Emotion processing in children showing disordered behaviour referred into a crime prevention programme: Identifying impairments and developing and evaluating an emotion recognition training

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Summary of thesis

Early childhood behaviour problems have been linked to later antisocial and criminal behaviour. Emotion recognition impairments are hypothesised to contribute to these negative behaviours. However, before now, no study has looked at the nature and extent of emotion recognition impairments in children with disordered behaviour and whether they can be improved.

We hypothesised that whilst some children with disordered behaviour would show negative emotion recognition impairments, others would not, and that emotion recognition would improve after completing the specifically developed Cardiff Emotion Recognition Training (CERT). Secondary aims and hypotheses are included within the thesis.

Ninety-two children with disordered behaviour (DB; 64 male), confirmed by their teacher using the Strengths and Difficulties Questionnaire, and who were participating in a crime prevention programme, took part. A typically developing group of 58 children (45 male) formed a comparison group. All children initially completed a Facial Emotion Recognition (FER) test. An accuracy threshold was then applied to the DB children's FER scores, further categorising them into those with (DB+) and without (DB-) emotion recognition impairments. Only DB+ children completed the three-session CERT. All DB children then repeated the FER test.

59% of the DB children were impaired in negative and neutral emotion recognition (DB+). Completion of the CERT led to a significant improvement in fear, sadness, anger and neutral emotion recognition.

This thesis has extended knowledge; up until now, no study has investigated the extent of emotion recognition impairments and whether they can be improved in the same sample of children showing disordered behaviour. This has valuable implications for practitioners; we have shown that interventions should be delivered

early and target individual children's impairments. Emotion recognition training is a viable option in case of emotion recognition problems. Research should now investigate if the improvement in emotion recognition is related to an improvement in behaviour.

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List of Acronyms

AE	Affective Empathy
AOI	Area of Interest
ASB	Antisocial Behaviour
DB	Disordered Behaviour
DB-	Disordered Behaviour without emotion recognition impairments
DB+	Disordered Behaviour with emotion recognition impairments
CD	Conduct Disorder
CE	Cognitive Empathy
CERT	Cardiff Emotion Recognition Training
CU	Callous and unemotional
DSM	Diagnostic and Statistical Manual of Mental Disorders
FER	Facial Emotion Recognition
IES	Integrated Emotion Systems
IQ	Intelligence Quotient
NICE	National Institute for Health and Clinical Excellence
PCSO	Police Community Support Officer
SDQ	Strengths and Difficulties Questionnaire
SES	Socioeconomic status
SPSS	Statistical Package for the Social Sciences
TD	Typically Developing
UK	United Kingdom
US	United States
WASI	Wechsler Abbreviated Scale of Intelligence

1 General Introduction

Published Paper

This Chapter is based on Hunnikin & van Goozen (2018). How can we use knowledge about the neurobiology of emotion recognition in practice? Journal of Criminal Justice, in press, https://doi.org/10.1016/j.jcrimjus.2018.01.005

1.1 Overview

We know that a small group of children and adolescents are at high risk for persistent antisocial behaviour (ASB), including repeated involvement in the criminal justice system. Judicial figures of criminality indicate that 80% of crime in the United Kingdom (UK) is being committed by a small group of individuals who exhibited behavioural problems in childhood and adolescence (Sainsbury Centre for Mental Health, 2009). Recent reviews of evidence from neuroscience (Fairchild, van Goozen, Calder, & Goodyer, 2013), clinical science, forensic psychology and criminology (Skeem, Scott, & Mulvey, 2014) indicate that high-risk juveniles differ from other young people in degree, rather than kind; they have poorer parental supervision, come from more disadvantaged neighbourhoods, have greater problems in emotion function and exhibit alterations in brain structure and function. However, research challenges the notion that high-risk children inevitably mature into adult offenders (Odgers et al., 2007), raising the possibility that well-targeted interventions could create a turning point in ASB for high-risk juveniles. Interventions delivered early in childhood and targeted towards impairments that influence aggressive behaviours have the greatest potential for preventing this developmental trajectory to persistent ASB (van Goozen & Fairchild, 2008; White, Frick, Lawing, & Bauer, 2013; Wilkinson, Waller, & Viding, 2015). One of the most replicated findings in this population is an impairment in recognising emotions in others (Bowen, Morgan, Moore, & van Goozen, 2014) and in empathising with others (Jolliffe & Farrington, 2004). Research has recently begun to assess the effectiveness of emotion recognition training on ASB and a reduction in offence severity has been shown (Hubble, Bowen, Moore, & van Goozen, 2015). However, its use as an early intervention is currently unknown and there are still several key research questions outstanding surrounding the use of

emotion recognition interventions in this sample, such as its influence on empathy. This Chapter discusses the emotion impairments observed in ASB samples, limitations with current ASB interventions and outstanding research questions that surround the use of emotion recognition training in ASB samples.

1.2 What is antisocial behaviour?

ASB is an umbrella term that covers a broad spectrum of behaviours defined by clinical diagnoses or judicial definitions. When aggressive and antisocial behaviour is pervasive and affects several domains of the individual's functioning, clinical diagnoses are given to the individual. Clinical definitions of ASB include diagnoses of Antisocial Personality Disorder for those aged over 18 years, Conduct Disorder (CD) and Oppositional Defiant Disorder. The term Disruptive Behaviour Disorder incorporates both CD and Oppositional Defiant Disorder. Common across these diagnoses is an inability to conform to and a violation of social norms, chronic and repetitive aggressive behaviour and a disregard for the rights of others (Diagnostic and Statistical Manual of Mental Disorders; DSM-5; American Psychiatric Association., 2013). Common antisocial activities and defiant behaviours include stealing, lying, vandalism and physical violence. Such diagnoses show a high rate of persistence into adulthood; 82-90% of adults with Antisocial Personality Disorder were given a diagnosis of CD during childhood (Loeber, Burke, & Lahey, 2002).

Judicial definitions of ASB consider levels of criminality and delinquency, such as arrest and conviction rates (Morgan & Lilienfeld, 2000). In the year ending March 2016, there were 79,600 proven offences committed by young people alone in the UK, 26% of which were classified as 'violence against the person' (Ministry of Justice, 2016). However, these rates rely on official records of criminal behaviour and so do not include undetected or unrecorded criminal behaviour. Nonetheless, looking at

official rates provides another perspective on ASB and also highlights the persistent nature of ASB; between 2014-2015 in the UK, juvenile offenders had a proven reoffending rate of 38% and committed on average 3.12 re-offenses each (Ministry of Justice, 2016). Again, highlighting that interventions to reduce this recidivism rate are required.

Aggressive behaviour is a central trait to both clinical and judicial definitions of ASB (DSM-5; American Psychiatric Association, 2013). However, it should be noted that not all antisocial acts are aggressive (Dodge, Coie, & Lynam, 2006). Nonetheless, aggression shows strong continuity throughout childhood and adulthood and appears to be a stable genetic trait (Eley, Lichtenstein, & Moffitt, 2003). Two forms of aggression have been identified, comprising a hostile subtype and an instrumental subtype. Hostile aggression is typically explosive, reactive aggression, whereas instrumental aggression usually involves controlled, premeditated aggression used to achieve a goal beyond hurting another (van Goozen, Fairchild, Snoek, & Harold, 2007). However, whilst described as two distinct types of aggression, the same individual is capable of displaying both instrumental and hostile aggression (van Goozen et al., 2007). Indeed, the existence of these two subtypes has been called into question (Bushman & Anderson, 2001).

Given the range of different definitions and operationalisations of ASB and the wide range of literature that are covered in this thesis, the omnibus term of ASB is used to cover all legal and clinical definitions, as in van Goozen et al. (2007). The omnibus term ASB can include both criminal behaviour and other behaviour that violates social/moral norms but is not typically subject to criminal sanctions (e.g., lying and bullying; Skeem, Scott, & Mulvey, 2014).

1.2.1 Prevailing subtypes of antisocial behaviour

ASB represents a heterogeneous group with subgroups showing differences in behaviour severity and aetiology (Moffitt, 1993). One subgroup specifically within CD is those who show callous and unemotional (CU) traits. These traits are characterised by a lack of guilt and remorse and a lack of concern and empathy for others (Frick & White, 2008) and are described as the childhood precursor to adult psychopathy (Barry et al., 2000). The presence of CU traits is a diagnostic criterion in the DSM-5, being described as 'limited prosocial emotions' (American Psychiatric Association, 2013). CU traits exist on a continuum in the community and appear to be important for predicting levels of ASB; the presence of these traits results in a more severe, aggressive and constant pattern of behaviour and is associated with aggression that is more likely to be premeditated and instrumental (Frick, Cornell, Barry, Bodin, & Dane, 2003; Frick & White, 2008; Kruh, 2005).

Age of onset is also thought to be a contributing factor to behaviour severity as two developmental taxonomies have been identified in ASB: adolescent-onset and life-course persistent (Moffitt, 1993). Those on a life-course persistent pathway begin offending earlier in childhood and engage in ASB at every life stage, resulting in a more severe and persistent behaviour. It is thought that this continuity is related to neuropsychological deficits, such as verbal and executive function deficits, combined with social problems, such as neglect. Conversely, those defined by an adolescence-limited pathway typically start offending during adolescence but desist in adulthood. It is thought that this is largely due to mimicking the behaviour of antisocial peers and therefore does not have a neuropsychological basis (Moffitt, 1993). However, recent work suggests that it is the seriousness of ASB, regardless of age of onset that is associated with neuropsychological deficits, such as emotion processing deficits

(Fairchild et al., 2011; Fairchild, van Goozen, Calder, Stollery, & Goodyer, 2009; Fairchild, van Goozen, et al., 2013). Differences in the age of onset of ASB can be due to factors such as suboptimal environmental conditions during childhood, poverty and poor parental supervision (Fairchild, van Goozen, et al., 2013).

1.2.2 Risk factors of antisocial behaviour

Research has shown a multitude of risk factors associated with the development of ASB including problematic behaviour in childhood, family criminality, poverty and poor parenting, amongst others (Farrington, 1995). Poor and hostile parenting is a known risk factor shown to independently contribute to the development of aggressive behaviour (Loeber & Farrington, 2000; Weiss, Dodge, Bates, & Pettit, 1992). This can include inconsistent discipline and poor supervision (Loeber, Green, Keenan, & Lahey, 1995). Relatedly, parental imprisonment has been shown to predict antisocial outcomes as far up to age 32 years old (Murray & Farrington, 2005). This parental imprisonment appears to affect children more so than other types of separation, such as through parental illness or death. Marital instability also is thought to play a role in the development of ASB, with research showing that children whose mothers showed more than one marital change were at increased risk for later ASB (Bor, McGee, & Fagan, 2004). Parental substance abuse has also been shown to predict the onset of CD (Loeber et al., 1995). Because of the role of parental factors in the development of ASB, interventions have focused on parental and family interventions (see section 1.8.1).

Other risk factors relate to the individual themselves and their social environment. One of the strongest predictors of later ASB is problematic behaviour in childhood (Bor et al., 2004; Murray & Farrington, 2005). Specifically, physical aggression has been shown to be significantly related to the onset of later CD (Loeber et al., 1995).

Antisocial children also come from low socioeconomic families (Murray & Farrington, 2005). In a longitudinal study looking at the predictors of CD, 70% of the boys studied who developed CD were from the lowest socioeconomic bracket (Loeber et al., 1995). Other social factors have also been shown to be risk factors in the development of aggressive behaviour, such as rejection by peers (Coie & Dodge, 1998). However, peers can also influence delinquent activities; in the National Youth Survey (Elliot & Menard, 1996), it was shown that bonding with delinquent peers encouraged delinquency but the reverse was also true; performing acts of delinquency encouraged bonding with delinquent others.

These risk factors appear to have a cumulative effect; the higher number of risk factors that these individuals are exposed to, the more serious the offending later on in life (Stouthamer-Loeber, Wei, Loeber, & Mastenb, 2004)**.** Knowledge of these risk factors helps researchers and clinicians alike to advance preventative and early interventions (Loeber et al., 1995).

1.2.3 What is the impact of antisocial behaviour?

ASB is a prominent issue in today's society and it is associated with a range of negative outcomes in adulthood. Not only does it predict future arrests, crime severity and conviction rates (Huesmann, Eron, & Dubow, 2002), but also substance abuse and dependence (Bardone et al., 1998; Fombonne et al., 2001), persistent health problems and psychiatric illness, amongst others (Fombonne et al., 2001; Odgers et al., 2008). Since the global prevalence of CD between 2006 and 2013 was 1.6% (Global Burden of Disease Collaborators, 2015), these consequences have an effect at a global level. The consequences are also long lasting; it has been shown that 80% of UK crime is being committed by individuals who exhibited behavioural problems during their childhood and adolescence (Sainsbury Centre for Mental Health, 2009).

The financial costs are similarly extreme; the cost of crime attributable to young people who had CD in England and Wales, amounts to approximately £60 billion per year (Sainsbury Centre for Mental Health, 2009). Costs include the use of police resources, medical resources associated with increased physical and mental health requirements, extra educational provision, state benefits and foster/residential care (Scott, Knapp, Henderson, & Maughan, 2001). For these reasons, intervention strategies and support for young people displaying ASB are highly desirable.

1.3 A case for emotion recognition

1.3.1 What is emotion recognition and why is it important?

Emotions are described as responses from part of the brain to the body in reaction to environmental or situational cues (Damasio, 1998). These responses can involve an automatic biological response and a conscious and subjective response (Cicchetti, Ackerman, & Izard, 1995). Certain stimuli can trigger emotional bodily reactions and our perception of those changes constitutes our conscious experience of emotions (James, 1884). Modern theorists state that emotions are triggered by significant or relevant events, that they encompass a set of changes in brain and body and that they are adaptive for the individual in that they help the individual to cope with the emotion-eliciting event (Adolphs, 2010a).

Emotion recognition is defined as the identification of emotionally salient information in the environment (Phillips, 2003). This can include identifying verbal and nonverbal (i.e. facial, visual and postural) cues to the emotions of others. This thesis specifically focuses on facial emotion recognition. The emotions we express and experience help us to form and maintain social relationships and thus are viewed as important for social survival (Fischer & Manstead, 2006). Being able to detect, process and respond appropriately to the emotions of others is crucial for normal

social interaction (Corden, Critchley, Skuse, & Dolan, 2009; Fridlund, 1991). Facial emotional expressions play a communicatory role in conveying information to the observer, such as projecting the valence of a situation (Blair, 2003; Marsh, Kozak, & Ambady, 2007). Interpreting others' facial displays of emotion provides insight into their thoughts, beliefs and intentions and allows one to explain, interpret and predict another's behaviour. An aptitude in emotion recognition helps to initiate and maintain healthy social relationships; individuals with high emotion recognition accuracy show higher levels of social competence and better functioning in social situations (Izard et al., 2001; Leppänen & Hietanen, 2001; McClure & Nowicki, 2001) and they are rated as more socially skilled and popular (Leppänen & Hietanen, 2001; Manstead & Edwards, 1992).

1.3.2 How is emotion recognition learned?

Recognition of others' emotions is learned through experience and based on the gradual refinement with age of children's production and recognition of emotional signals (Moulson et al., 2015; Pollak, Cicchetti, Hornung, & Reed, 2000; van Goozen, 2015). Caregivers play a substantial role in developing their child's emotion recognition proficiency. Not only do they expose children to many emotional facial expressions (Malatesta, 1985), particularly by modelling and mirroring emotional expressions (DeOliveira, Bailey, Moran, & Pederson, 2004), they also provide situational context and behavioural responses to emotional expressions, enabling children to learn the meaning of emotional expressions (Pollak & Sinha, 2002). Importantly, aberrant caregivers show positive emotional expressions less frequently and negative emotional expressions more frequently and as a result children who are adversely treated or exposed to these aberrant emotional signals exhibit a range of emotion recognition difficulties (Pollak et al., 2000; Shackman & Pollak, 2014). For

example, English, Wisener and Bailey (2018) showed that a history of emotional maltreatment was related to the slower recognition of fear. However, recent research has called this into question; in a large sample of 6,506 children, Dunn et al. (2018) showed that there was no evidence to support an association between emotion recognition deficits and prior exposure to adversity. Attachment to caregivers has also been shown to be important; Forslund and colleagues (Forslund, Kenward, Granqvist, Gredebäck, & Brocki, 2016) showed that those categorised as having a disorganised attachment style showed diminished emotion recognition abilities.

1.3.3 When does emotion recognition develop?

Emotion recognition begins crudely with some studies showing that infants as young as 4 months can differentiate between emotional displays of opposite valence (for review see Walle & Campos, 2012). Whilst at age 7 months, studies suggest that infants show increased attention-dwell time to fearful compared to neutral and happy faces (for review see Leppänen, 2011). As the child gets older (around 18-36 months), emotion processing and labelling continues to develop; studies using children as young as 3 years old have shown that they are capable of basic emotion recognition at this age (Pollak et al., 2000). After this, emotion recognition further increases with age; Berzenski and Yates (2017) showed that emotion recognition accuracy increased from age 4 to 8 years old. However, the age at which ceiling effects in emotion recognition emerges remains uncertain and it appears to be emotion-dependent (Durand, Gallay, Seigneuric, Robichon, & Baudouin, 2007). Durand et al., (2007) showed that at age 5 or 6 years of age, children were able to recognise facial expressions of happiness and sadness at an accuracy level similar to adults, whereas this ability did not develop for fear until 7 years of age, 9 years of age for anger and 13 years of age for disgust. Lawrence, Campbell and Skuse (2015)

showed, in their study of 478 children aged 6-16 years that there was no change in accuracy with age for sad and anger expressions across the ages but there was in recognising facial expressions of happiness, surprise, fear and disgust. In contrast, Chronaki, Hadwin, Garner, Maurage and Sonuga-Barke (2014), in their study of 4-11 year olds and adults, showed that accuracy for sadness improved with age but not for happiness and anger. Accuracy also improved with age for mild intensity expressions but not for moderate or high intensity expressions. Whilst it is clear that children begin to learn to recognise emotions throughout childhood, they do not reach adult levels of performance on emotion recognition tasks until early adolescence (Gao, Raine, Venables, Dawson, & Mednick, 2010; Herba & Phillips, 2004).

1.4 Antisocial behaviour and emotion recognition

The previous section of this Chapter has shown the importance of successfully recognising others' emotions and the relationship to social competence. However, the reverse is also true; a failure to interpret another's emotion correctly and respond appropriately can result in atypical behaviour in social situations, including ASB (Blair, 2003). Poorer emotion recognition abilities are associated with negative social behaviours, such as externalising behaviours (Izard et al., 2001) and social avoidance and distress (McClure & Nowicki, 2001). Indeed, emotion recognition problems are the most common pre-cursor of all forms of adult psychopathology (Copeland, Shanahan, Costello, & Angold, 2009; Kim-Cohen et al., 2003).

1.4.1 Facial emotion recognition impairments

Emotion recognition impairments have been studied across modalities, with substantial evidence that individuals who engage in inappropriate interpersonal behaviour, such as ASB, have problems in facial emotion recognition (Marsh & Blair, 2008). This has been 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., 2009), 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). Typically these populations are impaired at recognising fear and sadness (Blair & Coles, 2000; Blair et al., 2004, 2001; Marsh & Blair, 2008; Montagne et al., 2005), anger (Fairchild et al., 2009; Schönenberg, Louis, Mayer, & Jusyte, 2013) and disgust (Kosson, Suchy, Mayer, & Libby, 2002). By contrast, some other researchers have found evidence of pervasive impairments for negative emotions in general (Bowen et al., 2014) and in all basic emotions (Dawel, O'Kearney, McKone, Palermo, & O'Kearney, 2012). A recent study in young offenders found support for poor emotion recognition across differing intensities, but in particular poor recognition of low intensity anger and high intensity fear expressions (Bowen et al., 2014). Recent research has shown an emotion recognition impairment is even apparent in families of adolescents diagnosed with CD; Sully, Sonuga-Barke and Fairchild (2015) found that unaffected relatives were impaired in the recognition of anger and happiness, whereas the adolescents with CD showed impairments in recognising anger, fear, happiness, sadness and surprise.

Reasons for the different findings for impaired emotion recognition can include differences in the samples studied, as adolescents show different recognition impairments compared to adults (Dawel et al., 2012), different methodologies used, such as morphed expression tasks versus static faces, differences in the number of emotions studied (Bowen et al., 2014) and differences in the intensities of emotions shown (Bowen et al., 2014). Similarly, it could be that separate mechanisms may be

responsible for recognising different emotions and that not one central mechanism is responsible for all emotions (Sprengelmeyer, Rausch, Eysel, & Przuntek, 1998; Whalen et al., 2001). This implies that individuals can be selectively impaired (or unimpaired) in some expressions but not others.

It is also important to note that when it comes to emotion processing, there is a great deal of individual variability and individual differences are commonplace (Eugène et al., 2003). Emotion stimulus evokes a wide range of responses across individuals (Hamann & Canli, 2004), which accounts for some of the individual variability. Indeed, whilst studies showing emotion recognition deficits in antisocial samples are normal, others have shown intact emotion recognition (Glass & Newman, 2006). Therefore, not all antisocial individuals are likely to be impaired in emotion recognition.

1.4.2 Cognitive biases in emotion recognition

Individuals characterised by ASB are not only impaired in recognising emotional facial expressions but they also show a bias in interpreting neutral or ambiguous faces more negatively, consistent with a hostile attribution bias (Crick & Dodge, 1994; Dodge, Pettit, Bates, & Valente, 1995). They are more likely to interpret an expression of disgust as angry (Sato, Uono, Matsuura, & Toichi, 2009) and ambiguous expressions as angry (Dadds et al., 2006; Mellentin, Dervisevic, Stenager, Pilegaard, & Kirk, 2015; Schönenberg & Jusyte, 2014). Schönenberg and Jusyte (2014) found that aggressive offenders interpreted ambiguous stimuli as hostile and Philipp-Wiegmann, Rösler, Retz-Junginger, and Retz (2017) showed that ‘reactive aggressive’ offenders showed higher rates of misidentifying non-anger expressions as anger than ‘proactive aggressive’ offenders and a group of control individuals. This bias has also been shown in research with adolescents; Dadds et al. (2006) showed,

in adolescents displaying ASB, that poorer recognition of neutral faces was associated with ASB, and that these neutral faces were most often mistakenly classified as angry. Research looking at reducing this cognitive bias has been conducted and the subsequent influence on subjective anger has been assessed. Penton-Voak et al. (2013) were successful in modifying the cognitive bias of anger in a group of 40 healthy volunteers and showed that lower levels of state anger were reported only in those who took part in the modification training. This further suggests that emotion-recognition biases play a role in subjective anger and aggression; the hostile attribution bias may lead them to be more likely to be involved in aggressive situations, thereby contributing to ASB.

1.4.3 Emotion recognition impairments in other modalities

Facial emotion recognition deficits have been the key focus for the majority of research, but researchers have also investigated whether this impairment is present across modalities, such as body posture and voices. Muñoz (2009) investigated youths showing CU traits and found that those who scored highly on these traits were less accurate when labelling fearful body postures, in addition to fearful faces. This suggests a generalised deficit in recognising fear, not specific to faces. Only a handful of studies have investigated vocal affect impairments. Stevens, Charman and Blair (2001) found evidence of an impairment in recognising sad vocal affect whereas Blair, Budhani, Colledge and Scott (2005) found evidence of an impairment for fearful vocal affect only, both in samples of children with psychopathic traits. In a recent meta-analysis, Dawel et al. (2012) first, highlighted the low number of papers investigating vocal emotion recognition and secondly noted that, of the six studies that investigated this, psychopathy was associated with significantly poorer vocal recognition of fear, happiness and surprise. Therefore, it is clear that some emotional recognition

impairments may exist in other modalities but the exact nature of these is not yet understood.

1.4.4 Theories linking emotion recognition and ASB

Several key theories account for the relationship between ASB and impairments in facial emotion recognition. The first, the Violence Inhibition Mechanism model (Blair, 1995; Blair, Jones, Clark, & Smith, 1997), specifies the existence of a system called the violence inhibition mechanism. This mechanism is activated by distress cues, which generate a negative emotional response in the observer. This results in increased autonomic activity and activation of a threat response system. It is proposed that ASB and psychopathy is associated with a deficient violence inhibition mechanism leading to an insensitivity to interpersonal distress cues (specifically fear and sadness).

The second theory, the Integrated Emotion Systems (IES) model (Blair, 2005a) was developed from the violence inhibition mechanism and emphasises the role of the amygdala in emotion impairments in ASB and in creating associations to learn from behaviour (for detailed description of the role of the amygdala in ASB and emotion recognition impairments see section 1.7.2). Accordingly, distress cues, such as fear and sadness, serve to inhibit ASB; the correct processing of others' distress-related cues is thought to elicit empathy that in turn results in learning to avoid aggressive acts that cause fear and sadness through creating an association between another's distress and the harm-causing behaviour. It is thought that individuals showing aggressive and antisocial behaviour are impaired not only in recognising the expression, but also in the learning that typically follows from observing distress cues, and so continue with their negative behaviour as they cannot learn the association. Indeed, the inability to experience another's distress vicariously or to empathise with

another person affectively has been identified as a causal factor of ASB (Decety & Jackson, 2004). The findings by Bowen et al. (2014) showing an impairment in low intensity angry faces also show how this impairment impacts on behaviour; angry faces serve as warning signals of social punishment and individuals displaying ASB may therefore be less sensitive to low intensity (early warning) signals and as a result continue to behave in socially unacceptable ways. This is the theory that is most commonly cited in ASB literature.

Social-cognitive models also explain how an impairment in emotion recognition contributes to ASB. Social information processing theories suggest that a person carries out behavioural responses by (a) receiving social cues (b) making meaning of these cues (c) accessing possible behavioural responses and (d) selecting the behavioural response (Dodge & Rabiner, 2004). Discrepancies between one or more of these factors involved in social information processing may be responsible for ASB (Muñoz, Qualter, & Padgett, 2011). Since individuals with ASB are impaired in receiving and understanding the social cues, it then has an impact on selecting an appropriate behavioural response, resulting in aggressive and antisocial behaviours.

Damasio's somatic marker theory (Damasio, Tranel, & Damasio, 1991) proposes that somatic markers help in decision-making scenarios when emotions are involved. Different regions are involved in the generation of somatic markers but the primary inducer is thought to be the amygdala. When this area is damaged, the somatic response to emotional objects or events is limited, meaning the individual experiences limited physiological feedback relating to their current situation and is unable to learn the association between their behaviour and their physiological reaction. It is thought that this too contributes to the development and continuation of ASB. Indeed, there is research that shows that, for example, children with CD generally show low

physiological arousal to affective pictures and/or a blunted cortisol stress response when negatively challenged (Fairchild, van Goozen, et al., 2013; van Goozen, Matthys, Cohen-Kettenis, Buitelaar, & van Engeland, 2000). This is also linked to the observation of more impulsive, fearless and aggressive temperaments (van Goozen, 2015) and an inability to learn which situations should be avoided (Syngelaki, Fairchild, Moore, Savage, & van Goozen, 2013), meaning they are more likely to engage in aggression, particularly to obtain rewards and social status (Raine, 2002).

1.4.5 The role of CU traits in emotion recognition impairments

CU traits have been shown to be associated with a more severe, aggressive and stable pattern of behaviour (Frick & White, 2008; Kruh, 2005) and as such, research has looked at their role in the emotion recognition impairments shown by this sample. Dadds et al. (2006) showed that CU traits were negatively correlated with fear accuracy and Marsh et al. (2008) showed that amygdala activation was reduced in youths with CU traits when processing fearful expressions compared to healthy comparison subjects. These studies help to show that individuals with CU traits show reduced responsiveness to distress cues, as explained by the IES (Blair, 2005a). In a contradictory study, Woodworth and Waschbusch (2008) showed that children with high CU traits but no conduct problems (CU traits alone) showed impairments in recognising expressions of sadness and that those with high CU traits were actually more accurate at recognising fear compared to children with low CU traits. Therefore, the role of CU traits within emotion recognition impairments is not clearly understood.

1.5 Antisocial behaviour and empathy

Individuals displaying ASB have shown to be not only impaired in emotion recognition but also in empathy. It is thought that these two concepts are intertwined, with emotion recognition being a precursor to empathy.

1.5.1 What is empathy and why is it important?

Empathy is broadly defined as the ability to understand and share another's feelings (de Wied, Gispen-de Wied, & van Boxtel, 2010). It is typically thought to consist of three parts: cognitive, affective and motor empathy. Cognitive empathy is the ability to understand another's perspective in an emotional situation (Blair, 2005b). Affective empathy is the experiencing of another's emotion (Bons et al., 2013) and motor empathy refers to automatic mimicry processes, such as automatically mimicking emotional facial expressions (de Wied et al., 2010). This thesis focused largely on cognitive and affective empathy. These two empathy constructs are thought to be interrelated but dissociable constructs (Shamay-Tsoory, Aharon-Peretz, & Perry, 2009). Being capable of empathy is a positive factor, which relates to concepts including being rated as more popular (Warden & MacKinnon, 2003) and prosocial behaviour (Mayer, Jusyte, Klimecki-Lenz, & Schönenberg, 2018). Empathy is also negatively correlated to undesirable behaviours, such as adopting hostile roles at school (Belacchi & Farina, 2012; Izard, 2001) and empathy impairments have been linked to impairments in moral judgements (Marsh & Cardinale, 2012).

1.5.2 Antisocial behaviour and empathy impairments

Individuals characterised by ASB show an inability to empathise (Robinson, Roberts, Strayer, & Koopman, 2007). Some researchers have shown that ASB is associated with impairments in affective empathy (Brouns et al., 2013; Carr & Lutjemeier, 2005; Jones, Happé, Gilbert, Burnett, & Viding, 2010). In a series of studies, de Wied and colleagues showed that boys with Disruptive Behaviour Disorder reported feeling less affective empathy to negative (but not positive) emotions in self-reports, which was confirmed by blunted physiological response patterns and fewer facial mimicry responses (de Wied, Goudena, & Matthys, 2005; de Wied, Van Boxtel,

Zaalberg, Goudena, & Matthys, 2006; de Wied, van Boxtel, Posthumus, Goudena, & Matthys, 2009). However, other studies have shown that there is an inconsistent association between affective empathy and aggression in children (Lovett & Sheffield, 2007). Recent research has shown that affective empathy is impaired in this ASB population but cognitive empathy is intact (van Goozen et al., 2016). However, other studies have shown evidence of a cognitive empathy impairment (Bons et al., 2013; Dadds et al., 2009; Gonzalez-Gadea et al., 2014; Pasalich, Dadds, & Hawes, 2014). Jolliffe and Farrington (2004), in their meta-analysis of 25 studies, found a negative relationship between cognitive empathy and offending, as did Gonzalez-Gadea et al. (2014) who found that adolescent offenders exhibited deficits in cognitive empathy.

Empathy, or a lack of it, plays an important role in Blair's (2005a) IES 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. It is thought that this deficiency in empathy allows an individual to commit interpersonal crimes without the constraint of concern for the emotional or physical harm of others (Carr & Lutjemeier, 2005).

CU traits are also thought to influence the type of empathy impairments observed in this sample. Pasalich et al. (2014) found that CU traits were associated with deficits in cognitive empathy and similar results were shown by Anastassiou-Hadjicharalambous and Warden (2008) who showed that children with CD and high CU traits showed a lower magnitude of heart rate change during emotionally evocative film clips, indicative of lower affective empathy.

1.6 The relationship between empathy and emotion recognition

Emotion recognition is a contributing factor in the ability to empathise with others and has been theorised to be a precursor to empathy (Blair, 2005b; Marshall & Marshall, 2011; Marshall, Hudson, Jones, & Fernandez, 1995). In Blair's (2005a) IES model, it is described that recognising distress cues evokes empathy, which leads to helping behaviours. Emotion recognition is one aspect of recognising distress cues. Indeed, Marshall and colleagues (2005, 2011), in their staged multicomponent model of empathy stated that the ongoing process of empathy involves four discriminable steps: (1) emotion recognition (2) perspective taking (3) emotion replication (4) response decision. It is therefore thought that a lack of empathy results from an inability to recognise emotional expressions that indicate distress in others (Blair, 2001, 2005b). Empathy has been related to recognition accuracy across basic emotions (Besel & Yuille, 2010; Gery, Miljkovitch, Berthoz, & Soussignan, 2009), to recognition accuracy at lower intensities (Martin, Berry, Dobranski, Horne, & Dodgson, 1996) and to recognising fearful expressions (Carr & Lutjemeier, 2005).

The relationship between emotion recognition and empathy can also be seen when considering prosocial behaviour. This behaviour is generally defined as any behaviour that is positive and helps another (Marsh & Ambady, 2007). Observing emotional expressions of distress in others (emotion recognition) is thought to elicit similar feelings in the individual (empathy) which then is associated with an increased likelihood of engaging in prosocial behaviour (Marsh & Ambady, 2007). That is, the sight of another's negative affect triggers empathy and this stimulates the motivation to help the other individual (Nichols, 2001). Marsh and Ambady (2007) showed that participants who were more accurate in recognising fear expressions showed greater levels of hypothetical prosocial responding and Marsh et al. (2007) extended this by

showing that accuracy for fear expressions predicted prosocial behaviour in a helping task.

More recently, a study has looked at the mechanisms behind deficient cognitive and affective empathy in adolescents with high-CU traits. Lui, Barry and Sacco (2016) investigated the role of affective perspective-taking and facial emotion recognition, given that both aspects are implicated in empathy. They found that both cognitive and affective empathy were related to CU traits and specifically cognitive empathy was related to emotion recognition. Given that cognitive empathy is defined as the ability to understand another's perspective on an emotional situation (Blair, 2005b), this appears logical.

1.7 Potential mechanisms and causes of emotion impairments

1.7.1 The importance of the eyes

Impaired attentional mechanisms, specifically to the eye region, have been hypothesised to play a role in the facial emotion recognition and empathy deficits seen in ASB. Eye contact is thought to be critical for the healthy development of conscience and social competence (Skuse, 2003). Impaired attention to the eyes inhibits children's capacity to attribute mental states including emotions and intentions to others and more broadly disrupts the quality of social interactions with others (Rigato & Farroni, 2013).

Attention to the eyes is considered necessary for face processing and recognition of facially expressed emotions (Itier & Batty, 2009) and is critical for the development of emotion recognition (Skuse, 2003). Healthy individuals first fixate on the eyes and then spend relatively more time looking at the eyes than at other features of the face (Itier & Batty, 2009) and overall spend more time looking at the eye region than any other region in the face (Scheller, Buchel, & Gamer, 2012). In particular, healthy

individuals are best able to recognise partially hidden emotional expressions when the eye region is visible for fear expressions and when the mouth region is visible for happy expressions (Smith, Cottrell, Gosselin, & Schyns, 2005). The eyes are an important source of social information especially for fear expressions (Adolphs et al., 2005).

Dadds and colleagues (Dadds et al., 2006; Dadds, El Masry, Wimalaweera, & Guastella, 2008) hypothesised that a lack of attention paid to the eye region of the face, as evidenced by fewer fixations to the eye region, leads to poorer emotion recognition in antisocial populations. They found that boys with high CU traits show impaired attention to the eye region when freely viewing emotional faces. However, when explicitly instructed to look at the eyes, they showed normal patterns of fear recognition (Dadds et al., 2006; Dadds, El Masry, et al., 2008). Similar results have been shown with adult male violent offenders when their attention was implicitly directed to the eye region (Schönenberg, Christian, et al., 2013).

It has been shown that these individuals are not only impaired at looking at the eye region during computerised research tasks, but also during interactions with caregivers. Dadds, Jambrak, Pasalich, Hawes and Brennan (2011) showed, in a sample of 92 male children aged between 5-16 years old that those displaying high CU traits showed less eye contact with their mother when mothers displayed their love for the child. Indeed, they demonstrated that levels of eye contact were correlated with an independent measure of fear recognition. Similar results were found in children high in CU traits who showed lower levels of reciprocal eye contact and less affection towards their caregiver (Dadds et al., 2014). It has been suggested that this failure to pay attention to the eyes will compromise the influence of parental

affection and discipline due to the inability to understand the emotional state of the parent (Dadds et al., 2014, 2011).

Recent research, however, has suggested that attention to the eyes does not play a role in the observed emotion recognition deficits. Studies with adolescents with Attention Deficit Hyperactivity Disorder plus comorbid CD and adolescents with CD have shown that emotion recognition deficits are not mediated by abnormal fixation to the eye region (Airdrie, Langley, Thapar, & van Goozen, 2018; Martin-Key, Graf, Adams, & Fairchild, 2017).

Eye contact is not only critical to understanding the emotional state of the other, but also for the healthy development of empathy (Skuse, 2003). Attention to and responsiveness to emotional stimuli is thought to be a fundamental building block of the development of higher-order human functions, including empathy (Blakemore, 2008; Skuse, 2003). Social attention is an essential precursor to empathy and is thought to be required to ensure an empathic response (van Zonneveld, Platje, de Sonneville, van Goozen, & Swaab, 2017). Indeed, Cowan, Vanman and Nielsen (2014) found a positive relationship between trait empathy and looking towards the eyes during an emotional film clip. To date, however, only one very recent study has explored the relationship between attention to the eye region and empathy using emotionally evocative film clips (van Zonneveld et al., 2017). Despite finding evidence of reduced affective empathy in a group of 8-12 year olds boys at high risk of criminal behaviour, they found no evidence of reduced cognitive empathy or social attention in this group. They concluded that these high-risk children had specific problems with experiencing others' negative emotions (affective empathy). This, in combination with their results on social attention, suggests that an impairment in looking towards the eyes is not a mechanism by which these children show reduced affective empathy.

The role of attention to the eyes in both emotion recognition and empathy requires further research with at-risk children.

1.7.2 The role of the amygdala

Structural scans of young people who display ASB have shown an amygdala dysfunction (Fairchild et al., 2011; Jones et al., 2009; Marsh et al., 2008; Sterzer, Stadler, Krebs, Kleinschmidt, & Poustka, 2005). Fairchild et al. (2011) showed that structural amygdala abnormalities were present in adolescents with CD, no matter whether their disorder was of child- or adolescent-onset, compared to healthy adolescents**.**

The amygdala has been shown to play a key role in emotion recognition. In neuropsychological studies, individuals with damage to the amygdala have been found to be less able to recognise negative facial expressions, particularly fear but also anger, disgust and sadness (Adolphs et al., 1999; Fairchild, van Goozen, et al., 2013; Schmolck & Squire, 2001). Functional imaging studies with healthy populations have also shown an activation of the amygdala in response to fearful stimuli (Breiter et al., 1996; Morris et al., 1996; Whalen et al., 2001). In their meta-analysis of 20 studies, Marsh and Blair (2008) found a robust link between ASB and specific deficits in the recognition of fearful expressions, which the authors suggest is linked to this amygdala dysfunction. This, combined with the knowledge that the amygdala is activated when individuals view negative facial expressions or pictures (Whalen et al., 2001), has led to the belief that the amygdala is important for processing threat information. Evidence of this dysfunction also supports Blair's (2005a) IES model because the amygdala is thought to be involved in the formation of stimulus-reinforcement associations, thus it not only impairs the ability to recognise these distress cues but also to learn from them.

Evidence of pervasive impairments (e.g., Dawel et al., 2012) appear to conflict with theories linking amygdala dysfunction to ASB via a deficit in distress recognition (specifically fear). However, further evidence suggests that the amygdala responds to a range of facial expressions, not just fear (Fitzgerald, Angstadt, Jelsone, Nathan, & Phan, 2006). Current theories now suggest that the amygdala plays an important role in detecting salient and socially relevant information (Adolphs, 2010b), specifically in orientating attention and eye gaze towards emotionally salient information (Han, Alders, Greening, Neufeld, & Mitchell, 2012; Vuilleumier, 2015). Kimonis, Frick, Fazekas, and Loney (2006) found that children high in CU traits exhibited less attentional orientating to distressing pictures, while Moul, Killcross and Dadds (2012) suggest that emotional stimuli fails to grab the attention of psychopaths in the same way it would with non-psychopaths because they fail to elicit the same allocation of attention. Both these samples have been associated with amygdala damage (Fairchild et al., 2011; Jones et al., 2009; Marsh et al., 2008; Sterzer et al., 2005). Taken together, these findings suggest that the amygdala damage contributes to dysfunctional attentional mechanisms to socially relevant information. The eye region portrays a lot of emotional information so a failure to attend to the eye region may underlie the facial emotion recognition deficits in those who show ASB (e.g., Dadds et al., 2006). 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). Indeed, amygdala damage has been associated with abnormal processing of the eye-region of faces in both experimental (Adolphs et al., 2005) and real-life settings (Spezio, Huang, Castelli, & Adolphs, 2007).

The amygdala also plays an important role in empathy; increased empathic responding is associated with increased amygdala functioning in adolescents (Dadds, Cauchi, Wimalaweera, Hawes, & Brennan, 2012). Early damage to the amygdala leads to cascading errors through the neural systems responsible for the development of higher-order systems underlying empathy and Theory of Mind (Shaw et al., 2004). Other studies have shown that the amygdala is involved with affective empathy but not cognitive empathy; the prefrontal brain areas, including the ventromedial prefrontal cortex and lateral orbitofrontal cortex, and temporal areas, including the superior temporal sulcus and temporal pole are thought to be important for cognitive empathy (Sebastian et al., 2012). Affective empathy, on the other hand, primarily involves the inferior frontal gyrus, insula and limbic structures, including the amygdala (Völlm et al., 2006).

In a recent review, Marsh (2016) reconsidered the role of the amygdala in emotion recognition impairments, specifically in relation to fearful expressions. She posits that the amygdala's role in directing attention to salient information does not fully explain why fearful emotion recognition deficits have also been observed in other modalities such as vocal expressions (Blair et al., 2005) or body postures (Muñoz, 2009). Instead an early hypothesis put forward by Adolphs and colleagues (Adolphs, Tranel, Damasio, & Damasio, 1995) provides a more thorough account of the role of the amygdala in fearful emotion recognition. Here, the amygdala is believed to be essential for linking perceptual representations of fear to internal representations of fear, via empathy. An ability to identify and label stimuli as relating to fear is required to be able to link the external perceptual cue (the facial expression) to an internally generated representation of fear (empathy). In individuals with amygdala damage, it is thought that because they are impaired in experiencing fear (the internal

representation), they struggle to label it in external cues (emotion recognition), therefore being unable to link the external stimuli to the internal representation. The amygdala is not thought to be required for other emotions, such as disgust or anger, because it is not involved in generating internal representations for these emotions. Marsh suggests that the amygdala is essential for basic forms of empathy relating to fear. However, evidence of pervasive impairments (Bowen et al., 2014; Dawel et al., 2012) is again at odds with the theory that the amygdala is only important for recognising fearful expressions. Indeed, it will be interesting to find out whether other brain areas are involved in empathic responses to other emotions, such as sadness, and whether these areas are impaired in individuals who struggle with emotion recognition. Figure 1.1 provides an overview of how amygdala deficits observed in ASB populations are thought to play a key role in not only the development and continuation of ASB but also for being proficient in emotion recognition and empathy.

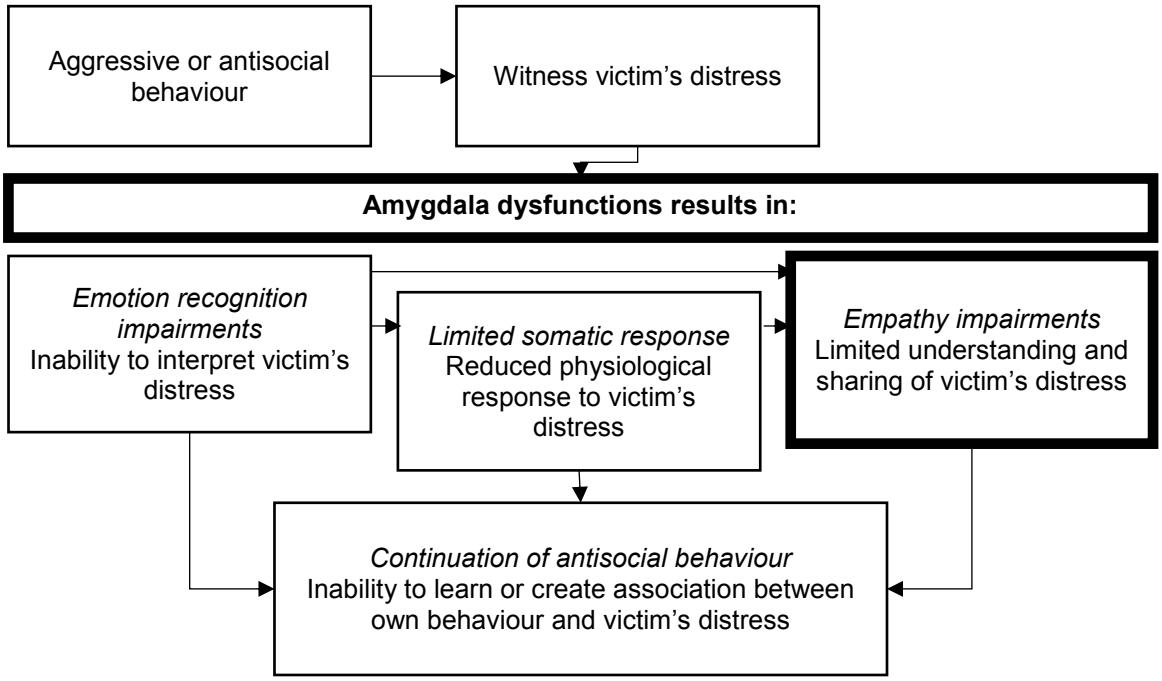


Figure 1.1. Schematic representation of the impact of amygdala dysfunctions on emotion recognition, empathy and the continuation of antisocial behaviour

1.8 Current psychological interventions

ASB has a lasting negative impact and numerous interventions have therefore been developed that aim to reduce ASB and its negative consequences (Scott et al., 2001). Evidence demonstrating a high persistence of childhood offending into adulthood offending highlights the need for intervention strategies and support for young people with ASB in order to alter this offending trajectory. Whilst many different types of intervention are available, this Chapter only focuses on psychological interventions, providing first a very brief overview of some of the current interventions and then a critical evaluation of these options.

1.8.1 Overview of current interventions for ASB

Due to the multifaceted nature of ASB, several different interventions have been developed to address the many risk factors associated with it. One such intervention is Social Skills Training. This is targeted at individuals who struggle with relating to other people; it aims to teach specific verbal and non-verbal behaviours that are appropriate when interacting with others. Generally, individuals characterised by ASB are rejected by their peers as they lack the social skills to participate with others and maintain friendships (Kazdin, 1995; Kupersmidt, Coie, & Dodge, 1990) and there is a positive correlation between ASB and negative reciprocity within friendship groups (Dishion, Andrews, & Crosby, 1995). Webster-Stratton, Reid, and Hammond (2001) showed that following participation in the Incredible Years Dinosaur Social Skills and Problem Solving Curriculum, participants showed fewer externalising problems, less aggression and more prosocial behaviour. Losel and Beelmann (2003) have also showed small to medium mean effect sizes at the post-intervention stage following participation in social skills training.

Another common intervention used for ASB is Multisystemic Therapy . This is an intensive, individualised family- and community-based intervention for young people with serious ASB designed to address the multifaceted nature of their behaviour. It is one of the most extensively validated and widely used interventions in ASB samples (Henggeler & Sheidow, 2012). Central to this therapy is the view that individuals are nested within multiple systems (for example, family, school and neighbourhood) that have direct and indirect influences on their behaviour. Interventions are guided by an assessment to determine the key problems identified by the family and others, e.g., poor parenting behaviour or poor school attendance. Sundell et al. (2008) showed that in 156 children who met the diagnostic criteria for CD, those who took part in Multisystemic Therapy showed a general decrease in psychiatric problems and ASB. Similar results were shown by Butler, Baruch, Hickey and Fonagy (2011) in that following participation in Multisystemic Therapy, youth offenders showed a significant reduction in self- and parental-reports of aggression and delinquency.

Cognitive Behavioural Therapy is another intervention for ASB. The central idea is that our thoughts and behaviour have an effect on each other. It assumes that faulty thought patterns cause maladaptive behaviours and so it focuses on changing thought processes. It requires participants to examine the assumptions behind their faulty thought patterns in order to change their negative behaviours. Landenberger and Lipsey (2005) conducted a meta-analysis of 58 studies assessing the effects of this therapy and found that the mean odds ratio of not offending was 1.53 times greater in the cognitive behavioural therapy group than the control group.

Family dynamics and parenting are thought to play a key role in ASB (Loeber et al., 1995) and as such interventions have focused on this. Parent management training aims to improve the parent-child relationship and to reduce ASB by helping

parents to learn how to control aggressive behaviour (Kazdin, 1987). One type of family intervention is Functional Family Therapy. This views ASB as a symptom of dysfunctional family relations. It aims to motivate families to change critical problems in their functioning by establishing and maintaining new patterns of family behaviour, replacing any dysfunctional patterns. This type of intervention has been shown to have some beneficial effects for ASB. Dretzke et al. (2009), in their systematic review, found that children participating in such training programmes do show beneficial outcomes, such as a reduction in the number of difficult behaviour problems. However, it should be noted that the majority of these studies included parental reports of the outcome, which may represent biased opinions given their participation in the training. Barnoski (2002) did report, however, that Functional Family Therapy was successful in reducing recidivism (measured via objective records) in a study of 400 families in a US state-wide implementation administered through juvenile courts.

1.8.2 Evaluation of current interventions for ASB

The multidimensional nature of ASB means that developing an intervention to address the range of dysfunctions seen in this population is challenging. Although the aforementioned studies show that these options can be effective to some extent, key limitations remain. For example, parenting training require extensive parental effort and some parents cannot or will not participate in such training (Kazdin, 1997; Webster-Stratton et al., 2001). Similarly, regarding Cognitive Behavioural Therapy there are issues about whether children and adolescents will actually engage in cognitive behaviour procedures long enough for it to better their behaviour (Singh et al., 2007). Overall, current interventions for ASB have been found to be only moderately effective and time-intensive (and therefore expensive; Foster, 2010).

Given the shortage of time, money and resources experienced by mental health and police services, there is a need for cheaper, shorter and more effective interventions.

1.8.2.1 *Effectiveness*

Given the lasting negative consequences associated with ASB, a key topic of research has understandably been investigating the effectiveness of the aforementioned training programmes. A key question that all interventions must consider is "is the change enough to make a difference in the lives of the youths who are treated?" (Kazdin, 1997, p.169). Although there is now evidence supporting the long-term effectiveness of some current interventions, reoffending data suggests they do not necessarily work for everyone. Current interventions show modest behavioural improvements in ASB and even the most successful interventions are only effective in two-thirds of cases (Beauchaine, Webster-Stratton, & Reid, 2005). There is often disagreement in the literature as to whether interventions are effective. For example, some studies have shown that parenting/family therapies are not effective in reducing violence (for example, see Bilukha et al., 2005), with it showing only a small to moderate impact in reducing ASB (Piquero, Farrington, Welsh, Tremblay, & Jennings, 2008). The same is also found for Multisystemic Therapy; Leschied and Cunningham (2002) found no evidence of intervention effects in serious young offenders following participation in Multisystemic Therapy.

Perhaps more worryingly, some interventions have been shown to *increase* negative behaviours. 'Scared Straight' is a programme that involves organised visits to prison facilities by children or juvenile delinquents in the hope to deter participants from future offending. In a review conducted by Petrosino, Turpin-Petrosino, Hollis-Peel, and Lavenberg (2013), they showed that not only does it fail to reduce crime, but it actually leads to *more* offending; it increases the odds of offending by between

1.6/1.7 to 1. Therefore, when looking at both reoffending rates and levels of ASB, not all interventions have been shown to be effective.

1.8.2.2 *Cost*

Cost is a key factor that must be considered in any intervention. Given the high cost associated with ASB, even an expensive intervention may prove to be cost-effective (Foster, 2010). However, Moffitt (2005) stated that valuable resources and finances have been wasted on interventions that have no impact on negative behaviours. As few studies have been conducted in the UK, research from the United States (US) is used to highlight the cost of current interventions. Dodge et al. (2015) showed that the Fast Track Intervention, which provides guidance in developing social skills and behaviour regulation, resulted in a reduction in both externalising and internalising behaviours, fewer convictions and higher ratings of well-being. However, the cost was extensive, amounting to approximately $58,000 per child. Given this cost, researchers have conducted cost-benefit analyses on the Fast Track Intervention; Foster (2010) looked at the outcomes of 3,274 children who had participated in the intervention and concluded that it did not show meaningful effects on costly outcomes and therefore was not cost effective. Similarly, a total of £3100 million has been invested in the Sure Start scheme by the UK Government with research showing that the initial £20m of the programme showed no significant effect in preventing or reducing CD (Belsky, Melhuish, Barnes, Leyland, & Romaniuk, 2006; Hutchings et al., 2007). Therefore, it is clear that interventions need to be effective and the benefits need to outweigh the costs.

1.8.2.3 *Time and resources*

Just as finances are limited, so are the resources available to administer ASB interventions, meaning shorter, yet effective, interventions are preferable. Agencies

may lack the resources, support, or oversight necessary to implement ASB interventions properly (Curtis, Ronan, & Borduin, 2004). Generally, ASB interventions are time consuming and require extensive time from trained therapists, of which there is a significant shortage (Rodrigo, Rajapakse, & Jayananda, 2010). For example, Caldwell, McCormick, Umstead and Van Rybroek (2007) showed that interventions focusing on the formation of social bonds have some success, with a reduction in aggression and improved compliance being reported. However, this intervention took on average 45 weeks to complete. Similarly, the Fast Track Intervention was a 10-year programme, meaning it is a large commitment for any organisation to use (Dodge et al., 2015). Additionally, Multisystemic Therapy is a similarly intensive intervention; Henggeler et al. (1992) showed that the average time to complete this therapy was 13.4 weeks and this required three therapists who provided a 24-hour-a-day case support. Therapies were conducted every day at a maximum or weekly as a minimum.

1.8.2.4 *Applicability to the United Kingdom*

Another limitation is that much of the current intervention research has come from the US and so the replicability to the UK has been questioned. Differences in cultural, social and legal contexts, as well as the lower standard of services for antisocial youths in the US limit the generalisability of outcomes to the UK (Butler et al., 2011; Cary, Butler, Baruch, Hickey, & Byford, 2013; Losel & Beelmann, 2003; Ross, Duckworth, Smith, Wyness, & Schoon, 2011). As such, it is very difficult to determine whether the interventions shown to be somewhat successful in the US will also have similar success in the UK. Whilst some research has been done in the UK (see Butler et al., 2011; Cary et al., 2013), much of it has been criticised for the lack of a suitable control group, the lack of proper baseline data, the use of subjective behaviour reports

and short follow-up periods (Ross et al., 2011). There is a great need to show the effectiveness of any intervention in the UK, in addition to addressing these research limitations.

1.9 Emotion training

Current interventions are of moderate effectiveness, costly and time consuming so there is a need for alternative interventions. It has been suggested that interventions need to be tailored to the individual cognitive, emotional and social characteristics of those who display ASB (van Goozen & Fairchild, 2008; White et al., 2013; Wilkinson et al., 2015). It has been widely shown that those displaying ASB exhibit impaired emotional functioning such as emotion recognition and empathy (Bowen et al., 2014; van Goozen et al., 2016) and therefore, the effectiveness of emotion training, particularly, emotion recognition training is beginning to be researched.

The importance of emotions in ASB is being considered in not only the academic fields but also the criminal justice fields. Sherman (2003, p.1) stated that “modern criminology is now poised for reinventing justice around the emotions of victims, offenders and society”. He specifies the term “emotionally intelligent justice", which acknowledges and recognises that emotions play a critical role in the behaviour of offenders (Sherman, 2003, p.2). The importance of the social and emotional wellbeing of children and adolescents has also been recognised by the National Institute for Health and Clinical Excellence (NICE) with the release of two guidelines, recommending the need for good social, emotional and psychological health in children and adolescents (National Institute for Health and Clinical Excellence, 2008, 2009). Specifically, they acknowledge that “good social, emotional and psychological health protects young people against emotional and behavioural problems, violence and crime, teenage pregnancy and the misuse of drugs and alcohol” (National

Institute for Health and Clinical Excellence, 2009, p.6). These recommendations and attention to the importance of emotions in ASB pave the way for interventions that put emotions to the forefront of their work.

1.9.1 Emotion Recognition Training

Based on the emotion dysfunctions observed in ASB samples, research has begun to investigate the effectiveness of emotion training in antisocial samples. One avenue of this is looking at the effect of making other's distress cues more salient. Van Baardewijk, Stegge, Bushman and Vermeiren (2009) looked at the effect of making distress cues salient in a competitive task by allowing participants to blast an opponent with a loud noise. The opponent's distress was then made salient through a written message. Noise levels in this condition were compared to a condition where no written message was provided. They found that when the opponent's distress was not made clear to them, children with high CU traits were more aggressive, whereas the aggression levels were reduced when the opponent's distress was made salient to them. This implies, therefore, that making another's distress more salient can attenuate aggressive acts. Another way of making these cues more salient could be by improving an individual's ability to recognise distress cues from others facial expressions via emotion recognition training.

The importance of emotion recognition training has been specified by the NICE guidelines for managing ASB and CD in children and young people, by recommending that selective prevention should include increasing children's awareness of their own and other's emotions (National Institute for Health and Clinical Excellence, 2013), something which emotion recognition training aims to do. This type of training is particularly beneficial as it does not require parental input, which can be a barrier to other intervention options in this sample (Losel & Beelmann, 2003).

Similarly, the training addresses the emotion recognition impairment that has been shown to be important for prosocial behaviour (Marsh et al., 2007), social functioning (Izard et al., 2001), empathy (Gery et al., 2009) and ASB (Marsh & Blair, 2008).

Emotion recognition training has already been shown to be effective in other samples who also show emotion recognition impairments, such as those with schizophrenia (Sachs et al., 2012) or autism spectrum disorders (Golan et al., 2010). Indeed, within the autism literature compensatory changes in neural activity, measured by fMRI, have been observed alongside improved recognition in those with autism spectrum disorders trained to attend to and interpret emotional expressions (Bolte et al., 2006). In addition, an improvement in social interactions has been observed in both individuals with autism spectrum disorders and schizophrenia after participating in emotion recognition training (Hopkins et al., 2011; Sachs et al., 2012).

Some interventions that touch upon emotion recognition are already being administered in schools. One commonly used programme is the Emotional Literacy Support Assistant programme, which is designed for administration by teaching assistants to provide emotional support for children. The larger aim of the programme is to support children to understand and regulate their own emotions. Studies investigating this programme have suggested some success; following this intervention there was a significant improvement in conduct and peer problems and hyperactivity on the Strengths and Difficulties questionnaire (SDQ) (Burton, Osborne, & Norgate, 2010). However, with regard to emotion recognition, only one or two activities specifically focus on this and these activities largely include cartoon faces. Additionally, to administer the programme, it requires six full training days delivered by two Educational Psychologists. Further, when specifically considering antisocial populations, interventions perform better when focusing on one particular social skill

than multiple skills (Lui, Barry, & Sergiou, 2017). Therefore, for children and adolescents displaying ASB, research has focused on specific and focused emotion recognition training.

1.9.1.1 *The effectiveness of current emotion recognition training for ASB*

Attempts to improve emotion recognition ability based on the hypothesis that impairments are due to attention dysfunctions to salient facial features have been carried out. Dadds et al. (2006) showed that directing boys with high levels of psychopathic traits to look at the eyes significantly improved their fear recognition. Similar results have been reported with incarcerated male violent offenders when their attention was implicitly directed to salient facial features using dot-probe tasks (Schönenberg, Christian, et al., 2013). However, the longevity of this improvement in emotion recognition is unknown and any links to behaviour change were not investigated in these studies. Other research did include behavioural change measures following participation in emotion recognition training (see Table 1.1 for an overview). These studies have provided some evidence that emotion recognition training is effective in young people with behavioural problems. One study found a beneficial effect on parent and teacher reports of conduct problems, measured with the SDQ, in children with CU traits (Dadds et al., 2012). However, since the training involved close parent-child interactions that were not mirrored in the treatment-as-usual group, it is not known whether any benefits in training were due to improvements in relationships. Similarly, as the parents were involved in the training and the reporting on the behaviour change, it is possible that they were more positive in their evaluation of their child's behaviour.

Penton-Voak et al. (2013) were successful in modifying emotional cognitive biases of angry ambiguous expressions in aggressive youths, who subsequently reported

fewer self- and staff-reported aggressive incidents in the two weeks following the intervention. The addition of staff-reported behaviour in this study is particularly useful given that the accuracy and honesty of self-reported behaviour can be questioned. 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.

Research from our own laboratory (Hubble et al., 2015) shows that fear, sadness and anger recognition can be improved in juvenile offenders as result of two hours of training. This computerised training, originally developed by Neumann and colleagues (Neumann, Babbage, Zupan, & Willer, 2014), directs attention to key facial features that are important for the correct processing and identification of basic emotions and was delivered in one-to-one sessions by a trained researcher. The training also involves different activities such as identifying situations where the individual has felt specific emotions and engaging in emotional expression mimicry. Importantly, this study was the first to demonstrate an effect of emotion recognition training on objectively recorded criminal behaviour in the form of a significant reduction in the severity of crimes committed in a 6-month follow-up period.

The more formal emotion recognition training, that investigated the effects on subjectively reported or objectively recorded behaviour, have some key advantages. First, they directly target the neuropsychological impairments that play a causal role in the development of ASB. Indeed, interventions of this type have been predicted to be successful in reducing aggressive and antisocial behaviour (White et al., 2013; Wilkinson et al., 2015). These types of interventions are also relatively short, requiring only a couple of sessions to complete, meaning they are less intrusive and less difficult to implement in everyday practice compared to, for example, family-oriented

programmes (Kazdin & Wassell, 1999). Consequently, the costs of this type of intervention are relatively low, also because they can be delivered by police or school workers.

Table 1.1. Current emotion recognition training for antisocial youths and their outcomes

Facial emotion training program (Reference)	**Program description**	**Sample**	**Outcomes**
Facial affect recognition training (Hubble et al., 2015)	Computerised program to direct attention to relevant facial features; 2-3 sessions, total training time 2 hours.	24 male youth offenders (Training) and 26 male youth offenders (Control) (mean age = 16 years).	Significant improvement in the recognition of fear, sadness and anger; significant decrease in the severity of crimes 6 months later.
MindReading (Dadds et al., 2012)	Daily parent-child interactional exercises and therapist sessions with computerised MindReading program; 4 x 90 minute sessions.	196 clinic-referred children and adolescents (mean age = 11 years) assigned to treatment-as-usual group (n = 109) or emotion-recognition intervention (n = 87).	Significantly greater improvement in conduct problems 6 months later, only in those displaying high levels of CU traits. No differences in emotion recognition abilities post-training.
Modifying hostility biases (Penton-Voak et al., 2013)	Computerised program to modify automatic tendency to interpret ambiguous expressions as anger by adjusting balancing point of when an ambiguous face is classified as angry vs. happy; 4 sessions, unknown duration.	46 juveniles (mean age = 13 years; control group, n = 23; training group, n = 23) with histories of frequent aggressive behaviour and/or criminal records.	Significantly modified biases to encourage perception of happiness instead of anger in ambiguous pictures. Associated with a decrease in self-reported anger and aggression and in independently rated aggressive behaviour 2 weeks later.

1.9.1.2 *Outstanding matters for emotion recognition training*

Overall, it is positive that short and focused emotion recognition training shows not only that emotion recognition can be improved, but also that these improvements

positively affect subsequent behaviour. However, there is still more research that needs to be done to improve their effectiveness and ensure widespread use (Hunnikin & van Goozen, 2018).

Firstly, such training needs to be offered in a tailored way so that those who need it most are receiving it. There is individual variation in emotion recognition performance, with some aggressive and antisocial individuals performing worse than others (Bowen et al., 2014). This implies that the training might be more effective in those individuals who perform less well at initial assessments. A targeted treatment approach is also more cost-effective as only those individuals who have specific impairments, and therefore would benefit from the training, receive it.

The role of attention to the eye region of the face after emotion recognition training also needs to be considered. For example, Hubble et al. (2015) directed attention to the key areas of the face for each emotion and provided a description of how to interpret this area of the face. However, eye tracking was not conducted before and after the training so it is unclear whether it also resulted in an improvement in looking towards the eyes. Given the importance of paying attention to the eye region for not only emotion recognition, but also for empathy, research now needs to look at whether emotion recognition training does improve eye-looking behaviours.

In order to understand a true change in emotion recognition skills, research must look at the unbiased hit rates to understand increased emotion detection rate and whether this was due to an increase in bias for the emotions contained within the training. Griffiths, Jarrold, Penton-Voak, and Munafò (2015) showed that after training to detect expressions of happiness and fear, there was no improvement in the number of correct recognition attempts, once an adjustment was made for the increase in false alarms (detecting the target emotion in non-target expressions). This means that

participants simply selected the trained emotions more, resulting in not only a higher accuracy for these emotions but also a higher false alarm rate (i.e. saying an expression was happy when it wasn't). We now need to understand whether the training programmes are indeed increasing recognition or simply increasing the number of times participants choose the trained emotion when responding on emotion recognition tests, thereby skewing the results.

Finally, the timing of the intervention needs to be considered, in particular, whether early intervention to improve emotion recognition is effective and can prevent adverse development and outcomes. Emotion recognition develops with age (Durand et al., 2007) and intervening at a time when children are already learning about emotional expressions could therefore be especially beneficial. In addition, given the important role of the amygdala for emotion recognition and directing attention, research has shown that early damage to the amygdala results in cascading deficits through higher-order empathic functions, whereas later damage to the same region does not (Shaw et al., 2004). We know that children and adolescents displaying ASB show a dysfunctional amygdala and so intervening earlier on and addressing a key impairment associated with amygdala damage might help prevent the cascading deficits observed.

1.9.2 Can emotion training be used as an early intervention?

1.9.2.1 *Why is early intervention important?*

Interventions are currently reactive in nature, and most children do not receive early intervention or receive it long after they really need it. The children's commissioner for England has acknowledged that as many as 1.6 million children are "invisible" to key services as they have not yet reached the crisis point required for services to intervene (Children's Commissioner, 2018). It is important to intervene

early because antisocial individuals often start show disordered behaviour early in life (Moffitt, 1993) and ASB in childhood predicts future ASB (Fombonne et al., 2001). It has been shown that interventions that seek to help individuals at-risk for future criminal behaviour lead to better outcomes than interventions delivered later in adolescence or adulthood (Humphrey & Wigelsworth, 2016; Skeem et al., 2014). Hektner, August, Bloomquist, Lee and Klimes-Dougan (2014) showed that intervening in children aged 6 years old resulted in significantly fewer CD symptoms and increased social skills when they reached high school. Not only are early interventions likely to be more effective, they also show a cost-benefit. In February 2015 The Early Intervention Foundation (http://www.eif.org.uk/our-work), a UK charity to promote evidence-based early intervention programmes, estimated that in England and Wales £17 billion is spent each year in addressing the problems that affect children and young people, including mental health problems, school refusal (truancy), youth crime and youth unemployment. The Early Intervention Foundation report 'Spending on Late Intervention: How can we can do better for less' (http://www.eif.org.uk/publications/spending-on-late-intervention-how-we-can-do-better-for-less/) examined the cost of 'late intervention' across a number of sectors including local authorities, education, the criminal justice system and the NHS. They found that local authorities carried the greatest cost (£6.5 billion), followed by welfare costs (£3.7 billion) and NHS (£3 billion). Intervening early will therefore not only result in greater behavioural improvements but also represent a significant money-saving exercise. In particular the Early Intervention Foundation urges that early interventions should focus on children's social and emotional skills as these help children to develop resilience and avoid risky situations, preventing the development of future

problems (http://eif.org.uk/we-need-more-effective-early-intervention-to-respond-to-the-needs-of-the-vulnerable-children-identified-by-the-childrens-commissioner/).

1.9.2.2 *Can emotion recognition training be used as an early intervention?*

Emotion recognition training represents a feasible early intervention strategy. These training programmes are likely to be more effective when children are targeted at an *early* period. The period between childhood and (early) adolescence is a time when children are particularly adept at specific kinds of social and emotional learning (Blakemore, 2008). Brain processes that underlie social and emotional behaviour have not yet matured, meaning there is increased capacity for learning appropriate social and emotional behaviour (Spear, 2000). During childhood children naturally learn to recognise facial expressions in others (see section 1.3.3). Childhood therefore represents a key period in which children are particularly adept to learn how to accurately recognise emotions in other people. Intervening at this time using emotion recognition training could prevent a series of self-reinforcing mechanisms from becoming entrenched, preventing, or at least reducing, the development of aggressive and antisocial behaviours and potentially improving positive capabilities such as empathy and prosocial behaviours (Foster, 2010). Research is now needed to address the outstanding questions discussed in section 1.9.1.2.

1.10 Goals and overview of the thesis

One of the strongest predictors of later criminal and antisocial behaviour is disordered behaviour in childhood (Bor et al., 2004; Murray & Farrington, 2005). However, despite emotion recognition and empathy impairments being involved in criminal and antisocial behaviour, no study has simultaneously investigated these impairments in children with disordered behaviour and investigated if these impairments could be improved. If these children show similar emotion recognition

and empathy impairments to those identified in antisocial and criminal adults, not only may they sustain some immediate benefit from intervening to improve these, but also a pathway towards criminal behaviour may be interrupted. If not all these children show these impairments, it also paves the way for more focused interventions. Emotion recognition interventions could therefore be used early and focused on those who could really benefit. Based on this knowledge, this thesis had three primary aims that were explored in the two empirical Chapters. Specifically, we aimed to understand whether:

- Emotion recognition impairments for negative emotions are evident in children with disordered behaviour, paving the way for early intervention
- Children with disordered behaviour could be subcategorised into those who do and do not show emotion recognition impairments for negative emotions, paving the way for targeted intervention
- These emotion recognition impairments could be improved using an early and targeted emotion recognition training, the Cardiff Emotion Recognition Training (CERT)

Secondary aims were to understand whether:

- Cognitive and affective empathy impairments are evident in children with disordered behaviour
- Emotion recognition impairments are related to cognitive and affective empathy impairments
- Improved emotion recognition is associated with improved cognitive or affective empathy
- Emotion recognition and empathy impairments are related to impaired social attention to emotion cues, specifically the eyes

- An improvement in emotion recognition is associated with increased social attention to emotional cues, specifically the eyes

In addition to the current Chapter, this thesis contains a methodological overview Chapter, which presents all preliminary research, and two empirical Chapters describing the research conducted during this PhD.

In Chapter 2, the methodological overview, I provide an outline of the development of the emotion recognition and empathy measures used throughout the thesis, in addition to the development of the CERT created during this PhD.

In Chapter 3, the nature and extent of emotion recognition and empathy impairments was examined in a sample of 92 7-11 year old children who show disordered behaviour and are part of a police crime prevention programme. A comparison sample of 58 typically developing 7-11 year old children also participated. Both groups of children completed an emotion recognition task and an empathy task. Concurrent eye tracking was recorded during both tasks. To understand to what extent children with disordered behaviour show negative emotion recognition impairments, this group was then further categorised into whether they performed above or below an accuracy threshold. Aims and hypotheses for this study are included in this Chapter.

In Chapter 4, we investigated whether completing the CERT improved emotion recognition and whether this was associated with improved empathy in the same sample of children with disordered behaviour described above. Only those children who showed emotion recognition impairments in Chapter 3 completed the CERT, ensuring it was delivered in a targeted way. Aims and hypotheses for this study are included in this Chapter. The typically developing children were only included in Chapter 3 and not this Chapter.

The two empirical Chapters are currently in the process of being submitted or have been submitted as journal papers. They have therefore been presented in paper format. Because of this, there may be some repetition in the introductions; however, the hypotheses and results are unique to the individual Chapters.

2 Methodological Overview

The current Chapter provides an overview of the unique sample of children with disordered behaviour who were participating in the studies throughout this thesis. This Chapter also includes a description of the materials used and the development of the updated emotion recognition training, the Cardiff Emotion Recognition Training (CERT), created during this PhD.

Given that the materials used in Chapters 3 and 4 were developed prior to the research, and these materials were piloted and tested with different samples of children than those described in Chapters 3 and 4, it was considered appropriate to include information related to the development of these materials in this Chapter, rather than subsequent Chapters. However, a brief description of the materials is also included in the subsequent Chapters to aid reading and understanding.

2.1 Ethics Statement

The studies throughout this thesis were approved by the Cardiff University School of Psychology Research Ethics Committee. Written informed consent was obtained from participant's parents and teachers and written assent was obtained for all participants due to being aged under 16 years.

2.2 Participants

The 164 participants who took part in the studies described in this thesis were categorised into two participant groups according to the behaviours they displayed. All participants were currently attending mainstream schools in the UK. One participant group showed disordered behaviour (DB group) and were participating in a police crime prevention programme. The other group formed a typically developing comparison group and showed no disordered behaviour (TD group).

2.2.1 Disordered behaviour group: description and recruitment procedure

The 106 children (86 male) aged between 7 and 11 years who were assigned to the DB group were showing disordered behaviour as described by their school teacher and were participating in a police crime prevention programme. This programme was part of an Early Intervention Hub created by Northamptonshire Police Force. The Hub is set up to address the large number of young people displaying problematic behaviours in the county (Doran, 2018). The Hub aims to provide support to at-risk families whose children show disordered behaviour, ultimately aiming to play a preventative role via early intervention. As part of this Hub, a Police Community Support Officer (PCSO) is placed in the child's school to complete interventions with them.

Referrals into the Hub are done through Police Protection Orders (https://www.gov.uk/government/publications/domestic-violence-protection-orders), referring professionals (schools, police officers and social workers) and through Early Help co-ordinators (Doran, 2018). Police Protection Notices are given for multiple reasons, but can include incidents of domestic abuse in the home or when the child has gone missing. Early Help co-ordinators work within the Troubled Families Framework (https://www.gov.uk/government/news/troubled-families-programme-annual-report-published) to ensure families are given correct interventions at the right time to prevent escalation to specialist or statutory services.

Typically, the children referred to the Hub have been subjected to a wide range of Adverse Childhood Experiences, including poverty, mental health issues within the home and domestic abuse (Felitti et al., 1998). Because of these factors and the referrals described above, these children have been classified by the police as being at high-risk for future criminal and antisocial behaviour and therefore could benefit

from being part of a criminal prevention programme, namely the Early Intervention Hub. For an overview of the recruitment procedure into the Early Intervention Hub, see Section A of Figure 2.1.

The children who are referred to the Hub have no formal behavioural diagnoses, but they do show disordered behaviour. However, because these children have not yet reached a crisis point, they are considered "the blind spot" of the social services. The purpose of the Hub is to help these families before the children reach an escalation point.

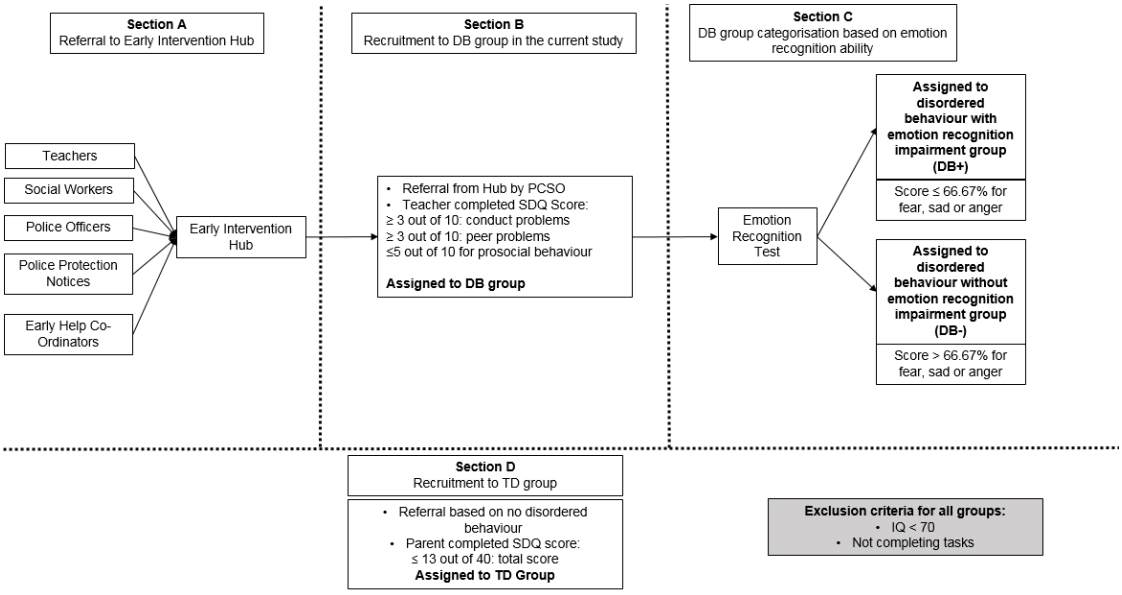


Figure 2.1. A description of the recruitment into the DB (Disordered Behaviour) and TD (Typically Developing) groups described in this thesis.

The children with disordered behaviour who took part in the studies mentioned in this thesis were referred to participate from the Early Intervention Hub, specifically from the PCSO who worked with the child. After a referral from the Hub, the child's school teacher then completed the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) to confirm the child's behavioural status. To be eligible, children needed to show either 'slightly raised" conduct or peer problems (a score of ≥ 3 out of 10) or 'slightly lowered' prosocial behaviour (a score of ≤5 out of 10) (Goodman,

1997). ‘Slightly raised’ or ‘slightly lowered’ is the terminology within the SDQ scoring and represents only 10% of the UK population (Goodman & Goodman, 2011). Participants needed to reach the threshold for one of these three subscales to be eligible. The hyperactivity subscale was not chosen as a recruitment criterion because a recent study has shown that emotion recognition impairments in Attention Deficit Hyperactivity Disorder are only specific to participants with comorbid Conduct Disorder (CD; Airdrie et al., 2018). Similarly, the emotions problems subscale was not used as this is related to more internalising problems (example item: ‘often complains of headaches’) whereas emotion recognition impairments, especially those related to negative emotions, are more often related to externalising, behaviour problems (Hubble et al., 2015; Hunnikin & van Goozen, 2018).

Inclusion criteria for the DB group was a referral from the Hub and showing either ‘slightly raised’ conduct or peer problems or ’slightly lowered’ prosocial behaviour, based on the SDQ. Exclusion criteria for the DB group were an estimated IQ (intelligence quotient) less than 70 and not completing the tasks. Based on these criteria, fourteen children were excluded, leaving a final sample of 92 DB children. For an overview of how the DB children were recruited into the study, see Section B of Figure 2.1.

A breakdown of the SDQ items per subscale revealed that participants in the DB group showed high levels of disobedience, were not liked by other children, would not share with others, were not considerate of other’s feelings and would not help others (see Figure 2.2.).

It is important to note that I refer to the DB children throughout this thesis as children with disordered behaviour as they only had to reach the threshold for one of three of the SDQ subscales so they could be showing conduct and/or peer problems and/or limited prosocial behaviour. They are not limited to just showing conduct

problems. I also do not refer to them as “at-risk” because this has not been confirmed in this thesis.

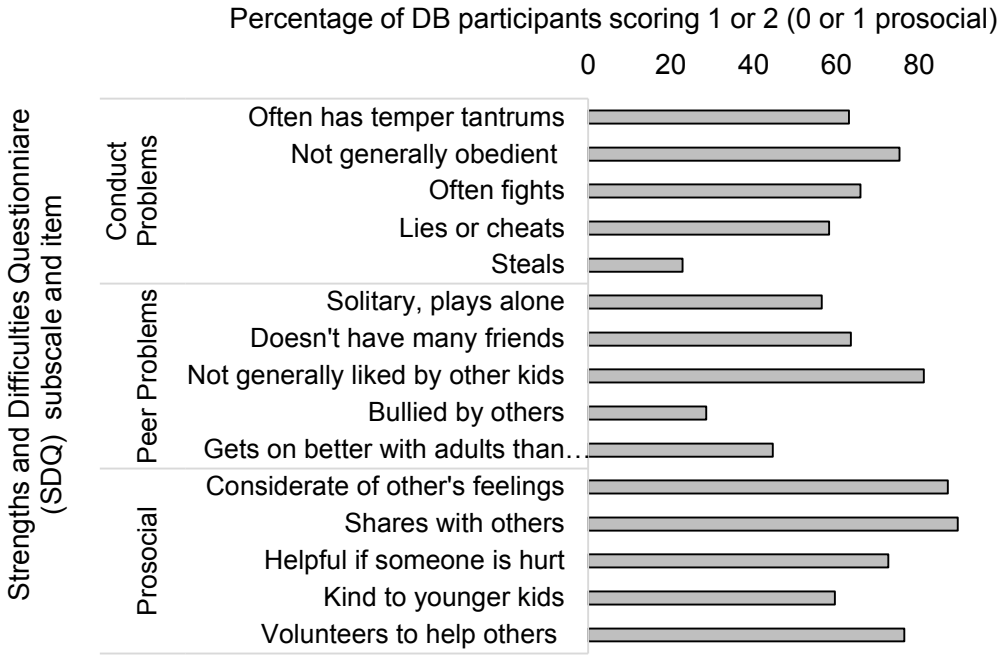


Figure 2.2. Percentage of DB (Disordered Behaviour) participants scoring one or two for the items within the conduct and peer problems subscales and zero and one for prosocial behaviour subscale of the SDQ. 0 = not true, 1 = somewhat true, 2 = certainly true.

2.2.2 Disordered behaviour group: further categorisation according to emotion recognition abilities

Given that one of the key aims of this thesis was to understand to what extent children with disordered behaviour show negative emotion recognition impairments, this group was further categorised based on their emotion recognition abilities. Given the role of negative emotion recognition in antisocial behaviour (ASB; Bowen et al., 2014; Hunnikin & van Goozen, 2018), participants were assigned to the disordered behaviour with emotion recognition impairments group (DB+) if they performed equal to or less than 66.67% for fear, sadness and/or anger expression recognition (n = 54, 59% of DB group). This threshold represents 1.5 standard deviations below the

average based on a preliminary study (see section 2.3.2.1). This subgroup then went on to complete the CERT. The remaining DB participants were assigned to the disordered behaviour without emotion recognition impairments group (DB-, *n* = 38, 41% of DB group) and did not complete the training. For an overview of the recruitment procedure and criteria for assignment to groups based on emotion recognition abilities, see Section C of Figure 2.1.

2.2.3 Typically developing comparison group: description and recruitment procedure

The typically developing (TD) comparison group consisted of 58 participants (45 male) aged between 7 and 11 years old. They were recruited from schools in Cardiff and Essex. Teachers were asked to select children who were not showing disordered behaviour. Parents of the selected children then provided written informed consent and completed the SDQ to confirm the absence of disordered behaviour. Participants were required to score 'close to average' on their total score (a score of ≤ 13 out of 40) (Goodman, 1997). The total score was used for TD participants to confirm the absence of any behavioural or emotional difficulties, ensuring a 'normal' and typically developing comparison group. Due to difficulty with teacher availability, parents completed this.

Inclusion criteria for the TD group were a referral from the teacher for not showing disordered behaviour and a score ≤ 13/40 ('close to average') for total SDQ score. The same exclusion criteria applied to the TD and DB groups; participants were excluded if they had an estimated IQ less than 70 and did not complete the tasks within the study. No TD participants were excluded on this basis; therefore, a sample of 58 TD children participated. For an overview of the recruitment procedure for the

TD group, see Section D Figure 2.1. A description of the dropout and exclusion rates to the individual groups, both DB and TD, can be seen in Figure 2.3.

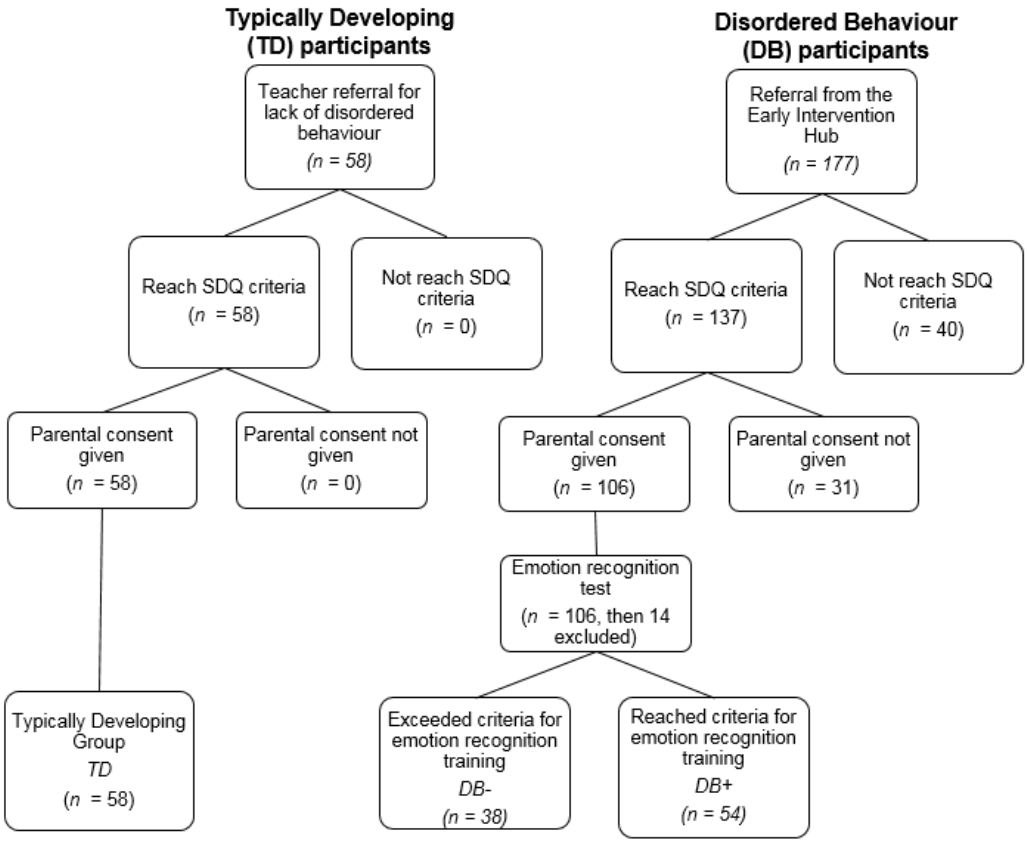


Figure 2.3. Dropout and exclusion rates for each group in the study.

2.3 Materials

2.3.1 Demographic and behavioural characteristics

Participants were asked for their date of birth and gender. The Wechsler Abbreviated Scale of Intelligence, first edition (WASI; Wechsler, 1999) was used to provide an estimated IQ score. Socioeconomic 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+; Hubble et al., 2015).

The SDQ is a 25-item questionnaire assessing, on five different scales, problematic and prosocial behaviour (Goodman, 1997). The SDQ is scored on a 3-point scale (0, 1, 2), giving a sum of between 0 - 10 for each subscale, as well as an overall total difficulties score (out of 40, prosocial subscale is removed). A score between 19 and 40 for 'total difficulties' indicates a very high score. This is a widely used, valid and reliable measure (Stone, Otten, Engels, Vermulst, & Janssens, 2010). The SDQ has been shown to be an efficient screener for the identification of psychiatric disorders in youth (Warnick, Bracken, & Kasl, 2008) and is recommended to be used in the initial assessment for Conduct Disorder (CD; National Institute for Health and Clinical Excellence, 2013). It has a diagnostic accuracy of 94% for CD when compared to the Development and Well-Being Assessment (Johnson, Hollis, Marlow, Simms, & Wolke, 2014) and has been shown to predict consistent behavioural problems (Wilson et al., 2012).

In the current study, there was good internal reliability for the individual subscales (Peer problems: .69; Conduct problems: .79; Prosocial behaviour: .87). See Table 2.1 for an overview of demographic and behavioural characteristics for the full sample. Statistical analyses of the sample can be seen in section 3.4.1 and 4.4.1.

Table 2.1. Demographic and behavioural characteristics of participants – total sample

Variable	TD (*n* = 58)	DB- (*n* = 38)	DB+ (*n* = 54)
Age (years)	9.67 (1.11)	8.95 (1.04)	8.72 (1.30)
IQ	104.65 (17.20)	95.18 (13.86)	89.11 (11.32)
Gender			
% Male	77.6	84.2	77.8
% Female	20.7	15.8	22.2
SES			
% Low	0	8.1	6.7
% Medium	22	62.2	51.1
% High	78	29.7	42.2
SDQ score			
Conduct Problems	1.02 (1.05)	3.74 (2.55)	4.44 (2.70)
Peer Problems	1.47 (1.29)	2.76 (1.81)	4.16 (2.52)
Prosocial Behaviour	8.24 (2.57)	3.93 (2.99)	4.56 (2.68)
Total	7.49 (3.20)	15.68 (5.38)	19.53 (6.16)

Notes: Means are presented (with standard deviations in parentheses) or % of group. IQ = intelligence quotient (two-subtest WASI), SES = Socioeconomic status, SDQ = Strengths and Difficulties Questionnaire.

2.3.2 Facial Emotion Recognition Measure

The Facial Emotion Recognition (FER) measure consisted of 60 photos of males and females of varying ethnicities and ages displaying four emotions (happiness, sadness, fear and anger) plus a neutral expression. It was based on the FER used in Bowen et al. (2014) but shortened to be suitable for a sample of children. The photos were taken from the Radboud Faces Database (Langner et al., 2010) and were morphed to be of either high or low emotional intensity using FantaMorph software (Abrosoft, China). The photographs were morphed by overlapping the original, full-intensity expression with the actor's neutral expression. The differences in intensity were first confirmed subjectively by four individuals at either doctorate or post-

doctorate level and were then confirmed with a sample of 20 typically developing and healthy children (section 2.3.2.1 for supporting data).

The hair and background of the image had been blacked out so that only the facial features remained (see Figure 2.4). Participants were asked to answer the question 'what emotion (if any) is this person showing?' and were given five options of the target emotions plus neutral ('no emotion' option). Participants were required to state aloud which emotion they thought was being displayed and their response was recorded by the researcher. Percentage correct recognition for each emotion was calculated. The procedure took approximately 7 minutes.

Low intensity

High intensity

Figure 2.4. Example stimuli selected from the Facial Emotion Recognition task.

2.3.2.1 *Facial Emotion Recognition Measure: Supporting Data*

As the FER measure was developed as part of this PhD, a preliminary study was conducted to assess the suitability of it. Twenty participants (16 male) with a mean age of 8.58 years (*SD* = .96) were recruited from schools in Newport and Essex to confirm intensity differences in the FER Measure. Participant sample size was based on an *apriori* power calculation (G*Power 3.1; Faul, Erdfelder, Lang, & Buchner, 2007) for a repeated measures ANOVA with 90% power (α = .05) to detect a medium effect size of *f* = 0.25 (J. Cohen, 1992). To examine the effect of differing intensity on emotion recognition, a two-way ANOVA was run, with intensity (2 levels) and emotion

(4 levels) as within-subjects factors. Neutral expressions were not included due to the lack of intensity differences. The majority of emotion recognition scores violated the assumption of normality ($p < .05$). Given that there is no non-parametric alternative to this statistical test and it has been suggested that ANOVAs are robust to violations of normality (Ghasemi & Zahediasl, 2012; Öztuna, Elhan, & Tüccar, 2006), the ANOVA was still ran. Any significant simple main effects were then analysed using non-parametric alternatives. Mauchly's test of sphericity indicated that the assumption of sphericity was met for the two-way interaction, $\chi^2(5) = 4.15$, $p = .53$.

There was a statistically significant two-way interaction between emotion and intensity, $F(3, 57) = 6.65$, $p = .001$, $\eta_p^2 = .26$ (see Figure 2.5). There was no significant simple main effect of intensity for expressions of happiness, $F(1, 19) = 1.52$, $p = .23$, $\eta_p^2 = .07$. There were significant simple main effects of intensity for expressions of sadness, fear and anger (all *p's* < .001) with participants showing significantly higher levels of accuracy for high intensity expressions (all *p's* < .001).

The pilot study helps to validate the two intensity levels. However, it was shown that there was no impact of intensity for expressions of happiness. This is not surprising as children as young as 5 or 6 years old have been shown to be at similar accuracy levels to adults (Durand et al., 2007). Indeed, the ASB literature suggests that these individuals are proficient in happiness recognition (Marsh & Blair, 2008).

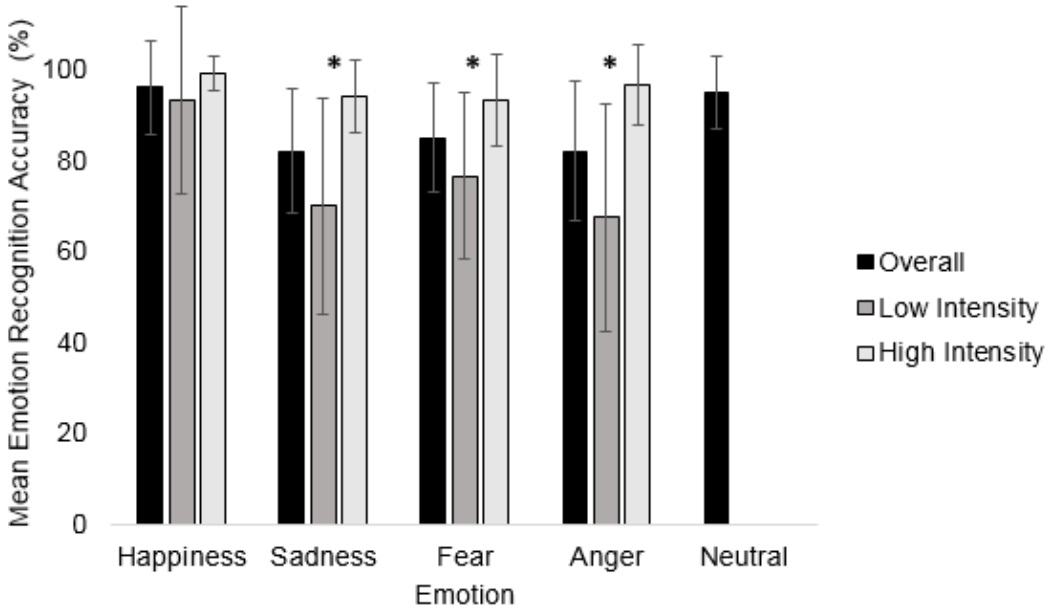


Figure 2.5. Mean percentage recognition scores for expressions of happiness, sadness, fear, anger and neutral in the preliminary study. Error bars are set at ± 1 standard deviation. * = $p < .05$.

2.3.2.2 *Facial Emotion Recognition: Eye tracking*

For time and practical reasons, only a subsample of participants completed eye tracking during the FER task (Total: $n = 96$; TD: $n = 43$; DB-: $n = 27$; DB+: $n = 26$). Eye-movements were recorded with a portable Tobii X2-60 compact eye tracker sampling at 60 hertz with a screen resolution of 1920 x 1080. The hardware consisted of an eye-tracking device located below the laptop screen that captured eye movements by illuminating the pupil via an infrared light source and using two image sensors to record the reflection patterns. A chin rest was not used, as this equipment is robust to changes in head-position. Participants were positioned approximately 60-65cm away from the 15" laptop screen and a 9-point calibration was performed. Prior to displaying the stimuli, calibration quality was checked and repeated if necessary. 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 for all recordings using a sample rate percentage that gives an approximate estimate of the quality of eye tracking by providing a percentage score of successfully recorded data. Where this could not be confirmed individual recordings were further analysed. Participants for whom this validity fell below 60% were excluded from the final analysis.

Participants were presented with four slides for each facial stimulus. The first was a blank screen to prevent any visual carryover effects and to separate the stimuli. The second contained a fixation cross to control for participant's initial eye position, the face stimulus was then presented alone and finally the emotion labels were presented alongside the face. The duration of each stimulus can be seen in Figure 2.6. Location of the fixation cross was presented away from the face but located at the halfway point between the eyes and the mouth. It was randomly presented on either the left or right side of the face to ensure that participants were not routinely looking at the same area of the face when it was first presented. The emotion labels were also randomly presented on the left or right side of the screen, similarly presented halfway between the eyes and the mouth.

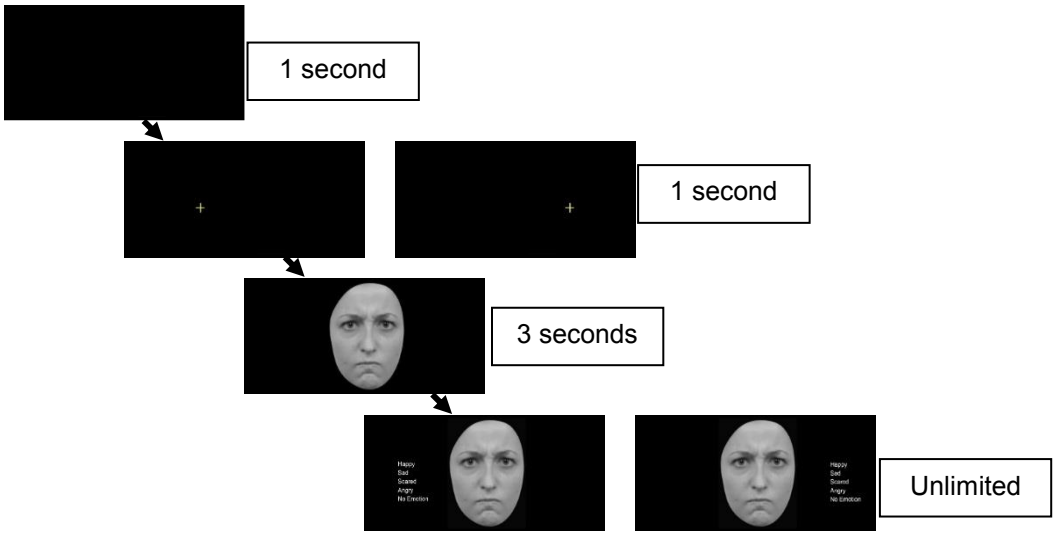


Figure 2.6. Overview of the order of slides presented during eye tracking for the Facial Emotion Recognition task.

Tobii Studio was used to analyse eye-gaze during the period of three seconds that the face was presented alone. This was due to the face being the focal object and there being no other distractions on the screen. Areas of Interest (AOI) were created around the eyes, mouth, face as a whole and the entire screen (see Figure 2.7). The duration of fixation to the eyes was derived by averaging fixation times across trials for each relevant emotion. Overall percentage dwell time to the eyes was calculated by summing all fixations to the eyes divided by the total duration of time spent looking at the face. Time to first fixation to the eyes was also analysed. Values more than 2 standard deviations above the mean and trials with values of zero were excluded for time to first fixation analyses.

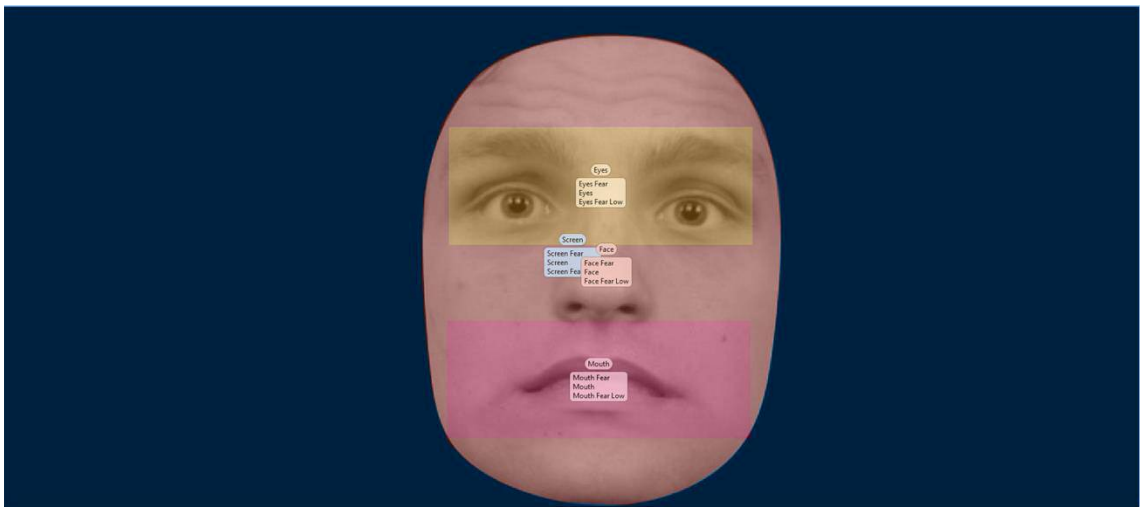


Figure 2.7. Example of Areas of Interest for the emotional stimuli included in the Facial Emotion Recognition task.

2.3.3 Empathy

Six film clips from the Harry Potter cinematic films were used to evoke empathic reactions (see Appendix A for a description of the clips used). These clips were chosen to ensure consistency by using the same actors. Two clips represented each target emotion (happy, sad, fearful), agreed upon by more than 96% of 6- to 11-year old children in a preliminary study (see Section 2.3.3.1 for supporting data). To reduce

the effects of fatigue, clips were edited to be between one and three minutes in duration. Participants' previous experience of each clip was checked by asking whether they had seen the clip before. Participants viewed three film clips (one happy, one sad and fear) at pre- and post-test and order of administration was counterbalanced both within and between participants and research sessions.

Participants were asked to watch and pay attention to the clips (displayed on a 15" laptop screen) and were not provided with any other information or instructions until the end of the clip. After each clip, participants completed two questionnaires, one concerning the main character's emotions and the other about their emotions while viewing the clip. By selecting a number from 0-10 (not at all to very much), participants were asked to indicate how strongly they or the main character felt on a range of eight emotions (anger, sad, upset, fearful, happy, scared, cheerful and surprised). Participants were next asked to give the reason for the emotion they identified in the main character and/or in themselves. These responses were coded for cognitive and affective empathy using the Cardiff Empathy Scoring System (van Goozen et al., 2016; van Rijn, Barendse, van Goozen, & Swaab, 2014). This took into consideration four elements of empathy: (1) whether the target emotion was correctly identified; (2) whether other relevant emotions were identified; (3) the intensity of the emotion(-s) identified and (4) the explanation for the causes of the emotion (see Appendix B for a full description of the scoring system used). Cognitive empathy scores ranged from 0-9 whereas affective empathy scores ranged from 0-7, with a higher score being indicative of greater empathy. The procedure took approximately 30 minutes. Interrater reliability ranged from .94 (cognitive) to .98 (affective).

2.3.3.1 *Empathy: Supporting Data*

To ensure the validity and intensity of the film clips, 31 children from schools in Birmingham and Essex completed the task. Participants consisted of 16 females and 15 males and were aged between 6 and 11 years old (M = 8.19 years, SD = 1.54 years). Participant sample size was based on an *a priori* power calculation (G*Power 3.1; Faul, Erdfelder, Lang, & Buchner, 2007) for a repeated measures ANOVA with 90% power (α = .05) to detect a medium effect size of f = 0.25 (J. Cohen, 1992). Inter-rater reliabilities for both cognitive and affective empathy measures were confirmed between two blind raters using a subset of the data (20%) across the six film clips. Cronbach's alphas ranged from .78 (cognitive) to .98 (affective). Between-subjects' t-tests (and Mann-Whitney U tests where necessary) revealed no effect of film familiarity on emotional intensity as experienced by the participants or as observed in the main character (all p's >.05).

Participants saw only three videos (one per target emotion) due to time restraints. As there were two film clips per target emotion, between-subjects t-test (or Mann-Whitney U test where necessary) were run to check the two clips were similar in intensity. Given the majority of variables violated the assumption of normality, Table 2.2 shows the median cognitive and affective empathy scores, both in total and for each clip by target emotion. Overall, the statistical tests showed no significant difference between the two happiness clips (cognitive: p =.17, affective: p = .40), fear clips (cognitive: p = .08, affective: p = .79) and sadness clips (cognitive: p = .49, affective: p = .33). Therefore, the two clips per target emotion were similar for both cognitive and affective empathy.

In order to check the clips were similar across emotions, cognitive and affective empathy scores for happiness, sadness and fear clips were compared (see Table

2.2). A Friedman's test was used due to violations in normality. There was no statistically significant difference in cognitive empathy scores, $\chi2(2) = .15$, $p = .93$, nor affective empathy scores, $\chi2(2) = 4.00$, $p = .14$. This shows that the clips were similarly intense for cognitive and affective empathy across the three emotions.

Table 2.2. Median empathy scores for each emotion clip for cognitive and affective empathy

Emotion	Clip Number	Median cognitive empathy (0-9)	Median affective empathy (0-7)
	Total	**6.00**	**5.00**
Happiness	1	5.00	4.00
	2	6.00	5.00
	Total	**6.00**	**3.00**
Sadness	1	6.00	3.00
	2	6.00	4.50
	Total	**6.00**	**4.00**
Fear	1	6.00	5.00
	2	5.50	4.00

Finally, as in de Wied, van Boxtel, Matthys and Meeus (2012), repeated measures ANOVAs were run to confirm that the film clips evoked distinct emotions. For cognitive empathy for fear, following a significant difference, $F(2, 60) = 107.79$, $p < .001$, $\eta_p^2 = .78$, pairwise comparisons showed that participants reported that the main characters displayed fear significantly more in the fear clips compared to the happiness and sadness clips (both *p's* < .001). The same was also true for happiness, $F(2, 60) = 364.15$, $p < .001$, $\eta_p^2 = .92$, with participants reporting happiness significantly more in the happy clips than the sad and fear clips (both *p's* < .001). Similar patterns were true for sadness, $F(2, 60) = 114.45$, $p < .001$, $\eta_p^2 = .79$; participants reported significantly more sadness for the sad clips compared to the happy and fear clips (both *p's* < .001).

A similar pattern emerged for affective empathy. There was a significant difference in reporting feeling happiness whilst watching the clips, $F(2, 60) = 103.98$, $p < .001$,

η_p^2 = .78. Participants reported happiness significantly more in the happy clips than the sad and fear clips (both *p's* < .001). The same was true for sadness, $F(2, 60) = 32.91$, $p < .001$, $\eta_p^2 = .52$; participants reported significantly more sadness for the sad clips compared to the happy and fear clips (both *p's* < .001). There was a significant difference in ratings of fear, $F(2 ,60) = 11.54$, $p < .001$, $\eta_p^2 = .28$, with pairwise comparisons showing that participants reported that they felt fear more in the fear clips compared to the happiness clips ($p < .001$). There was a trend towards significance for sad clips ($p =. 06$).

2.3.3.2 *Empathy: Eye tracking*

For time and practical reasons, only a subsample of participants completed eye tracking (Total: $n = 75$; TD: $n = 32$; DB-: $n = 22$; DB+: $n = 21$). The same eye tracking equipment, validity checks and analysis process as described in section 2.3.2.2 was used. Similar to the FER, AOIs were created around the eyes, mouth, face as a whole and the entire screen (see Figure 2.8). Eye-gaze was analysed during a 6-8-second segment that was judged to have included the highest emotional content in each clip. This was decided based on a pilot study with six people. Percentage dwell time to the eyes was calculated by summing all fixations to the eyes divided by the total duration of time spent looking at the face. Time to first fixation was not used for the empathy task due the 6-8 second segments occurring at different parts of the entire clip and so participants were most likely already looking at the screen.

Figure 2.8. Example of Areas of Interest for the emotional stimuli included in the empathy task.

2.3.4 The Cardiff Emotion Recognition Training (CERT)

2.3.4.1 *Background and description*

Participants allocated to the DB+ group were eligible to complete the CERT due to the impairments they showed in emotion recognition. The CERT is a computerised intervention developed using Microsoft Visual Basic 2010. This program was developed during the first year of this PhD. It was designed to improve the identification of facial expressions of happiness, sadness, fear and anger by directing attention to key facial features and providing assistance with the interpretation of these features. In addition to improving emotion recognition abilities, the CERT also aims to (a) improve the ability to understand when certain emotions are shown, (b) improve the understanding that a person can show more than one emotion in response to the same situation and (c) provide an understanding of how it is appropriate to respond to someone displaying a certain emotion.

The CERT is based upon a previous training program called the Facial Affect Recognition training developed by Neumann, Babbage, Zupan and Willer (2014). This program was used by Hubble et al. (2015) and was originally developed to improve emotion recognition abilities in adults who have suffered traumatic brain injury. Adjustments and updates were made to this program to ensure it was suitable for a sample of children. These include adjusting and simplifying the terminology used, changing stimuli and adding new activities.

The CERT consists of three sessions that occur once a week for three consecutive weeks, each taking on average 20-30 minutes to complete. The sessions are designed to get progressively harder because there is a reduction in the intensity of the facial expressions across the sessions, manipulated using FantaMorph software (Abrosoft, China). In session one, faces are of approximately 100% intensity; this drops to approximately 75% for session two and reduces further to approximately 50% for session three. Similarly, there is a reduction in both written and pictorial hints, encouraging the participant to recognise the facial expression without the help of the hints. Different models are included in the different sessions in order to expose participants to as many different faces and varying emotional displays as possible.

Several learning strategies are adopted in CERT. The program consists of repetition of activities across sessions as seven out of thirteen activities are repeated. The purpose of the repetition is two-fold: first, to encourage the learning of the key facial features for each emotion and secondly, to assess participants' learning from the previous session. In order to aid learning, participants are given instant feedback as to whether their answer is correct or incorrect. They must achieve a correct answer to proceed and regardless of whether an answer is correct or incorrect, they are provided with hints displaying the common facial features for that emotion.

2.3.4.2 *Activities within the CERT*

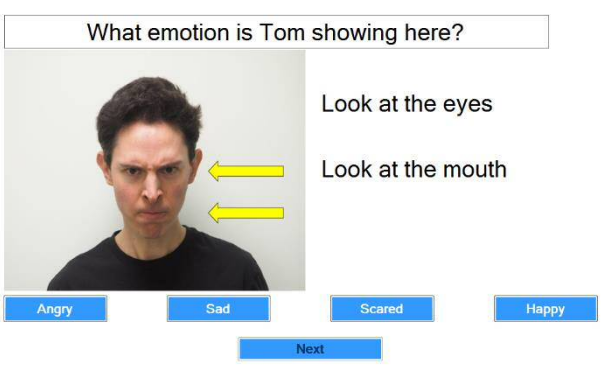
The layout of each session of CERT is similar. It consists of an introduction, the different activities, a review and then a test (see Table 2.3 for a description of all the CERT activities).

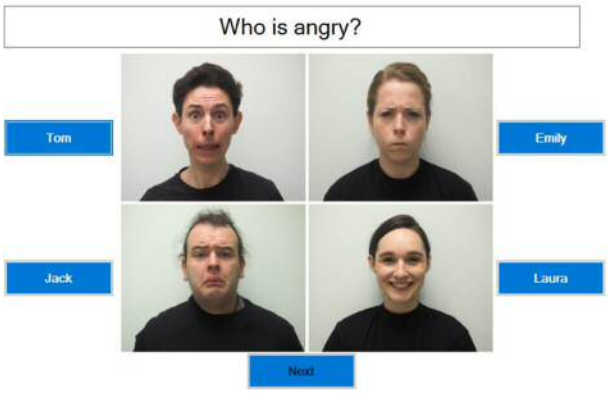
Table 2.3. Description of activities within the Cardiff Emotion Recognition Training (CERT).

Activity Name	**Description of Activity**	**Session activity is completed in**
Introduction	Participants are told the purpose of the training, provided with a description of what emotions are and introduced to a description of the key facial features that are important for each emotional expression.	Sessions one, two and three
What emotion are they showing?	Participants are asked to choose which emotion they think a model is showing (see Figure 2.9a for a picture of this activity)	Sessions one, two and three
When have you shown this emotion?	Participants are required to first identify the correct emotion the model is displaying and then think of a situation when they experienced this emotion.	Session one
Choose the emotion	Participants are presented with four different photos and they are required to identify which model is displaying the target emotion (see Figure 2.9b for a picture of this activity)	Sessions one and two
Emotion videos	Participants view a video of a face morphing from a neutral expression to an emotional display (100% intensity), created using FantaMorph software (Abrosoft, China). Participants pause the video when they can identify an emotional display and name the emotion.	Session one, two and three
Parts of the face	Participants are told to consider the separate facial features (eyes, eyebrows and mouth) and choose the correct description for each facial feature for each emotion out of three forced-choice options.	Sessions one and two
Emotion stories	Participants view emotional vignettes and they choose which emotion they would show if they were in this situation.	Session three
Copy the face	Participants first identify the emotion the model is showing and then imitate the expression.	Session two
Make a face	Participants view photos of two different emotional expressions from the same person that are split in half. The participant is required	Session two

	to drag and drop the top half and the bottom half to create a specified emotional expression.	
Talking to your friend	Participants view a photo of a model displaying an emotion and are asked to provide an open-ended response of what they think is an appropriate response to the emotional display. They then view three-forced choice options and select which response they believe is the most appropriate one.	Session three
Your emotions	Participants view photos of their own emotional displays, taken during the 'copy the emotion' activity and are required to identify which emotion they were showing.	Session three
Review	At the end of each session, a review activity summarises the key facial features of each emotion and there is the opportunity to discuss the session.	Sessions one, two and three
Test	Participants view photos and they are required to say what emotion the model is showing. No feedback is provided and a 'no emotion' option is included.	Sessions one, two and three

Figure 2.9. Pictures of the (a) 'What emotion are they showing?' (b) 'Choose the emotion' activities from CERT (Cardiff Emotion Recognition Training).





2.3.4.3 *Production of stimuli for the CERT*

The photos within the CERT were taken specifically for use in the training. Twenty-nine individuals aged between 7 and 33 years old were asked to have their photograph taken for purpose of being included in the training. They were asked to display expressions of happiness, sadness, fear and anger plus a neutral expression, providing 145 expressions in total. In order to ensure that the prototypical elements of each expression as proposed by Ekman and Friesen (1976) were included, a training

manual was created for the models, utilising pictorial and verbal descriptions of the facial expressions. Models received the training manual at least 48 hours in advance. Prior to photo taking, the researchers went through the training manual with the model and the model practiced the facial expressions with the manual and a mirror. Models were required to tie back long hair, remove make-up, glasses and jewellery and wear a plain black t-shirt to ensure consistency. The camera was set up 1.25m away from the model. Quality checks were performed by both the researcher operating the camera and by a second researcher who watched the expression as the model displayed them. Models were continuously coached and provided feedback to improve the accuracy and naturalness of their expression.

After photo taking, the researchers chose one photo per expression from 20 of the models who were able to accurately and naturally display at least two of the required expressions (excluding neutral). These photos were then sent to a Facial Action Coding System (Ekman & Friesen, 1976) coder for confirmation of the facial expressions. After feedback and small alterations, a set of 100 photos were shown to 28 Cardiff University Psychology Undergraduate students to confirm the emotions shown by the models. Participants were asked to choose which emotion the person was displaying out of five options: happy, sad, fear, anger and neutral. The emotions were correctly identified with an average accuracy of between 95.05% - 99.49% (see Figure 2.10). Therefore, all expressions were accepted for use in the training.

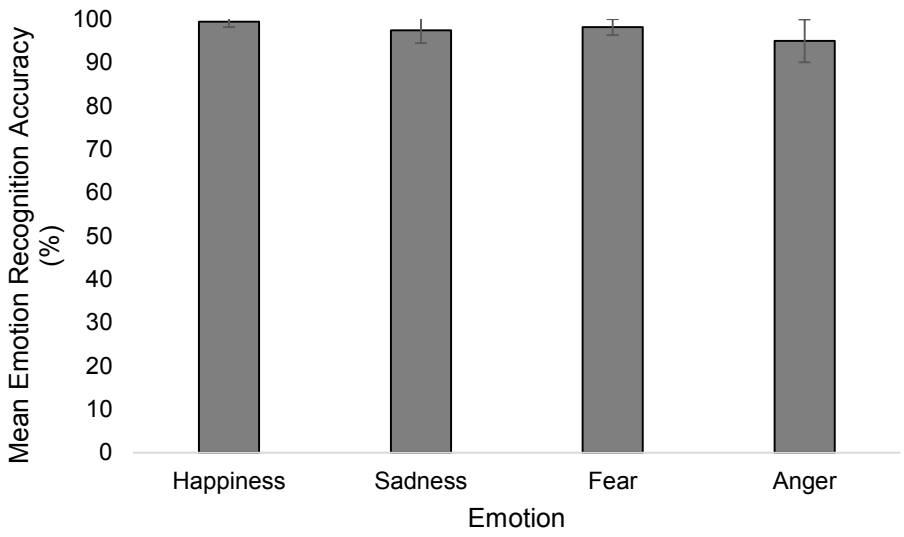


Figure 2.10. Mean recognition accuracy for the photos of expressions of happiness, sadness, fear and anger to be used in the CERT (Cardiff Emotion Recognition Training). Error bars represent ±1 standard deviation.

2.3.4.4 *Administration of the CERT*

The CERT should be completed one session per week for three consecutive weeks. In the studies mentioned in this thesis, the CERT was administered in a quiet room at the child's school by the school's Family Support Worker or PCSO. The training was delivered one-to-one allowing immediate instructive feedback to be given plus the opportunity for participants to ask any questions or ask for clarification throughout. To ensure the validity of CERT administration, all Family Support Workers and PCSOs attended an intensive training session and had a one-to-one opportunity to go through and discuss the training with the researchers. In addition to this, the CERT is designed so it can only be completed in the specified order. The timing of each individual activity and overall session is recorded throughout, allowing for the assessment of the duration of the training by each Family Support Worker and PCSO. All Family Support Workers and PCSOs followed a manual that provided a script for each session, ensuring the same content and quantity of information was available across participants and sessions.

2.3.4.5 *The effectiveness of the CERT: Preliminary Study*

Sixteen participants (two female) were recruited from primary schools in the Northampton area to take part in a preliminary study assessing the effectiveness of CERT (see Table 2.4 for a description of participant demographics). Participant sample size was based on an *a priori* power calculation (G*Power 3.1; Faul et al., 2007) for a repeated measures ANOVA with 90% power (α = .05) to detect a medium effect size, f = 0.25 (Cohen, 1992). The power calculations specified a total sample size of 17 so the pilot study is underpowered by one participant due to recruitment difficulties.

This preliminary study had different eligibility criteria to one used for the main studies as described in section 2.2. This is because the aim was to assess the feasibility and logistics of the training and the wider study. In this preliminary study, eligible children were aged between 5 and 11 years old. They were not required to meet the emotion recognition threshold described in section 2.2; all participants completed the training. The criteria of an estimated IQ >70, completion of the tasks, the referral from the Hub and the teacher-reported SDQ criteria remained the same. Participants also completed the FER task from Bowen et al. (2014), rather than the version described in section 2.3.2.

Participants completed the first CERT session on average seven days after a pre-test research session in which the FER assessment was completed. The duration of the training varied across the sessions; session one lasted on average 32 minutes (*SD* = 9 minutes); session two lasted on average 25 minutes (*SD* = 9 minutes); and session three lasted on average 24 minutes (*SD* = 10 minutes). Overall, the average total training time was 81 minutes. The average time between session one and session two was 15 days and the average time between session two and session

three was 7 days. The extended duration between sessions one and two was due to the half-term holiday. After participants had finished the third and final training session, a two-week break occurred, followed by the post-test research session, where the FER was repeated.

Table 2.4. Demographic and behavioural characteristics of pilot participants

Variable	Training group
Age (years)	8.44 (*1.59*)
Gender	
Male	87.5%
Female	12.5%
IQ	96.86 (*10.03*)
SDQ (teacher; available for n=16)	
Conduct problems	2.75 (*1.73*)
Peer problems	2.94 (*2.74*)
Prosocial	4.69 (*2.47*)
SDQ (parent; available for n=9)	
Conduct problems	4.11 (*2.93*)
Peer problems	3.00 (*2.83*)
Prosocial	6.22 (*1.99*)

Notes: Table entries show mean values (standard deviations in parentheses), or % of group. IQ = intelligence quotient, SDQ = Strengths and Difficulties Questionnaire.

To assess the effect of the CERT on pre- and post-training emotion recognition, a two-way repeated measures ANOVA was used with emotion (5 levels), and time (2 levels) as within-subject factors. The assumption of normality was violated but given that there is no non-parametric alternative to a two-way repeated measures ANOVA and it has been suggested that ANOVAs are robust to violations of normality (Ghasemi & Zahediasl, 2012; Öztuna et al., 2006), the ANOVA was still run. Any significant simple main effects were then analysed using a Wilcoxon Signed Rank or Sign Test to confirm the significant differences. The assumption of sphericity was met for the two-way interaction, $\chi^2(9) = 7.16$, $p = .62$.

There was a statistically significant two-way interaction between emotion and time, $F(4, 60) = 5.91$, $p < .001$, $\eta_p^2 = .28$ (see Figure 2.11). Therefore, the effect of time on each emotion was next investigated, using Bonferroni-corrected alpha levels. There was no significant simple main effect of time for recognition of happiness, $F(1, 15) = 1.39$, $p = .26$, $\eta_p^2 = .09$, and sadness, $F(1, 15) = .02$, $p = .89$, $\eta_p^2 = .001$. There was a simple main effect of time for fear recognition, $F(1, 15) = 21.92$, $p < .001$, $\eta_p^2 = .59$, with participants showing significantly better fear recognition post-training ($p < .001$). There was a simple main effect of time for anger recognition, $F(1, 15) = 17.93$, $p = .001$, $\eta_p^2 = .55$ and again, participants were significantly better at anger recognition post-training ($p = .001$). There was also a simple main effect of time for neutral recognition, $F(1, 15) = 14.20$, $p = .002$, $\eta_p^2 = .49$. Pairwise comparisons showed that participants were significantly better at recognising neutral expressions post-training ($p = .002$). These significant differences remained when running non-parametric tests (with Bonferroni-corrected alpha levels).

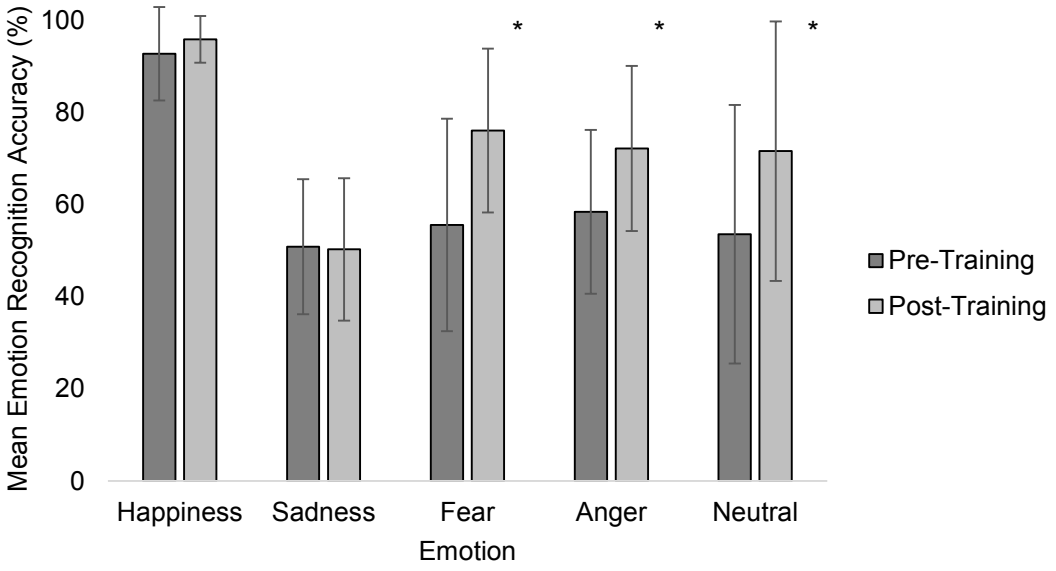


Figure 2.11. Mean recognition scores for expressions of happiness, sadness, fear, anger and neutral at pre- and post-training. Error bars are set at ± 1 standard deviation. * = $p < .05$.

This preliminary study showed that participants significantly improved in recognising fear, anger and neutral expressions after completing the CERT. The improvement in recognising fear and anger expressions is in line with previous studies showing similar results in juvenile offenders (Hubble et al., 2015). To our knowledge, no study has looked at the change in identifying neutral expressions after participation in an emotion recognition training. There was no significant improvement in recognising expressions of happiness at post-training. At pre-training participants were already performing at a very high recognition rate (*M* = 92%), leaving little room or need for improvement. This supports other studies that show that young people displaying ASB generally do not show impairments in detecting expressions of happiness (Best, Williams, & Coccaro, 2002; Blair et al., 2001). There was also no significant improvement in the recognition of sadness expressions. This contrasts previous studies such as Hubble et al. (2015) who showed that juvenile offenders did show improved sadness recognition following their emotion recognition training. When comparing participant's scores on the test in CERT session three (the most difficult session) to their scores at post-training, there is a large decrease in mean accuracy, specifically for sadness expressions; performance drops from 87% (*SD* = 16.00%) in CERT session three to 50% (*SD* = 15.48%) on the post-training FER. This shows that the children were competent in sadness emotion recognition at CERT session three. The decrease of 37% between CERT session three and post-test was the largest for sadness expressions compared to all other emotions where there is only an average decrease of 2.65% (happiness; -4.17%, fear 4.37%, anger -14.53% and neutral 3.73%). Therefore, this suggests that the children were accurate in recognising sadness during the training, but this was not reflected in their scores at post-training. One potential explanation is that the photos used in the FER were from Ekman and Friesen (1976) whereas the photos in the CERT were modern photos, which could

have affected interpretation. Although it is not clear why this would affect only sadness recognition.

Following the preliminary study, several changes were made to the overall study based on feedback from the participants and the Family Support Workers. A new version of the FER was created and used for the main study (described in Section 2.3.2). The version by Bowen et al. (2014) was deemed to be too long and the children were struggling to complete the task in one sitting. In addition, modern photos were used from the Radboud Faces Database (Langner et al., 2010) to ensure that the quality of the photos is similar to the CERT. The age of participation in the study was also increased from 5 years to 7 years due to an inability of the children to complete all the research measures in one sitting. The TD group was also added to the main study to allow us to understand the emotional abilities of children with disordered behaviour compared to typically developing children. No major amends were made to the CERT following feedback from the Family Support Workers. Minor amends were made that were largely technical or textual (i.e. changing instructions so they were better understood by the children).

2.4 Overall Procedure

All parts of the study were completed at the participant's school. All participants completed an initial research session conducted by a trained researcher, lasting approximately 75 minutes. This session included a range of other assessments as part of a larger study. For the DB participants, assent was obtained, after which, they first completed the emotion recognition task with concurrent eye tracking followed by the empathy task with concurrent eye tracking.

For participants assigned to the DB group, their scores on the emotion recognition test were assessed immediately after the session. This was to determine whether

participants should be assigned to the DB+ or DB- group, that is, those with or without emotion recognition impairments, respectively. The Family Support Worker or PCSO at the child's school was informed whether or not the participant had been assigned to the DB+ group and would therefore receive the CERT. The Family Support Worker or PCSO then carried out the three CERT sessions with the children assigned to the DB+ group. The children assigned to the DB- group did not complete any training. Both DB- and DB+ groups then went on to complete another research session, the post-test session, on average between 51-54 days after the pre-test research session. In the post-test research session, participants repeated the emotion recognition test with concurrent eye tracking and the empathy test with concurrent eye tracking. Participants watched different videos at post-test for the empathy task. Participants were then debriefed as to the nature of the study and had the opportunity to ask any questions.

As described above, the DB- group completed both pre- and post-test research sessions mainly to demonstrate the reliability of the FER task, showing that there is no significant change in performance despite repeating it.

Participants assigned to the TD group only completed one research session that had the same structure and order as the first session completed by the DB participants; first assent was obtained, then they completed the emotion recognition task with eye tracking and then the empathy task with eye tracking. TD participants were then debriefed and given the opportunity to ask any questions. For an overview of the procedure for all groups, see Figure 2.12.

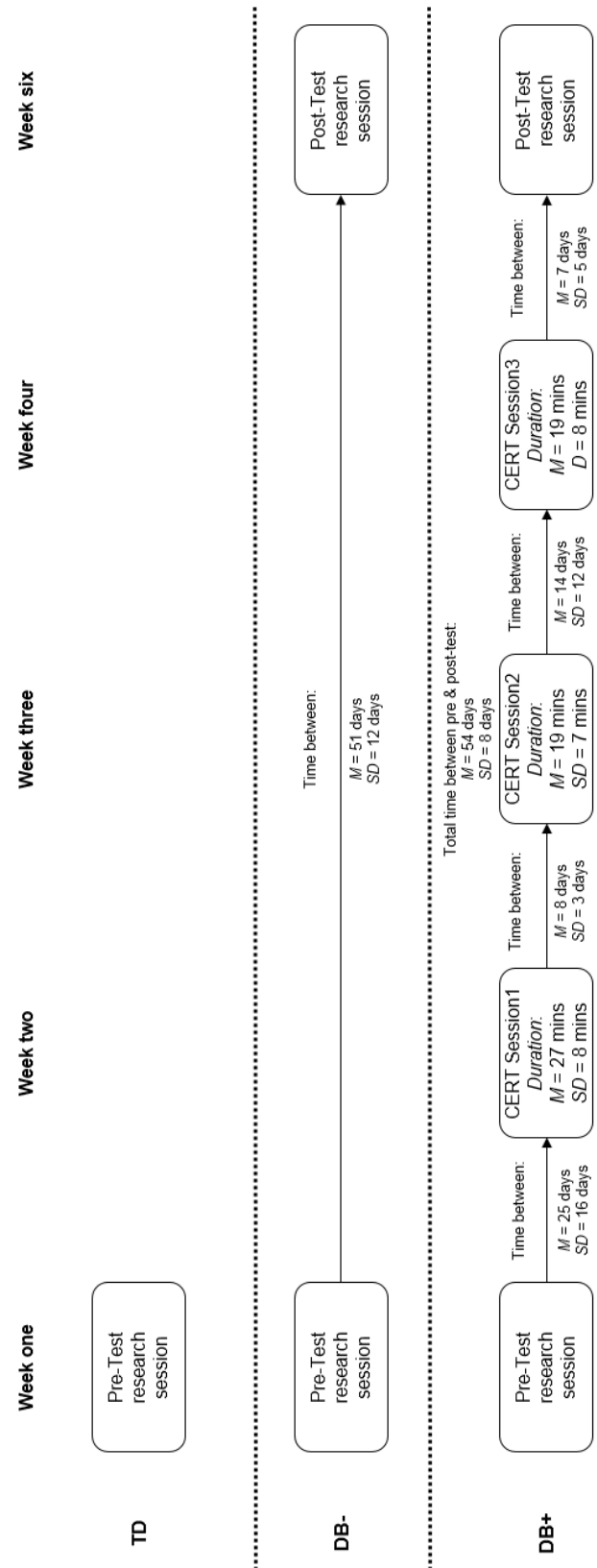


Figure 2.12. Schematic representation of the testing schedule by each participant group. TD: Typically Developing, DB: Disordered Behaviour.

2.5 Overall Statistical Analysis

Analyses were carried out using SPSS 20 (SPSS Inc., Chicago, Illinois). ANOVA testing was largely used throughout this thesis and the assumptions were tested beforehand. Outliers were assessed via visual inspection of boxplots. The Shapiro-Wilk test was used to assess the assumption of normality although it should be noted that there are propositions that deviations from a normal distribution have little effect on results with ANOVAs (Ghasemi & Zahediasl, 2012; Öztuna et al., 2006). Levene's test for equality of variances was used to assess the assumption of homogeneity of variances. Where violated and where appropriate, a Welch ANOVA was used instead. When the assumption of sphericity was violated, as indicated by Mauchly's test of sphericity, the Greenhouse Geisser correction was used. Where follow-up tests were required, Bonferroni correction was used except where a Welch ANOVA was used, when the Games-Howell post-hoc adjustment was used. Effect sizes were calculated as partial eta squared (η_p^2; small ~ .03, medium ~ .06, large ≥ .14; Cohen, 1988). For practical reasons, the results of the assumption testing are not always presented. Where assumptions were violated and there was a non-parametric alternative, this was used. Where there was no non-parametric alternative, analyses were run using the parametric test and any significant differences were confirmed with non-parametric tests to understand whether the significant differences remained. Parametric results are presented and then any differences in conclusions based on non-parametric testing are reported. Each individual emotion was analysed separately given different hypotheses for each emotion.

Participant sample size was based on an *apriori* power calculation (G*Power 3.1; Faul, Erdfelder, Lang, & Buchner, 2007) for a factorial ANOVA with 90% power (α = .05) to detect a medium effect size, f = 0.25 (Cohen, 1992). This sample size was

based on completing a factorial ANOVA, accounting for the analyses investigating pre- and post-test differences in emotion recognition.

We did not look at any intensity effects for the emotion recognition task. This is because preliminary analyses where intensity was included revealed no intensity by group interactions ($p > .05$) only evidence that participants performed better on high intensity expressions compared to low intensity expression (all $p's < .001$). Based on the lack of significant interactions with intensity and because we were interested in specific emotion recognition impairments and not in emotion specific intensity impairments, we collapsed the intensity scores and calculated mean emotion recognition score for each of the four emotions across the two intensities (high and low).

3 The nature and extent of emotion processing impairments in children with disordered behaviour referred into a crime prevention programme

Paper in preparation

This Chapter is based on Hunnikin, Wells, Ash & van Goozen (2018). The nature and extent of emotion recognition and empathy impairments in children showing disordered behaviour referred into a crime prevention programme.

Paper under review at European Child & Adolescent Psychiatry.

Chapter 2 described the materials and methods used throughout this thesis. Next, Chapter 3 uses these methods to assess the nature and extent of emotion processing impairments (emotion recognition and empathy) in the sample of children showing disordered behaviour described previously. Their performance was compared to that of the typically developing children.

3.1 Abstract

Background. Early childhood behaviour problems have been linked to later antisocial and criminal behaviour. Emotion recognition and empathy impairments, thought to be caused by inattention to the eye region, are hypothesised to contribute to antisocial and criminal behaviour. However, before now, no study has simultaneously looked at emotion recognition and empathy impairments in children with disordered behaviour.

Hypotheses. We hypothesised that children with disordered behaviour would show negative emotion recognition impairments and cognitive and affective empathy impairments but not impaired attention to the eyes. We also hypothesised that there would be a subgroup of children with disordered behaviour who are unimpaired in negative emotion recognition, supporting the need for targeted interventions.

Methods. 92 children with disordered behaviour as described by their schoolteacher using the Strengths and Difficulties Questionnaire (DB; mean age 8.8 years, 80% male) took part. These children were participating in a police crime prevention programme. There was a comparison group of 58 typically developing children (TD; mean age 9.7 years, 78% male). All children completed emotion recognition and empathy tasks, both with concurrent eye tracking to assess social attention. A threshold was then applied to emotion recognition scores to understand differences in emotion recognition in the DB group.

Results. Of the DB children, 59% were impaired in sadness, fear, anger and neutral recognition. Those DB children with and without emotion recognition impairments did not differ in empathy, but both groups were impaired in cognitive and affective empathy compared to the TD group. There were no group differences in attention to the eye region on either task.

Conclusions. Emotion-specific impairments which have been found in antisocial adults have now been found in an identifiable group of children displaying disordered behaviour. These findings provide evidence to encourage the use of early and tailored interventions.

3.2 Introduction

Antisocial behaviour (ASB) describes a persistent pattern of negative behaviours, including an inability to conform to and a violation of social norms and a disregard for the rights of others (Diagnostic and Statistical Manual of Mental Disorders; DSM-5; American Psychiatric Association, 2013). The individual, societal and financial cost associated with ASB is significant; for example, it is related with an increased likelihood of committing a serious crime (Huesmann et al., 2002) and physical and mental health problems (Odgers et al., 2008; Pajer, 1998). This accumulates to a significant financial burden (Sainsbury Centre for Mental Health, 2009; Scott et al., 2001).

One mechanism that has been found to be important in explaining the behavioural characteristics of ASB is an impairment in emotion recognition (Bowen et al., 2014; Marsh & Blair, 2008). The emotions we express and experience help us to form and maintain social relationships (Fischer & Manstead, 2006). Being able to detect, process and respond appropriately to the emotions of others is crucial for normal social interaction (Corden et al., 2009; Fridlund, 1991). Typically antisocial individuals

are impaired in recognising expressions of fear and sadness, which are regarded as distress emotions (Marsh & Blair, 2008). However, impairments in other emotions have also been identified, including anger (Fairchild et al., 2009), disgust (Kosson et al., 2002), general negative emotions (Bowen et al., 2014) and all basic emotions (Dawel et al., 2012). It is important to note, however, that not all individuals displaying ASB are impaired in emotion recognition (Glass & Newman, 2006; Marshall et al., 1995). Additionally, research has shown that there is a great deal of individual variability in emotion processing (Eugène et al., 2003; Hamann & Canli, 2004).

Another mechanism thought to be important in explaining ASB is an impairment in empathy. This is broadly defined as the ability to understand and share another's emotional state (Cohen & Strayer, 1996), which can be broken down into three subcomponents: motor, cognitive and affective empathy. Motor empathy refers to automatic mimicry processes (de Wied et al., 2010); cognitive empathy is the cognitive awareness of another's emotional state (Blair, 2005b) and affective empathy is the vicarious experience of another's emotions (Bons et al., 2013). Because little research has been conducted on motor empathy within ASB (Bons et al., 2013), this thesis focuses on cognitive and affective empathy. The ability to empathise with others is important for motivating prosocial behaviours and inhibiting aggressive behaviour because empathic people find their own aggression vicariously punishing (Blair, 2008; Eisenberg, Eggum, & Di Giunta, 2010; Vachon, Lynam, & Johnson, 2014).

When considering empathy impairments shown by individuals displaying ASB, the distinction between cognitive and affective empathy is important (Jolliffe & Farrington, 2004). Some studies have shown that such individuals are impaired at both cognitive and affective empathy (Cohen & Strayer, 1996; Muñoz, Qualter, & Padgett, 2011;

Pasalich, Dadds, & Hawes, 2014). Whereas other studies have shown evidence for impaired affective empathy but intact cognitive empathy (Schwenck et al., 2012; van Zonneveld et al., 2017). The affective impairment seems to be specific to negative emotional situations (de Wied et al., 2009; van Zonneveld et al., 2017). Thus, affective empathy has been consistently shown to be impaired in antisocial populations but the results for cognitive empathy are mixed. Different definitions of cognitive empathy, and thus different measurements of it, may contribute to these inconsistent findings. While some studies equate cognitive empathy with Theory of Mind (Baron-Cohen et al., 2015), others conclude that these two concepts are not interchangeable (Reniers, Corcoran, Drake, Shryane, & Völlm, 2011). Theory of Mind is concerned with the attribution of cognitions to others while cognitive empathy is concerned with the attribution of emotions to others. Other researchers equate cognitive empathy with perspective-taking, often measuring cognitive empathy with the Perspective Taking subscale of the Interpersonal Reactivity Index (Davis, 1983). However, this considers one's broad ability to consider another's point of view, rather than one's ability to understand the emotions of others (Jolliffe & Farrington, 2004). Another commonly used questionnaire of empathy is Bryant's Empathy Index (Bryant, 1982), of which the validity has been challenged by more recent research (de Wied et al., 2007).

A deficiency in understanding and experiencing another's emotions is causally linked to ASB; Blair's (2005a) Integrated Emotion Systems (IES) model proposes that emotional facial expressions signal distress in others, which then evokes empathic responses, which acts as an inhibitor of aggressive acts. In addition, there is a failure to create the association between the aggressive act and another's distress. Therefore, an inability to recognise facial displays of emotion and to empathise reduces the likelihood that aggressive acts are inhibited.

As seen in the IES model (Blair, 2005a), one of the key processes thought to underpin deficient empathy is the deficient recognition of others' distress cues (Blair, 2008). Theoretically, it is reasonable to expect an association between emotion recognition and empathy in that one needs to be able to recognise emotions accurately to respond empathically (Lui et al., 2016). Accurate emotion recognition could be viewed as an initial step in the empathy process (Dadds et al., 2011; Viding et al., 2012). In their staged multicomponent model of empathy, Marshall et al. (1995) stated that the empathy process involves four discriminable steps: (1) emotion recognition (2) perspective taking (3) emotion replication (4) response decision. Whilst this model has been updated (Marshall & Marshall, 2011), recognising another's distress is still the first step towards empathy. However, other models of empathy, for example the perception-action model (Decety & Lamm, 2006), suggest that observing emotions results in affective empathy that facilitates emotion recognition, suggesting a different order of events (Singer, 2006). Regardless of the order, emotion recognition is thought to be a key component in the ability to empathise with others.

Empathy has been related to recognition accuracy across basic emotions (Besel & Yuille, 2010), to recognition accuracy at lower intensities (Martin et al., 1996) and to recognising fearful expressions (Carr & Lutjemeier, 2005). Given the importance of distinguishing between cognitive and affective empathy (Jolliffe & Farrington, 2004), Lui et al. (2016) showed that facial emotion recognition was positively correlated with cognitive empathy but not affective empathy, which was more related to affective perspective-taking in adolescents with high callous-unemotional (CU) traits. Given that cognitive empathy is defined as understanding another's emotional state, a relationship between emotion recognition and cognitive empathy is logical. Indeed, some researchers equate cognitive empathy with emotion recognition (Schwenck et

al., 2012). Nonetheless, it is important to note that there is some evidence that emotion recognition is related to affective empathy (Gery et al., 2009).

Social attention to the eye region is thought to be a key requirement for successful emotion recognition and empathy (Bons et al., 2013; Dadds et al., 2006). Impaired attention to the eyes inhibits children's capacity to attribute mental states, emotions and intentions to others and more broadly disrupts the development of higher-order human functions such as Theory of Mind (Blakemore, 2008; Rigato & Farroni, 2013; Skuse, 2003). Reduced attention to the eye region has been observed in antisocial populations (Dadds et al., 2006; Dadds, El Masry, et al., 2008). Dadds and colleagues showed that boys with high CU traits show impaired attention to the eye region when freely viewing fearful faces; however, when directing their attention to the eye region, they showed normal patterns of fear recognition. Regarding empathy, Cowan, Vanman and Nielsen (2014) showed that trait empathy and looking towards the eyes during an emotional film clip were positively related. However, recent evidence has contrasted this hypothesis. Van Zonneveld et al. (2017) found no evidence of reduced social attention during emotional viewing in a group of 8-12 year olds boys at-risk for criminal behaviour. Airdrie, Langley, Thapar and van Goozen (2018) also showed that in adolescents with Attention Deficit Hyperactivity Disorder plus Conduct Disorder (CD), emotion recognition impairments were not due to a lack of attention to the eyes. Similarly, Martin-Key, Graf, Adams and Fairchild (2017) showed that social attention did not explain emotion recognition impairments in adolescents with CD. This recent line of evidence suggests that an impairment in looking towards the eyes is not a mechanism by which these children show reduced empathy and emotion recognition, but this still warrants further investigation.

Age of onset is thought to be a contributing factor to ASB severity (Moffitt, 1993). One of the strongest predictors of later ASB is problematic behaviour in childhood (Bor et al., 2004; Murray & Farrington, 2005). Both emotion recognition and empathy impairments are hypothesised to contribute to antisocial and criminal behaviour (Blair, 2005a). However, to our knowledge, no study has yet investigated the nature and extent of emotion recognition and empathy impairments in the same sample of young children who are showing disordered behaviour. We also do not have a full understanding of the relationship between emotion recognition and empathy and the underlying mechanism, namely social attention to the eye region. If these young children show similar emotion recognition and empathy impairments as have been shown in antisocial adults, this paves the way for early and targeted interventions to address behavioural and emotional problems before they become entrenched. If there is a relationship between emotion recognition and empathy, which is due to impaired attention to the eye region, this suggests that emotion recognition interventions that focus on directing attention to the eyes will be successful for improving both emotion impairments.

3.2.1 Aims and hypotheses

The current study aimed to understand whether:

a. Emotion recognition impairments for negative emotions are evident in children showing disordered behaviour, paving the way for early intervention
b. Only a subgroup of children would show these emotion recognition impairments, paving the way for targeted intervention

Secondary objectives were to understand whether:

a. Cognitive and affective empathy impairments are evident in children with disordered behaviour
b. Emotion recognition impairments are related to cognitive and affective empathy impairments
c. Emotion recognition and empathy impairments are related to impaired social attention to emotional cues, specifically eye gaze

Based on these objectives, we assessed the emotion recognition and empathy abilities of children with disordered behaviour and compared their performance to a group of typically developing children. During both tasks, social attention to the eyes was assessed using eye tracking.

We made the following primary and secondary hypotheses:

Primary hypotheses:

a. Children with disordered behaviour would show emotion recognition impairments for negative emotions compared to the typically developing group
b. Negative emotion recognition impairments would distinguish subgroups of these children with disordered behaviour; those with and those without emotion recognition impairments

Secondary hypotheses:

a. Children with disordered behaviour would show cognitive empathy impairments compared to the typically developing group
b. Children with disordered behaviour would show affective empathy impairments for negative emotions only compared to the typically developing group

c. Emotion recognition impairments would be related to cognitive, but not affective, empathy impairments for the same emotions
d. Emotion recognition and empathy impairments would not be associated with impaired eye gaze

3.3 Method

For ease of reading, descriptions of participant recruitment, group allocation and materials have been repeated here in a condensed manner. For further information, see Chapter 2.

3.3.1 Participants

150 participants (119 male) aged 7 – 11 years were recruited from schools across Northamptonshire, Wales and Essex. The participants in this study were first assigned to one of two participant groups based on their behaviour: either the Disordered Behaviours (DB) group or the typically developing (TD) group.

Participants assigned to the DB group were described by their school teacher as showing disordered behaviour and were part of a crime prevention programme ran by Northamptonshire Police, namely the Early Intervention Hub. As part of the Hub, Police Community Support Officers (PCSOs) were placed in schools to provide support to children from vulnerable families. These children had no formal clinical diagnosis, but were living in vulnerable family situations (e.g. parental mental illness, domestic violence, parental addiction). As these children have not yet reached a crisis point, they are considered “the blind spot” of the social services (Children’s Commissioner, 2018). Following referral from the Hub to the current study, the children’s teachers completed the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) to confirm behavioural status for the last 6 months. To be included in the disordered behaviour group, a score in the slightly raised or above range for

conduct or peer problems (≥ 3) or slightly lowered or below range for prosocial behaviour (≤ 5) was required (Goodman, 1997).

The DB group were further divided based on their emotion recognition abilities. To be included into the DB+ subgroup (with emotion recognition impairments), participants had to score equal to or below the threshold (66.67%) for fear, sadness and anger recognition (Hunnikin & van Goozen, 2018) (DB+, *n*=54); children who scored higher than this were assigned to the DB- subgroup (without emotion recognition impairments; *n*=38). Not all children were able to complete eye tracking during the emotion recognition (n=96; TD: *n*=43; DB-: *n* = 27; DB+: *n* = 26) or empathy (n=75; TD: *n*=32; DB-: *n*=22; DB+: *n*=21) tasks.

For the comparison group of typically developing children, teachers first referred them on the basis that they were not showing disordered behaviours. Parent-completed SDQ scores confirmed their behavioural status (within 'close to average' range for total difficulties, a score of ≤ 13/40).

3.3.2 Materials

3.3.2.1 *Demographic and behavioural characteristics*

The Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999) provided an estimated intelligence quotient (IQ) score. Socioeconomic status (SES) was estimated using Office for National Statistics estimates of average household weekly income based on postcode (Low = 0–£520; Middle = £521–£670; High = £671+).

The SDQ is a 25-item widely used, valid and reliable questionnaire assessing problematic and prosocial behaviour (Goodman, 1997).

3.3.2.2 *Facial Emotion Recognition*

The Facial Emotion Recognition (FER) tests consisted of 60 photos of male and female faces of varying ethnicities and ages displaying four emotions (happiness, sadness, fear, anger) plus a neutral expression from the Radboud Faces Database (Langner et al., 2010). Children were asked to choose which emotion the person was displaying (see Bowen et al., 2014).

3.3.2.3 *Empathy*

Participants viewed three clips from Harry Potter films, which evoked empathic reactions. Each clip represented happiness, sadness or fear as agreed upon by 96% of 31 6- to 11-year old children in another study (section 2.3.3.1). Previous experience with each clip revealed no effect of film familiarity. Participants were asked questions about the main character's emotions in the clip (cognitive empathy) and their own emotions while viewing the clip (affective empathy). They were asked how strongly they and the main character felt eight emotions and to explain the reason for the emotion. Responses were coded using the Cardiff Empathy Scoring System (see Appendix B; van Goozen et al., 2016; van Rijn, Barendse, van Goozen, & Swaab, 2014; van Zonneveld, et al., 2017). Cognitive empathy scores ranged from 0-9 and affective empathy scores from 0-7, with higher scores indicating greater empathy. Interrater reliability from two raters ranged from .94 (cognitive) to .98 (affective).

3.3.2.4 *Eye tracking*

During both emotion recognition and empathy tasks, social attention was assessed using concurrent eye tracking. A portable Tobii X2-60 compact eye-tracker sampling at 60Hz with a screen resolution of 1920 x 1080 was used. Participants were positioned 60 cm away from a 15" laptop screen. Calibration quality was

checked and repeated if necessary. An I-VT fixation filter with a minimum fixation criterion of 60msec sampled average raw data of both eyes to produce information on eye position and duration. Eye-gaze validity was checked for all recordings. Validity ranged from 60-99% (emotion recognition average accuracy: 82%; empathy average accuracy: 87%).

3.3.3 Procedure

All parts of the study were completed at the child's school. All children completed the research session conducted by a trained researcher, lasting approximately 75 minutes, which included a range of other assessments as part of a larger study. Lights were turned off where available during eye tracking tasks. All participants first provided assent and then completed the FER with concurrent eye tracking and then the empathy task, with concurrent eye tracking. Participants were then debriefed. DB group allocation to the DB- or DB+ group occurred after they had completed the research session, based on their score on the FER task.

3.3.4 Statistical analyses

Demographic and behaviour variables. Differences in demographic and behavioural characteristics between groups were analysed using one-way ANOVAs for continuous variables and χ^2 tests for binary variables. Spearman's rho correlations were used to examine relationships between emotion recognition, empathy and dwell time to the eyes. Only emotions where group differences were present were included in correlations. Bonferroni corrections were applied.

Emotion Recognition. Percent correct for each emotion was calculated. One-way ANOVAs were run for each emotion.

Empathy. Independent samples t-test and one-way ANOVAs were run separately for each emotion and for cognitive and affective empathy. First, the two groups (DB

and TD) were compared (independent samples t-tests) and then, to understand any influence of emotion recognition differences, analyses were rerun with the three groups (DB-, DB+ and TD; one-way ANOVA).

Eye tracking. Tobii Studio was used to analyse eye-gaze. Areas of interest (AOIs) were created around the eyes, mouth and face as a whole and the entire screen (see section 2.3.2.2. and 2.3.3.2 for example AOIs). Percentage dwell time to the eyes was calculated by summing all fixations to the eyes divided by the total duration of time spent looking at the face. This tells us the amount of time spent looking at the eyes when focusing on the face. Time to first fixation was also analysed just for the emotion recognition task. Values more than 2 standard deviations above the mean and trials with values of zero were excluded from the time to first fixation analyses. Two-Way ANOVAs were run with emotion and group for dwell time and time to first fixation.

3.4 Results

3.4.1 Demographic and behavioural data

Participants in the TD group were older and had a significantly higher SES than both DB groups (see Table 3.1). The TD group had a higher IQ than the DB+ group. The gender ratio was similar in both groups and there was no difference in emotion recognition accuracy by gender, $t(148) = -.86$, $p = .39$, nor was there an effect of gender on cognitive empathy, $t(134) = -1.50$ $p = .14$ or affective empathy $t(134) = -1.35$, $p = .18$. Participants in the TD group showed significantly fewer conduct and peer problems and had significantly higher prosocial scores than both DB groups. The DB groups therefore did not differ on demographic and behavioural variables.

Table 3.1. Demographic and behavioural characteristics of participants.

Variable	TD (*n* = 58)	DB- (*n* = 38)	DB+ (*n* = 54)	*p*-value	Posthoc
Age (years)	9.67 (1.11)	8.95 (1.04)	8.72 (1.30)	< .001	TD > DB- & DB+
IQ	104.65 (17.20)	95.18 (13.86)	89.11 (11.32)	< .001†	TD > DB+
Gender				.69	
% Male	77.6	84.2	77.8		
% Female	20.7	15.8	22.2		
SES				< .001⁺	TD > DB- & DB+
% Low	0	8.1	6.7		
% Medium	22	62.2	51.1		
% High	78	29.7	42.2		
SDQ score					
Conduct Problems	1.02 (1.05)	3.74 (2.55)	4.44 (2.70)	< .001	TD < DB- & DB+
Peer Problems	1.47 (1.29)	2.76 (1.81)	4.16 (2.52)	< .001§	TD < DB- & DB+
Prosocial Behaviour	8.24 (2.57)	3.93 (2.99)	4.56 (2.68)	< .001	TD > DB- & DB+

Notes: Means are presented with standard deviations in brackets. IQ = intelligence quotient, SES = Socioeconomic status, SDQ = Strengths and Difficulties Questionnaire. †No group difference present for emotion recognition eye tracking sample. ⁺For both empathy and emotion recognition eye tracking samples, TD > DB- only. §Empathy eye tracking subsample, TD < DB+.

3.4.2 Covariates

Spearman correlations were run to understand the relationship between IQ and age with emotion recognition. Age was not significantly correlated with emotion recognition, $r_s(150) = .00$, $p = .22$, but IQ was, $r_s(143) = .38$, $p < .001$. However, IQ was not included in analyses for several reasons. First and foremost, the DB groups differed in emotion recognition, but not IQ, ruling out a key role for IQ (see Table 3.1).

Secondly, previous similar studies have shown that IQ does not influence emotion recognition; even when significantly correlated, there is no change in conclusions when IQ is or is not included in the analysis (van Zonneveld, de Sonneville, van Goozen, & Swaab, 2018). Other studies have shown no significant correlation between IQ and emotion recognition in adolescents with disruptive behaviours (Airdrie et al., 2018).

Thirdly, as argued by Dennis, Francis, Cirino, Barnes and Fletcher (2009), it has been recommended that IQ should not be included as a covariate in studies of neurodevelopmental disorders. The main argument is that correcting for IQ produces overcorrected and counterintuitive findings; our groups represent inherently different participant groups with different characteristics and so correcting for IQ would be inappropriate based on the arguments by Dennis and colleagues.

Finally, researchers and statisticians have recommended that a covariate should only be included if the correlation is above $r = 0.5$ (Pocock, Assmann, Enos, & Kasten, 2002); this is because the covariate needs to show a clear and direct link with the dependent variable to justify the loss of power, which is not the case in this study.

3.4.3 Emotion Recognition

There were significant group differences for sadness, Welch's $F(2, 95.33) = 13.91$, $p < .001$, $\eta_p^2 = .17$, fear, Welch's $F(2, 94.51) = 18.71$, $p < .001$, $\eta_p^2 = .21$, anger, Welch's $F(2, 94.48) = 23.63$, $p < .001$, $\eta_p^2 = .27$, and neutral recognition, Welch's $F(2, 82.49) = 8.15$, $p = .001$, $\eta_p^2 = .11$ (see Figure 3.1). Pairwise comparisons showed that DB+ participants performed significantly worse than DB- and TD participants for sadness, fear and anger (all *p's* ≤ .001). For neutral expressions, participants in the DB+ group performed significantly worse than the TD group only ($p < .001$). There were no group differences in recognition of happy expressions ($p = .226$).

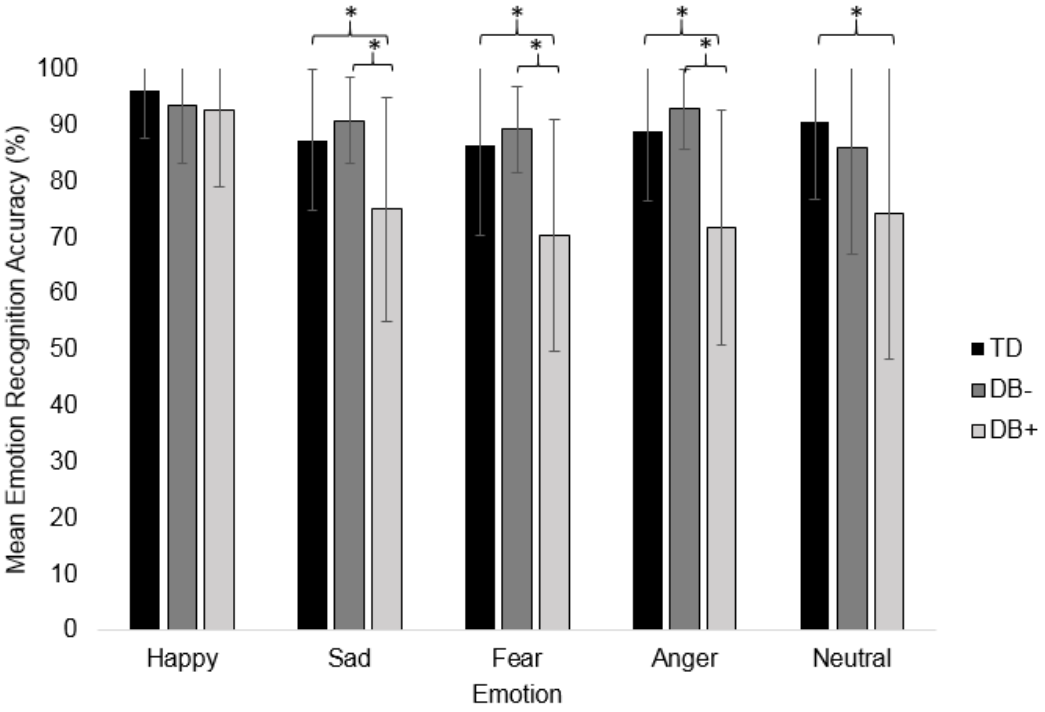


Figure 3.1. Mean emotion recognition scores for expressions of happiness, sadness, fear, anger and neutral. Error bars are set at ± 1 standard deviation. * = $p < .05$. TD: Typically Developing, DB: Disordered Behaviour.

3.4.4 Empathy

For time and practical reasons, 14 participants (9 TD, 1 DB-, 4 DB+) were unable to complete the empathy task. DB participants reported significantly less cognitive empathy than TD participants for happiness, $t(134) = -2.80$, $p = .006$, sadness, $t(129.59) = -4.53$, $p < .001$, and fear, $t(131.11) = -3.93$, $p < .001$ (see Figure 3.2). The same group differences were seen for affective empathy (happiness $p = .012$; sadness, $p = .016$; fear $p = .018$; see Figure 3.3).

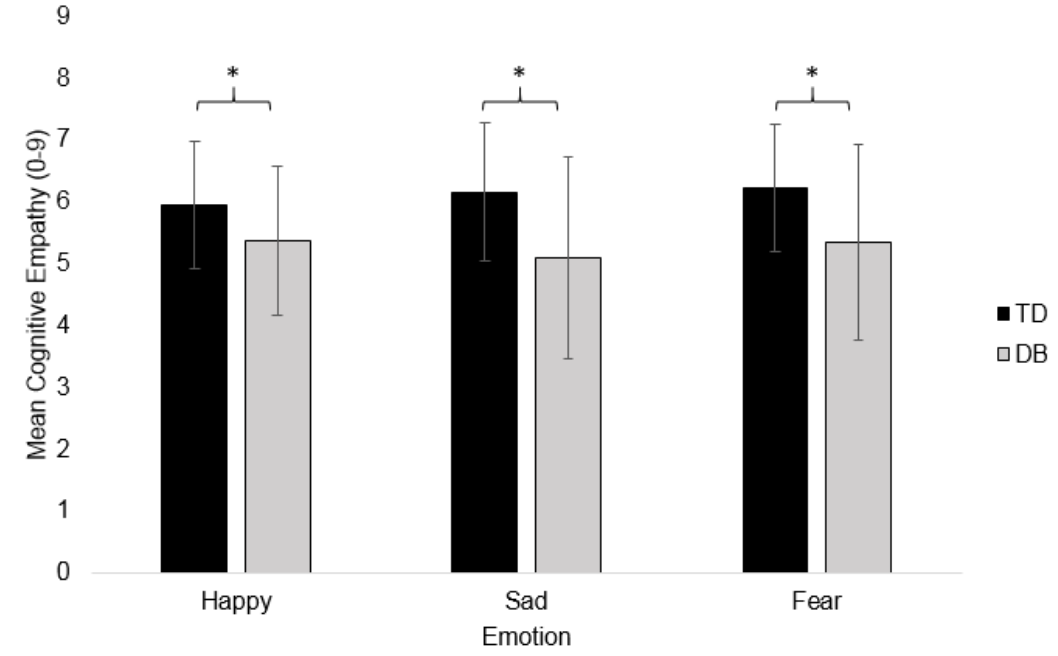


Figure 3.2. Mean cognitive empathy scores for happiness, sadness and fear. Error bars are set at ± 1 standard deviation. * = $p < .05$. TD: Typically Developing, DB: Disordered Behaviour.

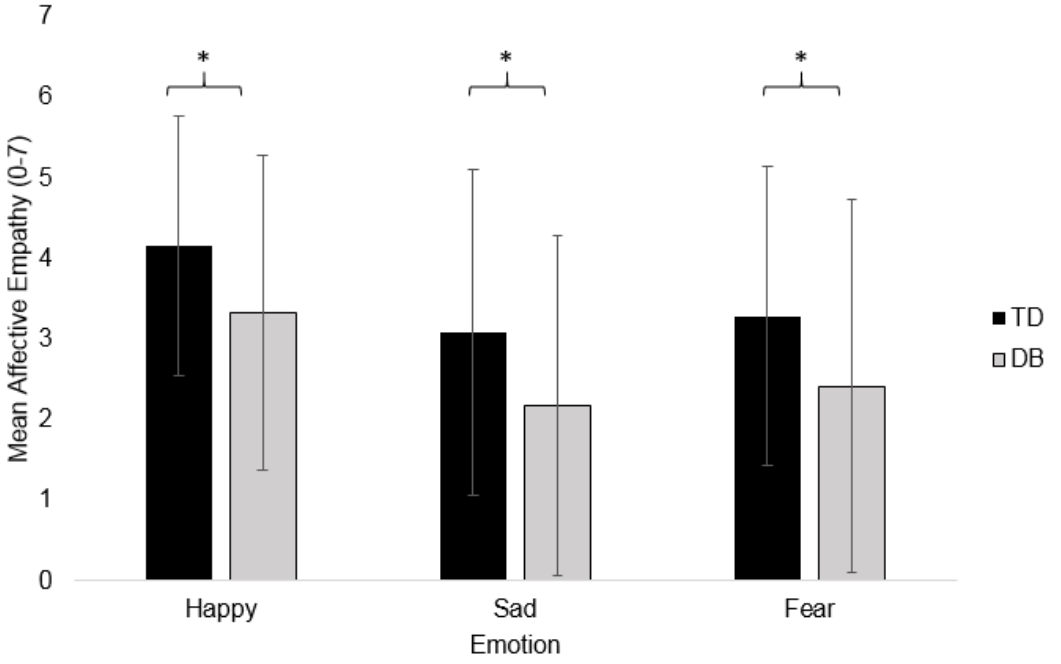


Figure 3.3. Mean affective empathy scores for happiness, sadness and fear. Error bars are set at ± 1 standard deviation. * = $p < .05$. TD: Typically Developing, DB: Disordered Behaviour.

When looking at the three groups, whilst there was a significant main effect of group for cognitive empathy for happiness, χ^2 (2) = 8.55, p = .014, and fear, χ^2 (2) = 8.40, p = .015, no pairwise comparisons survived Bonferroni-corrections (all *p's* > .0167 [.05/3]). For sadness, there was a group difference, Welch's F(2, 77.83) = 10.15, p < .001, η_p^2 = .12, and pairwise comparisons survived Bonferroni-correction showing that both DB groups expressed less cognitive empathy than the TD group (DB-: p = .002; DB+; p = .001). There was no overall group difference for affective empathy for happiness, χ^2(2) = 6.01, p = .05. For affective empathy for sadness, whilst there was an overall group difference, χ^2 (2) = 7.05, p = .029, no pairwise comparisons survived Bonferroni-corrections (all *p's* > .0167 [.05/3]). There was a significant group difference in affective empathy for fear, χ^2 (2) = 6.83, p = .033, but no pairwise comparisons survived Bonferroni-corrections (all *p's* > .0167 [.05/3]). See Table 3.2.

Table 3.2. Mean cognitive and affective empathy scores for happiness, sadness and fear

		TD (*n* = 58)	**DB- (*n* = 38)**	**DB+ (*n* = 54)**
Cognitive	Happy	5.94 (1.03)	5.43 (1.01)	5.32 (1.33)
	Sad	6.16 (1.11) [ab]	4.95 (1.84) [a]	5.20 (1.48) [b]
	Fear	6.22 (1.03)	5.46 (1.41)	5.26 (1.70)
Affective	Happy	4.16 (1.61)	3.16 (2.18)	3.44 (1.79)
	Sad	3.08 (2.30)	2.32 (2.16)	2.06 (2.09)
	Fear	3.29 (1.86)	2.41 (2.39)	2.42 (2.28)

Notes: Means are presented with standard deviations in brackets. [a] Significant difference between TD and DB-. [b] Significant difference between TD and DB+

3.4.5 Relationships between emotion recognition accuracy and empathy.

There were no significant correlations between emotion recognition and empathy (see Table 3.3). These correlations included the full sample. For correlations within the DB group or DB+ subgroup, see appendices C and D, respectively.

Table 3.3. Relationships between emotion recognition and empathy variables.

	Happy ER	Sad ER	Fear ER	Anger ER	Neutral ER
Happiness CE	0.04	0.02	0.02	0.10	0.09
Sadness CE	0.19	0.10	0.15	0.18	0.11
Fear CE	0.09	0.08	0.08	0.13	0.01
Happiness AE	0.00	0.07	-0.10	0.19	-0.09
Sadness AE	0.12	0.18	0.05	0.09	0.07
Fear AE	0.04	0.08	-0.09	0.06	-0.01

Notes: ER = Emotion Recognition, CE = Cognitive Empathy, AE = Affective Empathy. Values represent Spearman's rho, *n* = 136. Bonferroni corrections applied.

3.4.6 Eye tracking: Dwell time to the eye region

The three groups did not differ in attention to the screen during the emotion recognition, $F(2, 93) = 1.94$, $p = .15$, $\eta_p^2 = .04$, and empathy tasks, $F(2, 72) = .68$, $p = .51$, $\eta_p^2 = .02$. For emotion recognition there was no main effect of group, $F(2, 93) = 1.90$, $p = .16$, $\eta_p^2 = .04$, nor was there an interaction between emotion and group, $F(8, 372) = .67$, $p = .72$, $\eta_p^2 = .01$. There was also no group difference when comparing DB to TD ($p > .05$).

For empathy, there was no significant main effect of group, $F(2, 61) = 1.55$, $p = .22$, $\eta_p^2 = .05$ nor was there a significant interaction between emotion and group, $F(2, 4, 122) = .84$, $p = .51$, $\eta_p^2 = .03$ (see Figure 3.4). There was also no group difference when comparing DB to TD ($p > .05$).

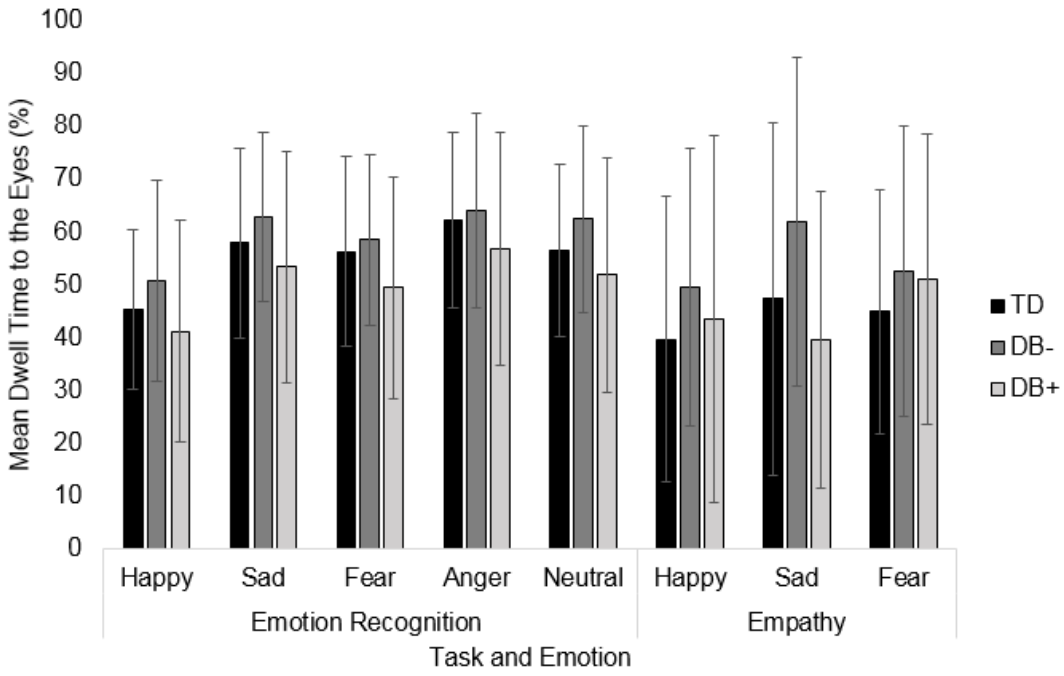


Figure 3.4. Mean percentage dwell time to the eyes for emotion recognition and empathy tasks. Error bars are set at ± 1 standard deviation. TD: Typically Developing, DB: Disordered Behaviour.

3.4.7 Relationships between emotion recognition, empathy and attention to the eyes

There were no significant correlations between attention to the eye region and emotion recognition and empathy (see Table 3.4). These correlations concerned the full sample. For correlations within the DB group or DB+ group, see appendices E and F, respectively.

Table 3.4. Relationships between emotion recognition, empathy and attention to the eyes

		Emotion Recognition % accuracy				Empathy % accuracy					
		Sad	**Fear**	**Anger**	**Neutral**	**Happy CE**	**Sad CE**	**Fear CE**	**Happy AE**	**Sad AE**	**Fear AE**
Emotion Recognition % dwell time	**% eyes sad**	0.14	0.10	0.06	0.01	-0.13	0.11	-0.01	0.07	0.16	-0.12
	% eyes fear	0.14	0.19	0.08	0.02	-0.16	0.10	0.01	0.02	0.10	-0.14
	% eyes anger	0.13	0.08	0.10	0.02	-0.21	0.03	-0.03	0.02	0.12	-0.19
	% eyes neutral	0.11	0.17	0.10	0.03	-0.13	0.10	0.02	0.05	0.20	-0.13
Empathy % dwell time	**% eyes happy**	0.02	0.11	0.09	0.00	0.02	0.20	-0.08	0.10	0.16	-0.03
	% eyes sad	0.18	0.04	0.19	-0.10	-0.02	0.29	-0.04	0.04	0.22	-0.03
	% eyes fear	0.05	-0.07	0.01	-0.01	-0.18	-0.01	-0.16	-0.06	0.08	-0.24

Notes: CE = Cognitive Empathy, AE = Affective Empathy. Values represent Spearman's rho. Correlations for emotion recognition variables, n = 137, correlations for empathy variables, n = 124. Bonferroni corrections applied.

3.4.8 Eye tracking: Time to first fixation to the eye region

One participant was removed from analyses due to a mean time to first fixation of zero. There was no significant group difference in time to first fixation to the eye region, $F(2, 92) = .51$, $p = .60$, $\eta_p^2 = .011$, nor was there a significant interaction between emotion and group, $F(8, 368) = 1.56$, $p = .14$, $\eta_p^2 = .033$ (see Figure 3.5).

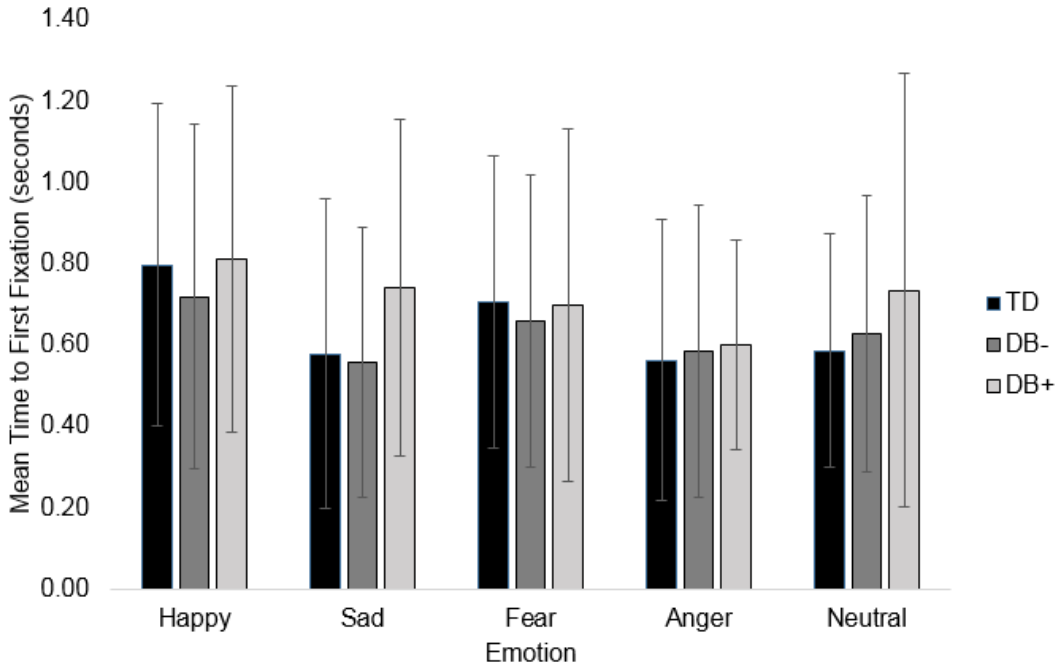


Figure 3.5. Mean time to first fixation to the eye region for expressions happiness, sadness, fear, anger and neutral. Error bars are set at ± 1 standard deviation. TD: Typically Developing, DB: Disordered Behaviour.

3.5 Discussion

Disordered behaviour in childhood is a significant predictor of later antisocial and criminal behaviour, which is associated with emotion recognition and empathy impairments. We investigated these impairments in a sample of children showing disordered behaviour. Specifically, we aimed to understand the nature and extent of emotion recognition impairments, in addition to understanding whether they show empathy impairments, the relationship between emotion recognition and empathy impairments and whether both impairments are due to inattention to the eye region. We have shown that an identifiable group of children with disordered behaviour show negative and neutral emotion recognition impairments, as whole they also show cognitive and affective empathy impairments, which are not statistically related to their emotion recognition impairments and they do not show impaired attention to the eyes.

It was hypothesised that firstly, the children with disordered behaviour (DB group) would show negative emotion recognition impairments compared to the typically developing group. The evidence supported this hypothesis. We demonstrated that the children with disordered behaviour were impaired in the recognition of negative (sad, fear and anger) emotions and neutral expressions. This supports the literature showing evidence of more pervasive recognition impairments beyond fear and sadness in antisocial populations (Dawel et al., 2012). These results underpin the importance of early detection of at-risk children; in our sample, the children are currently showing disordered behaviour and have been classified by the police as being at-risk for future criminal behaviour. Their emotion recognition impairments are similar to those reported in antisocial adults. These specific impairments have been implicated in the development and continuation of ASB (Blair, 2005a; van Goozen & Fairchild, 2008).

Secondly, we hypothesised that emotion recognition impairments would distinguish subgroups within the DB group: those with and without emotion recognition impairments, paving the way for tailored interventions. We showed that only a subgroup of children with disordered behaviour were impaired in emotion recognition. 41% of these children showed comparable emotion recognition to the typically developing comparison group. This supports the notion that there is individual variability in emotion recognition with some antisocial individuals being relatively unimpaired (Eugène et al., 2003; Glass & Newman, 2006; Woodworth & Waschbusch, 2008) casting doubt on explanations that suggest a key role for emotion recognition in (all) ASB. This also supports the use of targeted interventions; emotion recognition training should only be given to those who really need assistance.

We hypothesised that children with disordered behaviour would show cognitive and affective empathy impairments compared to the typically developing group, though affective empathy impairments would be specific to negative emotions. In line with previous studies (Cohen & Strayer, 1996; Pasalich et al., 2014), the children with disordered behaviour as a group showed a general impairment in cognitive empathy, supporting our hypothesis. For affective empathy, our hypothesis was partially supported as we found evidence for impairments in all emotions. Our results showing affective empathy impairments for fear and sadness are in line with previous literature (van Zonneveld et al., 2017). However, we did not expect that these children would also show impaired affective empathy for happiness based on previous studies (e.g., de Wied et al., 2009; van Zonneveld et al., 2017). A recent meta-analysis suggests emotion impairments are pervasive across emotions, including happiness (Dawel et al., 2012) and there is evidence for reduced activation in key brain areas whilst viewing emotional stimuli, including happy stimuli, in individuals with high CU traits (Decety, Skelly, Yoder, & Kiehl, 2014). Currently, empathy is often measured using questionnaires that do not differentiate empathy for distinct emotions (de Wied et al., 2009) and when emotions are differentiated, different emotional stimuli are often used across studies (Bons et al., 2013). These factors may account for the different findings in the literature. Future research should aim to understand the nature of affective empathy impairments for positive emotions in populations with disordered behaviour, especially as happiness is thought to diffuse hostility and encourage prosocial behaviour (Becker & Srinivasan, 2014).

This study also aimed to understand the relationship between emotion recognition and cognitive and affective empathy impairments. Firstly, for cognitive empathy we hypothesised that emotion recognition impairments would be related to cognitive

empathy impairments for the same emotions. However, despite the proposed relationship between emotion recognition and cognitive empathy (Lui et al., 2016; Marshall & Marshall, 2011; Marshall et al., 1995), the two DB groups did not differ in cognitive empathy despite differing in emotion recognition. We also found no significant correlations between cognitive empathy and emotion recognition. This contrasts the results of the study by Lui et al. (2016) which found a positive correlation. This discrepancy is likely due to the different approaches used. Lui and colleagues used a questionnaire measure of empathy, whereas we used affective film clips to induce empathy, which was then coded. Similarly, they looked at an overall cognitive and affective empathy score and a general emotion recognition score, without considering individual emotions, despite differences in both emotion recognition and empathy abilities being dependent on emotion (Marsh & Blair, 2008; van Zonneveld et al., 2017). However, despite this significant correlation, Lui and colleagues did find that in adolescents with CU traits, impaired cognitive empathy was not mediated by emotion recognition.

A potential explanation for the lack of relationship observed in the current study could be due to differences in our measurements of cognitive empathy and emotion recognition, and thus the skills needed to be successful in completing these tasks. To assess cognitive empathy, we used dynamic emotional video clips and asked participants to explain their emotion choices. This type of stimuli required the ability to understand additional vocal, gestural and contextual information whereas our emotion recognition task required the ability to recognise static facial expressions only. It could be that whilst some individuals are able to recognise facial expressions, they may struggle with the additional elements required for cognitive empathy (Decety & Jackson, 2004). Supporting this, research has shown that antisocial populations are

impaired in vocal (Blair et al., 2005) and postural emotion recognition (Muñoz, 2009), and struggle to integrate multiple sources of emotional information (Gonzalez-Gadea et al., 2014). Additionally, previous research has suggested that emotion recognition and cognitive empathy are separate social skills (Reniers et al., 2011). Lui and colleagues suggested that other processes may be more important than emotion recognition in explaining cognitive empathy impairments, such as a lack of concern regarding others' feelings, which would be pervasive across emotions as evidenced here (Muñoz et al., 2011; Pasalich et al., 2014).

Regarding affective empathy, it was hypothesised that there would be no relationship between emotion recognition and affective empathy. Our hypothesis was confirmed. The DB group showed an impairment in affective empathy for all emotions and the two DB groups did not differ in affective empathy, despite the differences in emotion recognition. There were also no significant correlations between emotion recognition and affective empathy. This supports the findings by Lui et al. (2016), who also found no evidence for a relationship between emotion recognition and affective empathy.

Another secondary aim of this study was to understand whether the observed emotion recognition and empathy impairments were related to impaired social attention to the eye region. We hypothesised, on the basis of recent studies (Airdrie et al., 2018; Martin-Key et al., 2017; van Zonneveld et al., 2017), that there would be no relationship between these emotion recognition and empathy impairments and social attention to the eye region and this hypothesis was supported. Our participant groups did not differ in attention to the eye region despite differing in emotion recognition and empathy abilities and there were no significant correlations between these variables. This contrasts Dadds et al. (2006), who reported that fear recognition problems in

adolescents with CU traits were due to impaired attention towards the eyes and these problems were reversed when directing attention to the eyes. Supporting the current study, recent evidence with at-risk children, adolescents with CD or adolescents with Attention Deficit Hyperactivity Disorder plus CD have also shown that attention to salient facial features, particularly the eye region, does not account for the emotion impairments in these populations (Airdrie et al., 2018; Martin-Key et al., 2017; van Zonneveld et al., 2017). Further, no relationship between emotion recognition and social attention has also been evidenced in healthy individuals (Barabanschikov, 2015). Perhaps it is the interpretation of the facial features that are important, rather than the attention. Evidence of training in young offenders that aimed to improve emotion recognition by directing attention to the key facial features and providing information for how to interpret these, showed a significant improvement in negative emotion recognition (Hubble et al., 2015). Although eye tracking was not conducted, it could be the interpretation of the facial features that were important, rather than the social attention but future research should investigate this.

The findings of the current study should be interpreted in light of some limitations. Firstly, practical limitations prevented the collection of eye tracking data with the full sample. It is also important to note that eye movement behaviour was considered across all trials, regardless of accuracy. It could be possible that eye movement behaviours would be different when considering correct versus incorrect trials. Future research should investigate this with a larger sample. Additionally, we did not explore motor empathy, which is an important component of empathy (van der Graaff et al., 2016). Further, given that children may have difficulties verbalising their personal thoughts and feelings, (Quiggle, Garber, Panak, & Dodge, 1992), future research

should employ physiological measures to examine empathy impairments in populations showing disordered behaviour, including motor empathy.

Conclusions and Clinical Implications

There is a statistical relationship between disordered behaviour in childhood and later antisocial and criminal behaviour. We have provided evidence that emotion recognition impairments, as have been found in antisocial and criminal adults, are evident in some 7-11 year-olds who are concurrently displaying disordered behaviour. This research supports the use of early interventions that improve both emotion recognition and empathy development and that existing emotion recognition interventions need to be given to only those who show problems in this social skill. A targeted and early intervention approach is not only likely to be more effective but also represents a better use of finances and resources.

4 Improving emotion recognition in children with disordered behaviour participating in a crime prevention programme: Are there positive effects on social attention and empathy?

Paper in preparation

This Chapter is based on Hunnikin, Wells, Ash & van Goozen (2018). Improving emotion recognition in children with disordered behaviour participating in a crime prevention programme: Are there positive effects on social attention and empathy?

Paper in preparation.

Chapter 3 showed that some of our sample of children with disordered behaviour showed impairments in emotion recognition. Next, Chapter 4 investigates the effectiveness of the Cardiff Emotion Recognition Training (CERT) to improve emotion recognition in these children. The wider effects of the training on empathy and social attention are also considered.

4.1 Abstract

Background. Individuals displaying antisocial behaviour (ASB) show emotion recognition and empathy impairments that may contribute to the development and persistence of their behaviour. Given that early childhood behaviour problems have been linked to later antisocial and criminal behaviour, we explored whether the delivery of an early emotion recognition training would improve emotion recognition impairments in children displaying disordered behaviour. We also explored whether any positive effects of this training would be associated with improvements in empathy and social attention.

Hypotheses. We hypothesised that negative emotion recognition would be improved and that this would be associated with improved cognitive, but not affective, empathy but it would not be associated with change in social attention.

Method. Participants were 7- to 11- year old children showing disordered behaviour (*N* = 92, mean age: 8.8 years, 80% male) who were taking part in a crime prevention programme due to being classified by the police as being at high-risk for future criminal and antisocial behaviour. All participants completed emotion recognition and empathy tasks, both with concurrent eye tracking. A subsample of participants showed emotion recognition impairments (*n* = 54, mean age: 8.72 years, 77.8% male) and so completed the Cardiff Emotion Recognition Training, whilst the remaining participants showed unimpaired emotion recognition abilities (*n* = 38, mean

age: 8.95 years, 84.2% male) and therefore did not receive the training. Emotion recognition and empathy tasks were then repeated.

Results. Children who completed the training improved significantly in fear, sadness, anger and neutral recognition. The improvement in emotion recognition was not however, associated with an immediate improvement in cognitive or affective empathy abilities. There was no association between the training and changed social attention to the eyes.

Conclusions. This study shows that emotion recognition, which can be a problem in children with disordered behaviour who have been classified by the police as being at high-risk for future criminal behaviour, can be improved by completing a simple and quick emotion recognition training.

4.2 Introduction

Displaying antisocial behaviour (ASB) in childhood and adolescence can lead to persistent and increasingly negative outcomes in adulthood. Not only is early ASB related to future indicators of criminal behaviour, such as number of future arrests and crime severity (Huesmann et al., 2002), but also negative individual outcomes, such as substance abuse, health problems and psychiatric illness (Fombonne et al., 2001; Odgers et al., 2008), amongst others. However, not all children showing ASB will mature into adult offenders (Moffitt, 1993; Odgers et al., 2007). Those who do tend to have poorer parental supervision, come from more disadvantaged neighbourhoods, exhibit alterations in brain structure and function and have greater problems in emotion function (Fairchild, van Goozen, et al., 2013; Skeem et al., 2014).

Two key problems in emotion function are thought to contribute to the development and continuation of ASB. Firstly, there is a difficulty in recognising emotions from other's facial expressions, particularly fear and sadness expressions

but also other basic emotions, including anger and disgust (Bowen et al., 2014; Dawel et al., 2012; Fairchild et al., 2009; Kosson et al., 2002; Marsh & Blair, 2008). Secondly, these individuals show impaired cognitive and affective empathy (Cohen & Strayer, 1996; Lui, Barry, & Sacco, 2016; Muñoz, Qualter, & Padgett, 2011; Pasalich, Dadds, & Hawes, 2014; this thesis, see Chapter 3), although there is evidence for just an affective impairment limited to negative emotions (Bons et al., 2013; van Zonneveld et al., 2017). Both of these impairments are thought to be related to an impairment in social attention to the eye region; Dadds et al. (2006) showed that adolescents with high callous-unemotional (CU) traits showed normal levels of fear recognition when directed to attend to the eyes but not so when freely viewing faces. The empathy impairments observed in antisocial populations have also been hypothesised to be caused by a lack of attention to the eye region (Bons et al., 2013). However, recent evidence has cast doubt to this, finding no evidence of an impairment in social attention to the eyes in at-risk children, in adolescents with Attention Deficit Hyperactivity Disorder and comorbid Conduct Disorder (CD), and in adolescents with CD (Airdrie, Langley, Thapar, & van Goozen, 2018; Martin-Key, Graf, Adams, & Fairchild, 2017; van Zonneveld et al., 2017; Chapter 3). This recent line of evidence suggests that other mechanisms may account for these emotion recognition and empathy impairments, but the social attention hypothesis still warrants further investigation.

Emotion recognition and empathy impairments are contributing factors in the development and continuation of ASB. Blair's (2005a) Integrated Emotion Systems (IES) model proposes that emotional facial expressions signal distress in others, which then evokes empathic responses, which acts as an inhibitor of aggressive acts. In addition, there is a failure to create the association between the aggressive act and

another's distress. As suggested in this IES model, emotion recognition and empathy are thought to be interrelated constructs. Empathy has been related to recognition accuracy across basic emotions (Besel & Yuille, 2010), to recognition accuracy at lower intensities (Martin et al., 1996) and to recognising fearful expressions (Carr & Lutjemeier, 2005). One recent study has looked further into the relationship between these two constructs in a sample of adolescents in a residential programme because of dropping out of high school. They showed that facial emotion recognition is positively correlated with cognitive empathy but not affective empathy (Lui et al., 2016). They concluded that accurately recognising facial expressions helps to identify another's emotional state but does not necessarily translate to feelings for them; instead, affective perspective taking is important for this. However, it is important to note that there is some evidence of a relationship between affective empathy and emotion recognition (Gery et al., 2009).

Taken together, we know that individuals displaying ASB show affective impairments in emotion recognition and empathy that likely contributes to the persistent nature of their ASB (Blair, 2005a). Therefore, intervention strategies and support for these young people are especially important and necessary. Given its role in ASB and empathy, research has begun to look at the effectiveness of emotion recognition training. Dadds, Cauchi, Wimalaweera, Hawes and Brennan (2012) found that children with high CU traits showed improvements in affective empathy and conduct problems, as rated by their mothers, following emotion recognition training. However, importantly, there was no improvement in emotion recognition after the training. Penton-Voak et al. (2013) were successful in manipulating the perception bias from anger to happy in aggressive youths and this change was associated with a significant decrease in independently-rated aggressive behaviour two weeks later

(Penton-Voak et al., 2013). However, the ability of this training to improve the impairments shown for other emotions is not known. A recent study has looked at the influence of emotion recognition training on objective crime data. Hubble et al. (2015) found that juvenile offenders' ability to recognise negative emotions significantly improved following a short but intensive training. In addition, the severity of their criminal behaviour significantly decreased in the six months following the training (Hubble et al., 2015). This helps to show the potential for emotion recognition training in reducing ASB.

Overall, it is encouraging that emotion recognition training is being shown to have a positive influence on behaviour. However, there are still outstanding matters that need to be addressed (Hunnikin & van Goozen, 2018). First, previous studies have not assessed emotion recognition abilities before participation in training. Recent research has shown that only a subgroup of children with disordered behaviour are impaired in emotion recognition (see Chapter 3). This supports evidence from other antisocial populations showing intact emotion recognition (Del Gaizo & Falkenbach, 2008; Glass & Newman, 2006) and individual variability (Eugène et al., 2003). For example, some studies have shown that some children with behavioural problems are actually better in fear recognition (Woodworth & Waschbusch, 2008). A targeted treatment approach is likely to be more effective and represents a better use of finances and resources (van Goozen & Fairchild, 2008; White et al., 2013; Wilkinson et al., 2015).

Secondly, most interventions are reactive in nature. Currently in the UK, it is estimated that 1.6 million children are ignored by social support systems because they have not reached crisis point (Children's Commissioner, 2018). We know that age of onset is thought to be a contributing factor to ASB severity (Moffitt, 1993) and

one of the strongest predictors of later ASB is problematic behaviour in childhood (Bor et al., 2004; Murray & Farrington, 2005). Interventions that seek to help individuals *at-risk* for future criminal and antisocial behaviour lead to better outcomes than interventions delivered later in adolescence or adulthood when the individual is already engaged in such behaviours (Humphrey & Wigelsworth, 2016; Skeem et al., 2014). This means that early interventions have the greatest potential for preventing future and persistent ASB and to prevent these children from reaching an escalation point (van Goozen & Fairchild, 2008; White et al., 2013; Wilkinson et al., 2015).

Thirdly, at present we do not know the wider implications of emotion recognition training on related constructs, such as empathy. The study by Dadds et al. (2012) is one of few studies to investigate this. However, although they found evidence for an improvement in affective empathy, there was no change in emotion recognition, so it is highly likely that another mechanism accounted for this improvement. Children's parents completed both practice exercises with the child and the pre- and post-training measure of empathy, and this could have influenced the findings. A case study conducted by Datyner, Kimonis, Hunt and Armstrong (2016), however, showed that emotional training resulted in improved emotion recognition and empathic responding in a 7-year-old boy with high CU traits. However, given the case study design, more research needs to be conducted to understand any wider implications of emotion recognition training, specifically for empathy, given its contributing role in ASB and its relationship to emotion recognition (Marshall & Marshall, 2011; Marshall et al., 1995).

Fourthly, in order to understand a true change in emotion recognition skills, research must look at the unbiased hit rates to understand increased emotion detection rate, and whether this is due to an increase in bias for the emotions included

within the training. Griffiths, Jarrold, Penton-Voak, and Munafò (2015) showed that there was no improvement in the recognition of happiness and fear expressions after training once the increase in the number in false alarms had been adjusted (detecting the target emotion in non-target expressions). This means that participants simply selected the trained emotions more often, resulting in not only a higher accuracy for these emotions but also a higher false alarm rate (i.e. saying an expression was happy when it was not). We now need to understand whether the training programmes are indeed increasing recognition or simply increasing the number of times participants choose the trained emotion when responding on emotion recognition tests, thereby skewing the results.

Finally, questions remain around the mechanism of improvement and the role of attention to the eye region given the recent line of contrasting evidence against this hypothesis (Airdrie et al., 2018; Martin-Key et al., 2017; van Zonneveld et al., 2017). The emotion recognition training used in Hubble et al. (2015) not only directed attention to the key facial features such as the eyes, but also provided information in how to interpret these, so it could be possible that the emotion recognition improvement was related to the assistance with interpretation, not the directing of attention. However, eye tracking was not conducted in this study, so questions remain unanswered.

4.2.1 Aims and hypotheses

The current study aimed to address the outstanding matters listed above. Specifically, we primarily aimed to understand whether emotion recognition impairments could be improved in children with disordered behaviour following emotion recognition training, the Cardiff Emotion Recognition Training (CERT).

Secondary aims of the study were to understand whether:

- An improvement in emotion recognition was related to an improvement in cognitive and affective empathy immediately after the training
- An improvement in emotion recognition was related to increased social attention to emotional cues, specifically the eye region

In order to assess these aims, we conducted a targeted, early emotion recognition training with children showing disordered behaviour and emotion recognition impairments. An emotion recognition and empathy task, both with concurrent eye tracking, was conducted before and after training. The child's participation in the CERT was determined by their performance on the emotion recognition task at pre-test; only those showing impaired emotion recognition took part in the CERT to ensure a tailored approach.

Based on the literature, we hypothesised that:

- Children with disordered behaviour who completed the CERT would show an improvement in recognising fear, sadness, anger and neutral expressions
- This improvement would remain after assessing for unbiased hit rates
- The improvement in emotion recognition would be associated with an improvement in cognitive empathy for the same emotions, but there would be no association with affective empathy
- That the improvement in emotion recognition would not be related to increased social attention to the eye region

4.3 Methods

For ease of reading, descriptions of participant recruitment, group allocation and materials used have been repeated here in a condensed manner. For further information, see Chapter 2.

4.3.1 Participants

92 participants (74 male) aged 7–11 years old (*M* = 8.82, *SD* = 1.12) took part in this study. Participants were referred to take part in the study from an Early Intervention Hub, which is a crime prevention programme set up by Northamptonshire Police Force. These children were participating in this programme because they were classified by the police as being at high-risk for future criminal behaviour.

As part of the Hub, Police Community Support Officers (PCSOs) are assigned to Primary Schools to work with children and their families who are identified through a multi-agency process (social workers, police, schools). These children have no formal behavioural diagnosis but they show current disordered behaviour and often have several risk factors associated with future criminal behaviour (e.g. parental mental illness, domestic violence or family member in prison). However, because they have not reached crisis point, these children are 'invisible' to a social support system (Children's Commissioner, 2018). The Hub aims to work with at-risk children and their families to provide early support and intervention.

After children were referred to the current study from the Early Intervention Hub, the child's teacher confirmed their disordered behaviour using the Strengths and Difficulties questionnaire (SDQ; Goodman, 1997). Eligible participants were classified as 'slightly raised' or above for conduct or peer problems (a score of ≥ 3 out of 10) or 'slightly lowered' or below for prosocial behaviour (a score of ≤5 out of 10). They were only required to reach this threshold for one subscale

To ensure a tailored approach, these children were further categorised according to their emotion recognition ability, after they had completed an emotion recognition test as part of the research study. If they scored less than or equal to 66.67% for expressions of sadness, fear and anger, they were assigned to the disordered

behaviour with emotion recognition impairments group (DB+, *n* = 54). Given that these participants showed emotion recognition impairments, they completed the CERT. The threshold for identifying emotion recognition impairments represented 1.5 standard deviations below the average performance of a sample of 31 typically developing children (section 2.3.2.1). The remaining participants were assigned to the disordered behaviour without emotion recognition impairments group (DB-, *n* = 38) and so did not complete the training. For time and practical reasons, only a subsample of participants completed eye tracking; the emotion recognition sample was 53 (DB-: *n* = 27; DB+: *n* = 26) and the empathy sample was 43 (DB-: *n* = 22; DB+: *n* = 21).

4.3.2 Materials

4.3.2.1 *Demographic and behavioural characteristics*

The Wechsler Abbreviated Scale of Intelligence, first edition (WASI; Wechsler, 1999) was used to provide an estimated intelligence quotient (IQ) score. Socioeconomic 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+; Hubble et al., 2015).

The SDQ is a 25-item questionnaire assessing problematic and prosocial behaviour (Goodman, 1997). This is a widely used, valid and reliable measure (Stone et al., 2010). The SDQ is scored on a three-point scale (0, 1, 2). There are five subscales including conduct problems, peer problems and prosocial behaviour. It is estimated that only 10% of the UK population would be classified as slightly raised/lowered (Goodman & Goodman, 2011).

4.3.2.2 *Facial Emotion Recognition*

The Facial Emotion Recognition (FER) measure consisted of 60 photos of males and females of varying ethnicities and ages displaying four emotions (happiness, sadness, fear and anger) plus a neutral expression. Photos from the Radboud Faces Database (Langner et al., 2010) were used. Participants were required to choose what emotion the person was displaying out of five forced-choice options.

4.3.2.3 *Empathy*

Participants viewed six film clips from the Harry Potter cinematic films. Two clips represented one target emotion (happy, sad or fearful), which were similar for intensity and lasted between one and three minutes. Participants viewed one set of film clips at pre-test and another at post-test, with the order counterbalanced within and between participants and research sessions. Familiarity with the film clips did not influence participant's responses. After each clip, participants were asked which emotion the main character felt, how strongly and why they felt that emotion. They then repeated this for their own emotions whilst viewing the clip. The Cardiff Empathy Scoring System was then used to score participant's responses (see Appendix B, van Goozen et al., 2016 and van Rijn, Barendse, van Goozen, & Swaab, 2014 for a full description of the scoring system). Cognitive empathy scores ranged from 0-9 whereas affective empathy scores ranged from 0-7, with a higher score being indicative of greater empathy. Interrater reliability ranged from .92 (cognitive) to .99 (affective).

4.3.2.4 *Eye tracking*

A subset of participants completed eye tracking during the emotional tasks using a portable Tobii X2-60 compact eye-tracker sampling at 60Hz with a screen resolution

of 1920 x 1080. Participants were positioned approximately 60-65cm away from the 15" laptop screen. Calibration quality was checked and repeated if necessary. An I-VT fixation filter with a minimum fixation criterion of 60msec sampled average raw data of both eyes to produce information on eye position and duration. Eye-gaze validity was checked for all recordings using a sample rate percentage that gives an approximate estimate of the quality of eye tracking by providing a percentage score of successfully recorded data. Where this could not be confirmed individual recordings were further analysed. Overall, the validity ranged from 60-99% (FER mean accuracy: 80%; empathy mean accuracy: 88%).

4.3.2.5 *Cardiff Emotion Recognition Training*

Participants allocated to the DB+ group were eligible to complete the CERT that was specifically developed during this PhD. This is a computerised intervention and is designed to improve the identification of facial expressions of happiness, sadness, fear and anger. In addition to improving emotion recognition abilities, the CERT also aims to (a) improve the ability to understand when certain emotions are shown, (b) improve the understanding that a person can have more than one emotion in response to the same situation and (c) provide an understanding of how it is appropriate to respond to someone displaying a certain emotion.

CERT is based upon a previous training program called the Facial Affect Recognition program developed by Neumann, Babbage, Zupan and Willer (2014) and was used by Hubble et al. (2015). Adjustments and updates were made to this program to ensure it was suitable for a sample of children. The CERT consists of three sessions that occur once a week for three consecutive weeks, each taking on average 20-30 minutes to complete. The sessions were delivered by either the PCSO or the school's Family Support Worker. Individuals delivering the training attended an

hour-long training session in how to administer the CERT beforehand and all data relating to the training, such as dates and timings, were recorded. The sessions are designed to get progressively harder because there is a reduction in the intensity of the facial expressions and a reduction in both written and pictorial hints, encouraging the participant to recognise the facial expression without the help of the hints. Different models are included in the different sessions in order to expose participants to as many different faces and varying emotional displays as possible.

4.3.3 Procedure

All parts of the study were completed at the child's school. All children completed an initial research session conducted by a trained researcher, lasting approximately 75 minutes, which included a range of other assessments as part of a larger study. In this session, participants first provided assent to take part in the study and then completed the FER with concurrent eye tracking and then the empathy task with concurrent eye tracking. Lights were turned off where available during eye tracking tasks. Participant's performance on the FER task was then assessed to determine if they were allocated to the DB+ group (those with emotion recognition impairments) or the DB- group (those without emotion recognition impairments). To ensure a tailored approach, only those allocated to the DB+ group completed the CERT. These children completed the three CERT sessions with the PCSO or Family Support Worker lasting approximately 1.5 hours. They then completed a post-test research session, taking the same structure and order as the pre-test research session. After finishing the post-test research session, participants were debriefed (see Figure 4.1 for timings and durations for DB+ group).

The DB- group also completed both pre- and post-test research sessions, with the same structure and assessments. They completed both research sessions, not just

the pre-test session. This was to demonstrate the reliability of the FER task that there is no significant change in performance after redoing it. Therefore, the focus of this study and results will be on the DB+ group.

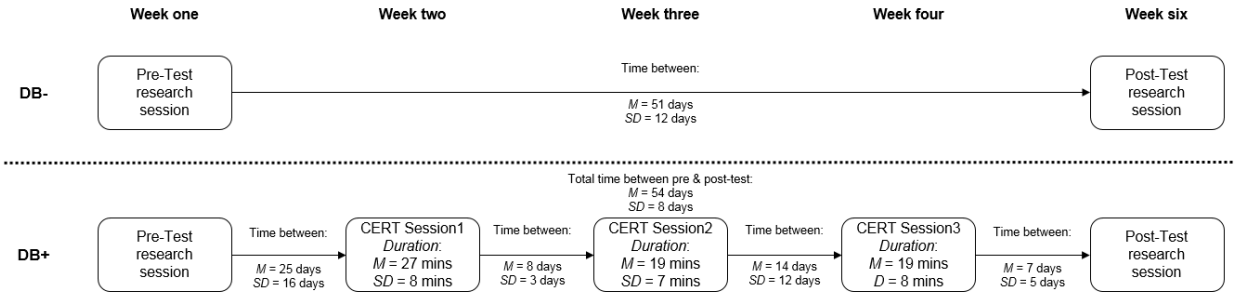


Figure 4.1. Schematic representation of the research process, timings and duration. M = Mean; SD = standard deviation; mins = minutes. DB: Disordered Behaviour.

4.3.4 Statistical analyses

Demographic and behavioural variables. Differences in demographic and behavioural characteristics between groups were analysed using t-tests for continuous variables and χ^2 tests for binary variables.

Emotion Recognition (raw data). Percent correct for each emotion on the FER task was calculated and two-way ANOVAs (time and group) were run.

Emotion Recognition (unbiased hit rates). Unbiased hit rates determine accuracy by assessing raw accuracy (how frequently an expression is correctly identified) and differential accuracy (how frequently a response category is used correctly compared to how many times it is used) (Griffiths et al., 2015; Wagner, 1993). These two proportions are then multiplied, the difference between the resulting values then undergo arcsine-transformation. Arcsine values range from 0 to 1.57 where 1.57 means the participant always chose the correct emotion when it appeared and never for a different expression (Naor, Shamay-Tsoory, Sheppes, & Okon-Singer, 2017).

Empathy. Two-way ANOVAs were run separately for each emotion and for cognitive and affective empathy (time and group).

Eye tracking. Tobii Studio was used to analyse eye-gaze. Areas of interest (AOIs) were created around the eyes, mouth and face as a whole and the entire screen for both emotion recognition and empathy tasks (see sections 2.3.2.2 and 2.3.3.2 for example AOIs). Percentage dwell time to the eyes was calculated by summing all fixations to the eyes divided by the total duration of time spent looking at the face. This tells us the amount of time spent looking at the eyes when focusing on the face. Time to first fixation was also analysed just for the emotion recognition task. Values more than 2 standard deviations above the mean and trials with values of zero were excluded from the time to first fixation analyses. Three-way ANOVAs were run with emotion, time and group, repeated for both the dwell time and time to first fixation for emotion recognition and dwell time for empathy.

4.4 Results

4.4.1 Demographic and behavioural data

Participants were comparable for age, gender, SES, conduct problems and prosocial behaviour (see Table 4.1). Participants in the DB- group had a significantly higher IQ and showed fewer peer problems than the DB + group. There was no difference in emotion recognition accuracy by gender, $t(90) = -.41$, $p = .68$, nor cognitive empathy, $t(85) = -.21$ $p = .84$ or affective empathy $t(85) = -.75$, $p = .45$.

Table 4.1: Demographic and behavioural characteristics of participants

Variable	DB- (*n* = 38)	DB+ (*n* = 54)	*p*-value
Age (years)	8.95 (1.04)	8.72 (1.30)	.36
IQ	95.18 (13.86)	89.11 (11.32)	.02†
Gender			.44
% Male	84.2	77.8	
% Female	15.8	22.2	
SES			.27+
% Low	8.1	6.7	
% Medium	62.2	51.1	
% High	29.7	42.2	
SDQ score			
Conduct Problems	3.74 (2.55)	4.44 (2.70)	.22
Peer Problems	2.76 (1.81)	4.16 (2.52)	.003†
Prosocial Behaviour	3.93 (2.99)	4.56 (2.68)	.30

Notes: Means are presented with standard deviations in brackets (except where indicated otherwise). IQ = intelligence quotient (two-subtest WASI), SES = Socioeconomic status, SDQ = Strengths and Difficulties Questionnaire. † No significant differences in the eye tracking samples. +Significant difference for FER eye tracking sample DB+ > DB-.

4.4.2 Covariates

IQ and age were not included in analyses, as they were not significantly correlated with cognitive or affective empathy, nor negative emotion recognition (all *p's* > .05).

4.4.3 Emotion Recognition

Happy. There were no significant main effects or interactions when using the raw data (all *p's* > .05; see Figure 4.2). However, using the unbiased hit rate data, there was a significant two-ways interaction between time and group, $F(1, 90) = 5.72$, $p = .019$, $\eta_p^2 = .06$, with the DB+ group showing a significant improvement from pre- to post-test ($p < .001$, $\eta_p^2 = .27$; see Figure 4.3).

Sad. There was a significant time by group interaction, $F(1, 90) = 7.31$, $p = .008$, $\eta_p^2 = .08$, reflecting that the DB+ group significantly improved from pre- to post-test ($p = .003$, $\eta_p^2 = .16$).

Fear. There was a significant time by group interaction, $F(1,90) = 20.20$, $p < .001$, $\eta_p^2 = .18$, showing again that the DB+ group significantly improved from pre- to post-test, *(*$p < .001$, $\eta_p^2 = .42$).

Anger. There was a significant time by group interaction, $F(1, 90) = 28.04$, $p < .001$, $\eta_p^2 = .24$. The DB+ group significantly improved from pre- to post- test, ($p < .001$, $\eta_p^2 = .42$).

Neutral. There was a significant time by group interaction, $F(1, 90) = 7.82$, $p = .006$, $\eta_p^2 = .08$. The DB+ group significant improved from pre- to post- test, ($p < .001$, $\eta_p^2 = .27$).

For sadness, fear, anger and neutral recognition, the same conclusions were reached when analysing the unbiased hit rate data. Across all emotions, the DB- group did not show a significant change in emotion recognition across time.

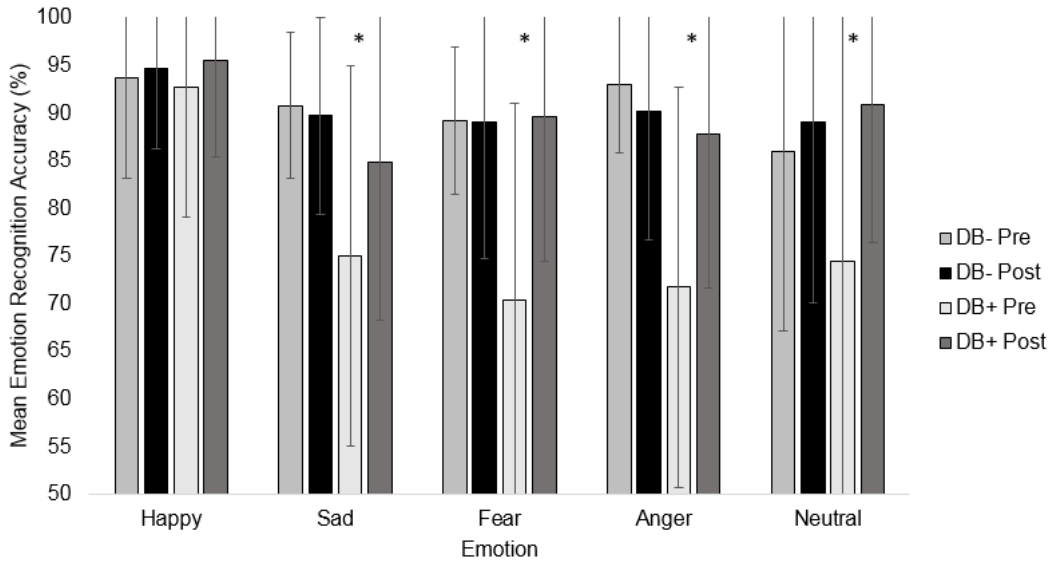


Figure 4.2. Mean emotion recognition scores for expressions of happiness, anger, sadness, fear and neutral at pre- and post-test. Error bars are set at ± 1 standard deviation. * = $p < .05$. DB: Disordered Behaviour.

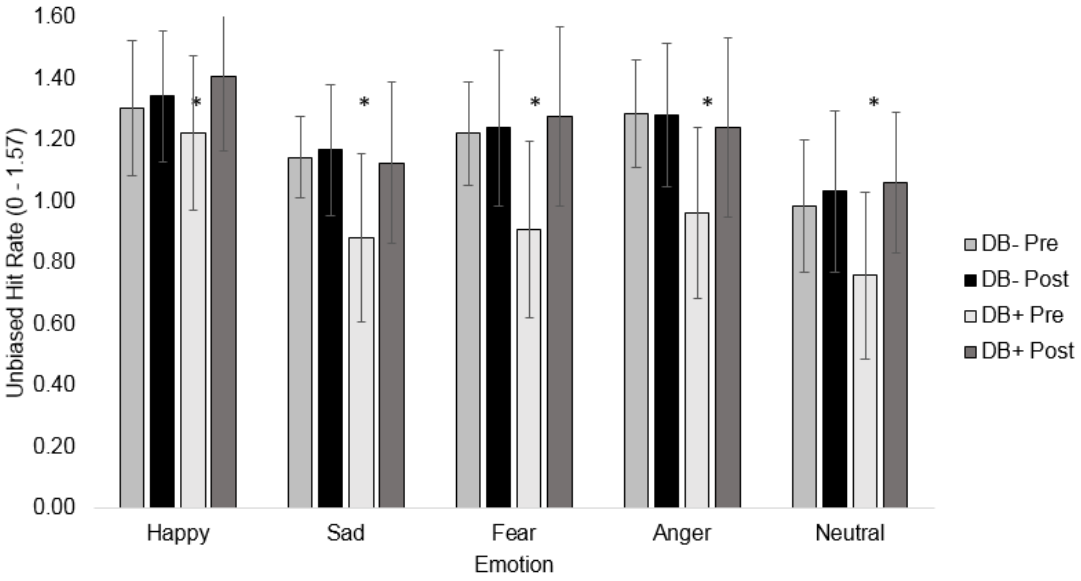


Figure 4.3. Mean emotion recognition scores (unbiased hit rates) for expressions of happiness, sadness, fear, anger and neutral at pre- and post-test. Error bars are set at ± 1 standard deviation. * = $p < .05$. DB: Disordered Behaviour.

4.4.4 Empathy

For time and practical reasons, five participants (1 DB-, 4 DB+) were unable to complete the empathy task. For cognitive empathy for all emotions, there was no significant main effect of time, group nor any significant interactions between time and group (all *p's* > .05; see Figure 4.4).

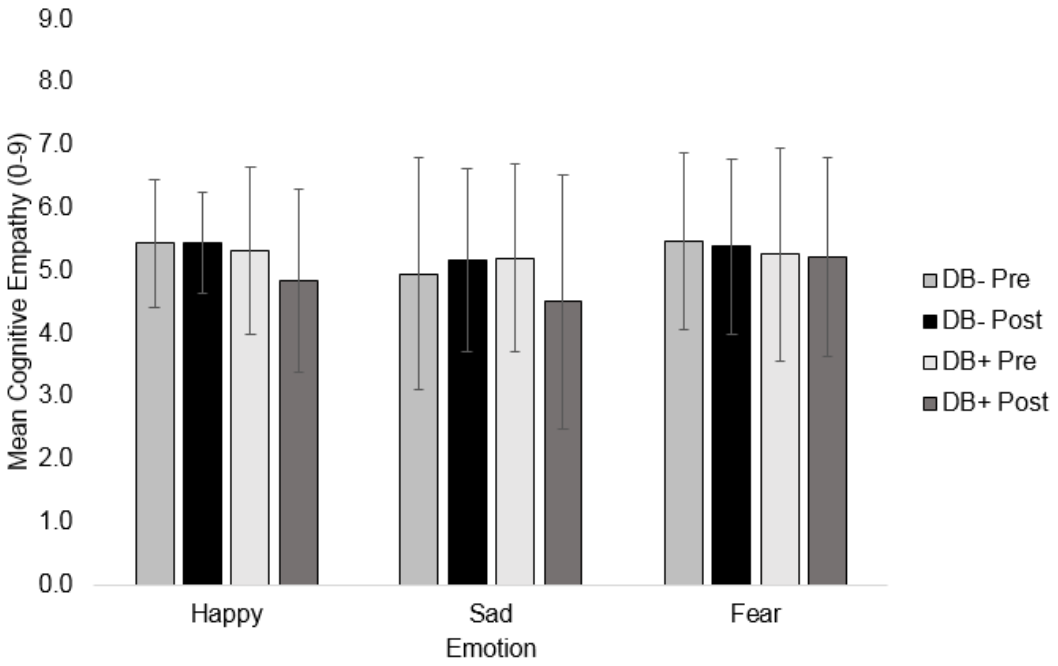


Figure 4.4. Mean cognitive empathy scores for happiness, sadness and fear at pre- and post-test. Error bars are set at ± 1 standard deviation. DB: Disordered Behaviour.

For affective empathy for happiness, there was no significant main effect of time or group (both *p's* > .05; see Figure 4.5). For affective empathy for sadness and fear, there was a significant main effect of time (Sadness: $F(1, 85) = 7.30$, $p = .008$, $\eta_p^2 = .08$; Fear: $F(1, 85) = 5.05$, $p = .027$, $\eta_p^2 = .06$) with both groups showing higher levels of affective empathy at pre-test than post-test (both *p's* < .03). There was no significant main effect of group for either emotion (both *p's* > .05). For all emotions, there were no significant interactions between time and group (all *p's* > .05).

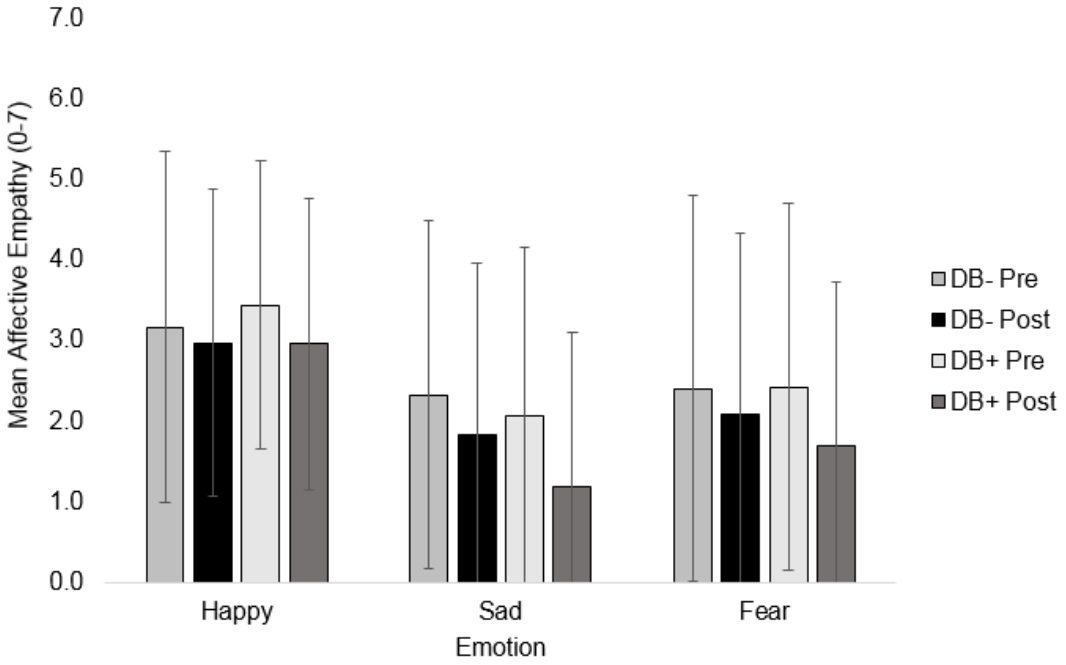


Figure 4.5. Mean affective empathy scores for happiness, sadness and fear at pre- and post-test. Error bars are set at ± 1 standard deviation. DB: Disordered Behaviour.

4.4.5 Eye tracking

4.4.5.1 *Emotion recognition: Dwell time to the eyes*

There was a significant main effect of time, $F(1, 51) = 10.52$, $p = .002$, $\eta_p^2 = .17$, with participants spending less time looking at the eyes at post-test (see Figure 4.6). There was no significant main effect of group, $F(1, 51) = 3.44$, $p = .07$, $\eta_p^2 = .06$, nor any significant interactions between group and time (all *p's* > .05).

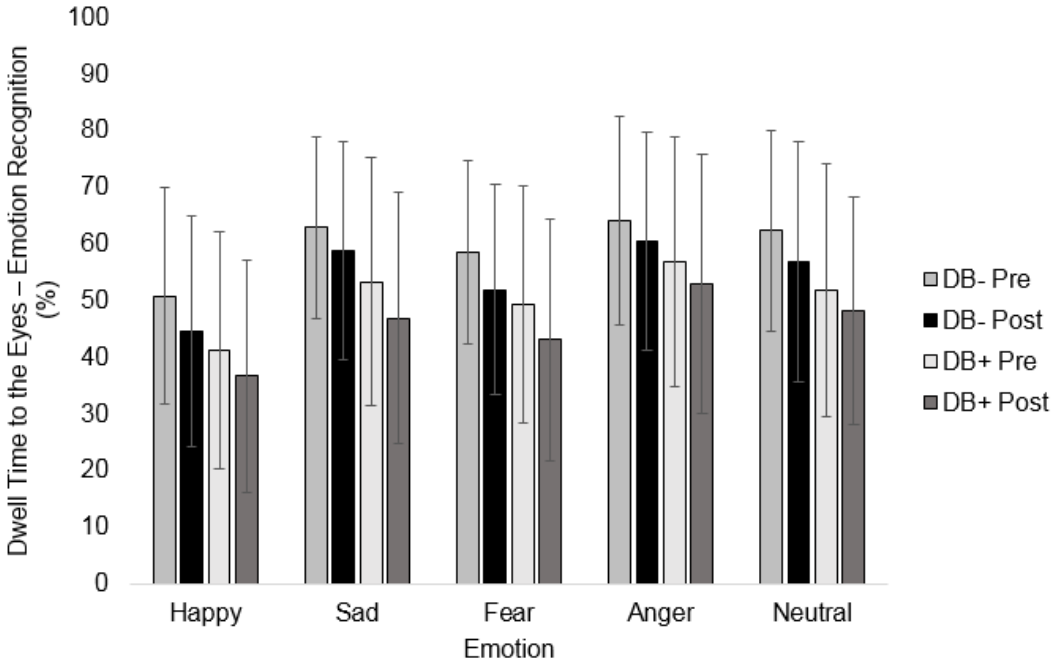


Figure 4.6. Mean percentage dwell time to the eyes (emotion recognition task) for expressions of happiness, sadness, fear, anger and neutral at pre- and post-test. Error bars are set at ± 1 standard deviation. DB: Disordered Behaviour.

4.4.5.2 *Emotion recognition: Time to first fixation on the eyes*

After removing participants due to having a mean time to first fixation of zero, 26 participants remained in the DB- group and 23 in the DB+ group. There was no significant main effect of group, $F(1, 47) = .11$, $p = .74$, $\eta_p^2 = .002$, or of time, $F(1, 47) = 3.79$, $p = .06$, $\eta_p^2 = .08$, nor any significant interactions between group and time (all *p's* > .05; see Figure 4.7).

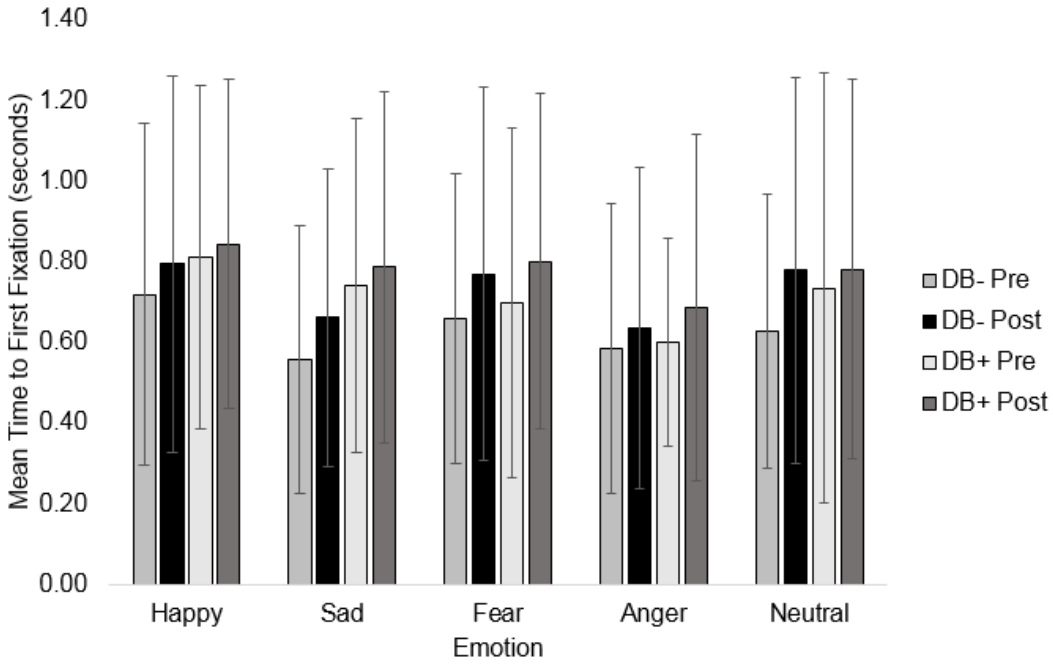


Figure 4.7. Mean time to first fixation for expressions of happiness, sadness, fear, anger and neutral at pre- and post-test. Error bars are set at ± 1 standard deviation. DB: Disordered Behaviour.

4.4.5.3 *Empathy: Dwell time to the eyes*

After removing participants with a mean dwell time of zero at pre- or post-test, 18 DB- and 16 DB+ participants remained for empathy. There was no significant main effect of time or an interaction between time and group (all *p's* > .05; see Figure 4.8). There was a significant main effect of group, $F(1, 32) = 4.94$, $p = .03$, $\eta_p^2 = .13$, with the DB- attending to the eye region more than the DB+ group.

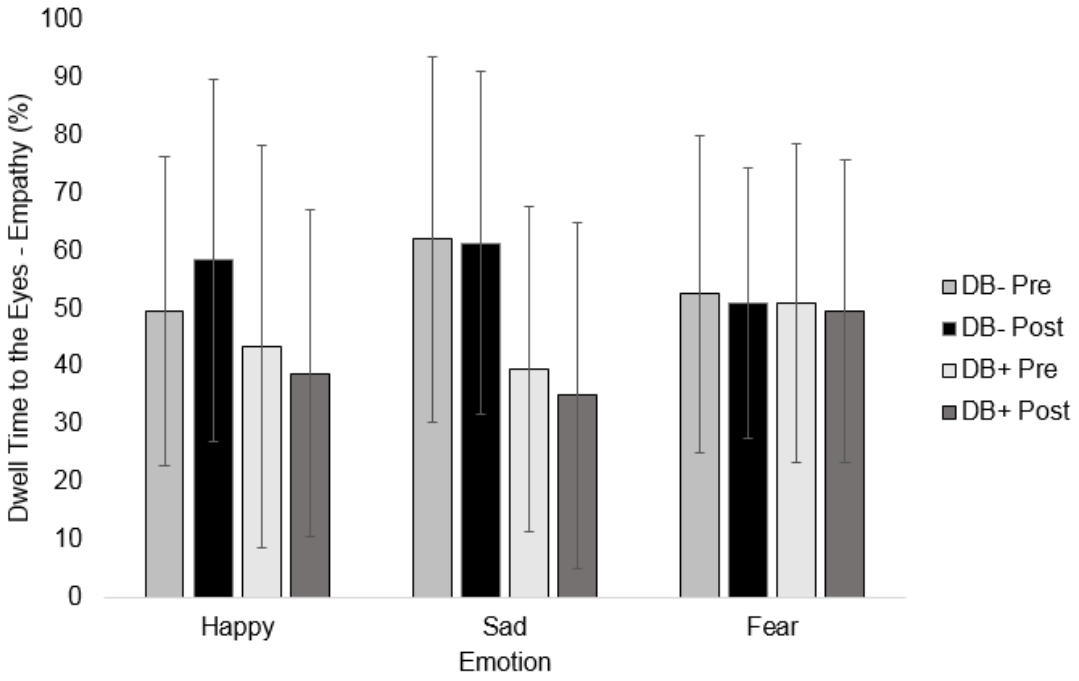


Figure 4.8. Mean percentage dwell time to the eyes (empathy task) for happiness, sadness and fear clips at pre- and post-test. Error bars are set at ± 1 standard deviation. DB: Disordered Behaviour.

4.5 Discussion

The present study aimed primarily to understand whether emotion recognition abilities could be improved in a group of children with disordered behaviour who demonstrated emotion recognition problems. Secondary aims of this study were to understand whether any improvement in emotion recognition would be associated with improved cognitive and affective empathy or social attention immediately after the training.

Regarding the first aim, it was hypothesised that, firstly, children who completed the CERT would show an improvement in recognising negative and neutral expressions. Supporting this hypothesis, we demonstrated that those who completed the training showed a significant improvement in sadness, fear, anger and neutral emotion recognition. Fear and sadness recognition has been most consistently shown

to be impaired in antisocial populations (Marsh & Blair, 2008) and recent evidence has shown that antisocial populations may struggle to detect expressions of anger also (Bowen et al., 2014). There was also significant improvement in recognising neutral expressions at post-test. This is likely due to an improvement in the ability to recognise emotional expressions, which spilled over to recognising when an expression was not emotional. Whilst not a focal aim of this study, it is important to note that these improvements were specific to the group who received the training and not due to any positive effects related to repeated testing.

Secondly, it was hypothesised that these improvements in emotion recognition would remain after adjusting for unbiased hit rates. This hypothesis was also supported. This suggests that the improvement in negative and neutral recognition was not due to an increase in false detections of the target emotions. When using the unbiased hit rates, the results also showed that the DB+ group improved in the recognition of happiness. Antisocial populations do not typically show impairments in detecting happiness expressions (Blair et al., 2001). However, a meta-analysis has contrasted this, showing evidence of impaired happiness recognition (Dawel et al., 2012). The improved happiness recognition after CERT is hypothesised to be beneficial for the children as expressions of happiness are thought to indicate prosocial intentions and diffuse hostility (Becker & Srinivasan, 2014).

One of the secondary aims of the study was to assess whether any improvement in emotion recognition was related to an improvement in cognitive and affective empathy. Specifically regarding cognitive empathy, we hypothesised that an improvement in emotion recognition would be related to an improvement in cognitive empathy for the same emotions immediately after the training. This was hypothesised because both emotion skills involve recognising and understanding another's

emotions (Marshall & Marshall, 2011; Marshall et al., 1995) and some previous research has shown that there is a relationship between cognitive empathy and emotion recognition (Lui et al., 2016). However, contrary to our hypothesis, we found no evidence of a change in cognitive empathy after the training. In the literature, evidence for the relationship between emotion recognition and cognitive empathy is mixed. Woods, Wolke, Nowicki and Hall (2009) found no relation between cognitive empathy and emotion recognition and similarly in Chapter 3, we found no significant correlations between these two concepts. Based on this lack of association, it is not surprising that we did not find an improvement in cognitive empathy, despite an improvement in emotion recognition. Whilst these constructs may be related, other factors must contribute to successful cognitive empathy. This is understandable as the dynamic emotional situations used to assess empathy include additional vocal, gestural and contextual information, whereas emotion recognition was tested using static facial expressions; Research has shown that adolescent offenders have difficulty with the integration of cues from face, prosody, gesture and social context (Gonzalez-Gadea et al., 2014). Indeed, research has also shown that antisocial populations are impaired in vocal (Blair et al., 2005) and postural emotion recognition (Muñoz, 2009). The CERT trained the children with disordered behaviour to recognise static and dynamic facial expressions without training the additional emotional cues (e.g. gestures, vocal tone) required for cognitive empathy. Additionally, it may be possible that an improvement in cognitive empathy could be observed once a sufficient amount of time after training has elapsed to allow more (good quality) interactions with others following the improvement in emotion recognition (Rawdon et al., 2018).

Regarding affective empathy, we hypothesised that an improvement in emotion recognition would not be related to an improvement in affective empathy and this hypothesis was confirmed. Previous research has shown no relationship between facial emotion recognition and affective empathy, which suggests that recognising another's emotions does not appear to translate to feeling that same emotion (Lui et al., 2016). Indeed, in Chapter 3, we found no significant correlations between affective empathy and emotion recognition. Research has suggested that perspective taking is more important for affective empathy than for emotion recognition; Lui and colleagues showed that CU traits and deficient affective empathy were mediated via perspective taking, not emotion recognition. Supporting research has shown that perspective taking elicits empathic concern and responding (Knafo, Steinberg, & Goldner, 2011). Therefore, this suggests that interventions that focus on perspective taking are more likely to influence affective empathy than emotion recognition training.

A final hypothesis was that an improvement in emotion recognition would not be related to improved social attention to the eye region. This hypothesis was confirmed, as there were no changes in dwell time to the eyes for the DB+ group, despite an improvement in emotion recognition. These findings are important in the context of the CERT; two of the key aims of this training are to direct attention to key facial features and to provide hints to assist with the interpretation of such features. Given we found no change in dwell time to the eyes but an increased emotion recognition ability, it seems plausible that the observed improvements are due to the help with the interpretation of features, rather than simply directing attention to relevant parts of the face. Evidence of this is seen in other populations; Tsotsi, Kosmidis and Bozikas (2017) compared the effectiveness of two types of emotion recognition intervention in individuals with schizophrenia. The first intervention was similar to the CERT whereas

the second intervention simply taught participants to direct their attention to the eyes and mouth. They found that the first intervention was more effective in improving emotion recognition. This suggests the importance of teaching others to understand and interpret facial cues, rather than simply paying attention to them. Although the generalisability of these findings to children with disordered behaviour is questionable.

To our knowledge, this study is one of the first to show the viability of using emotion recognition training as an early intervention. We know that age of onset is thought to be a contributing factor to ASB severity (Moffitt, 1993) as one of the strongest predictors of later ASB is problematic behaviour in childhood (Bor et al., 2004; Murray & Farrington, 2005). The children in the current study are showing disordered behaviour and are taking part in a crime prevention programme, having been classified by the police as being at high-risk for future criminal behaviour. However, because they do not have a formal diagnosis or have not yet reached an escalation point, social support systems are currently 'blind' to them. In this study, we have provided evidence that impairments in emotion recognition can be improved, through a quick, simple and targeted emotion recognition intervention. The CERT can be easily taught and delivered by individuals working with the child to aid with the ease of delivery. Although the CERT did not influence empathy, likely because of the extra components required for this, but also potentially due to an increased time needed to assess a change in empathy (Rawdon et al., 2018), the CERT could be used in combination with other training programmes. For example, one that focuses on recognising and interpreting vocal, postural and contextual emotional information, which then may influence cognitive empathy, in combination with improved facial emotion recognition. Research has also shown that impaired affective empathy in children with high CU traits is mediated via affective perspective taking (Lui et al.,

2016). Therefore, training could also incorporate this to try to influence affective empathy. It is important to note, however, that a meta-analysis has shown that interventions are more effective if they are targeted and focused, as the CERT currently is, rather than trying to target multiple socioemotional skills (Lui et al., 2017).

The findings of the current study should be interpreted in light of some limitations. First, practical limitations prevented the collection of eye-tracking data with the full sample. It could be possible that with a larger sample a difference in eye-looking behaviour could be observed. However, in light of recent studies showing that attention to the eye region is not reduced in similar samples (Airdrie et al., 2018; van Zonneveld et al., 2017), arguably the same conclusions might be made. Secondly, it could be argued that there is a lack of a control intervention, such as simply exposing participants to faces or an attention to facial features task as in Tsotsi et al. (2017). Based on the study by Tsotsi and colleagues, there is evidence that attention-only training does not improve emotion recognition and the study by Hubble and colleagues (2015) suggests that more in-depth training like the CERT will be effective. Given that the CERT was completed during school hours by school and police staff, practical and time limitations related to testing in schools meant that only the interventions most likely to be effective were used. Thirdly, the children in our sample may have difficulties verbalising their personal thoughts and feelings, (Quiggle et al., 1992) so future research should employ physiological measures to examine empathy impairments in populations with disordered behaviour. Fourthly, we do not yet know whether the improvement in emotion recognition is associated with an improvement in the children's behaviour. Previous research has shown that improved emotion recognition reduces offence severity (Hubble et al., 2015) so it is plausible that the CERT will result in a similar improvement in behaviour. Finally, this study lacked a

control group who were matched at baseline on emotion recognition. Whilst this was an exploratory and preliminary study into the effectiveness of the CERT, in order to fully assess its effectiveness, a suitable control group would need to be included. This would require participants allocated to the DB+ group to be randomly allocated to receive the CERT or not. This would better allow us to see the effectiveness of the CERT.

This study is the first to investigate the effect of a targeted facial emotion recognition training in young children with disordered behaviour. These children are not currently involved with the Criminal Justice System or in receipt of any behavioural diagnosis but they have been classified by the police as being of high-risk for future criminal and antisocial behaviour. We have shown that it is possible to provide emotion recognition training in an early and targeted manner. As suggested by the Integrated Emotion Systems model (Blair, 2005a), research now needs to investigate what influence the improvement in emotion recognition has on behaviour on these children with disordered behaviour.

5 General Discussion

This Chapter consolidates the main findings throughout this thesis, addressing the specific aims and hypothesis and identifying strengths and limitations of the research, as well as providing suggestions for future study.

5.1 Aims of this thesis

For ease of reading, the aims of this thesis are repeated here. The primary aims of this thesis were to understand whether:

- Emotion recognition impairments for negative emotions are evident in children with disordered behaviour, paving the way for early intervention
- Children with disordered behaviour could be subcategorised into those who do and do not show emotion recognition impairments for negative emotions, paving the way for targeted intervention
- These emotion recognition impairments could be improved using an early and targeted emotion recognition training, the Cardiff Emotion Recognition Training (CERT)

The secondary aims were to understand whether:

- Cognitive and affective empathy impairments are evident in children with disordered behaviour
- Emotion recognition impairments are related to cognitive and affective empathy impairments
- Cognitive or affective empathy impairments are associated with improvements in emotion recognition
- Emotion recognition and empathy impairments are related to impaired social attention to emotion cues, specifically the eyes
- An improvement in emotion recognition was related to increased social attention to emotional cues, specifically the eyes

5.2 Overview

Chapter 1 of this thesis provided an overview of the current literature surrounding emotion recognition, empathy and interventions in antisocial populations. We know that such populations show impairments in emotion recognition and empathy that could be targets for new interventions because current options are mostly all reactive in nature, they do not target mechanisms of behaviour change and they are costly. Early interventions are not only likely to be more effective, but also more cost-effective. A handful of studies show that emotion recognition training represents a viable and effective intervention option for antisocial behaviour (ASB; Hubble et al., 2015; Penton-Voak et al., 2013). However, research has not yet investigated the use of emotion recognition training as an early and targeted intervention.

Chapter 2 described the unique nature of the sample used throughout this thesis. Participants were children aged between 7-to-11 years old who were currently attending mainstream primary schools. They had no formal behavioural diagnoses, such as Conduct Disorder (CD). However, they were showing significant behavioural problems as judged by their schoolteachers. The children had been referred to participate in the study from a crime prevention programme entitled the Early Intervention Hub. Children were referred to this Hub from Police Officers, Social Workers and Teachers and they have been subjected to a wide range of Adverse Childhood Experiences, including poverty, mental health issues within the home and domestic abuse. Children tended to be exposed to multiples of these risk factors that are associated with future criminal behaviour (Fox, Perez, Cass, Baglivio, & Epps, 2015). Because of this, the police considered to them to at high-risk for future criminal and antisocial behaviour and so could benefit from early intervention. Chapter 2 also

described the development of an updated emotion recognition training, the CERT, developed as part of this PhD.

Chapter 3 investigated the nature and extent of emotion recognition and empathy impairments that these children with disordered behaviour showed compared to a typically developing comparison group. Specifically, we aimed to understand whether these children with disordered behaviour showed emotion recognition impairments for negative emotions and whether this group of children could be distinguished based on their emotion recognition abilities, paving the way for tailored interventions. We also investigated their cognitive and affective empathy abilities and whether social attention to the eyes played a role in both emotion recognition and empathy impairments.

Chapter 4 aimed to investigate whether the emotion recognition impairments observed in Chapter 3 could be improved after participation in the CERT and then investigated any wider associations of improved emotion recognition with cognitive and affective empathy and social attention to the eyes.

This thesis presented research showing that a subgroup of children with disordered behaviour show impairments in negative emotion recognition and that this impairment can be improved using a short and specifically designed emotion recognition training, the CERT. We have also shown that children with disordered behaviour who are considered by the police to be at high-risk for future criminal behaviour show similar emotion recognition impairments that have been observed in antisocial adults. We know that early intervention is important as one of the strongest predictors of later antisocial and criminal behaviour is problematic behaviour in childhood (Bor et al., 2004; Murray & Farrington, 2005). Early intervention with children showing disordered behaviour is not only likely to be more effective but also more resource and cost-efficient (Skeem et al., 2014; Early Intervention Foundation:

http://www.eif.org.uk/publications/spending-on-late-intervention-how-we-can-do-better-for-less/). We have shown that emotion recognition is a feasible early intervention for children with disordered behaviour who also show emotion recognition impairments.

5.3 What emotion impairments do children with disordered behaviour?

5.3.1 Emotion recognition impairments

A primary aim of this thesis was to understand whether children with disordered behaviour showed negative emotion recognition impairments. Impairments in recognising emotions have been observed in a multitude of different antisocial populations, such as psychopathic adults (Blair et al., 2004), adolescents with early-onset or adolescence-onset Conduct Disorder (CD; Fairchild et al., 2009) and adolescents with mental health problems (Leist & Dadds, 2009). However, little is known about whether emotion recognition impairments are evident in children with disordered behaviour. Given that Blair (2005a) suggests that distress cues serve to inhibit ASB via learning to avoid hostile acts that can cause distress to others and one of the strongest predictors of later ASB is problematic behaviour in childhood, it is important to understand whether these children also show these impairments. The findings in Chapter 3 extend the literature by showing that children with disordered behaviour are impaired in emotion recognition, particularly in negative and neutral recognition as hypothesised. This points to the importance of early intervention as these children were showing similar impairments to those that have been observed in antisocial adolescents and adults.

It has been suggested that emotion recognition deficits in antisocial populations are typically specific to distress cues, i.e. fear and sadness (Marsh & Blair, 2008) but there is also evidence of impairments in recognising anger (Fairchild et al., 2009;

Schönenberg, Louis, et al., 2013) and in negative emotions in general (Bowen et al., 2014). In Chapter 3, we demonstrated that children showing disordered behaviour are impaired in recognising sadness, fear, anger and neutral expressions. Our results support the findings of a general negative emotion recognition impairment as seen in Bowen et al. (2014), rather than being specific to distress cues.

Another key aim of this thesis was to understand whether emotion recognition impairments would distinguish subgroups of these children with disordered behaviour into those with and those without emotion recognition impairments, providing evidence for tailored interventions. We have extended knowledge by showing evidence that just over half of the children in this study (59%) showed emotion recognition impairments, as hypothesised. This provides support for the notion that emotion recognition training should be delivered in a targeted way as not all children will show an impairment, therefore, there is the opportunity to target emotion recognition training to those who really need it most.

Previous studies investigating emotion recognition training in antisocial populations have not assessed participants' emotion recognition abilities beforehand. For example, in Hubble, Bowen, Moore and van Goozen (2015) young offenders were allocated to receive the training based on availability, not on their pre-existing emotion recognition abilities. The results in Chapter 3 show that it is possible to further refine and target interventions so that only those who are impaired in emotion recognition receive the training they need.

Research has provided some insight into why some children with disordered behaviour are impaired in emotion recognition and others are not. Firstly, it has been shown that in emotion processing, individual differences are commonplace (Eugène et al., 2003) and some studies have shown evidence of intact emotion recognition in antisocial populations, including children (Glass & Newman, 2006; Woodworth &

Waschbusch, 2008). Emotional stimuli can evoke a wide range of responses across individuals (Hamann & Canli, 2004) and the individual's past experiences are thought to play a role here (Pollak et al., 2000). Children who have been exposed to fewer social interactions show poorer accuracy in emotion recognition (Pollak et al., 2000) and children who have been exposed to abusive interactions and/or angry faces show a lower threshold to detect angry faces (Pollak & Sinha, 2002). These studies show the role of exposure to social situations in explaining individual variability in emotion recognition. Whilst these are just suggestions for the cause of individual variability, the mechanisms behind this variability in emotion recognition were beyond the scope of this thesis.

5.3.2 Empathy impairments

Chapter 3 investigated the nature of empathy impairments in the same sample of children with disordered behaviour. Research has shown that individuals displaying ASB may lack empathy, although the exact nature of the impairment is unclear; some research suggests that both cognitive and affective empathy are impaired (Cohen & Strayer, 1996; Muñoz, Qualter, & Padgett, 2011; Pasalich, Dadds, & Hawes, 2014), whereas other studies have shown evidence for impaired affective empathy but intact cognitive empathy (Schwenck et al., 2012; van Zonneveld et al., 2017). Other studies have suggested that affective empathy impairments are specific to negative emotions (de Wied et al., 2009).

We hypothesised that children with disordered behaviour would show a general cognitive empathy impairment. Our hypothesis was supported; children showing disordered behaviour showed impaired cognitive empathy than typically developing children. This is in line with previous research (Cohen & Strayer, 1996; Muñoz, Qualter, & Padgett, 2011; Pasalich, Dadds, & Hawes, 2014). However, results from

research on cognitive empathy in antisocial populations has been mixed, with some studies showing intact cognitive empathy (van Goozen et al., 2016; van Zonneveld et al., 2017) and others showing impaired cognitive empathy (Dadds et al., 2009; Gonzalez-Gadea et al., 2014; Pasalich et al., 2014). The discrepancy between some of the literature and our results can be explained by different approaches used. In the current study, we required participants to not only identify the emotion, but also explain the reason why the main character was experiencing that emotion, separated for each specific emotion, whereas most literature has relied on questionnaire measures of empathy, which do not differentiate between emotions and does not require explanations (Neumann & Zupan, 2018). Our method requires the integration of several different emotional cues, which antisocial populations have been shown to be impaired in, which is not present in questionnaire measures (Gonzalez-Gadea et al., 2014).Therefore, it is maybe less surprising that we also observed a cognitive empathy impairment when comparing our sample of children with disordered behaviour to typically developing children.

We hypothesised that children with disordered behaviour would show affective empathy impairments for negative emotions only. Our hypothesis was partially supported. Contrary to expectations and to some previous research (Bons et al., 2013; Schwenck et al., 2012; van Zonneveld et al., 2017), we found evidence for impaired cognitive and affective empathy for happiness, and not just for fear and sadness in children with disordered behaviour. One meta-analysis suggests emotion impairments are pervasive across emotions, including happiness (Dawel et al., 2012) and there is evidence for reduced activation in key brain areas whilst viewing happy stimuli in individuals with high callous-unemotional (CU) traits (Decety, Skelly, Yoder, & Kiehl, 2014). This impairment in understanding and experiencing another's

happiness is important as happiness can diffuse hostility and encourage prosocial behaviour (Becker & Srinivasan, 2014).

5.3.3 The relationship between emotion recognition and empathy

A secondary aim of this thesis was to understand whether emotion recognition impairments were related to cognitive and affective empathy impairments. As previously described, Blair (2005a) suggests that emotion recognition and empathy are two important emotion skills that influence the development, persistence and severity of ASB. Models of empathy generally assume a three-stage approach (Blair, 2005b; Marshall & Marshall, 2011; Marshall et al., 1995). This typically involves recognising the emotion in another, taking their perspective and then generating an emotional response. These models of empathy assume that emotion recognition is a precursor to cognitive empathy, and that cognitive empathy then leads to affective empathy. Given this, we hypothesised that children with disordered behaviour who were impaired in emotion recognition would show cognitive empathy impairments for the same emotions but that there would be no relationship between emotion recognition and affective empathy. However, we did not find any evidence to show a relationship between emotion recognition and either cognitive or affective empathy. In Chapter 3, we found that there were no differences in cognitive or affective empathy abilities between the two DB groups, even though they differed in emotion recognition. We also found no significant relationships between emotion recognition and cognitive or affective empathy. Facial emotion recognition is just one component of cognitive empathy (Decety & Jackson, 2004). Typically, cognitive empathy tasks, such as those employed in Chapter 3, require participants to label and explain the emotion of a character. This includes additional emotional cues beyond facial expressions such as body language, gestures, background scenery and social context. Research has

shown that adolescent offenders have difficulty with the integration of cues from different social sources including facial cues, prosody, gesture and social context (Gonzalez-Gadea et al., 2014) and antisocial samples are impaired in vocal (Blair et al., 2005) and postural emotion recognition (Muñoz, 2009); these features may have been implicated in the cognitive empathy task performance in the current study.

Very few studies have investigated the relationship between cognitive empathy, affective empathy and emotion recognition within the same study to shed light on the relationships between these three concepts. Indeed, to our knowledge, this is one of the first studies to investigate both emotion recognition and empathy in children with disordered behaviour. One study has investigated this in adolescents with callous-unemotional (CU) traits. Lui, Barry and Sacco (2016) found that cognitive, but not affective empathy was positively correlated with emotion recognition. Our findings partially support this, as we too did not find evidence for a relationship between affective empathy and emotion recognition, but we found no evidence for a relationship between cognitive empathy and emotion recognition. Cognitive empathy has been operationalised and measured in multiple different ways, which could account for the variability in results in the literature and may account for the differences observed between the current study and the study conducted by Lui and colleagues. That study used the Griffith Empathy Measure (Dadds, Hunter, et al., 2008), which is a parent-report measure of dispositional empathy, which they adapted to be a self-report measure. This measure has been criticised for not validly measuring cognitive empathy in children (Murphy, 2017). We measured state empathy whereas the Griffith Empathy Measure assesses trait empathy. It is possible that these different operationalisations of empathy have separate relationships with emotion recognition. As described previously, our measure of cognitive empathy required not only the correct identification of emotions in others, but also a relevant

explanation for the cause of the emotions, which is very different from filling in a questionnaire about own empathic functioning.

5.3.4 The mechanism of observed emotion impairments: the role of social attention to the eyes

Another secondary aim of this thesis was to understand whether emotion recognition and empathy impairments are related to impaired social attention to emotion cues, specifically the eyes. We hypothesised that there would be no relationship between emotion recognition and empathy impairments with attention to the eyes and our hypothesis was confirmed. This supports recent research that has also found no evidence for reduced social attention during emotional tasks in at-risk children, adolescents with CD and adolescents with Attention Deficit Hyperactivity Disorder plus CD (Airdrie et al., 2018; Martin-Key et al., 2017; van Zonneveld et al., 2017). In the current study, the groups differed in emotion recognition and empathy abilities but did not differ in attention to the eyes. Similarly, we found no significant relationships between emotion recognition or empathy abilities and attention to the eyes. The social attention hypothesis has previously been criticised (Dawel et al., 2012) because, as described in Chapter 1, antisocial populations also show emotion recognition deficits in other modalities (e.g. vocal and postural) (Blair et al., 2002; Muñoz, 2009). This hypothesis does not provide an immediate explanation for these deficits. Instead, it has been suggested that amygdala deficits as observed in antisocial populations (Jones et al., 2009) contribute to and explain the emotion impairments. Specifically, the amygdala is involved in directing attention to socially relevant information. In both tasks, there was other socially relevant information, such as the mouth in the Facial Emotion Recognition tasks, and vocal and postural cues in the empathy task. Therefore, it is possible that there were more relevant social cues

than the eyes. Alternatively, antisocial individuals may find the interpretation of socially relevant cues challenging (Airdrie et al., 2018). The intervention used by Hubble et al. (2015) aimed not only to direct attention to key facial features, but also to provide hints on how to understand the social cues portrayed in facial expressions, and as a result the youth offenders who received the training showed a significant improvement in negative emotion recognition. Unfortunately, eye tracking was not conducted in that study, but given recent research that fails to support the social attention hypothesis (Airdrie et al., 2018; van Zonneveld et al., 2017) it seems likely that it was the assistance with the interpretation of facial features that resulted in the improvement in emotion recognition.

5.4 Can emotion recognition and empathy be improved in children with disordered behaviour?

In addition to understanding the nature and extent of emotion recognition impairments, another primary aim of this thesis was to understand whether these emotion recognition impairments could be improved using an early and targeted emotion recognition training, the CERT. Our hypothesis that there would be an improvement in negative and neutral recognition was supported. Those who participated in the CERT showed a significant improvement in recognising sadness, fear, anger and neutral expressions. Different stimuli and different faces were used in the training to the emotion recognition task, and we have shown – importantly - that the training generalises to the recognition of new faces.

The observed improvements in emotion recognition were confirmed when analysing unbiased hit rates, as hypothesised. This shows that the improvement in negative and neutral recognition was not due to an interpretation bias; there was no increase in false detections of the target emotions. When using the unbiased hit rates,

the results also showed that the DB+ group improved in the recognition of happiness. Antisocial populations do not typically show impairments in detecting happiness expressions (Blair et al., 2001). However, a meta-analysis of 26 studies has found evidence of impaired happiness recognition across different antisocial populations (Dawel et al., 2012).

In addition to understanding whether the CERT improved emotion recognition, this thesis also aimed to understand the wider effects of the training. Specifically, we hypothesised that an improvement in emotion recognition would be related to an improvement in cognitive, but not affective, empathy. However, we did not find any evidence for a change in either cognitive or affective empathy within the time-period studied after participation in the CERT, despite showing an improvement in emotion recognition. Recent research by Lui et al. (2016) showed that in a study with adolescents with high CU traits, emotion recognition did not mediate deficient cognitive or affective empathy. Recent research has also shown that recognising emotions does not equal empathy; Neumann and Zupan (2018) found that in healthy individuals, accurate recognition of emotions did not always equate to empathy, which led them to conclude that emotion recognition training should not be expected to result in empathic responses. It is possible that other mechanisms account for deficient empathy. For example, it has been suggested that a lack of concern for others accounts for cognitive empathy deficits (Muñoz et al., 2011; Pasalich et al., 2014) whilst impaired affective perspective taking accounts for affective empathy deficits in ASB individuals (Lui et al., 2016). Therefore, future research should examine interventions that focus on these concepts to improve empathy abilities in children with disordered behaviour.

Another secondary aim of this thesis was to understand whether the improved emotion recognition was related to increased social attention to the eyes. The results

in Chapter 4 suggest that the improvement in emotion recognition was not associated with an increased attention to the eyes, as hypothesised. This is important in the context of the CERT; similar to the intervention used by Hubble et al. (2015), two of the key aims of the CERT are to direct attention to key facial features and to provide hints to assist with the interpretation of such features. We already suggested that perhaps it is the interpretation of facial emotional cues and not attention that is important. The results from Chapter 4 appear to support this idea, given that attention to the eyes did not significantly increase whereas emotion recognition did. Perhaps individuals with emotion recognition impairments may pay sufficient attention to the eyes but are unable to understand the social cues that they are portraying and therefore it is the interpretation of the facial features that is important, rather than the social attention. Evidence of the lack of importance of attention to the eyes is seen in other populations; Tsotsi, Kosmidis and Bozikas (2017) compared the effectiveness of two types of emotion recognition interventions in individuals with schizophrenia. The first was a six-stage process where individuals were trained to recognise the six basic emotions, similar to the CERT, and the second intervention was based around attention to facial features, whereby participants were taught to direct their attention to the eyes and mouth. They found that the first intervention was more effective in improving emotion recognition. This suggests the importance of teaching others to understand and interpret facial cues, rather than simply paying attention to them. However, the generalisability of these findings to children with disordered behaviour is not yet fully understood.

5.5 Strengths, limitations and future directions

5.5.1 Strengths

A key strength of this thesis is the focus on utilising an early and targeted intervention approach to improve known emotion processing impairments associated with ASB. Previous research has demonstrated impairments in emotion recognition and empathy in antisocial individuals, but few studies have attempted to improve these abilities and indeed, to our knowledge, no studies have looked at providing such training in an early and targeted manner. This thesis extends and contributes to the literature by showing that it is possible to teach children who have been considered by the police to be at high-risk for future criminal and antisocial behaviour how to recognise emotions and that it is feasible to only provide this training to those who are in need and show impairments.

This thesis has also provided evidence that warrants the further evaluation of the CERT. In this exploratory and preliminary research into the CERT, we have shown that it is successful in improving emotion recognition. However, this study only adopted a pre- and post-test design, given the preliminary nature of the CERT, therefore future research needs to be conducted using research study approach that is higher on the Maryland Scientific Scale (Farrington, Gottfredson, Sherman, & Welsh, 2002) to ensure the full benefits of the CERT are understood.

We have also identified the importance of working with school officials to identify children with disordered behaviour who are considered by the police to be at-risk for future criminal behaviour. Given the amount of time that children spend in schools, this setting is an important location for prevention efforts (Domitrovich, Durlak, Staley, & Weissberg, 2017). The children in this study were showing disordered behaviour, were exposed to multiple risk factors for future crime and were identified by the police

as being at high-risk, all whilst still attending mainstream primary schools. It was noted in the interim evaluation of the Northamptonshire Early Intervention Hub (Doran, 2018), that there was evidence of alcohol and/or drugs misuse as well as diagnosed or undiagnosed mental health issues in these families, which prevented the parents from engaging with social services, highlighting the importance of assertive outreach processes within schools to help these families and their children.

Another strength of this thesis is that we have shown that it is possible to teach school and police officials how to run the CERT themselves, which can be continued once participation in the research project has finished. Research has shown that interventions conducted in schools by school staff achieve similar or better outcomes compared to those outside (Barnes, Smith, & Miller, 2014; Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). Additionally, research indicates that school-based interventions are very cost-effective (Domitrovich et al., 2017) if they require little outside input and can be delivered at school.

5.5.2 Limitations and future research

A number of limitations in this thesis need to be discussed. Firstly, whilst this thesis has shown that the CERT improves emotion recognition, we have not addressed the next step, that is, whether an improvement in emotion recognition is related to an improvement in behaviour. We are currently in the process of following up the same participants six-months later and are collecting repeat behavioural data from the child's schoolteacher. Importantly, the schoolteachers were not aware of who was taking part in the CERT, as it was completed during times when the child would have normally been with the Police Community Support Officer (PCSO) or Family Support Worker. However, because the teachers were aware that children were participating in a study, there are potential issues surrounding objectivity. Because of

this, we are also collecting objective data, such as the number of parental meetings about problematic school behaviours and exclusion rates, to find out whether a change in behaviour has occurred subsequent to the improvement in emotion recognition. Previous studies have shown that improving emotion recognition is associated with reduced aggressive behaviours and a reduction in the severity of crimes (Hubble et al., 2015; Penton-Voak et al., 2013) so it seems plausible that similar improvements in behaviour may be observed in the current sample. We have shown in section 2.2 that the children featured in this thesis are typically not liked by other children, they would not share with others and are not considerate of other's feelings and would not help others. Emotion recognition is thought to be related to social skills (Vachon et al., 2014) and Hubble et al. (2015) showed that an improvement in emotion recognition was related to a reduction in the severity of crimes committed in the 6 months following the intervention. High severity crimes generally involve more physically aggressive behaviour and more interpersonal violence and so these authors rationalised that the improvement in emotion recognition may have resulted in a better understanding of the emotions of potential victims. Indeed, emotion recognition is predictive of positive social adjustment and prosocial behaviour (Belacchi & Farina, 2012; Leppänen & Hietanen, 2001). It could be likely that in our sample we would see an improvement in social skills and better friendships with others, which is a protective factor in preventing further behavioural issues and future criminal behaviours (Hodges, Boivin, Vitaro, & Bukowski, 1999).

Secondly, whilst we obtained informal feedback from both the children participating in the CERT and the individuals who delivered it, we currently do not have any formal feedback. Again, this is currently being addressed as we are in the process of collecting qualitative data from the individuals who provided the CERT. Informal feedback does appear positive though; the children appear to enjoy the

activities, specifically the interactive nature of them, and they enjoyed the fact that it was on a computer. Individuals delivering the CERT have commented on the usefulness of it being a short intervention. A more in-depth evaluation of the CERT, including a cost-benefit analysis, however, needs to be conducted.

Another issue is that we lacked a suitable control group within Chapter 4. The current research was an exploratory and preliminary study into changes in emotion recognition and empathy impairments after completing the CERT. However, our two participant groups differed on emotion recognition at baseline and, therefore, are not suitable to compare at post-test. The next step in this research would be a study design higher on the Maryland Scientific Scale (Farrington et al., 2002) whereby the DB+ group are randomly allocated to receive the CERT or not. This would provide two groups who were similar at pre-test and then could be directly compared again at post-test. However, the sample size of the DB+ group prevented us adopting this approach in this thesis.

To be included in the DB group, they only had to reach the threshold for one of three of the SDQ subscales. Because they were recruited from the Early Intervention Hub, this group were also exposed to a range of different risk factors (e.g. domestic abuse and mentally ill parents). It is possible that these differences in behaviour and risk factor exposure could have influenced their emotion recognition and empathy abilities. For example, Pollak and Sinha (2002) showed that physically abused children require less sensory input to identify facial displays of anger than controls. Future research should aim to examine the influence of these risk factors on emotion recognition and empathy ability.

This study did not consider the influence of CU traits despite their hypothesised importance in emotion recognition and empathy (Dadds et al., 2006; Pasalich et al.,

2014). Future research should investigate the role of CU traits in the emotion recognition and empathy abilities of children with disordered behaviour.

Finally, we did not correct for IQ when analysing emotion recognition scores. This is because in Chapter 3, our DB groups differed in emotion recognition but not IQ, ruling out a key role for IQ in emotion recognition abilities. Additionally, we did not find a significant correlation between negative emotion recognition and IQ in Chapter 4. Some research does suggest that IQ plays a role in emotion recognition (Lawrence et al., 2015); however, other research has questioned this (Airdrie et al., 2018; van Zonneveld et al., 2018). Therefore, future research should aim to further investigate the role of IQ in emotion recognition.

Additionally, we do not know how long the duration of emotion recognition improvement lasts. Previous studies have tested emotion recognition immediately after training and have not investigated the duration of improvement over time. Additionally, it would be interesting to see if emotion recognition abilities continued to improve once a sufficient amount of time after training has elapsed to allow more (good quality) interactions with others (Rawdon et al., 2018). Perhaps we would see a further improvement in emotion recognition once the children had more time to practice and consolidate their emotion recognition skills, which may then influence other social skills. We have already shown that the positive effects of the training transfer to the recognition of novel faces and the effect of training may thus go on to influence participants' real-world social interactions.

Regarding our empathy measure, relying solely on participants to report their own emotional states can be problematic because antisocial children may have difficulties verbalising their thoughts and feelings (Quiggle et al., 1992). Since estimates of IQ were not related to measures of empathy, we believe this particular issue was not a problem with using self-report empathy in this thesis. Nevertheless, self-reported

emotional states are vulnerable to demand characteristics and social desirability (Eisenberg-berg & Hand, 1979; Eisenberg et al., 1989). 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 measures have been employed to assess affective empathy such as heart rate or skin conductance (van Zonneveld et al., 2017). Nonetheless, these measures are also open to some criticism. For example, skin conductance measures general arousal and is not sensitive to discrete emotions (Mauss & Robinson, 2009). Since we considered discrete emotions, this would not have been suitable. Furthermore, it is currently uncertain whether empathy, sympathy and distress can be reliably distinguished by using these physiological measures (Zhou, Valiente, & Eisenberg, 2003); self-report measures can attempt to disentangle these different concepts even though the reliability and validity of these measures in samples of young children and/or those with limited verbal ability remains a doubt. Additionally, we did not include a measure of motor empathy, although it has also been implicated in emotion recognition (Blair, 2005b). To date there is little research on motor empathy within antisocial populations (Bons et al., 2013) so future research should determine the nature of motor empathy impairments and therefore whether interventions would also be required to improve motor empathy and its relationship to emotion recognition.

Another issue is that we did not consider gender differences throughout the thesis. We know that there are sex differences in emotion recognition (Wingenbach, Ashwin, & Brosnan, 2018) and empathy (Decety & Ickes, 2009), typically showing that females outperform males (Baron-Cohen & Wheelwright, 2004). CD also presents differently in males and females (Euler et al., 2015). Conversely, there is also evidence for no gender difference in emotion processing (Fairchild et al., 2010) and brain structure abnormalities (Fairchild, Hagan, et al., 2013). Additionally, the gender ratio was

similar in both groups and we found no evidence for a gender difference in either emotion recognition or empathy. Further, given that participants were referred to the study, we could not specifically recruit participants on their gender. Our sample with a higher percentage of males also corresponds to the literature showing that a higher number of males are involved in the Criminal Justice system (Ford, Goodman, & Meltzer, 2003)**.** Future research should aim to understand the similarities and differences in affective processing in both male and female children with disordered behaviour and to understand whether the sexes respond differently to emotion recognition training.

5.6 Implications and conclusions

Disordered behaviour in children can sometimes be persistent and can contribute to the development of later criminal and antisocial behaviour. Although some behavioural interventions have been shown to be effective in milder forms of these problems, their effectiveness in more seriously disturbed children is limited. This is partly because of the fact that we lack a comprehensive understanding of the cognitive and emotional problems of these children and the (neuro-) psychological causes of these difficulties. However, one thing we do know is that antisocial individuals have clear and pervasive impairments in emotion recognition. By offering interventions (such as emotion recognition training), that are tailored to the causal processes that influence the development, persistence and severity of aggressive behaviour, there is a better chance of achieving beneficial and longer-term change for these individuals.

This thesis has shown that children who show disordered behaviour and who are participating in a crime prevention programme because they have been identified as being at high-risk for future criminal behaviour show similar emotion recognition and

empathy impairments to youth offenders and antisocial adults. These findings have important implications for schoolteachers, clinicians, social workers and parents. Given the impact of these impairments on prosocial and antisocial development, it highlights the importance of early intervention within a school setting. We have shown that it is possible to improve emotion recognition children with disordered behaviour within schools. Given the lack of time, resources and staff currently in UK schools, we have shown that it is feasible to target only individuals for intervention who are impaired in emotion recognition, ensuring it is only provided to those who really need it.

What is now needed for these interventions to be brought into mainstream practice is a greater understanding of the role of emotion recognition in specific types of disordered behaviour, what explains the individual differences in emotion recognition ability and the longer-term impact of emotion recognition on different aspects of prosocial and antisocial behaviour. In addition, emotion recognition training that is easily and readily available for wide-scale use, such as the CERT, need to be distributed among key individuals within youth offending services, primary and secondary schools, and those who work with children with disordered behaviour in other contexts, to allow for a greater understanding of the impact that improving emotion recognition has on behaviour.

The juvenile justice system is undergoing reform and the role of emotions in criminal offending is beginning to be acknowledged. The juvenile justice reform movement needs to be complemented by research that addresses fundamental questions about earlier intervention and examines specific mechanisms of change that could lead to reductions in crime. Interventions could then target the psychological processes that contribute to antisocial development in high-risk children before they start to get involved in the criminal justice system. We have shown in this

thesis that children with disordered behaviour can be taught to recognise emotions in others and alongside the research showing that teaching antisocial adolescents to recognise emotions has positive effects on subsequent crime levels (Hubble et al., 2015), this suggests that emotion recognition training should be considered as an early intervention to prevent future criminal and antisocial behaviour. Overall, emotion recognition training represents a developmentally sensitive, practically feasible risk reduction strategy for children with disordered behaviour that focus on emotion recognition as a mechanism that can be targeted for behaviour change.

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Appendix

Appendix A: Description of emotion eliciting videos used throughout the thesis for the empathy task

Target emotion	Description	Duration (minutes)
Happiness	Harry Potter's house team are awarded last minute house points meaning they win the House Cup.	01:41
	Harry Potter catches the Golden Snitch ensuring his team wins the Quidditch match.	01:31
Sadness	Hermione tells Hagrid, Harry and Ron about Malfoy calling her a horrible name.	01:17
	Harry and Ron witness Hermione frozen in hospital and they describe how much they miss her and how much they need her.	01:00
Fear	Harry and Ron fly into the Whomping Willow, which proceeds to attack them.	01:44
	Harry and Ron are in the Enchanted Forest when they are attacked and threatened by a large spider and hundreds of other little spiders.	02:26

Appendix B: Description of Cardiff Empathy Scoring System

Cognitive Empathy
Target emotion
0 = Target emotion not identified in main character 1 = Target emotion identified at a low intensity (1-2) 2 = Target emotion identified at a high intensity (3+)
Similar relevant emotion
0 = Similar relevant emotion not identified in main character 1 = Similar relevant emotion identified at a low intensity (1-2) 2 = Similar relevant emotion identified at a high intensity (3+)
Explanation of emotion
0 = Incorrect or irrelevant explanation of emotion e.g., “The girl was fearful because she was scared” 1 = Explanation provides one factual reason for emotion e.g., “The girl was fearful because there was a shark” 2 = Explanation provides more than one factual reason for emotion e.g., “there was a shark and the boat got knocked” OR provides one consequence of the event e.g., “she thought she might die” 3 = Explanation provided one 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 more than one 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 (1-2) 2 = Target emotion identified at a high intensity (3+)
Similar relevant emotion
0 = Similar relevant emotion not identified in self 1 = Similar relevant emotion identified at a low intensity (1-2) 2 = Similar relevant emotion identified at a high intensity (3+)
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” 3 = An answer worthy of a 2-score that didn’t require prompting

Appendix C: Relationship between emotion recognition and empathy variables for DB participants only

As can be seen in the table below, when considering just at-risk participants, there were no significant relationships between emotion recognition and empathy.

	Happy ER	Sad ER	Fear ER	Anger ER	Neutral ER
Happiness CE	0.07	0.05	0.03	0.00	0.07
Sadness CE	-0.06	0.10	0.02	0.04	-0.06
Fear CE	0.11	0.02	0.07	-0.12	0.11
Happiness AE	-0.04	-0.10	0.12	-0.17	-0.04
Sadness AE	0.04	0.08	0.00	0.00	0.04
Fear AE	-0.02	-0.15	0.03	-0.13	-0.02

Notes: ER = Emotion Recognition, CE = Cognitive Empathy, AE = Affective Empathy. Values represent Spearman's rho, *n* = 87. * Correlation is significant at the 0.05 level. ** Correlation is significant at the 0.01 level. Bonferroni corrections applied

Appendix D: Relationship between emotion recognition and empathy variables for DB+ participants only

As can be seen in the table below, when considering just at-risk participants with emotion recognition problems, there were no significant relationships between emotion recognition and empathy.

	Happy ER	Sad ER	Fear ER	Anger ER	Neutral ER
Happiness CE	0.00	0.07	0.14	0.03	0.00
Sadness CE	0.02	0.08	0.17	0.11	0.02
Fear CE	0.14	-0.01	0.12	-0.14	0.14
Happiness AE	-0.10	-0.16	0.10	-0.28	-0.10
Sadness AE	0.11	0.18	0.07	-0.15	0.11
Fear AE	-0.06	-0.26	-0.03	-0.26	-0.06

Notes: ER = Emotion Recognition, CE = Cognitive Empathy, AE = Affective Empathy. Values represent Spearman's rho, n = 50. * Correlation is significant at the 0.05 level. ** Correlation is significant at the 0.01 level. Bonferroni corrections applied

Appendix E: Relationship between emotion recognition, empathy and attention to the eyes – DB participants only

When including just DB participants in the correlations between emotion recognition, empathy and dwell time to the eyes, there were no significant correlations between emotion recognition accuracy and dwell time to the eyes. For empathy, dwell time to sad eyes was positively correlated with cognitive empathy for sadness.

		Emotion Recognition				Empathy					
		Sad	**Fear**	**Anger**	**Neutral**	**Happy CE**	**Sad CE**	**Fear CE**	**Happy AE**	**Sad AE**	**Fear AE**
Emotion Recognition	**% eyes sad**	0.18	0.16	0.06	0.16	-0.03	0.12	0.07	0.13	0.26	-0.01
	% eyes fear	0.12	0.20	0.06	0.14	-0.08	0.11	0.04	0.08	0.16	-0.03
	% eyes anger	0.10	0.13	0.07	0.15	-0.11	0.05	-0.04	0.10	0.20	-0.11
	% eyes neutral	0.10	0.20	0.10	0.20	-0.08	0.14	0.04	0.10	0.32	-0.06
Empathy	**% eyes happy**	-0.19	0.08	-0.15	0.26	0.03	0.24	-0.09	0.13	0.32	0.06
	% eyes sad	0.15	0.31	0.25	-0.06	0.12	0.45**	0.15	0.06	0.21	-0.07
	% eyes fear	0.00	-0.06	0.08	-0.11	-0.08	0.10	-0.04	0.01	0.13	-0.31

Notes: CE = Cognitive Empathy, AE = Affective Empathy. Values represent Spearman's rho. Correlations for emotion recognition variables, *n* = 53, correlations for empathy variables, *n* = 39 ** Correlation is significant at the 0.01 level. Bonferroni corrections applied.

Appendix F: Relationship between emotion recognition, empathy and attention to the eyes – DB+ participants only

When considering just DB+ participants, again, there were no significant correlations between dwell time to the eyes and emotion recognition accuracy or empathy.

		Emotion Recognition				Empathy					
		Sad	**Fear**	**Anger**	**Neutral**	**Happy CE**	**Sad CE**	**Fear CE**	**Happy AE**	**Sad AE**	**Fear AE**
Emotion Recognition	**% eyes sad**	0.05	0.01	-0.09	0.14	0.22	0.24	0.07	0.06	0.18	-0.10
	% eyes fear	-0.03	0.14	-0.06	0.29	0.15	0.26	-0.10	0.07	0.06	-0.10
	% eyes anger	-0.01	0.15	-0.04	0.27	0.15	0.15	-0.08	0.03	0.14	-0.22
	% eyes neutral	-0.04	0.17	0.10	0.26	0.21	0.25	-0.04	-0.02	0.20	-0.31
Empathy	**% eyes happy**	-0.38	-0.05	-0.24	0.31	0.19	0.26	-0.20	-0.16	0.03	-0.35
	% eyes sad	0.15	0.03	0.40	-0.06	0.31	0.24	0.23	-0.12	0.00	-0.40
	% eyes fear	-0.20	-0.09	-0.09	-0.08	0.07	0.16	-0.03	-0.01	0.21	-0.46

Notes: CE = Cognitive Empathy, AE = Affective Empathy. Values represent Spearman's rho. Correlations for emotion recognition variables, *n* = 26, correlations for empathy variables, *n* = 19. Bonferroni corrections applied