section 5 Public Order Act 1986 (harassment, alarm or distress)		
	Placing people in fear of violence		
1406	**Rioting**	6	
1407	**Violent disorder**	5	
1408	**Other/unspecified public order offence**	2	
15	OTHER		
1501	**Other specified offences**		
	Absconding from lawful custody	5	
	Air weapons offences	3	
	Blackmail	5	Serious
	Cruelty to animals or unlawful killing of animals	3	
	Firearms Act Offences (e.g. no firearm licence)	2	
	Interfering with witness/perverting justice	5	
	Obstruct police or fire service	3	
	Public nuisance (common law offence)	2	
	Resisting arrest	2	
	Sending indecent/offensive articles	4	
	Trespassing on a railway	2	

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
1502	**Other minor offences**	1	
	Abusive language		
	Begging		
	Consuming alcohol under the age of 18 in a public place		
	Concealment of birth		
	Cycling in pedestrian area		
	Failure to make children attend school		
	Infuriating an animal (Section1 (1) (a) Protection of Animals Act 1911)		
	Inciting a child away from Local Authority care		
	Littering		
	Nuisance on educational premises		
	Urinating in a public place		
	Vagrancy		
	Making hoax/abusive or malicious telephone calls		
	Non-payment of financial penalty		
	Purchasing alcohol under the age of 18		
	Wasting police time		
1503	**Other/unspecified offence**	3	
16	RACIALLY AGGRAVATED		
1601	**Criminal damage – racially aggravated**	3	**Serious**
1602	**Other wounding – racially aggravated***	3	
	Actual bodily harm		
	Common assault		
	Intentional harassment alarm or distress		
	Putting people in fear of violence		
	Threatening, abusive or insulting words or behaviour		
1603	**Wounding or other act endangering life – racially aggravated***	6	**Serious**
	Wounding with intent to do grievous bodily harm		
1604	**Other/unspecified racially aggravated offence**	3	
17	BREACH OF CONDITIONAL DISCHARGE – this only applies where the breach has resulted in an additional substantive outcome. Where a young person has been re-sentenced, please refer back to the original offence for the seriousness.		
1701	**Breach of conditions of discharge**	1	
18	BREACH OF BAIL – this only applies where the breach has resulted in an additional substantive outcome. Where a young person has been re-sentenced, please refer back to the original offence for the seriousness.		
1801	**Breach of conditions of bail**	2	
19	BREACH OF STATUTORY ORDER – this only applies where the breach has resulted in an additional substantive outcome. Where a young person has been re-sentenced, please refer back to the original offence for the seriousness.		
1901	**Breach of Order or license conditions**	4	