UNIVERSITY OF SOUTHAMPTON

FACULTY OF SOCIAL AND HUMAN SCIENCES

Psychology

The impact of comorbid anxiety on the neuropsychological and clinical features of conduct disorder in adolescence

by

Roxanna Short

Thesis for the degree of Doctor of Philosophy

September, 2016

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

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THE IMPACT OF COMORBID ANXIETY ON THE NEUROPSYCHOLOGICAL AND CLINICAL FEATURES OF CONDUCT DISORDER IN ADOLESCENCE

Roxanna Marie Liza Short

Conduct disorder (CD) is a common condition that emerges in childhood or adolescence, and is characterised by rule-breaking, aggression and delinquency. CD entails a considerable economic burden and is linked to unfavourable adult outcomes such as antisocial personality disorder and persistent criminality. CD therefore represents a considerable treatment need. However, it remains difficult to treat, and this is partly due to the extensive heterogeneity of the disorder. Part of this heterogeneity is a result of comorbidity with other disorders. There is converging evidence that links CD with anxiety disorders (ADs). However, the precise relationship between CD and ADs is as yet unclear: there is evidence for attenuating and exacerbating effects of ADs on CD severity and prognosis. Furthermore, little is known regarding the neuropsychological profile of individuals with comorbid CD+ADs compared to those with CD alone. This is important given that alterations in emotion processing have been implicated in the aetiologies of both CD and ADs.

The present study investigated the effect of comorbid ADs on the clinical presentation and emotion processing styles of adolescents with CD, by comparing groups of adolescents with CD-only (n = 31), ADs-only (n = 23), comorbid CD+ADs (n = 20) and a typically-developing control group (n = 30). We used a range of clinical and questionnaire-based assessments, as well as a series of emotion processing tasks: three threat processing tasks and a facial emotion recognition task. We found that whilst the presence of comorbid ADs in CD had little effect on the clinical and personality characteristics of CD (e.g., callous-unemotional traits), individuals with comorbid CD+ADs performed differently on the emotion processing tasks compared to individuals with CD or ADs alone (and tended to perform similarly to controls, suggesting a protective effect of comorbid ADs). This suggests that the comorbid CD+ADs condition may represent a distinct disorder with its own distinct emotion processing style, which may have implications for the treatment of individuals with CD.

Table of Contents

List of Tables

List of Figures

DECLARATION OF AUTHORSHIP

I, Roxanna Short, declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

The impact of comorbid anxiety on the neuropsychological and clinical features of conduct disorder in adolescence

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
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   Short, R. M., Sonuga-Barke, E. J., Adams, W. J., & Fairchild, G. (2016). Does comorbid anxiety counteract emotion recognition deficits in conduct disorder? *Journal of Child Psychology and Psychiatry, 57(8)*, 917–926. http://doi.org/10.1111/jcpp.12544

   Short, R., Adams, W., Garner, M., Sonuga-Barke, E., & Fairchild, G. (2016). Attentional biases to emotional faces in adolescents with conduct disorder, anxiety disorders, and comorbid conduct and anxiety disorders. *Journal of Experimental Psychopathology* (In Press).

Signed: ..... Date: .....

Acknowledgements

I would like to thank Dr. Graeme Fairchild, Prof. Wendy Adams, and Prof. Edmund Sonuga-Barke for their tireless supervision and assistance throughout the course of this work. Thanks also to Dr. Matthew Garner for his contributions to various sections of this thesis, as well as his assistance with laboratory equipment and task programming.

The recruitment of the many participants in this study would not have been possible without the collaboration of my friends and colleagues in the department: Kate Sully, Nadia Peppa, Nayra Martin-Key, Areti Smaragdi, Karen Gonzalez and John Broulidakis. I also had invaluable help with interviewing and testing the participants from MSc students and (voluntary) research assistants: Alex Robinson, Lara Barbuselu, Emily Crewsden, Ruth Denton, Vicki Woodell-Hall, Georgie Lithauer, and Vicky Payne; thank you all.

Deepest thanks go to the Youth Offending Teams, Pupil Referral Units, schools and colleges (and especially Paul Watson at Southampton City College) who helped with recruitment, and to all of the young people and their parents/carers who took part in the research.

Last, but by no means least, I would like to thank my husband James for his support; through the hard times, through the good times; and for always believing that I could do this.

Abbreviations

ACT	Attentional Control Theory
ADHD	Attention Deficit/Hyperactivity Disorder
ADs	Anxiety disorders
AFC	Alternative Forced Choice
ANOVA	Analysis of Variance
APA	American Psychiatric Association
APSD	Antisocial Process Screening Device
APSS	Adolescent Psychotic-like Symptoms Screener
AST	Affective Simon Task
AQ	Autism-Spectrum Quotient
ASD	Autism-Spectrum Disorder
ASPD	Antisocial Personality Disorder
BAS	Behavioural Activation
BFRT	Benton Facial Recognition Test
BIS	Behavioural Inhibition System
BIS/BAS	Behavioural Inhibition/Activation Scales
BPAQ	Buss & Perry Aggression Questionnaire
CBT	Cognitive Behaviour Therapy
CD	Conduct Disorder
CPs	Conduct Problems
CU	Callous-Unemotional
DBD	Disruptive Behaviour Disorder
DSM	Diagnostic and Statistical Manual of Mental Disorders
EAST	Extrinsic Affection Simon Task
EI	Error Interference
EOG	Electrooculogram
fMRI	Functional Magnetic Resonance Imaging
FNE	Fear of Negative Evaluation
FSSC-R	Fear Survey Schedule for Children – Revised
GAD	Generalised Anxiety Disorder
GM	Grandiose-Manipulative
HAB	Hostile Attribution Bias
HADS	Hospital Anxiety and Depression Scale
IAPS	International Affective Picture System
IAT	Implicit Association Test
ICU	Inventory of Callous-Unemotional Traits
IES	Integrated Emotion Systems
II	Impulsive-Irresponsible
IQ	Intelligence Quotient
K-SADS-PL	Kiddie-Schedule for Affective Disorders and Schizophrenia – Present & Lifetime
MDD	Major Depressive Disorder
NES	Neighbourhood Environment Scale
OCD	Obsessive Compulsive Disorder

ODD	Oppositional Defiant Disorder
O.R.	Odds Ratio
PCL:YV	Psychopathy Checklist: Youth Version
PCL-R	Psychopathy Checklist - Revised
PRU	Pupil Referral Unit
PTSD	Posttraumatic Stress Disorder
RM	Response Modulation
RT	Reaction Time
RTI	Reaction Time Interference
SAD	Separation Anxiety Disorder
SADS	Social Anxiety and Distress Scale
SEM	Standard Error of the Mean
SES	Socio-Economic Status
SIP	Social Information Processing
STAI	State-Trait-Anxiety Inventory
TES	Threat Evaluation System
VIM	Violence Inhibition Mechanism
VP	Visual Probe
WASI	Wechsler Abbreviated Scale of Intelligence
YOT	Youth Offending Team
YPI	Youth Psychopathic Traits Inventory

Chapter 1 Conduct disorder with and without anxiety disorders: key terms and concepts

1.1 General Introduction

Conduct disorder (CD) is a common disorder that emerges in childhood or adolescence. It is characterised by frequent rule-breaking behaviours, aggression and delinquency (APA, 2013). CD is linked to unfavourable adult outcomes such as antisocial personality disorder and persistent criminality (Robins, 1978). As a result, CD is a considerable economic and social burden (Scott et al., 2001). The effective treatment of CD is complicated by the fact that it often co-occurs with other conditions, both externalising (e.g., attention-deficit/hyperactivity disorder [ADHD]), and internalising (e.g., anxiety and depression); see Angold et al. (1999) for a review. The current thesis focuses on one, somewhat counterintuitive, pattern of comorbidity seen in the high proportion of individuals with CD who also suffer from elevated levels of anxiety or even diagnosable anxiety disorders (ADs; Polier et al., 2012; Zoccolillo, 1992). The causes of this co-occurrence remain to be determined (Lahey et al., 2002; Masten et al., 2005). Some authors argue that a specific developmental pathway to CD is associated with elevated levels of anxiety (e.g., Frick et al., 1999). Individuals with CD on this pathway are likely to have problems with emotional regulation, and have high levels of emotional reactivity (Frick & Morris, 2004). This reactivity, along with poor impulse control, leads them to react with aggression and hostility to perceived threat. There is also evidence that a fearful temperament in childhood is related to improved conscience development (Kochanska et al., 2002). This may explain the finding that whilst anxious CD individuals may commit impulsive acts of aggression, they can feel high levels of guilt and shame afterwards (see Frick & Morris, 2004). In addition, it seems that the presence of anxiety in children with CD may alter developmental outcomes. Some studies have reported that anxiety has an attenuating effect on CD, and may lead to better outcomes (e.g., Walker et al., 1991), whereas others suggest that anxiety exacerbates CD or is more likely to lead to negative outcomes (Ialongo et al., 1996; Kendall et al., 2001; Sourander et al., 2007).

Given the overlap between CD and ADs, as well as the potential consequences for the prognosis of individuals with CD, it is important to better understand the clinical, cognitive and demographic profile of individuals with comorbid CD and ADs, and what cognitive processes mediate this comorbid presentation. In order to address this question in the present thesis, groups of adolescents with CD alone, ADs alone, comorbid CD and ADs, and typically-developing adolescents were compared across a number of variables, including: their clinical, personality, cognitive and demographic characteristics, and their performance on a series of emotion processing tasks examining selective attention to different emotions and facial emotion recognition.

Chapter 1 will focus on defining the key terms and concepts that are relevant to this thesis, as well as introducing the different issues raised when CD is accompanied by clinical levels of anxiety. Chapter 2 will then consider the literature that deals with emotion processing and neuropsychological performance in groups with CD and ADs – a potentially important focus for understanding the origins of the overlap between these two conditions. Chapter 3 will present the participant recruitment and screening procedures, as well as the general methods relevant to the remainder of the thesis. The empirical chapters will examine the clinical and personality features (Chapter 4), threat processing characteristics (Chapter 5) and emotion recognition abilities (Chapter 6) associated with CD+ADs comorbidity. The thesis will then conclude with a general discussion (Chapter 7).

1.1.1 A note on the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*)

During the course of the present study, the most commonly used diagnostic manual (the *DSM*) underwent a substantial revision from the *DSM-IV-TR* (4th edition, text revision; APA, 2000) to *DSM-5* (5th edition; APA, 2013). Although the diagnostic criteria for the disorders relevant to this thesis have not changed, these disorders have been re-grouped into different categories. For example, CD was part of a group of disruptive behaviour disorders (DBDs) in *DSM-IV-TR*, which also included attention-deficit/hyperactivity disorder (ADHD). However, in the *DSM-5*, CD has now been included as part of a "disruptive, impulse-control and conduct disorder" cluster, which does not include ADHD. Similarly, obsessive-compulsive disorder (OCD) and posttraumatic-stress disorder (PTSD) were grouped with ADs in *DSM-IV-TR*, but have been re-positioned in the *DSM-5.* Most of the previous research that this thesis draws upon has used *DSM-IV* or *DSM-IV*-TR criteria, and in many cases diagnoses have been grouped together according to *DSM-IV* categories: for example, in studies of anxiety, different ADs have been grouped together. This is also true for the present study: *DSM-IV* criteria were used to assess the participants, who were assigned to the comorbid CD+ADs and ADs groups on the basis of *DSM-IV* AD groupings (which included OCD and PTSD). As such, when describing disorders in this thesis I will focus on *DSM-IV-TR* definitions and will refer to *DSM-5* changes where appropriate.

1.1.2 What's in a name? "Comorbidity" vs. "co-occurrence"

The term "comorbidity" was introduced by the epidemiologist Feinstein (1970): "For purposes of the discussion here, the term *co-morbidity* will refer to any distinct additional clinical entity that has existed or that may occur during the clinical course of a patient who has the index disease under study" (p. 456-457). However, since its inception, the term has been the subject of considerable debate among authors, particularly those in the field of psychopathology. Some authors argue that a distinction should be made between *comorbidity* and *co-occurrence*. For example, Lilienfeld and colleagues (Lilienfeld, 2003; Lilienfeld et al., 1994) argue that the former refers to the covariation among disorders (i.e., two or more disorders that occur together more often than would be expected by chance), and the latter to the simultaneous occurrence of two or more disorders (that are not

necessarily correlated) within individuals. Others, such as Spitzer (1994), argue that it is useful to apply the term *comorbidity* to the simultaneous occurrence of two psychiatric disorders within an individual, regardless of whether this comorbidity is true or artefactual (e.g., as a result of assessment methods, etc.). Whilst it has been noted that a categorical approach to psychiatric disorders may not be ideal (Caron & Rutter, 1991; Hyman, 2010; Rutter, 1997), this is the approach that is most commonly used, and is the approach used in the present research. Therefore, to avoid confusion, throughout this thesis the term "comorbidity" will be used to describe individuals presenting with two or more psychiatric disorders, as well as to describe the literature relating to the covariation among psychiatric disorders across individuals.

1.2 Conduct Disorder

CD is one of a group of disruptive behaviour disorders (DBDs) in the *DSM-IV-TR* (APA, 2000), usually first diagnosed in childhood or adolescence. Other disorders in this group were oppositional defiant disorder (ODD) and attention-deficit/hyperactivity disorder (ADHD). Disorders of conduct were first included in the categorical diagnostic system in *DSM-II* (APA, 1968), however the term "conduct disorder" was not used as a diagnosis until its inclusion in *DSM-III* (APA, 1980). Figure 1.1 shows the diagnostic criteria for CD, according to *DSM-IV-TR* (APA, 2000) and *DSM-5* (APA, 2013). To receive a diagnosis of CD, an individual must meet at least three of 15 criteria, and these symptoms must together cause significant impairment. Given that these criteria relate to a wide range of behaviours (from truancy to physical cruelty), it is possible that two individuals with the same overall CD diagnosis will not share any of the same specific symptoms. Indeed, it has been calculated that 32,647 different symptom combinations are possible (Nock et al., 2006). In addition, given that a diagnosis of CD is based entirely on *behavioural* symptoms, the diagnosis implies little about the development, causation, or possible treatment of the disorder (Blair et al., 2005). As a result, a simple diagnosis of CD is relatively unhelpful in clinical or forensic settings (e.g., Vermeiren, 2003). In recognition of this issue, researchers have developed and tested various methods of categorising individuals with CD into more homogenous subtypes (Frick & Ellis, 1999).

A. A repetitive and persistent pattern of behaviour in which the basic rights of others or major age-appropriate social norms or rules are violated, as manifested by the presence of at least three of the following 15 criteria in the past 12 months from any of the categories below, with at least one criterion present in the past 6 months:

Aggression to people and animals

1. Often bullies, threatens, or intimidates others.
2. Often initiates physical fights.
3. Has used a weapon that can cause serious physical harm to others (e.g., a bat, brick, broken bottle, knife, gun).
4. Has been physically cruel to people.
5. Has been physically cruel to animals.
6. Has stolen while confronting a victim (e.g., mugging, purse snatching, extortion, armed robbery).
7. Has forced someone into sexual activity.

Destruction of property

8. Has deliberately engaged in fire setting with the intention of causing serious damage.
9. Has deliberately destroyed others' property (other than by fire-setting).

Deceitfulness or theft

10. Has broken into someone else's house, building or car.
11. Often lies to obtain goods or favours or to avoid obligations (i.e., "cons" others).
12. Has stolen items of nontrivial value without confronting a victim (e.g., shoplifting, but without breaking and entering; forgery).

Serious violations of rules

13. Often stays out at night despite parental prohibitions, beginning before age 13 years.
14. Has run away from home overnight at least twice while living in parental or parental surrogate home (or once without returning for a lengthy period).
15. Is often truant from school, beginning before age 13 years.

B. The disturbance in behaviour causes clinically significant impairment in social, academic, or occupational functioning.
C. If the individual is age 18 years or older, criteria are not met for Antisocial Personality Disorder.

Figure 1.1: *DSM-IV-TR* criteria for Conduct Disorder (CD)

1.2.1 Subtyping CD

1.2.1.1 DSM approaches to subtyping CD

Various methods for subtyping CD have been included in the different versions of the *DSM* (see Figure 1.2). *DSM-III* (APA, 1980) classified individuals with CD according to aggression and whether they were "socialised" or "undersocialised". This built on the work of Hewitt and Jenkins (1946), who distinguished between aggressive individuals who displayed psychopathic-like features (i.e., unable to form social bonds, lack of affect/empathy with others; "undersocialised aggressive") and individuals who were aggressive but able to form normal social attachments ("socialised aggressive"). Subsequent empirical research found that youth with undersocialised aggressive forms of CD had worse overall prognoses than youth with other forms of CD (Quay, 1987; Quay et al., 1987). Although this was a useful distinction empirically, in practise the lack of diagnostic clarity caused confusion with regard to distinguishing between socialised and undersocialised forms (Frick & Moffitt, 2010), and the distinction was not retained in *DSM-III-R* (APA, 1987). *DSM-III-R* instead introduced the

subtypes “group type” and “solitary aggressive” type, which distinguished individuals whose conduct problems occurred as part of a group activity with peers, from individuals whose aggressive behaviour was initiated alone. In *DSM-III-R* it was further specified that aggressive behaviour did not necessarily need to occur in a group context, whereas solitary types were predominantly aggressive. This meant that there was a potential confound between the group vs. solitary and the aggressive vs. nonaggressive distinctions (Achenbach, 1993). Consequently, more recent versions of the *DSM* (DSM-IV, DSM-IV-TR and DSM-5; APA, 1994, 2000, 2013) removed these subtypes and instead introduced a distinction based on age of onset, with a cut-off of 10 years of age (see Figure 1.2). This developmentally-focused subtyping strategy built on research that identified a group of offenders who committed their first antisocial acts at an early age, and who continued to persistently offend throughout their lifespan. These are known as “early starters” (Patterson et al., 1989) or “life-course persistent” offenders (Loeber & Stouthamer-Loeber, 1998; Loeber et al., 1993; Moffitt, 1993a). It is well documented that rates of crime in the general population tend to show an inverse U-shaped function with age, with peak rates occurring at adolescence, followed by a drop in early adulthood (e.g., Blonigen, 2010; Hirschi & Gottfredson, 1983; Steffensmeier et al., 1989). Longitudinal evidence suggests that this observed increase in crime rates during adolescence represents an increase in the number of individuals who offend, rather than an increase in the rate of offences committed by the same group of individuals (e.g., Farrington, 2003). This suggests that whilst there is a group of individuals whose offending remains stable over time, there is also a group of individuals who only offend during adolescence: these are termed childhood-onset and adolescent-onset CD groups, respectively (McMahon et al., 2006).

DSM-III (APA, 1980)

1. Socialised aggressive.
2. Undersocialised aggressive.
3. Socialised non-aggressive.
4. Undersocialised non-aggressive.
5. Atypical CD.

DSM-III-R (APA, 1987)

1. Group type.
2. Solitary aggressive type.
3. Undifferentiated type.

DSM-IV & DSM-IV-TR (APA, 1994, 2000)

1. Childhood-onset (at least one symptom present before age 10).
2. Adolescent-onset (no symptoms present before age 10).

DSM-5 (APA, 2013)

1. Childhood-onset (as above).
2. Adolescent-onset (as above).
3. Unspecified onset (if insufficient information to determine age of onset).

Additional descriptive specifier: *with limited prosocial emotions* (at least two of the following symptoms present: i) lack of remorse/guilt; ii) callous/lack of empathy; iii) unconcerned about performance; iv) shallow/deficient affect).

Figure 1.2: Conduct Disorder (CD) subtypes in the history of the *DSM*

1.2.1.2 Callous-Unemotional traits

Individuals with CD have also been subtyped according to their levels of callous-unemotional (CU) traits. Adult psychopathy is a long-established, empirically validated construct that has only relatively recently been extended to children and adolescents. Given its negative connotations and the widely-held (although not robustly supported; D'Silva et al., 2004; Skeem et al., 2002) notion that psychopaths are "untreatable", some clinicians and researchers are cautious to use the term "psychopath" in relation to children and adolescents. As such, the term "callous-unemotional traits" has been used to describe children and adolescents who present with traits such as: remorselessness, being lacking in empathy, having shallow emotions, and/or being manipulative, deceitful and cruel (Frick & Ellis, 1999; Frick et al., 1994). Unlike CD, psychopathy is argued to have a relatively homogeneous pathology (Blair et al., 2006b), and may therefore be a useful method for subtyping CD individuals. Indeed, the most recent version of the *DSM* (DSM-5; APA, 2013) has included a "limited prosocial emotions" specifier to further characterise a diagnosis of CD (see also Figure 1.2). Individuals meet the criteria for this specifier when they display two or more of four CU traits: "lack of remorse or guilt", "callous-lack of empathy", "unconcerned about performance", and "shallow or deficient affect" (APA, 2013, pp. 470-471). However, this specifier can only be met if multiple sources of information are considered (e.g., parent or teacher report as well as self-report; APA, 2013).

Assessing CU traits

Whilst there is a "gold-standard" assessment of adult psychopathy, namely the Psychopathy Checklist-Revised (PCL-R; Hare, 2003), the assessment of juvenile psychopathy is still in its relative infancy. The PCL-R is designed for use in incarcerated populations and uses a semi-structured diagnostic interview as well as a thorough review of institutional records to rate the individual on 20 traits and behaviours (Hare, 2003). Most of the assessment measures that have been designed for use in juvenile populations have used the PCL-R as a starting point. However, some of the traits that are included in the PCL-R are not applicable to children (e.g., "many short-term marital relationships") and others may be age-appropriate in typical children and adolescents (e.g., "need for stimulation/proneness to boredom"; see Edens et al., 2001). The Psychopathy Checklist: Youth Version (PCL:YV; Forth et al., 2003) is an adapted version of the PCL-R for use with adolescents. It is an assessment (i.e., requiring multiple sources of information) rather than a questionnaire measure, and is often used as a comparison for other measures (Kotler & McMahon, 2010; Salekin et al., 2004). However, the use of the PCL:YV in community offender and non-offender samples has practical limitations: these populations are unlikely to have extensive records of previous behaviour or indeed a criminal record at all (Kotler & McMahon, 2010). It may be more practical, then, to use questionnaire measures in these populations.

1.2.1.3 Aggression

Despite the removal of aggression-related subtypes of CD in the *DSM*, aggression remains of considerable interest to researchers, given its impact on victims, as well as its stability (Huesmann et al., 1984; McAuliffe et al., 2006; Tomada & Schneider, 1997) and the difficulties associated with its treatment (see Connor, 2016). Many previous studies have also distinguished between two types of aggressive behaviour: reactive (or hostile, affective) and proactive (or instrumental, predatory; for a meta-analysis, see Polman et al., 2007). Reactive aggression is typically defined as "hot-blooded" aggression in reaction to a perceived threat, whereas proactive aggression is "cold-blooded", the use of which is planned and instrumental (see Card & Little, 2006). Although these two types of aggression frequently co-occur (see Polman et al., 2007), it has been argued that they have distinct theoretical underpinnings. Reactive aggression may be explained by the frustration-aggression model (Berkowitz, 1993), where an angry or hostile response is the result of frustration caused by the impedance of the individual's goals. This is supported by studies on social information processing in aggressive individuals: reactively aggressive children have been found to interpret ambiguous social cues as hostile (Crick & Dodge, 1996; Schwartz et al., 1998). Proactive aggression, on the other hand, may be explained by social learning theory (Bandura, 1973), where aggression is a learned behaviour (via operant conditioning or vicarious learning) with positive outcome expectations (for a review, see Dodge, 1991). Again, there is support for this theory from social information processing studies: proactively aggressive children have been found to select instrumental (rather than relational) social goals and to evaluate aggression as positive when selecting between different responses (Crick & Dodge, 1996).

This distinction may also be clinically relevant: proactive (but not reactive) aggression has been found to be predictive of future delinquency and CD severity in adolescent boys (Vitaro et al., 1998). Furthermore, a combination of proactive and reactive aggression appears to be positively associated with CU traits (Fanti et al., 2009; Frick et al., 2003), and the presence of reactive aggression (without proactive aggression) is associated with anxiety (Vitaro et al., 2002).

1.3 Anxiety Disorders

Anxiety disorders (ADs) are characterised by persistent feelings of worry, fear or stress, which lead to avoidance of situations or entities that are the perceived causes of such emotional states. These psychological feelings of worry, fear or nervousness are usually accompanied by physiological symptoms (e.g., shortness of breath, sweating or elevated heart-rate) as well as physical complaints (e.g., headaches, nausea, muscle ache and sleeping difficulties). Although fear and anxiety may be evolutionarily advantageous in that they enable individuals to maintain safety and well-being by triggering a fight/flight/freeze response to threats in their environment (e.g., Lang et al., 2000), in anxious individuals this response is excessive, pervasive and difficult to control (e.g., Barlow, 2004).

The *DSM-IV-TR* (APA, 2000) recognised a range of ADs in children (see Figure 1.3): generalised anxiety disorder (GAD), panic disorder, social phobia, specific phobia, agoraphobia, separation anxiety disorder (SAD), obsessive-compulsive disorder (OCD), and posttraumatic stress disorder (PTSD). The National Comorbidity Survey, an epidemiological study of mental health amongst teenagers in the US, found that 31% (38% of females and 26% of males) of adolescents (aged 13-18 years) in the survey met criteria for a *DSM-IV-TR* (APA, 2000) AD, with severe ADs present in 8.3% of the total sample (Merikangas et al., 2010). In addition to this high prevalence in adolescence, ADs have been found to predict a range of psychiatric disorders in later life (Bittner et al., 2007; Copeland et al., 2009), as well as having high homotypic (i.e., with other ADs) and heterotypic (i.e., with disorders from different *DSM* categories) comorbidity (Costello et al., 2005). Furthermore, ADs in adolescence have been shown to predict negative psychosocial outcomes (e.g., psychosocial adjustment, family relationships, coping skills) in adulthood (Essau et al., 2014).

Generalised anxiety disorder • Persistent and excessive worry (6 months' duration). • Somatic symptoms (tension, fatigue, insomnia).	**Social phobia** • Persistent, marked fear of social or performance situations. • Avoidance of phobic situation(s).
Panic disorder • Recurrent and unexpected panic attacks. • Fear of having another attack.	**Specific phobia** • Excessive fear of a specific object or situation. • Avoidance of phobic object.
Separation anxiety disorder • Developmentally inappropriate persistent and excessive fear of separation from attachment figures.	**Agoraphobia** • Excessive fear of places or situations from which escape might be difficult/embarrassing.
Obsessive-compulsive disorder • Recurrent and persistent thoughts causing distress. • Repetitive performance of behaviours to reduce anxiety caused by the obsession(s).	**Posttraumatic stress disorder** • Recurrent flashbacks, distress, physiological reactivity following traumatic event. • Persistent avoidance of stimuli associated with the trauma.

Figure 1.3: Core features of the anxiety disorders (adapted from the *DSM-IV-TR*; APA, 2000).

1.3.1 Subtyping anxiety

As with CD, ADs are associated with a wide range of symptoms. The *DSM-IV-TR* continued with the practise of grouping disorders based on their "shared phenomenological characteristics" (APA, 2000, p. 10). However, there is a growing body of research that supports a hierarchical model of emotional (or "internalising") disorders (Kendler et al., 2003; Krueger, 1999; Lahey et al., 2004; Öhman, 2008; Sellbom et al., 2008; Vollebergh et al., 2001; Watson, 2005). This model indicates that some emotional disorders may be more

related to each other than others (in terms of genetic liability, as well as behavioural characteristics). Specifically, there is evidence for two dimensions of emotional disorders: one characterised by distress (also referred to as anxious-misery), and one characterised by fear (see Figure 1.4). There is clear evidence that generalised anxiety disorder (GAD), posttraumatic stress disorder (PTSD), major depressive disorder (MDD) and dysthymia are part of the distress dimension, and specific phobia, agoraphobia, social phobia, panic disorder and separation anxiety disorder (SAD) are part of the fear dimension (Kendler et al., 2003; Krueger, 1999; Seeley et al., 2011; Vollebergh et al., 2001). However, there is some behavioural genetics evidence that panic disorder and social phobia may also load onto the distress factor (Chantarujikapong et al., 2001; Kessler et al., 1997). The categorisation of obsessive-compulsive disorder (OCD) within these dimensions has been debated (see Tackett et al., 2008). However, the preponderance of evidence categorises OCD as a fear disorder (e.g. Lahey et al., 2004; Prenoveau et al., 2010; Seeley et al., 2011).

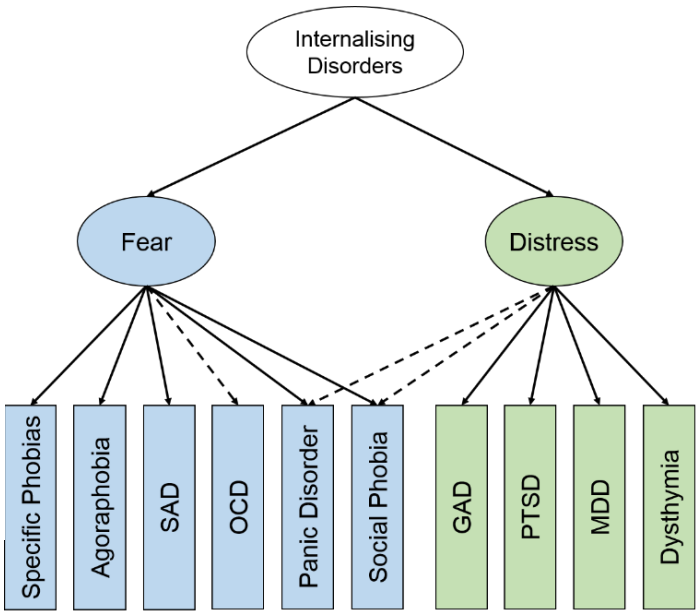

Figure 1.4: A simplified structure of the internalising disorders. *Note*: strong relationships are depicted by solid lines and weaker relationships by dashed lines. GAD = generalised anxiety disorder; MDD = major depressive disorder; OCD = obsessive-compulsive disorder; PTSD = post-traumatic stress disorder; SAD = separation anxiety disorder.

This distinction between fear and anxiety has also been noted in the cognitive and neurobiological literature (see Öhman, 1993, 2008; Sylvers et al., 2011a). For example, Waters et al. (2013) found that individuals with fear-related ADs had attentional biases away from threat, whereas individuals with distress-related ADs had attentional biases towards threat. This is consistent with McNaughton and Corr's (2004) reformulation of the Reinforcement Sensitivity Theory (Gray & McNaughton, 2000), in which fear is associated with avoidance behaviours (i.e., it is a defensive reaction to facilitate escape from threat), and anxiety is associated with approach behaviours (i.e., it is a hypervigilant state whilst approaching a potential threat), as a result of the activity of different neural systems. Other differences between fear and anxiety include: the specificity of the threat – fear is a response

to a specific threat, whereas anxiety is a response to a diffuse threat (Davis, 1998; Lang et al., 2000); the duration of arousal – fear is acute, whereas anxiety is chronic (Davis, 1998; Davis et al., 2010); and the temporal focus – fear is present-focused, whereas anxiety is future-focused (Davis et al., 2010; Grupe & Nitschke, 2013).

This is now reflected in the *DSM*-5 (APA 2013) section on ADs: "*Fear* is the emotional response to real or perceived imminent threat, whereas *anxiety* is anticipation of future threat" (p. 189). However, these terms are frequently used synonymously in the clinical literature (Sylvers et al., 2011a), which may partly explain the inconsistency in research findings on, for example, the relationship between anxiety and psychopathy (see Section 1.4.2, below).

1.4 Conduct disorder and anxiety disorders comorbidity

The comorbidity of psychiatric disorders in children and adolescents has been the subject of significant attention over the past decades. It has been shown to be pervasive, and occurs both within (homotypic) and between (heterotypic) classes of disorders (Angold et al., 1999; Copeland et al., 2013b; Kessler et al., 2012). Both CD and ADs are associated with considerable comorbidity within their respective classes: CD is commonly comorbid with other DBDs/externalising disorders, such as ODD (odds ratio [O.R.] 12.1; Nock et al., 2006) and ADHD (O.R. 4.9; Nock et al., 2006); and ADs are most commonly comorbid with other ADs (O.R. 8.9 for GAD with any other AD; Grant et al., 2005) and internalising disorders such as MDD (O.R. 8.2; Angold et al., 1999). Some comorbidity may be artefactual (see Caron & Rutter, 1991): for example, if the diagnostic criteria for two disorders overlap, it is more likely that both disorders will be diagnosed (this may explain the high level of comorbidity among anxiety disorders). However, there is also significant comorbidity between externalising and internalising disorders in community samples (Angold et al., 1999; Cunningham & Ollendick, 2010; Ford et al., 2003; Merikangas et al., 2010; Polier et al., 2012). For example, the British National Child and Adolescent Mental Health Survey 1999 (Ford et al., 2003) found that over 10% of children with psychiatric disorders exhibited co-occurring internalising and externalising disorders (see Figure 1.5). Given that these disorders belong to two different classes of disorders, with few overlapping symptoms, it is unlikely that their co-occurrence is artefactual (see Lilienfeld, 2003). Another possibility is that the comorbidity between ADs and CD can be explained by their associations with another disorder, namely depression. For example, Copeland et al. (2013b) found that the association between GAD and CD in three community samples of children and adolescents was reduced when an adjustment was made for the significant overlap between GAD and depression. This is known as "indirect comorbidity". However, the above study was unable to account for the temporal relationships between the disorders (only symptoms within the three months preceding the assessments were measured).

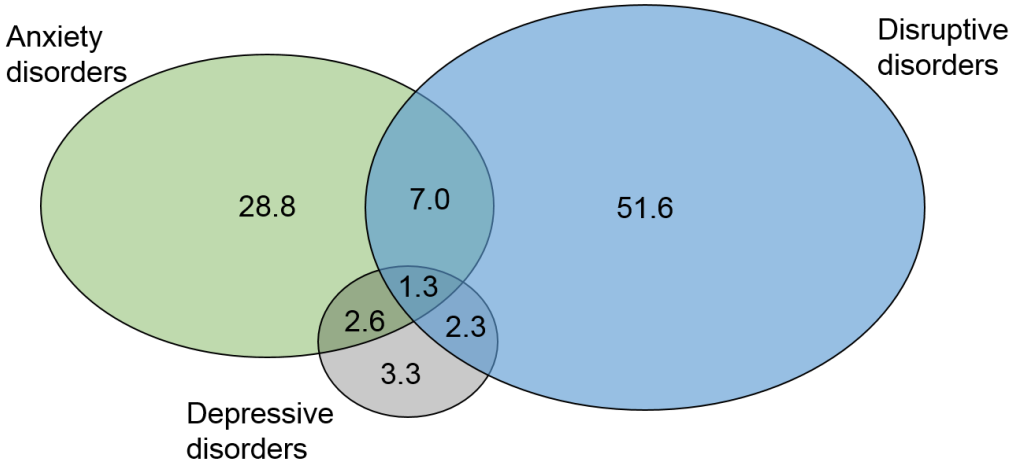

Figure 1.5: Comorbidity (%) among children with psychiatric disorders in Britain (excludes Northern Ireland). Adapted from Ford et al. (2003). *Note*: Disruptive disorders include conduct disorder, attention-deficit/hyperactivity disorder and oppositional defiant disorder.

According to various cross-sectional and longitudinal studies, CD and ADs co-occur at a rate that is higher than would be expected by chance (Angold et al., 1999; Copeland et al., 2013a; Costello et al., 2005; Costello et al., 2003; Lahey et al., 2002; Masten et al., 2005; Maughan et al., 2004; Nock et al., 2006; Zoccolillo, 1992). A meta-analysis estimated that individuals with ADs were 3.1 times more likely to meet criteria for CD than those without ADs (Angold et al., 1999). It has also been found that ADs may precede CD in development: a meta-analysis of longitudinal studies found that an individual with any AD in childhood was 2.19 times more likely to develop CD in adolescence than not (Copeland et al., 2013a). In addition to this overlap between CD and ADs in child and adolescent community samples, studies have found an elevated rate of ADs in juvenile delinquent populations (Fazel et al., 2008), as well as in adults with antisocial personality disorder (ASPD), which requires a diagnosis of CD before the age of 15 years (Coid & Ullrich, 2010; Hodgins et al., 2010).

Despite this well-documented overlap between CD and ADs, the effect that ADs have on the behavioural expression of CD is unclear: data from longitudinal studies have shown both attenuating (e.g., Mason et al., 2004; Pine et al., 2000; Raine et al., 1995) and exacerbating (e.g., Ialongo et al., 1996; Roza et al., 2003; Sourander et al., 2007) effects of ADs on the developmental course of CD.

1.4.1 Competing attenuation/exacerbation hypotheses

The hypothesis that the presence of anxiety would attenuate the severity of CD is based on the idea that anxious individuals are typically shy, inhibited and risk-averse (Maner et al., 2007; Prior et al., 2000; Schwartz et al., 1999). This seems to be at odds with having a diagnosis of CD, which is associated with increased risk-taking and disinhibited behaviour (Beauchaine et al., 2001; Fairchild et al., 2009b; Syngelaki et al., 2009). For example, social anxiety disorder has been found to be positively related to behavioural inhibition (Biederman et al., 2001), anxiety has been found to inhibit the reward-seeking behaviour associated with

CD (O'Brien & Frick, 1996), and behavioural inhibition has been found to protect against future delinquency (Kerr et al., 1997). Gray's reinforcement sensitivity theory of personality (Gray, 1987) suggests that an individual's temperament may be described by two broad dimensions: anxiety and impulsivity. These dimensions are controlled by two neural systems: the behavioural inhibition system (BIS, responsible for anxiety), and the behavioural activation system (BAS, responsible for impulsivity). It has been posited that these two systems compete with each other to control behaviour; the BAS acting as a "go" mechanism, and the BIS operating as a "stop" mechanism (Pickering & Gray, 1999). The BAS is activated by stimuli signalling reward or relief from punishment, whereas the BIS is activated by novel stimuli or punishment signals. As a consequence, individuals with an overactive BAS and an underactive BIS are likely to display impulsivity and reward-dominant behaviour (Quay, 1993). Conversely, individuals with an overactive BIS and an underactive BAS are likely to be hypersensitive to punishment cues, and more likely to avoid risky behaviours. Anxiety traits in CD individuals, according to Gray's theory, may therefore attenuate risky or aggressive behaviours.

This attenuation theory is supported by a number of cross-sectional and longitudinal studies. For example, Woolston et al. (1989) found that children with comorbid internalising and externalising disorders were found to be less impaired (in terms of adaptive functioning and behaviour) than those with externalising behaviours alone. Similarly, Walker et al. (1991) found that children with comorbid CD and ADs had fewer police contacts and were rated as less aggressive by peers than children with CD alone. Furthermore, Hofmann et al. (2009) found that individuals with comorbid externalising (including CD, ODD and ADHD) and anxiety disorders were less likely to have a comorbid substance use disorder than those with sole diagnoses of externalising or anxiety disorders. Longitudinal research has also identified that the presence of anxiety in children living in high-risk environments protects against future delinquency (Farrington, 1995), and self-reported shyness in childhood inhibits violence in adulthood (Mason et al., 2004).

On the other hand, there is also research that suggests that anxiety exacerbates CD or leads to negative outcomes (Garai et al., 2008; Ialongo et al., 1996; Roza et al., 2003; Sourander et al., 2007; Verhulst & Van der Ende, 1992). Furthermore, it has been consistently found that anxiety symptoms and reactive aggression are positively related in children and adolescents (see Card & Little, 2006; Vitaro et al., 2002), and that reactive aggression is associated with CD and ODD (Dodge et al., 1997; Waschbusch et al., 2002). This is consistent with a social information processing model of children's behaviour (e.g., Crick & Dodge, 1994), where information processing biases are hypothesised to influence the expression of behaviour. For example, there is evidence that aggressive children tend to interpret ambiguous information as hostile, which may increase the likelihood of an aggressive behavioural response (e.g., de Castro et al., 2002; Dodge et al., 1990). Anxious children also tend to be hypersensitive to threat (e.g., Bradley et al., 1999; MacLeod et al.,

1986; Yiend & Mathews, 2001). Therefore, anxiety in an aggressive child may serve to increase the likelihood of defensive/reactive violence.

This exacerbation hypothesis is supported by a number of cross-sectional and longitudinal studies. For example, Anderson et al. (1987) found that treatment-seeking children with comorbid internalising, externalising and emotional disorders were rated as more aggressive by parents and teachers than those with either type of disorder alone. Similarly, Ialongo et al. (1996) found that children with high levels of aggression and anxiety at the beginning of the school year were more likely to remain aggressive throughout the year than those with aggression and low levels of anxiety. Longitudinal studies have identified that children with comorbid internalising and externalising disorders have worse outcomes in terms of future offending, psychiatric and substance use disorders than those with either internalising or externalising problems alone (Roza et al., 2003; Sourander et al., 2007).

There is also some evidence that anxiety neither exacerbates nor attenuates conduct problems. For example, in a cross-sectional study, Ollendick et al. (1999) found that co-occurring ADs had no significant effect on the frequency or severity of delinquent acts in male and female adolescent offenders with severe CD. Similarly, Hodgins et al. (2011) found that adolescents with CD alone were similar to those with comorbid CD+ADs in terms of CD severity and delinquency. It is therefore possible that the moderating effect of anxiety may be weaker in the presence of more severe forms of CD. In a large community sample of children with ADHD and anxiety, Becker et al. (2012) found no association between parent-reported anxiety symptoms and parent-reported aggression. However, it has been noted that internalising symptoms are more difficult to measure than externalising behaviours (Michael & Merrell, 1998), therefore it is possible that parents under-report their child's anxiety symptoms as they are unaware of their child's difficulties or somatic symptoms.

There are a number of reasons for this discrepancy within the extant literature. For example, studies tend to differ in how they measure anxiety and conduct problems: some use indices of internalising and externalising symptoms, and some use clinical diagnoses. Additionally, all ADs tend to be grouped together: many studies have grouped together ADs linked with anxiety/distress (such as GAD and PTSD) and ADs linked with fear (such as specific phobias, SAD, or agoraphobia). As described above, anxiety and fear may represent different constructs that have different underlying mechanisms and are phenomenologically different (for reviews see; Öhman, 1993, 2008). Furthermore, as discussed below, it is possible that other traits (such as CU traits) moderate the impact of anxiety on CD.

1.4.2 Callous-unemotional traits and anxiety

The relationship between psychopathy and anxiety has received considerable attention in the literature since the 1940s. One of the first to highlight the importance of anxiety in the conceptualisation of psychopathy was Hervey Cleckley, who observed that psychopaths, "…are very sharply characterized by the lack of anxiety…" (Cleckley, 1976; p. 257), and that, "it is highly typical for him [the psychopath] not only to escape the abnormal anxiety and

tension fundamentally characteristic of this whole diagnostic group but also to show a relative immunity from such anxiety and worry as might be judged normal or appropriate in disturbing situations" (Cleckley, 1976; p. 339-340). David Lykken's work on the autonomic reactivity (or lack thereof) of Cleckley's psychopath (Lykken, 1957) also highlighted the importance of a lack of fear in psychopathy. However, as described above, there is a considerable overlap between antisocial behaviour and anxiety in adults (Hodgins et al., 2010), children and adolescents (Hodgins et al., 2011; Polier et al., 2010). Additionally, a high level of anxiety has been found in some antisocial youths with CU traits (Kahn et al., 2012; Kimonis et al., 2012; Lee et al., 2010).

Researchers have dealt with this issue by suggesting that there are two subtypes of psychopath; a low-anxiety *primary* variant, and a neurotic *secondary* variant (Blackburn, 1986; Karpman, 1941, 1948). In the assessment of adult criminal psychopathy, this is mirrored by the factor structure of the PCL-R (Hare, 2003). There is considerable debate concerning the precise latent structure of PCL-R items, however, in general, these can be split into two correlated factors; Factor 1 comprising items associated with the affective component of psychopathy (primary psychopathy; see Figure 1.6), and Factor 2 comprising items associated with the antisocial behaviour component of psychopathy (secondary psychopathy; see Figure 1.6). The relationship between the PCL-R and anxiety, however, remains a contentious issue. Some argue that psychopathy is a unitary construct (e.g., Hare & Neumann, 2010; Neumann et al., 2013), comprising both an interpersonal/affective component (CU) and an antisocial/impulsive behaviour component, with anxiety being subsumed into both factors (Neumann et al., 2013). Others argue that these form two distinct subtypes of psychopathy, each having different associations with anxiety (Frick et al., 1999; Lake et al., 2011; Skeem et al., 2007). In adults, primary psychopathy has been found to be associated with low anxiety (Blonigen et al., 2010; Hale et al., 2004; Harpur et al., 1989; Hicks et al., 2004), high positive emotionality and low stress reactivity (Verona et al., 2001). Secondary psychopathy, on the other hand, has been found to be associated with high anxiety (Blonigen et al., 2010; Hale et al., 2004; Hicks et al., 2004), negative emotionality and suicide risk (Verona et al., 2001).

Figure 1.6: PCL-R items (adapted from Hare, 2003)

Factor 1 – affective/interpersonal
1. Glibness/superficial charm
2. Grandiose sense of self worth
3. Failure to accept responsibility for own actions
4. Pathological lying
5. Conning/manipulative
6. Lack of remorse or guilt
7. Shallow affect
8. Callous/lack of empathy

Factor 2 – antisocial lifestyle
1. Need for stimulation/proneness to boredom
2. Parasitic lifestyle
3. Poor behavioural controls
4. Early behavioural problems
5. Lack of realistic, long term goals
6. Impulsivity
7. Irresponsibility
8. Juvenile delinquency
9. Revocation of conditional release [from prison]

Other items
1. Many short term marital relationships
2. Promiscuous sexual behaviour
3. Criminal versatility

There is evidence to suggest that psychopathy in children and adolescents can also be split into two dimensions: an impulsivity/conduct problems (ICP) dimension and a CU dimension (Frick et al., 1994). However, the results of studies examining the relationships between psychopathy dimensions and anxiety within child/adolescent groups do not always mirror those obtained within adult samples (Kahn et al., 2013; Kubak & Salekin, 2009; Lee et al., 2010). For example, Lee et al. (2010) found that high psychopathic traits (on all dimensions) were associated with high anxiety. Additionally, Kubak and Salekin (2009) found that anxiety mediated the relationship between psychopathy and offending in a sample of antisocial adolescents. Specifically, “higher levels of anxiety were linked to higher levels of psychopathy and higher levels of offending” (Kubak & Salekin, 2009, p. 281). It is possible that this reflects developmental differences between child and adult psychopathy (Lee et al., 2010). However, it may also reflect the fact that anxiety and fear are often conflated. For example, Dolan and Rennie (2007) found that trait anxiety and harm avoidance (i.e., fearfulness) showed different associations with psychopathic traits: anxiety showed no significant correlation, whereas harm avoidance was significantly negatively correlated with psychopathic traits.

1.5 Conclusion

In summary, many individuals with CD display comorbid anxiety. However, this relationship is complicated by the heterogeneity associated with CD, the differences among ADs, and the

presence of CU traits in many individuals with CD. In addition, both the mechanisms underlying the comorbidity of CD+ADs and its effects on developmental outcomes are unresolved. Chapter 2 will focus on the potential neuropsychological similarities and differences between CD and anxiety, and will examine the emotion processing impairments and biases associated with each disorder.

Chapter 2 Conduct disorder and anxiety: emotion processing

Chapter 1 examined the overlap between CD, anxiety and CU traits in terms of clinical and personality characteristics. Chapter 2 considers the neuropsychological similarities and differences between CD and anxiety, focusing particularly on emotion processing.

2.1 Social information processing and the influence of emotions

According to social information processing (SIP) theory (Crick & Dodge, 1994; Dodge, 1986), an individual's behavioural response to a situational stimulus is determined by a series of processing steps, which are influenced by their "database" of memories of past experiences (see Figure 2.1, black areas): i) *Encoding*. Stimuli are selected for processing via selective attention and/or sensory input; ii) *Interpretation and mental representation*. The individual interprets the stimulus and applies meaning to it for use in memory storage systems; iii) *Clarification of goals*. The individual selects a goal or desired outcome; iv) *Response accessing*. One or more possible behavioural and/or affective responses (e.g., vocalisations, motor and physiological responses, autonomic arousal) are associated with the mental representation and/or the goal as a result of prior conditioning; v) *Response evaluation*. The individual applies decision-making strategies to decide which (if any) response to enact (although it may not be possible to withhold, for example, physiological responses); vi) *Enactment.* The individual produces the resulting behaviour. These processing steps occur continuously during social interactions, and may be conscious or unconscious. Dodge (1993, p. 563) suggests that SIP theory "can be extended to describe and to explain general patterns of deviant behavior [sic] and child psychopathology". For example, biases or deficits within certain stages of SIP have been linked to the development of CD (Dodge, 1993; Dodge & Pettit, 2003), aggression (Dodge & Coie, 1987; Dodge et al., 1990) and ADs (Daleiden & Vasey, 1997).

Whilst the role of emotion in the original SIP model was not explicitly stated, Crick and Dodge (1994) acknowledged that emotion processes are integral to the social interactions described by their model (e.g., internal emotional states, external emotional cues, emotional relationship with peers, etc.). Subsequently, Lemerise and Arsenio (2000) adapted Crick and Dodge's (1994) model to fully integrate emotion processing in the cycle of encoding social information and accessing potential responses (see Figure 2.1, red areas). Lemerise and Arsenio suggest that the way in which an individual accesses their database of acquired memories and social knowledge is influenced by their internal emotional state (e.g., a negative mood state is likely to facilitate the access of negative memories), and will therefore impact upon many or all of the SIP stages. Furthermore, the presence of external emotional cues may influence the way in which cues are encoded and interpreted, therefore impacting upon later SIP stages. Of particular relevance to the present thesis are the processes that occur during stages 1 and 2 of the model: the selection and encoding of external emotional

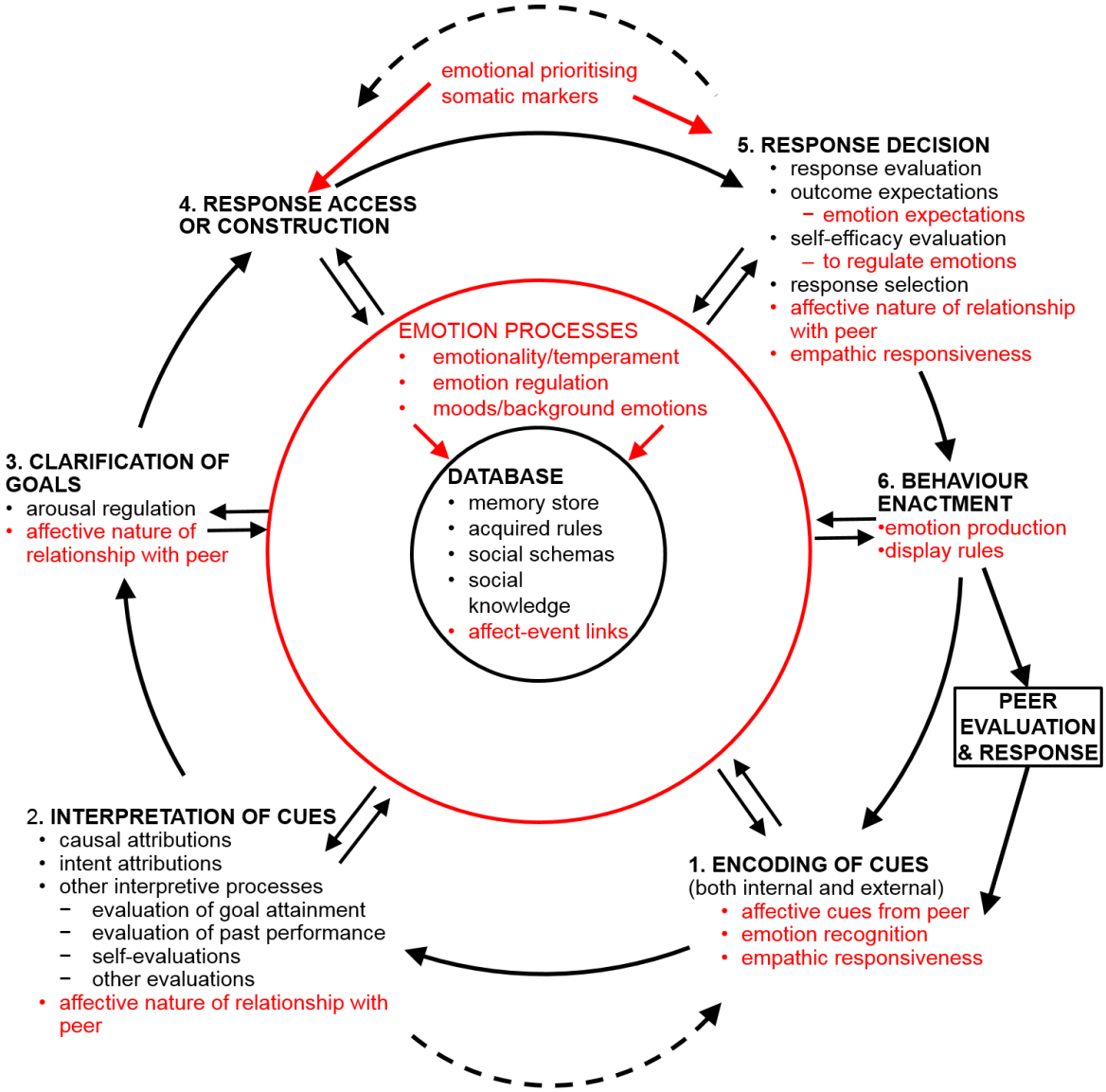

Figure 2.1: A social information processing model integrating cognitive and emotion processes. Items in black are reproduced from Crick and Dodge (1994). Items in red are reproduced from Lemerise and Arsenio (2000).

cues, emotion recognition, and the interpretation of the encoded cues (e.g., as hostile or neutral).

When an individual encounters a social situation, a large amount of information is available for processing. Given that the human cognitive system has a limited processing capacity (e.g., Kahneman, 1973), attentional mechanisms are used to select cues for further processing (e.g., Desimone & Duncan, 1995). Thus, selective attention is integral to the encoding stage of the SIP model. Selective attention is influenced by a number of factors, both internal (e.g., the individual's pre-existing biases) and external (e.g., the salience of the cue), and may take place both automatically (i.e., without conscious effort or control) and deliberately (i.e., with conscious effort). Desimone and Duncan (1995) suggest that

individuals use a balance of automatic, stimulus-driven (bottom-up), and controlled (top-down) processes to select cues for further processing. In healthy individuals, this balance of top-down and bottom-up mechanisms serves to reduce cognitive load, and may serve as an evolutionary advantage (i.e., allowing rapid detection of environmental threats), whilst maintaining control of attention when needed (e.g., when completing a task requiring attentional focus). However, when the balance tips too far in favour of either of these mechanisms, individuals may become sensitive to specific aspects of the stimulus (e.g., threatening content, in the case of individuals with ADs) at the expense of attentional control (Bishop, 2007), or overly goal-directed and relatively insensitive to task-irrelevant stimuli (as may be the case in psychopathy; Blair & Mitchell, 2009; Newman & Lorenz, 2003). Emotional stimuli have been found to benefit from a processing advantage: individuals have been found to respond quickly and involuntarily to these stimuli, even when they are masked (Mogg & Bradley, 1999) or presented outside of the focus of attention (Stenberg et al., 1998). Therefore, emotion recognition may impact on the encoding stage of the SIP model. Once cues are encoded, they are then interpreted for representation in memory systems. During this phase, the meanings of the encoded cues are evaluated (Crick & Dodge, 1994). If the cue is ambiguous (e.g., a mild, or neutral, facial expression), then its final appraisal (i.e., whether the face is positive or negative) will affect how the individual acts upon this information.

In healthy individuals, the perception and accurate recognition of others' emotions serves to facilitate social interactions. Indeed, previous research has found that children's understanding of others' emotions is related to the development of prosocial behaviour (e.g., Marsh & Ambady, 2007). Conversely, biases and deficits in emotion processing are linked to antisocial behaviour in general (Marsh & Blair, 2008), CD (Euler et al., 2014; Fairchild et al., 2009a; Fairchild et al., 2008), psychopathy (Kimonis et al., 2008; Lorenz & Newman, 2002; Newman, 1998) and anxiety disorders (Bar-Haim et al., 2007; Puliafico & Kendall, 2006).

2.2 Emotion processing in antisocial behaviour

There is a wealth of evidence relating SIP biases/deficits to emotion processing to antisocial behaviour. As such, emotion processing (and particularly early-stage emotion processing) plays an important role in various theoretical models of antisocial behaviour. However, work tends to fall into two categories: one focusing on aggressive behaviour, and another focusing on psychopathy. Whilst both of these strands of research may be applicable to CD (as an individual who meets diagnostic criteria for CD may show one or both of these traits), it is important to note that the types of emotion processing deficits described differ according to the two different perspectives. For example, theories of aggressive behaviour suggest that aggressive individuals show *hyper*sensitivity to negatively-valenced (and, in particular, threatening) emotional cues (Smith & Waterman, 2003) and a hostile attribution bias (de Castro et al., 2002). Conversely, theories of psychopathy suggest that psychopaths (or individuals with CU traits) are generally *hypo*sensitive to emotional cues (Blair & Mitchell,

2009; Lykken, 1995; Newman et al., 1997) or that they have specific difficulties recognising facial expressions conveying distress, such as fear and sadness (Marsh & Blair, 2008).

2.2.1 Emotion processing and aggression

Emotion processing in aggressive individuals has often been studied within a SIP framework. Indeed, Dodge's (1986) model was developed to explain social dysfunction and aggressive behaviour in children. As described above, whilst the original SIP model did not specifically integrate the role of emotion, it was noted as an important factor in social interactions (Dodge & Pettit, 2003; Lemerise & Arsenio, 2000). Studies testing the SIP framework in aggressive children have found biases in the encoding and interpretation stages of SIP. In particular, hostile attribution bias (or hostile attribution of intent) has been widely studied in aggressive individuals, and a tendency for aggressive individuals to attribute hostile intent to peers in ambiguous social situation is commonly found (Crick & Dodge, 1996; for a meta-analysis, see de Castro et al., 2002; Dodge & Coie, 1987; Dodge et al., 1990; Nas et al., 2005; Schwartz et al., 1998). In addition, this bias is more pronounced in clinic-referred samples compared to non-referred community samples (see de Castro et al., 2002).

Measures of hostile attribution bias (HAB) tend to be vignette-based: for example, participants listen to (or read) a vignette involving a social interaction in which someone is provoked by a peer, and are then either asked questions about it (e.g., "why did he do it?"), or asked to rate the intent of the provoker on a benign-hostile scale. However, this assumes a level of verbal comprehension that may not be present in individuals with CD, given the cognitive impairments associated with the disorder (e.g., Moffitt, 1993b). To overcome this problem, a small number of studies have used tasks involving the recognition of ambiguous facial expressions to measure HAB. For example, Schönenberg and Jusyte (2014) used morphed facial expression stimuli, where two emotions (either angry-happy, angry-fearful or happy-fearful) were blended together in varying proportions (90:10, 70:30 and 50:50), in a facial affect recognition task. The authors found that incarcerated male violent offenders were more sensitive to anger in the expressions containing relatively low proportions of anger than controls. Also, in an expression recognition task using neutral faces but with no "neutral" response option, Hoaken et al. (2007) found that incarcerated male violent offenders were more likely to label neutral faces as disgusted compared to incarcerated non-violent offenders. In the only study (to our knowledge) involving clinic-referred adolescents, Nasby et al. (1980) found that a self-reported measure of aggression was associated with the tendency to interpret ambiguous non-verbal social stimuli (facial expressions and body postures) as hostile. However, this study did not employ a non-clinical control group, therefore it was not possible to assess the potential mediating influence of psychopathology. Studies involving normative samples have found that self-reported measures of aggression are associated with the tendency to perceive ambiguous facial expressions as hostile (Burt et al., 2009; Knyazev et al., 2008).

As well as displaying HABs, individuals with high levels of aggression or trait anger tend to show attentional biases towards threatening stimuli (Cohen et al., 1998; Eckhardt & Cohen, 1997; van Honk et al., 2001a). For example, van Honk et al. (2001a) found that, in adults, an attentional bias towards angry faces was related to increased levels of trait anger. Additionally, using an emotional Stroop task, Eckhardt and Cohen (1997) found interference effects of angry words in high-trait-anger individuals only (although it should be noted that participants had been insulted prior to completing the task to induce anger). This suggests that aggressive individuals are likely to show increased interference effects from threatening (and specifically angry) stimuli. However, the above studies used trait-level measurements of anger in normative samples. Few studies have examined attentional biases in children or adolescents, forensic samples, or samples of individuals with clinically significant aggressive behaviour, and the results of existing studies have been mixed. For example, one study involving a large sample of school children found that attentional biases towards aggressive words were uniquely related to questionnaire measures of trait anxiety, rather than measures of aggression (Reid et al., 2006). Similarly, Kimonis et al. (2006) found that, in a sample of school children, a high level of aggression was associated with an attentional bias towards pictures conveying distress, but only in those with low levels of CU traits. Further studies by the same research group found differential effects of aggression, CU traits, and prior arrests on attentional biases to distressing images (Kimonis et al., 2007, 2008). Specifically, high levels of CU traits were associated with an avoidance of distress (this will be discussed further in the following section). Conversely, high levels of reactive aggression and a higher number of previous arrests (in combination with low CU traits) were associated with increased vigilance towards distress. In a study involving incarcerated adult offenders, Smith and Waterman (2003) found that violent offenders displayed attentional biases towards aggressive words in a visual probe task compared to non-forensic controls. They also found that the violent offenders displayed increased interference from aggressive words in an emotional Stroop task compared to controls.

In summary, aggressive individuals tend to interpret ambiguous social information (including ambiguous facial expressions) as hostile, and have been found to display attentional biases towards threatening stimuli. However, there are few studies examining either HABs or attentional biases in children or adolescents with clinically significant aggressive behaviour (i.e., with CD), and there is some evidence that other characteristics associated with CD such as CU traits or anxiety may have differential effects on these processing biases.

2.2.2 Emotion processing and psychopathy

Individuals with psychopathy have been found to show hypo-reactivity to emotional stimuli, and some authors suggest that this may reflect a problem with selective attention (Baskin-Sommers et al., 2011; Lorenz & Newman, 2002; MacCoon et al., 2004; Vitale et al., 2007). For example, Newman and colleagues (Lorenz & Newman, 2002; MacCoon et al., 2004; Newman & Lorenz, 2003) have proposed a response modulation (RM) hypothesis,

suggesting that psychopaths show deficits in both top-down and bottom-up mechanisms of selective attention. Specifically, psychopaths are less able to shift the balance of top-down and bottom-up attentional mechanisms to take into account information that is not the primary focus of either the current goal-directed behaviour (i.e., the balance is tipped in favour of top-down attentional control), or the dominant response activated by particular stimuli (i.e., the balance is tipped in favour of bottom-up stimulus features). For example, in tasks where there is a specific goal (e.g., in a picture-word Stroop task), psychopaths are less likely to show interference effects (Hiatt et al., 2004; Newman et al., 1997; Vitale et al., 2007; Vitale et al., 2005), and in tasks involving specific cues/stimuli (e.g., rewards in a risk-taking task), psychopaths are likely to commit more errors than non-psychopaths (e.g., Budhani & Blair, 2005). Furthermore, the results of lexical decision tasks (where a participant is asked whether a presented letter string is a word or not) suggest that psychopaths are insensitive to emotional cues. These tasks generally show that normal individuals are quicker to respond to emotional words than to neutral words (e.g., Strauss, 1983). However, Lorenz and Newman (2002) found that low-anxious psychopaths (or primary psychopaths, see Chapter 1) showed significantly less emotion facilitation than controls (i.e., they were not quicker to discriminate emotional compared to neutral words), whilst showing similar error rates.

Eva Kimonis and colleagues (Kimonis et al., 2012; Kimonis et al., 2006; Kimonis et al., 2007, 2008) have investigated attention in antisocial youths with CU traits using a visual probe task with emotional pictures. In the first of these studies, Kimonis et al. (2006) examined attention in a non-referred sample of children with self-reported CU traits. The authors used threatening, distressing, positive and neutral pictures from the International Affective Picture System (IAPS; Lang et al., 2008) in a standard visual probe task. It was found that low CU traits, combined with high levels of self-reported aggression, were associated with attentional biases towards distressing images. However, this was a non-referred sample with relatively low levels of CU traits and aggression. In an extension of this study with adolescent male prisoners, Kimonis et al. (2007, 2008) found further evidence to support an interaction of CU traits with aggression on attentional biases towards distressing images. Specifically, high levels of aggression and low CU traits were associated with biases towards distressing images (Kimonis et al., 2008). Conversely, low levels of aggression and low CU traits, as well as high levels of aggression and high CU traits were associated with avoidance of distressing images (Kimonis et al., 2007, 2008). However, the low levels of CU traits and aggression in the sample described above were only low in a relative sense and not in an absolute sense, as no true control group was included in these studies.

Another line of research involves the effects of psychopathy on facial emotion recognition. The interest in facial expression recognition in antisocial populations stems from theories of the role of empathy in prosocial behaviour (Blair & Coles, 2000). Eisenberg and Eggum (2010) suggest that empathy is important in the inhibition of aggression and antisocial behaviour, the promotion of prosocial behaviour, and the quality of interpersonal

relationships. Empathy is an emotional response, in which the individual mirrors the emotions of another person. The ability to recognise the emotions of others is therefore a key step in eliciting an emotional response (Eisenberg & Strayer, 1990). Deficient empathetic responding is also a key part of theories of psychopathy (Ali et al., 2009; Blair, 2005b, 2008; Cleckley, 1976), and forms part of the PCL-R criteria (Hare, 2003) (see Chapter 1). In the child and adolescent literature, deficits in recognising certain facial expressions have been linked with both CD and CU traits (Blair & Coles, 2000; Collin et al., 2013; Dadds et al., 2008; Dadds et al., 2006; Fairchild et al., 2010; Fairchild et al., 2009a; Stevens et al., 2001).

In the psychopathy literature, studies tend to show that adolescents with CU traits are impaired in recognising fearful and sad facial expressions (Blair & Coles, 2000; Blair et al., 2001; Dadds et al., 2006; Stevens et al., 2001). Results such as these support Blair's (Blair, 1995; Blair et al., 1997) Violence Inhibition Mechanism (VIM) theory of psychopathy. This theory posits that distress cues (such as facial expressions of fear and sadness) in response to anticipated or actual violent acts trigger the activation of the VIM in normal individuals, which in turn elicits a withdrawal response (as distress cues are experienced as aversive). Over time, typically-developing individuals learn to stop using aggression to achieve their goals through a process of aversive conditioning – they learn that physically harming others will elicit distress cues in the victim. Blair suggests that this mechanism is impaired in individuals with psychopathy, which means that the learning process is much slower or fails to take place, and as a result they are at increased risk for displaying instrumental aggression. An inability to recognise distress cues is one possible explanation for this VIM impairment in psychopathic individuals.

However, the above-mentioned studies have not taken account of the severity of conduct problems (CPs) when examining the relationship between CU traits and emotion recognition, or vice versa; participants are typically grouped by CD or CU traits. Alternatively, total scores on psychopathy questionnaires (i.e., combining CPs and CU traits) have been used in correlational analyses. It is therefore possible that CPs may interact with psychopathy. For example, in a study of 73 children assessed for CPs and CU traits, Woodworth and Waschbusch (2008) found that the combination of CPs and CU traits predicted recognition accuracy of fearful facial expressions. Specifically, children with high CU traits (regardless of the level of CPs) did not perform worse than controls, but children with low levels of CU traits and high CPs had deficits in recognising fearful facial expressions (Woodworth & Waschbusch, 2008).

In summary, individuals with psychopathy have been found to be hypo-reactive to emotional stimuli. Whilst this may be attributed to problems with attention in this group, few studies have specifically measured attentional biases in adolescents with CU traits. Furthermore, adult psychopaths and adolescents with CU traits have been found to show deficits in the recognition of emotions, and particularly those signalling distress (i.e., fear or sadness).

However, it is not always clear whether the observed effects are due to CU traits, conduct problems, or a combination of the two.

2.2.3 Emotion processing in conduct disorder

A small, but growing, body of studies have examined emotion processing in adolescents with clinical or research diagnoses of CD (rather than adolescents with a broader pattern of conduct problems, CU traits, or aggression, as assessed using questionnaires). These studies have tended to focus on facial emotion recognition. For example, Fairchild et al. (2009a) found that adolescents with childhood-onset CD showed deficits in recognising angry, disgusted, fearful and happy facial expressions, compared to controls. These findings suggest that adolescents with CD may show general deficits in emotion recognition, compared to controls. Using the same task in a sample of adolescent girls with CD, Fairchild et al. (2010) found that the CD group showed impairments in labelling facial expressions of anger and disgust compared to controls. Most recently, Sully et al. (2015) found that adolescents with CD showed deficits in anger, fear, happiness, sadness, and surprise recognition compared to controls. Conversely, Pajer et al. (2010) found no evidence of facial expression recognition deficits in adolescent girls with CD. The issue of gender is potentially important in studies of emotion recognition, as there is evidence to suggest that females show enhanced facial expression recognition relative to males (McClure, 2000). A further study by Guyer et al. (2007) found no significant differences in emotion labelling errors between a combined group of adolescents with either CD or ADHD and controls. However, task difficulty may have been a factor here, with potential ceiling effects influencing the interpretation of these findings.

Further studies in the psychophysiological literature have found reduced autonomic reactivity to emotional stimuli in CD individuals compared to controls. For example, Fairchild and colleagues (2010; 2008) found reduced galvanic skin responses to conditioned aversive stimuli, as well as reduced startle responses to startle probes in the presence of emotional images, in adolescent boys and girls with CD compared to controls. These results suggest that individuals with CD may be hypo-reactive to emotional stimuli (including facial expressions) and do not condition effectively to aversive stimuli. They may also show attenuated responses to aversive unconditioned stimuli such as loud noises.

Another promising area of research in CD has been within the field of functional neuroimaging. A number of functional magnetic resonance imaging (fMRI) studies have found that adolescents with CD show reduced activation in areas of the brain involved in emotion processing whilst viewing facial expressions or other affective stimuli. For example, Sterzer et al. (2005) found that adolescent males with CD showed a reduced response in the anterior cingulate cortex when viewing negative (compared to neutral) images compared to controls. Furthermore, Passamonti et al. (2010) found that adolescent males with CD showed reduced responses to angry and sad (compared to neutral) facial expressions in a number of brain areas, including the amygdala, compared with controls.

Taken together, these findings suggest that individuals with CD show deficits in emotion processing, similar to those found in both aggressive and psychopathic individuals. Such deficits might be explained by dysfunction in limbic brain regions in this group.

2.3 Emotion processing in anxiety disorders (ADs)

Early models of information processing biases in anxiety have tended to focus on the propensity for anxious individuals to pre-attentively direct their attention towards (or redirect their attention away from) threat (MacLeod et al., 1986). This is primarily due to early research failing to reliably find biases in later information processing stages (e.g., memory retrieval; Mogg et al., 1987). However, subsequent research has demonstrated that anxious individuals also show attentional biases towards moderately threatening stimuli (Mathews & Mackintosh, 1998; Mogg et al., 1987; Wilson & MacLeod, 2003) and tend to interpret ambiguous stimuli as threatening (Constans et al., 1999; Richards et al., 2002). This suggests that anxious individuals also show alterations in later, evaluative, stages of information processing.

2.3.1 Selective attention in anxiety disorders

There is a large evidence base on the role of altered selective attention in the development and maintenance of ADs (Beck & Clark, 1997; Beck et al., 1985; Eysenck et al., 2007; Hofmann et al., 2012; Mathews & Mackintosh, 1998; Mogg & Bradley, 1998). For example, schema-based theories (e.g., Beck & Clark, 1997; Beck et al., 1985) suggest that anxious individuals have schemas that bias all stages of information processing towards threat - including selective attention. Indeed, there is a considerable body of evidence showing that anxiety has a significant effect on performance in cognitive tasks that involve threat-related stimuli (e.g., Derakshan & Eysenck, 2009). Specifically, anxious individuals tend to display attentional biases towards threat, characterised by both facilitation and interference effects in selective attention tasks (see Bar-Haim et al., 2007; Cisler et al., 2009; Lau et al., 2012; MacLeod et al., 1986; Mogg & Bradley, 1998; Williams et al., 1996). A number of theoretical accounts for this threat-related attentional bias in anxiety have been proposed (see Cisler & Koster, 2010). However, these models do not all agree upon the specific mechanisms of this threat-bias in anxiety, only that there is some underlying pre-attentive threat detection mechanism.

From an attentional control theory (ACT; Eysenck et al., 2007) perspective, anxiety increases the allocation of attention to threat-related stimuli, thereby reducing attentional focus on task-relevant stimuli (unless the latter are also threat-related), and impairing attentional control. Specifically, anxiety is characterised by deficits in the top-down attentional control functions of inhibition (i.e., supressing automatic/dominant responses) and shifting (i.e., switching attention depending on task demands, see Eysenck et al., 2007). This means that individuals with anxiety are more likely to show rapid detection of threat, are more likely to be distracted by threatening stimuli even when instructed to ignore them (i.e.,

unable to inhibit their dominant response – to attend to the threat), and are less efficient in tasks that involve deliberately shifting attention to focus on task-relevant features in the presence of task-irrelevant threatening stimuli.

Much of the evidence used to support this theory has come from the large number of studies of selective attention in adults (see Bar-Haim et al., 2007; Williams et al., 1996). However, the study of selective attention in child and adolescent samples is growing, and these also provide evidence for an anxiety-related attentional bias towards threatening stimuli (Bar-Haim et al., 2007). Although the majority of studies in this area have used verbal stimuli (typically written words), there is now a small, but growing, body of studies that have used threatening images and facial expressions to measure selective attention. For example, studies have used emotional faces and images as stimuli in selective attention paradigms (e.g., visual probe, emotional Stroop, and visual search tasks). Consistent with the results of visual-probe tasks in adults, studies using emotional facial expressions in visual probe tasks with child and adolescent samples show an anxiety-related bias towards threat. For example, biases towards threatening faces have been found in children with high trait-level anxiety (e.g., Stirling et al., 2006; Susa et al., 2012; Telzer et al., 2008; Zhao et al., 2014), as well as full anxiety disorders (e.g., Price et al., 2014; Roy et al., 2008; Waters et al., 2013; Weissman et al., 2012). Similarly, Stroop and visual search tasks employing emotional faces have shown interference from threat in anxious individuals (e.g., Richards et al., 2007; Waszczuk et al., 2015).

In summary, although the study of selective attention towards emotional faces in children and adolescents with anxiety is still in its relative infancy, studies in this area have tended to show an anxiety-related attentional bias towards threat, consistent with the adult literature.

2.3.2 Emotion recognition in anxiety disorders

As described above, some theories of anxiety propose that deficits in attentional control are responsible for the threat-bias effects seen in anxious groups. However, other theories propose that attention is allocated to threat only after the threat has been appraised in some way. For example, Mathews and Mackintosh (1998) suggest that stimuli are automatically evaluated via a threat evaluation system (TES). If the output from the TES exceeds a certain threshold, further attentional resources will be allocated towards the threat via a threat representation system. The presence of elevated anxiety lowers this threshold, and therefore stimuli with a lower threat value are likely to command additional attentional resources. Similarly, Mogg and Bradley (1998) suggest that an automatic valence evaluation system is responsible for the initial appraisal of stimuli. The output from this system is, again, suggested to be modulated by anxiety, with highly anxious individuals being more likely to evaluate mildly threatening or ambiguous stimuli as threatening than low-anxious individuals.

The evidence for a biased interpretation of ambiguous stimuli in anxiety is, however, mixed. For example, socially anxious participants have been found to interpret interpersonal stories as more threatening than controls (Constans et al., 1999), individuals with social phobia

have been found to interpret neutral facial expressions as angry (Bell et al., 2011), and individuals with high levels of trait anxiety have been found to more readily interpret ambiguous facial expressions as fearful (Richards et al., 2002). However, other studies of subjective ratings of facial expressions have not found any differences in the interpretations of ambiguous expressions between anxious participants and controls (Jusyte & Schönenberg, 2014). Despite these mixed findings, it is possible that anxious individuals may still show biased *automatic* evaluation of valence – a bias that may be overruled by higher-order cognitive processes in the tasks highlighted above. As such, there has been increased interest in the measurement of automatic (or implicit) associations in anxiety as well as other forms of psychopathology, including anxiety (Huijding et al., 2010; Roefs et al., 2011).

In addition to this, there is a growing interest in examining the recognition of unambiguous facial expressions in anxious children and adolescents. However, the results of these studies have also been mixed: some studies find deficits (Easter et al., 2005; Jarros et al., 2012; Melfsen & Florin, 2002; Simonian et al., 2001), whilst others do not (Guyer et al., 2007; Manassis & Young, 2000; McClure et al., 2003). This may be due to the variation in methodologies used across these studies, or the nature of the samples employed. The studies vary in terms of the type of anxiety studied (e.g., GAD vs. social phobia vs. mixed anxiety disorders group), its measurement (e.g., questionnaires vs. clinical assessments), and the task design (e.g., task difficulty).

For example, Melfsen and Florin (2002) found that whilst there were no specific deficits in labelling emotions, children with high scores on a social anxiety questionnaire took significantly longer than controls to categorise facial expressions, and were more likely to label neutral faces as displaying emotion (either positive or negative). However, no other symptoms of anxiety were assessed, and therefore it is not known whether there was any comorbidity in the sample that may have affected the results. In a further study, Simonian et al. (2001) found that adolescents with diagnoses of social phobia made more errors than controls when labelling facial expressions, especially happy, sad or disgusted expressions. However, these results were limited by the small sample size.

Jarros et al. (2012), examining facial expression recognition in a group of adolescents with anxiety disorders (social phobia, GAD and SAD), found that anxiety was associated with deficits in recognising angry faces, compared to controls. In addition, the authors found enhanced recognition of neutral faces in the anxious group, compared to controls.

In summary, whilst there is a sound theoretical argument, supported by research in adults, that anxiety should be associated with biased interpretations of emotional stimuli, the studies performed to date in children and adolescents have yielded mixed findings.

2.4 Emotion processing in individuals with comorbid conduct disorder and anxiety disorders – a gap in the literature

Despite the evidence that both CD (including individuals with psychopathic and/or aggressive traits) and ADs are associated with altered information processing, as well as the well-documented comorbidity of CD and ADs, little is known regarding emotion processing in individuals with both CD and ADs. Furthermore, the little that is known is based on studies examining the effects of trait-level anxiety on emotion processing in individuals with psychopathy/CU traits, CD or antisocial behaviour.

For example, studies of adult psychopathy have found that primary (low-anxiety) and secondary (high anxiety) variants differ in emotion processing: the finding that psychopaths are hyposensitive to emotional stimuli tends to be specific to primary psychopathy (van Honk & Schutter, 2006), although this is not always the case (e.g., Glass & Newman, 2006). In a study on male juvenile offenders, Kimonis et al. (2012) found that individuals who displayed both high CU traits and high anxiety (secondary psychopathy) showed vigilance towards distressing images, whilst those with high CU traits and low anxiety (primary psychopathy) showed avoidance of distressing images in a dot-probe task. Kimonis et al. (2012) suggest that these differences in the processing of distress may indicate differences in temperament between the primary and secondary psychopathy groups. However, whilst the authors used a comparison group of low CU juvenile offenders, these were not split into groups of high and low anxiety, and there was no high-anxiety control group. Therefore, it is not clear whether the differences in emotion processing found were due to the interaction of CU traits and anxiety, or the interaction of conduct problems and anxiety.

There are a number of possible reasons for the true (rather than artefactual) comorbidity of two disorders: they may be two manifestations of the same disorder; they may represent two stages of the same underlying condition; they may share the same, or have correlated, risk factors; the comorbid condition may be a separate disorder; and one condition may predispose to the second condition or act as a precursor (Rutter, 1997). Whilst longitudinal study designs are required to fully test whether CD and ADs are distinct or shared conditions, it is possible to examine differences in symptomatology as well as the differences in correlates that are likely to reflect aspects of causal processes using cross-sectional research designs (Rutter, 1997). Previous studies have found both exacerbating and attenuating effects of the presence of anxiety on the severity of CD (Biederman et al., 1991; Cunningham & Ollendick, 2010; Kendall et al., 2001; Lilienfeld, 2003; O'Brien & Frick, 1996; Sourander et al., 2007). However, no study has examined the effects of CD+ADs comorbidity on the neuropsychological characteristics associated with the development of CD and ADs (e.g., information processing biases or deficits in emotion recognition).

An exacerbating effect of comorbid CD+ADs would support an additive/synergistic model of comorbidity, whereby the characteristic information processing styles of individuals with CD or ADs are combined when the two disorders co-occur. For example, Bubier and Drabick

(2009) suggest that one reason for the co-occurrence of anxiety and disruptive behaviour disorders (DBDs; including CD) is the presence of shared risk-factors, including: temperamental differences, alterations in autonomic arousal and biases in information processing. The authors propose that a difficult temperament (e.g., irritability, negative emotionality), autonomic hyperarousal in stressful situations, and the presence of threat-related information processing biases (i.e., hypervigilance to threat, and HABs), result in an increased likelihood of experiencing negative emotional states (e.g., anxiety and fear), and an increased likelihood of displaying reactive aggression (see Figure 2.2). Alternatively, an attenuating effect of comorbid CD+ADs would suggest that CD and ADs are associated with opposing information processing styles that counteract each other (e.g., Kerr et al., 1997).

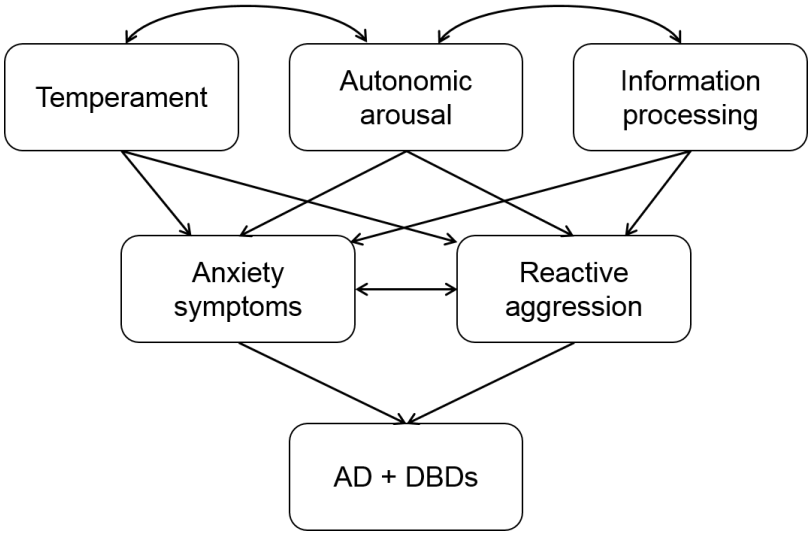

Figure 2.2: Model explaining the co-occurrence of anxiety disorders (AD) and disruptive behaviour disorders (DBDs). From Bubier and Drabick (2009).

In summary, whilst there is a clear link between CD and ADs, and some studies have investigated the effects of CD+ADs comorbidity on CD severity or course, little is known regarding the effects of CD+ADs comorbidity on information processing. It is possible that CD and ADs co-occur due to shared risk factors, one of which may be a disordered information processing style (i.e., hypervigilance to threat and a hostile attribution bias), which would support an additive/synergistic comorbidity model resulting in exacerbated information processing deficits in individuals with comorbid CD+ADs, compared to individuals with CD or ADs alone.

2.5 Thesis aims and outline

The main aim of this thesis is to characterise the clinical and neuropsychological profile of adolescents with comorbid CD+ADs, as compared to those with CD alone, ADs alone, and typically-developing adolescents.

Given the wide range of symptoms associated with both CD and ADs (see Chapter 1), the first objective was to characterise the clinical and personality profiles of individuals with CD alone, ADs alone and comorbid CD+ADs. Following an explanation of the participant recruitment procedures and general methods (in Chapter 3), I will present data on the similarities and differences in clinical, personality and demographic characteristics between adolescents with CD and comorbid CD+ADs, and between adolescents with ADs and comorbid CD+ADs (Chapter 4).

Following this, in Chapter 5, I will present the results of a series of selective attention tasks, examining the effects of CD, ADs and comorbid CD+ADs on attention to threat. Given that early information processing biases have been associated with both CD and ADs, I examined whether the presence of comorbid CD+ADs resulted in the exacerbation of information processing deficits, or a more typical (i.e., similar to controls) information processing style.

In Chapter 6, I will present the results of an emotion recognition task, again examining the effects of CD, ADs and comorbid CD+ADs on the ability to discriminate a range of emotional faces, and whether there are any recognition biases associated with these disorders. This task also included neutral facial expressions to examine whether those with CD, ADs or comorbid CD+ADs show biases in the interpretation of ambiguous social stimuli.

In Chapter 7, I will present a general discussion of the findings, how they can be integrated within the existing literature, and their implications for future research.

Chapter 3 General methods

This chapter will describe the clinical assessments, questionnaire measures and procedures used in the remainder of this thesis. The neuropsychological tasks and additional assessments will be described in greater detail within the main thesis chapters describing the results for each neuropsychological domain.

3.1 Ethical approval

Ethical approval was obtained from the University of Southampton Ethics Committee, the Southampton City Council Children's Services and Learning Directorate, and the Hampshire County Council Research and Evaluation Unit. These additional ethical approvals were needed in order to recruit participants from the Southampton Youth Offending Service and the Hampshire Youth Offending Team, respectively, as well as pupil referral units and education centres in these locations.

3.2 Participants

One hundred and four adolescent males and females aged 10-18 years were recruited from secondary schools, colleges, Youth Offending Teams (YOTs) and Education Centres/Pupil Referral Units (PRUs) in the Southampton and Hampshire area. Participants were assigned to one of the following study groups: conduct disorder only (CD-only); anxiety disorder only (ADs-only); comorbid CD and AD (comorbid CD+ADs); and the healthy control group. Power calculations conducted in G*Power 3.1.7 (Faul et al., 2007) indicated that a total sample size of 100 (25 in each group) would be required to detect significant main effects and interactions (based on a medium effect size, an alpha level of 0.05, and a power of 0.80).

3.2.1 Inclusion criteria

Participants were included in the study if they were:

- Aged 10-18 years.
- Fluent in spoken English.
- Met DSM-IV criteria for CD/oppositional defiant disorder (ODD), and/or one or more ADs (clinical groups).
- Free of any assessed present/lifetime DSM-IV disorder (control group).

The Kiddie Schedule for Affective Disorders and Schizophrenia – Present and Lifetime version (K-SADS-PL; Kaufman et al., 1997) diagnostic interview (see below) was used to assess for the following *DSM-IV* disorders: CD, ODD, Attention-Deficit/Hyperactivity Disorder (ADHD), Generalised Anxiety Disorder (GAD), Social Phobia, Specific Phobia, Panic Disorder, Obsessive Compulsive Disorder (OCD), Major Depressive Disorder (MDD), Alcohol and Substance Abuse, and Posttraumatic Stress Disorder (PTSD).

3.2.2 Exclusion criteria

Participants were excluded if they had:

- An estimated intelligence quotient (IQ) of below 75.
- A clinical diagnosis of psychosis or significant levels of psychotic symptoms.
- A clinical diagnosis of pervasive developmental disorder, or significant levels of autism-spectrum disorder (ASD) symptoms.

IQ was assessed using the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999), psychosis symptoms were assessed using the Adolescent Psychotic-like Symptoms Screener (APSS; Kelleher et al., 2011), and ASD symptoms were assessed using the Autism-Spectrum Quotient (AQ; Baron-Cohen et al., 2001). Due to the high levels of comorbidity among CD, ODD, ADHD, MDD and substance/alcohol abuse disorders, as well as between ADs and MDD, individuals with CD+ODD, CD+ADHD, CD+MDD, CD+substance/alcohol abuse disorders, or ADs+MDD were not excluded from the study. The depression subscale of the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was used to control for the level of depressive symptoms in the subsequent statistical analyses.

3.2.3 CD-only group

Individuals were assigned to the CD-only group if they:

- Met diagnostic criteria for current CD, or
- Met diagnostic criteria for current ODD plus one or more current CD symptoms.

Thirty one participants (24 males) were included in the CD-only group. The degree of comorbidity with disorders other than ADs is presented in Table 3.1, Figure 3.1 and Figure 3.2.

3.2.4 ADs-only group

Individuals were assigned to the ADs-only group if they:

- Met diagnostic criteria for either current GAD, Social Phobia, Specific Phobia, Panic Disorder, OCD or PTSD, and they:
- Did not meet diagnostic criteria for present/lifetime CD, ODD or ADHD.

Twenty three participants (5 males) were included in the ADs-only group. The degree of comorbidity with disorders other than CD and ODD is presented in Table 3.1, Figure 3.1 and Figure 3.2.

3.2.5 Comorbid CD+ADs group

Individuals were assigned to the comorbid CD+ADs group if they:

- Met diagnostic criteria for current CD, or
- Met diagnostic criteria for current ODD plus one or more CD symptoms, and

- Met diagnostic criteria for current GAD, Social Phobia, Specific Phobia, Panic Disorder OCD or PTSD.

Twenty participants (12 males) were included in the comorbid CD+ADs group. The degree of comorbidity with other disorders is presented in Table 3.1, as well as in Figure 3.1 and Figure 3.2.

Table 3.1: K-SADS-PL diagnoses by group

CD (N = 31)		AD (N = 23)		Comorbid CD+ADs (N = 20)	
Diagnoses	N	Diagnoses	N	Diagnoses	N
CD only	16	GAD only	6	CD & GAD	6
CD & MDD	6	GAD, MDD	3	CD, GAD & MDD	5
CD & ADHD	3	GAD & Panic	2	CD, GAD & ADHD	4
CD, ODD & ADHD	1	GAD, MDD & Panic	2	CD, GAD, ADHD & MDD	1
CD, ADHD & MDD	1	GAD, Panic & OCD	2	CD, GAD, ADHD & OCD	1
CD & Substance Abuse	1	Phobias only	2	CD, GAD, MDD & OCD	1
ODD only	2	OCD only	1	CD, GAD, MDD & Panic	1
ODD & ADHD	1	Social Phobia	1	CD, GAD, MDD, OCD & Substance Abuse	1
		GAD & Phobias	1		
		GAD, Panic & Phobias	1		
		GAD, MDD, OCD & Substance Abuse	1		
		Phobias & MDD	1		

Note: AD = Anxiety Disorder; ADHD = Attention-Deficit/Hyperactivity Disorder; CD = Conduct Disorder; GAD = Generalised Anxiety Disorder; MDD = Major Depressive Disorder; OCD = Obsessive-Compulsive Disorder; ODD = Oppositional Defiant Disorder.

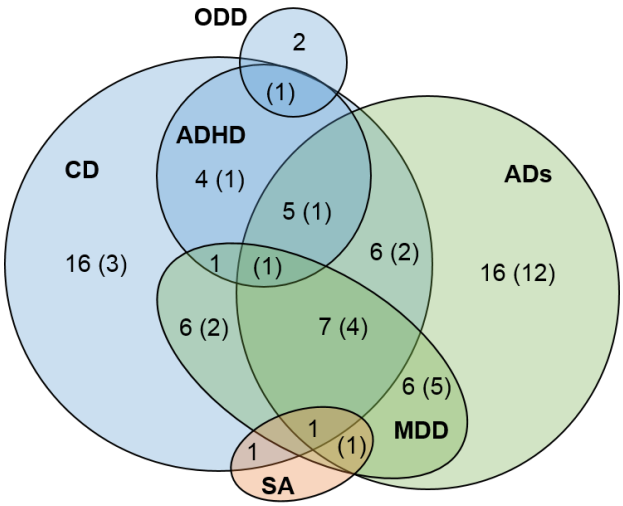

Figure 3.1: Overlap of diagnoses. *Note*: ( ) = females; ADs = anxiety disorders; ADHD = attention-deficit/hyperactivity disorder; CD = conduct disorder; ODD = oppositional defiant disorder; MDD = major depressive disorder; SA = substance abuse.

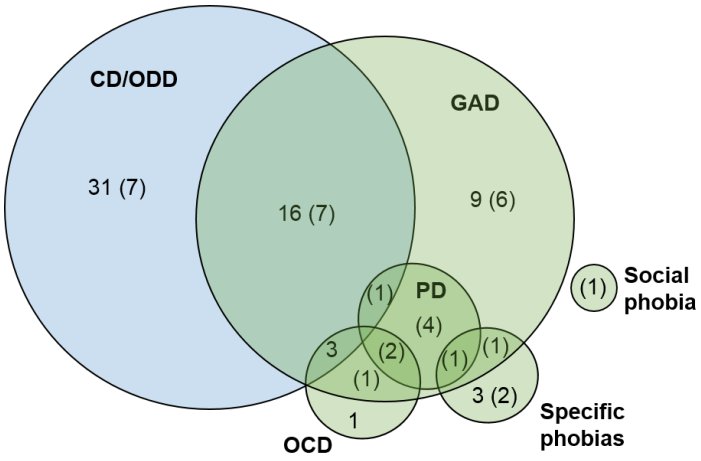

Figure 3.2: Overlap of conduct disorder and/or oppositional defiant disorder (CD/ODD) with specific anxiety disorders. *Note:* ( ) = females; GAD = generalised anxiety disorder; OCD = obsessive-compulsive disorder; PD = panic disorder.

3.2.6 Control group

Thirty typically-developing adolescents (24 males), who were free from any assessed current/lifetime *DSM-IV* disorder were included in the Control group.

3.2.7 Group matching

Whilst the groups were not formally matched in terms of age, IQ or socio-economic status, the following socio-demographic measures were collected: age (measured in years at the initial interview date), gender, estimated IQ score (assessed using the WASI; Wechsler, 1999) and neighbourhood disadvantage (as measured using the Neighbourhood Environment Scale; NES; Crum et al., 1996). Group differences in age, neighbourhood disadvantage, estimated IQ and gender are presented and discussed in Chapter 4.

3.3 Clinical Assessment Procedure

The participants initially responded to invitation letters or flyers sent via their teachers or given to them by their YOT caseworkers. After having replied to a study letter/flyer, having been referred by their YOT caseworker, or having expressed an interest in the study during a recruitment session at a school or college, an initial assessment session was arranged with the participant, either at their home or at the University of Southampton. During this session, the participant and their parent(s)/carer(s) were given further information about the study (both verbally, and via an information sheet). If they agreed to take part, the participant was asked to sign a consent form. If participants were aged 15 or below, they were asked to sign an assent form, and written informed consent was obtained from a parent/carer.

After consent/assent was obtained, the participant and a parent/carer (if available) were interviewed separately using the Kiddie Schedule for Affective Disorders and Schizophrenia – Present and Lifetime version (K-SADS-PL; Kaufman et al., 1997) diagnostic interview. The interviews were administered by two trained researchers in separate rooms: to the adolescents, who answered questions about themselves; and to parents/carers, who answered questions about their children. It was not possible to interview the parent/carer for all of the participants for various reasons, including: the parent/carer declined the invitation to

participate (but still gave consent for their child to take part, if aged under 16 years); there was no parent/carer available to be interviewed (e.g., if the adolescent was living alone, or was estranged from their family); or the participant (if aged 16 years or over) did not want their parent/carer to be involved in the study. In order to maximise the number of participants taking part in the study we based the clinical assessment solely on the adolescent report in cases where no parent/carer data were available.

If the participant was eligible to take part in the study, they were invited to take part in a neuropsychological testing session at the University, during which the neuropsychological tasks were administered and the remaining measures were collected. Participants were debriefed, and asked to sign a debriefing statement following the testing session. Participants and parents/carers were reimbursed for their time following each of the sessions.

3.4 Measures[1]

3.4.1 Clinical, socio-demographic and exclusion criteria measures

3.4.1.1 K-SADS-PL (Kaufman et al., 1997)

This is a semi-structured assessment of a number of current and past child and adolescent *DSM-IV* (APA,1994) and *DSM-III-R* (APA, 1987) disorders. Kaufman et al. (1997) found good inter-rater reliability (ranging from 93% to 100%), good-to-excellent test-retest reliability (κ coefficients ranged from .77 to 1.00), as well as good concurrent validity when compared to other measures of childhood disorders, namely, the Conners' Rating Scales (Conners, 1997), and Child Behaviour Checklist (Achenbach & Rescorla, 2000).

The interview is arranged into two parts: the first part is a screening interview, during which the primary symptoms associated with a wide range of disorders are assessed. In the current study, participants were screened for GAD, Social Phobia, Specific Phobia, Panic Disorder, OCD, MDD, ODD and substance/alcohol use disorders. In the second part of the interview, we assessed for the supplementary symptoms of disorders where the primary symptom criteria were endorsed in the screening interview. CD and ADHD were not included in the screening interview as both the primary and supplementary symptoms for these disorders were assessed during the second part of the interview for all participants, to ensure that we had dimensional information on these disorders for all individuals included in the study.

All symptoms were assessed on a four point scale, where 0 = no information, 1 = not present, 2 = subthreshold, and 3 = definitely present. A symptom was considered present if endorsed at threshold (i.e., given a rating of 3) by either the adolescent or the parent/carer.

[1] All of the materials used in the study are included in Appendix A.

3.4.1.2 Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999)

An estimate of each participant's full-scale IQ was obtained using the two-subtest version of the WASI (Wechsler, 1999). Verbal IQ was measured using the vocabulary subtest, in which participants were required to explain the meaning of words that were both read aloud and shown by the researcher. Performance IQ measured using the matrix-reasoning subtest, in which participants were required to find the missing piece of a matrix from a selection of five options. The summed T-scores for these subtests were then converted to yield an estimate of the participant's full-scale IQ score using normative data for each specific age group.

3.4.1.3 The Autism-Spectrum Quotient (AQ; Baron-Cohen et al., 2001)

This is a 50-item questionnaire that measures presence of autistic-spectrum traits. Items are either positively- (e.g., "I enjoy social chit-chat") or negatively-phrased statements (e.g., "I prefer to do things on my own than with others"), are rated on a scale of 1 to 4 ("Definitely agree" to "Definitely disagree"), and are scored on a scale of 0 to 1 (0 = absent, 1 = present). Scores range from 0 to 50, with a higher score indicating an increased level of autistic-spectrum traits. Baron-Cohen et al. (2001) suggest a cut-off score of 32, indicating a clinically significant level of autistic traits (although this does not indicate a presence of autism, given the lack of information as to the level of distress caused to the individual). None of the participants who completed the testing session had a score of 32 or higher. Internal consistency of the total AQ score in the present sample was acceptable ($\alpha = 0.75$).

3.4.1.4 The Adolescent Psychotic-like Symptoms Screener (APSS; Kelleher et al., 2011)

This is a very brief (7-item) screening questionnaire for psychotic-like symptoms (e.g., "Have you ever heard voices or sounds that no one else can hear?"). Items are scored on a scale of 0 to 1 (0="No", 1="Maybe", 2="Yes, definitely"), with a score of greater than 1 indicating a risk of psychosis. Internal consistency of the scale in the present sample was acceptable ($\alpha = 0.73$). None of the participants was excluded on the basis of having psychotic symptoms.

3.4.1.5 The Neighbourhood Environment Scale (NES; Crum et al., 1996)

This self-report scale consists of 18 true/false items relating to neighbourhood poverty, safety, antisocial behaviour in the community and other related factors, with higher scores indicating higher levels of neighbourhood disadvantage. It was used as a proxy measure for socio-economic status (SES). Internal consistency was good ($\alpha = 0.81$).

3.4.1.6 Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983)

This is a brief (14-item) scale, which provides measures of clinical anxiety and depression. Items are either negatively- (e.g., "I feel tense or wound up") or positively-phrased (e.g., "I can sit at ease and feel relaxed"), and are rated on a scale of 1 to 4, indicating the frequency of these feelings in the past week (e.g., "not at all", "most of the time", etc.). A higher score

indicates increased anxiety and/or depression. Internal consistency for the depression subscale was acceptable in the present sample (Cronbach's Alpha = 0.73).

3.4.2 Additional measures

A number of additional self-reported questionnaire measures were used to examine the personality and clinical characteristics often associated with both CD and ADs. A full discussion of these characteristics is presented in Chapter 4.

3.4.2.1 Externalising traits

Inventory of Callous-Unemotional Traits (ICU; Frick, 2004)

This is a 24-item self-report questionnaire that provides a measure of callous-unemotional (CU) traits. It is based on the CU scale of the Antisocial Process Screening Device (APSD; Frick & Hare, 2001), but does not include items related to antisocial behaviour or irresponsibility. It has been shown to have a three-factor structure (Essau et al., 2006), providing subscale scores for: callousness, uncaring and unemotional traits. Each item is phrased as a statement (e.g., "I do not care who I hurt to get what I want"), and participants are asked to rate how well it describes him/her on a scale of 0 to 3 (from "not at all true" to "definitely true"). Internal consistency of the scale within the present sample (n = 104) ranged from acceptable to good, with Cronbach's alpha values of 0.84, 0.62, 0.76 and 0.79 for the total, unemotional, uncaring and callous scores, respectively.

Youth Psychopathic Traits Inventory (YPI; Andershed et al., 2002)

This is a 50-item self-report measure of psychopathic traits in young people. It consists of ten subscales and three higher-order dimensions; Grandiose-Manipulative (GM), Callous-Unemotional (CU) and Impulsive-Irresponsible (II) dimensions. The items are phrased as statements (e.g., "I have the ability to con people by using my charm and smile"), and rated on a four-point scale (1 = "does not apply at all", 4 = "applies very well"). Higher scores indicate a higher level of psychopathic traits. Within the present sample, internal consistency was good to excellent for both the total score and the higher-order dimensions: total α = 0.95, GM α = 0.91, CU α = 0.82 and II α = 0.90.

Buss-Perry Aggression Questionnaire (BPAQ; Buss & Perry, 1992)

This is a 29-item self-report questionnaire that measures a range of aggressive traits and behaviours. Items are phrased as statements (e.g., "If somebody hits me, I hit back") and each is rated on a five-point scale (1 = "extremely uncharacteristic of me"; 5 = "extremely characteristic of me). Higher scores indicate a greater level of aggression. The scale consists of four subscales, each showing either good or excellent internal consistency in the present sample (n = 104): verbal aggression (α = 0.94), physical aggression (α = 0.88), anger (α = 0.84) and hostility (α = 0.83). Internal consistency for the total score was excellent: α = 0.94.

The Behavioural Inhibition/Activation Scales (BIS/BAS; Carver & White, 1994)

This is a 24-item (four of which are not scored) self-report questionnaire, which provides indices of dispositional sensitivity to Gray's (1987) theoretical motivational brain systems of behavioural activation (or "approach"; BAS) and behavioural inhibition (BIS). Items are phrased as statements (e.g., "I'm always willing to try something new if I think it will be fun"), and scored on a four-point scale (1 = "very true"; 4 = "very false"). All but two items are reverse-scored, such that higher scores indicate increased sensitivity to the BIS and/or BAS. Within the present sample, internal consistency was good for both the BIS (α = 0.79) and BAS (α = 0.88) subscales, respectively.

3.4.2.2 Internalising traits

State-Trait-Anxiety Inventory (STAI; Spielberger et al., 1983)

This 40-item self-report inventory is used in both clinical and research settings to assess levels of trait (i.e., relating to one's personality) and state (i.e. relating to a particular situation) anxiety. State and trait items are separated into two questionnaires, each with 20 items that are rated on a four-point scale (1=not at all; 4=very much so). Items on both forms of the inventory are similar, however participants are required to rate how they "generally feel", and how they feel "right now" on trait and state forms, respectively. Higher scores indicate higher levels of anxiety. The state and trait scales both showed excellent internal consistency in the present sample (state α = 0.93 and trait α = 0.93).

Fear Survey Schedule for Children – Revised (FSSC-R; Ollendick, 1983)

This is an 80-item questionnaire that measures fear/phobic symptoms in a variety of different dimensions: fear of failure and criticism, fear of the unknown, fear of minor injury and small animals, fear of danger and death, and medical fears (Ollendick, 1983). Items are presented as a list of fears (e.g., "Lizards", "Sharp objects"), and the participant is required to state the extent to which they are afraid of each item/scenario on a scale of 0 to 2 ("Not at all"; "Somewhat"; "A lot"). All items are positively scored, and the higher the total score, the more fears an individual has. The scale showed excellent internal consistency in the present sample, with a Cronbach's Alpha of 0.97.

Fear of Negative Evaluation (FNE; Watson & Friend, 1969)

This is a brief (30-item) measure of social anxiety; fear and distress of being evaluated by others (Watson & Friend, 1969). Thirteen of the true/false items are negatively scored (e.g., "I react very little when other people disapprove of me") and 17 items are positively scored (e.g., "If someone is evaluating me I tend to expect the worst"). Higher scores therefore indicate increased anxiety in social situations. The scale showed excellent internal consistency in the present sample (α = 0.91).

3.4.3 Neuropsychological test battery

In addition to the clinical assessments and questionnaire measures, the participants completed a series of four computerised tasks: three tasks examining various aspects of threat perception (the visual probe tasks, threat distractor task and extrinsic affective Simon task; EAST), and one examining facial emotion recognition. These tasks are described briefly below, and full descriptions are included in Chapters 5 and 6.

3.4.3.1 The visual probe tasks

We used two versions of a standard visual probe classification task to examine attentional biases towards emotional (angry, fearful and happy) compared to neutral faces. Participants were asked to respond to an arrow (by indicating its direction) that appeared on a computer screen following the presentation of a pair of images of faces (one emotional and one neutral, either presented for 500ms [version 1] or 17ms and then backwards masked [version 2]). The arrow appeared in the same position as one of the preceding face stimuli. Quicker reaction times (RTs) to the arrow in the position of, for example, the angry compared to the neutral face would indicate an attentional bias towards anger.

3.4.3.2 The threat distractor task

We used a threat distractor task, which was adapted from that used in Ewbank et al. (2009), to measure RT interference from task-irrelevant emotional or neutral faces. Participants were asked to decide whether two spatially-related images matched, in the presence of a second pair of task-irrelevant images. Participants were cued to match either a horizontal or a vertical pair of images. In one condition, participants were required to match images of houses in the presence of task-irrelevant faces (which were either angry, fearful or neutral). In the second condition, participants were required to match images of faces in the presence of task-irrelevant houses.

3.4.3.3 The extrinsic affective Simon task (EAST)

Similar to the threat distractor task, the EAST was used to examine interference from task-irrelevant emotional or neutral faces; however, the conditions varied by colour rather than spatial layout. Specifically, participants were asked to classify coloured emotional faces as green or blue, using response keys that had been previously associated with a positive and negative valence. This association was established during a training phase, where participants were asked to categorise greyscale images of objects and scenes as positive or negative.

3.4.3.4 The emotion discrimination task

We used a five-alternative-forced-choice task to examine recognition of angry, fearful, happy, sad, and disgusted facial expressions. Each facial expression was presented at varying levels of intensity: from 0% (i.e., neutral) to 75% intensity. This intensity manipulation was intended to increase the sensitivity of the task to subtle deficits in emotion recognition.

In addition, each facial expression was presented at three different fixation positions on the screen, corresponding to the eyes, nose and mouth, respectively. Each expression was presented for 250ms, after which participants were asked to identify the emotion by selecting one of five options (angry, fearful, happy, sad, or disgusted). The mislabelling of neutral stimuli as emotional was used as the index of bias in this experiment.

3.5 Neuropsychological testing session

During the neuropsychological testing session, participants completed the battery of computerised tasks, questionnaires and assessments. The session lasted approximately 3.5 hours, and breaks were provided as required. Each participant was assigned a unique study ID, upon which the task running order was based (see Figure 3.3). The discrimination task (see Chapter 6) and EAST (see Chapter 5) were more challenging than the other tasks; therefore, the order of these was counterbalanced across subjects to avoid effects of tiredness or concentration issues. The questionnaires were all completed in the following order: i) STAI-Trait; ii) STAI-State; iii) ICU; iv) AQ; v) YPI; vi) FSSC-R; vii) FNE; viii) BPAQ; ix) HAD Scales; x) NES; xi) BIS/BAS; and xii) APSS.

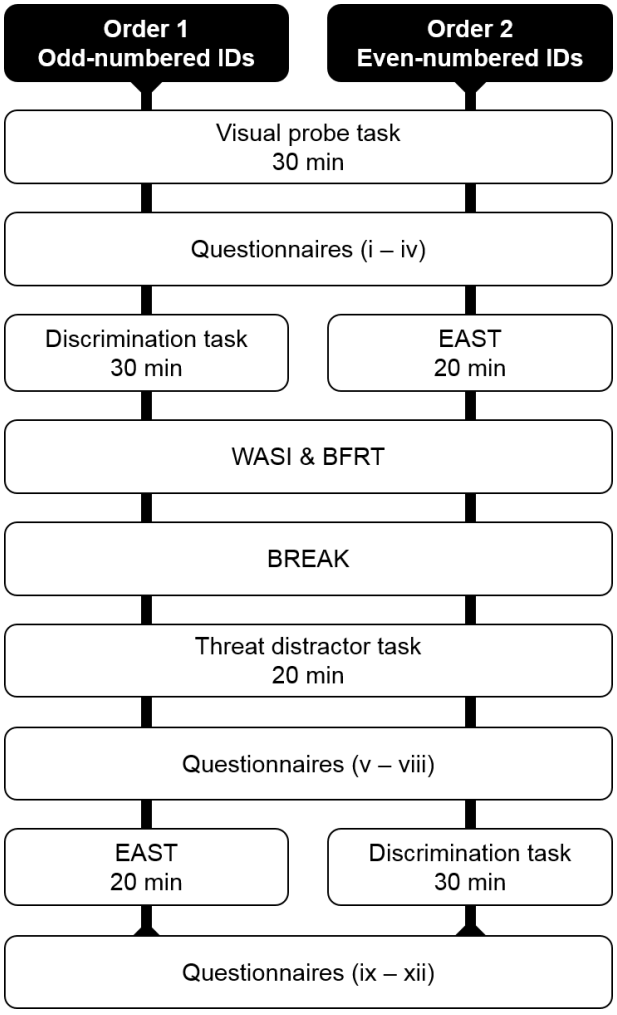

Figure 3.3: Task running orders for participants with odd- and even-numbered IDs.
Note: BFRT = Benton Face Recognition Task (see Chapter 6), EAST = Extrinsic Affective Simon Task, WASI = Wechsler Abbreviated Scale of Intelligence.

3.6 Conclusion

In summary, 104 adolescents were recruited to participate in the present study. Following the clinical assessments these participants were divided into four groups: CD-only, ADs-only, comorbid CD+ADs and controls. The participants then completed a series of questionnaires and neuropsychological tasks during a testing session run at the University. Chapter 4 will present an examination of the demographic, clinical, and personality characteristics of the sample. The results of the neuropsychological tasks will be presented in Chapters 5 and 6.

Chapter 4 Participant characteristics

4.1 Introduction

As discussed in Chapter 1, conduct disorder (CD) is a relatively prevalent disorder in childhood and adolescence, which is characterised by frequent rule-breaking behaviours, aggression, destruction of property and deceitfulness (APA, 2013). Individuals with CD comprise a highly heterogeneous group, however, and there have been many attempts to subtype CD into more homogeneous sub-groups (e.g., Frick & Ellis, 1999) to aid research and the development of treatments. In addition, a number of developmental pathways to CD have been proposed, each with a distinct set of risk factors, including the presence of comorbid anxiety and the level of callous-unemotional (CU) traits. This chapter will investigate the effect of comorbid anxiety disorders (ADs) on the clinical, personality and demographic characteristics of adolescents with CD by comparing groups of adolescents with CD alone, comorbid CD+ADs, ADs alone, and a typically-developing control group. Specifically, this chapter will address the following key questions:

1. Do individuals with comorbid CD+ADs present with similar types and levels of externalising psychopathology (e.g., severity of CD, CU traits and aggression) to individuals with CD alone?
2. Do individuals with comorbid CD+ADs present with similar types and levels of internalising psychopathology (e.g., distress-related anxiety symptoms, fearfulness and social anxiety) to individuals with ADs alone?
3. Do other variables, such as socio-demographic factors and IQ influence the relationships between CD and ADs?
4. In what way are different types of anxiety (i.e., trait anxiety, fearfulness and social anxiety) related to CU traits and CD severity?

Whilst there is clear evidence for an overlap between CD and ADs, it is currently unclear how the presence of a comorbid AD affects the presentation or severity of CD, or how it impacts on the future outcomes of those with CD. As discussed in Chapter 1, some studies have found that anxiety protects against or reduces antisocial behaviour and aggression (DeWall et al., 2010; Walker et al., 1991). This is consistent with Gray's reinforcement sensitivity theory of personality (Gray, 1987; Gray & McNaughton, 2000), which posits that individual differences in personality are associated with the relative strengths of two competing neural systems: the behavioural activation system (BAS) and the behavioural inhibition system (BIS). As discussed in Chapter 1, anxious individuals are suggested to have an over-active BIS, which results in hypersensitivity to punishment and an avoidance of risky behaviour. Individuals with an over-active BAS, however, are likely to display reward-dominant and impulsive behaviour. Other studies, however, have found that anxiety exacerbates antisocial behaviour and leads to more negative future outcomes (Ialongo et al., 1996; Kendall et al., 2001; Sourander et al., 2007). In addition, one study demonstrated that

individuals with comorbid CD+ADs were similar to their non-anxious CD counterparts in terms of antisocial behaviour and symptom severity (Hodgins et al., 2011).

Furthermore, the precise relationship between anxiety and CU traits is yet to be determined. As discussed previously, individuals with psychopathy are often characterised as being fear- or anxiety-deficient (e.g., Cleckley, 1976; Lykken, 1957), with anxiety and psychopathy being at opposite ends of a continuum. However, this is not robustly supported by research on psychopathic adults or children/adolescents with CU traits. For example, studies have found that adolescents with high CU traits are equally likely to have high or low levels of anxiety (Kahn et al., 2013; Kimonis et al., 2011; Lee et al., 2010). This is inconsistent with some theories on the development of CD and later antisocial personality disorder (ASPD). For example, De Brito and Hodgins (2008) suggest that adults with ASPD may be divided into two main subgroups: one made up of individuals with high levels of anxiety and no psychopathic traits, and the other made up of individuals with low levels of anxiety and varying levels of psychopathic traits. This second subgroup includes those with psychopathy. Blair (2013) also notes that there are various developmental pathways to CD, including one characterised by threat-based reactive aggression and anxiety, and one characterised by reduced emotional empathy and elevated CU traits. Alternative theories, attempting to reconcile the fact that individuals with CU traits or psychopathy often have high levels of anxiety, suggest two types of psychopathy: a low-anxiety *primary* variant, and a neurotic *secondary* variant (e.g., Blackburn, 1986; Karpman, 1941, 1948). These variants are hypothesised to have different causes: primary psychopaths are thought to show emotional deficits (e.g., shallow affect, callousness) due to genetic vulnerability, and secondary psychopaths display anxiety or neuroticism due to environmental causes (e.g., early adversity). Studies of children have found that CU traits are moderately heritable, and that children with CU traits (who also display antisocial behaviour) show atypical brain structure and function (see Viding & McCrory, 2012). However, this research has tended to combine primary and secondary subtypes (i.e., they do not take into account differences in anxiety), which may explain some of the variability in findings to date.

Further complicating our understanding of these relationships is the fact that there are different types of anxiety and ADs, each with its own potential relationship with CD and CU traits. For example, in an analysis of data from the National Comorbidity Study-Replication, Nock et al. (2006) found that CD was more likely to be preceded by specific phobias and social phobia, and was more likely to precede generalised anxiety disorder (GAD), panic disorder, post-traumatic stress disorder (PTSD) and obsessive-compulsive disorder (OCD). Therefore, it is possible that certain types of anxiety may be involved in the development of CD, whereas other types of ADs may develop alongside, or as a result of factors associated with, CD. However, it should be noted that the above study was a cross-sectional, and temporal orders were judged retrospectively. Furthermore, social anxiety (or social withdrawal) may be associated with a decreased risk of antisocial behaviour (e.g., DeWall et al., 2010), and a fearful temperament in childhood has been linked to improved conscience

development (e.g., Kochanska et al., 2002). On the other hand, samples of secondary psychopaths are often defined on the basis of levels of trait anxiety (i.e., level of dispositional stress, worry or discomfort; e.g., Spielberger et al., 1983), rather than fearfulness, which may partly explain the discrepancy in findings (e.g., high levels of psychopathy may be inversely related to fearfulness, and may be independent of trait anxiety). In addition, studies rarely differentiate between the severity of CD or conduct problems and CU traits. These are often related (e.g., Frick et al., 2003; Rowe et al., 2010b), therefore any previously-found relationships between CU traits and anxiety may be confounded by the severity of CD or conduct problems.

In addition to the above, other variables such as cognitive ability and gender may influence the relationships between CD, ADs and CU traits. For example, it is consistently found that having a low IQ is a risk factor for CD (Farrington, 1995; Frick et al., 1991; Lynam et al., 1993; Moffitt, 1990; Moffitt et al., 1981; Moffitt & Silva, 1988). In addition, it has been found that, in the general population, males are more likely to have CD (e.g., Moffitt et al., 2001; Nock et al., 2006) and females are more likely to have ADs (e.g., Kessler et al., 2005; McLean & Anderson, 2009).

The present study extended previous research by measuring various types of externalising (i.e., CU traits, psychopathy, aggression and behavioural activation) and internalising behaviours and personality traits (i.e., trait anxiety, fearfulness, social anxiety and behavioural inhibition), along with clinical (i.e., other types of psychopathology and CD symptom severity) and demographic (i.e., IQ and neighbourhood disadvantage) characteristics of male and female adolescents with CD, with ADs, with comorbid CD+ADs and a typically developing control group. We focused particularly on differences in externalising behaviours and personality traits between CD-only and comorbid CD+ADs individuals, as well as the differences in internalising traits between ADs-only and comorbid CD+ADs individuals. In addition to addressing the key questions outlined above, we examined the extent to which the four groups differed on the key demographic factors of age, gender, IQ and socio-economic status (SES).

Consistent with the idea that CU traits may be related to low-fearfulness and independent of trait-anxiety, we predict that any differences in CU traits between the CD and comorbid CD+ADs groups would be dependent on the type of anxiety predominantly seen within the comorbid CD+ADs group: a preponderance of worry-based ADs in the comorbid CD+ADs group may be reflected by similar levels of CU traits to the CD-only group, whereas a preponderance of fear-based ADs in the comorbid CD+ADs group may be reflected by lower levels of CU traits than the CD-only group. In line with this, we expect that, within the CD and comorbid CD+ADs groups, CU traits will be negatively related to fearfulness and social anxiety, but will be unrelated to trait anxiety.

In terms of demographic characteristics, we expect that CD will be associated with a low IQ, irrespective of ADs comorbidity, and we expect there to be higher proportions of females in

the ADs and comorbid CD+ADs groups than the CD-only group due to the differential vulnerability of males and females to externalising and internalising psychopathology.

4.2 Method

4.2.1 Participants

Please see Chapter 3 for a detailed description of the sample and recruitment procedures.

4.2.2 Data analysis

In order to assess the differences between the comorbid CD+ADs group and the CD-only and ADs-only groups, respectively (key questions 1 and 2), we conducted a separate one-way analysis of variance (ANOVA) for each of the socio-demographic, clinical, and personality trait dependent variables, with group as a factor with four levels (CD-only, ADs-only, comorbid CD+ADs and control). Post-hoc Bonferroni tests were conducted where F tests were significant. Chi-square tests were used to examine group differences in variables that were categorical (e.g., gender).

These tests indicated whether there were differences in the measured variables between the groups. However, in order to establish whether any of these variables were independently associated with membership of the comorbid CD+ADs group versus the CD-only or ADs-only groups, we calculated two hierarchical logistic regression models. In the first model, we examined the relative contribution of externalising behaviours and personality traits to the membership of the CD-only versus the comorbid CD+ADs group. Socio-demographic variables that differed between the groups were entered into the model first (key question 3), followed by the externalising variables (each as a separate step) that differed between the groups. In the second logistic regression model, we examined the relative contribution of internalising symptoms and personality traits to the membership of the ADs-only versus the comorbid CD+ADs group. Again, socio-demographic variables that differed between the groups were entered into the model first. These were followed by the internalising variables (each as a separate step) that differed between the groups.

To examine the strength and direction of the relationships between different types of anxiety, CU traits and CD symptom severity (key question 4), Pearson correlations were conducted between CU traits measures, CD symptoms, trait-anxiety, social anxiety and fearfulness within the CD-only and comorbid CD+ADs groups.

4.3 Results

4.3.1 Group comparisons

4.3.1.1 Socio-demographic characteristics

The socio-demographic characteristics of the sample are presented in Table 4.1. The groups did not differ in terms of age ($p = 0.46$), autistic traits ($p = 0.10$) or psychotic symptoms ($p = 0.11$). The CD-only group had significantly lower IQs than the controls ($p < 0.01$), which

appeared to be largely driven by lower verbal IQs, rather than performance IQs, which were similar in both groups. In addition, the CD-only group reported a higher level of neighbourhood disadvantage than the controls ($p < 0.01$). The ADs-only group contained a higher proportion of females than the other three groups ($p < 0.01$).

4.3.1.2 Clinical characteristics

The clinical characteristics of the sample are presented in Table 4.1. As expected, the CD-only and comorbid CD+ADs groups reported higher levels of CD symptoms (both aggressive and non-aggressive) than the ADs-only and control groups. Whilst there were similar rates of worry-based ADs (i.e., GAD or PTSD) within the ADs-only and comorbid CD+ADs groups, there were higher rates of fear-based ADs (i.e., social phobia, specific phobia, panic disorder and OCD) within the ADs-only group compared to the comorbid CD+ADs group. The CD-only and comorbid CD+ADs groups had similar rates of ADHD diagnoses, and all three clinical groups had similar rates of MDD diagnoses.

4.3.1.3 Externalising traits

Data on the externalising traits of the sample are presented in Table 4.1. As expected, the CD-only and comorbid CD+ADs groups scored higher than the ADs-only and control groups on all of the externalising trait indices, apart from the unemotional subscale of the Inventory of Callous-Unemotional traits (ICU) and the behavioural activation subscale of the BIS/BAS scales. All four groups had similar scores on these latter two measures. The CD-only group had higher scores on the CU dimension of the Youth Psychopathic Traits Inventory (YPI), and the comorbid CD+ADs group had higher verbal aggression scores than the ADs-only and control groups, but they did not differ from each other on these indices. In addition, the comorbid CD+ADs group had higher BPAQ hostility scores than the control group (but not the ADs-only group).

4.3.1.4 Internalising traits

The groups differed on all of the internalising traits variables (see Table 4.1). The ADs-only and comorbid CD+ADs groups had higher levels of trait anxiety, social anxiety and BIS sensitivity than the CD-only and control groups. However, the comorbid CD+ADs group had higher levels of state anxiety than the other three groups, and the ADs-only group had higher levels of fear than the other three groups. Unexpectedly, the CD-only group also had higher levels of trait anxiety than the control group, suggesting that even amongst a group defined on the basis of not having a formal AD, trait anxiety levels are elevated in CD. In addition, the CD-only and comorbid CD+ADs groups had higher levels of depressive symptoms than the control group.

Table 4.1: Demographic, clinical and personality characteristics of the sample

	Control[1] (N = 30)		CD[2] (N = 31)		ADs[3] (N = 23)		Comorbid[4] (N = 20)		Comparisons
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Socio-demographic characteristics:									
Age (years)	16.26	1.48	16.76	1.40	16.42	1.94	16.84	1.08	F = 0.87
Proportion of males (n)	80.00% (24)		77.41% (24)		21.73% (5)		60.00% (12)		χ^2 = 23.22** 1,2,4>3
Neighbourhood disadvantage	4.80	2.61	8.41	4.63	6.52	3.46	6.75	3.82	F = 4.6** 1>2
Intelligence Quotient									
Full-scale	109.03	12.25	94.52	9.67	102.78	11.44	103.15	13.16	F = 8.15** 1>2
Verbal	58.33	7.95	45.19	8.48	53.17	10.52	53.74	10.29	F = 10.75** 1,3,4>2
Performance	51.67	8.32	48.16	7.39	49.91	5.88	50.16	9.14	F = 1.06
Autism quotient	18.43	2.85	19.38	2.29	19.26	2.58	20.33	2.03	F = 2.18
Psychotic symptoms (APSS)	0.37	0.35	0.52	0.28	0.50	0.37	0.58	0.24	F = 2.06
Clinical characteristics:									
CD Symptoms									
Total†	0.10	0.40	7.77	3.07	0.35	0.65	6.45	3.52	*F* = 82.22** 2,4>1,3
Aggressive	0.07	0.37	2.65	1.66	0.04	0.21	2.20	1.64	*F* = 36.87** 2,4>1,3
Non-aggressive	0.03	0.18	5.13	1.89	0.22	0.42	4.72	1.90	*F* = 113.66** 2,4>1,3
Fear disorder present (N)	0		0		60.87% (14)		20.00%% (4)		χ^2 = 39.41** 3 > 1,2,4
Worry disorder present (N)	0		0		78.26% (18)		100% (20)		χ^2 = 87.13** 3,4>1,2
MDD present (N)	0		22.58% (7)		30.43% (7)		45.00% (9)		χ^2 = 15.53** 2,3,4>1
ADHD present (N)	0		19.35% (6)		0		30.00% (6)		χ^2 = 15.45** 2,4>1,3
Externalising traits:									
CU traits (ICU)									
Total	20.53	7.05	30.57	9.75	19.02	6.98	27.23	9.72	*F* = 11.15** 2,4>1,3
Unemotional	8.37	3.57	9.00	3.39	8.09	3.60	8.55	3.03	*F* = 0.34
Callous	5.73	3.42	10.78	5.06	5.24	4.23	9.13	4.27	*F* = 10.38** 2,4>1,3
Uncaring	6.43	2.61	10.79	4.75	5.70	2.98	9.55	4.73	*F* = 10.57** 2,4>1,3

Table 4.1: Demographic, clinical and personality characteristics of the sample

	Control[1] (N = 30)		CD[2] (N = 31)		ADs[3] (N = 23)		Comorbid[4] (N = 20)		Comparisons
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Psychopathic traits (YPI)									
Total	98.13	19.52	122.21	22.36	92.83	19.14	118.05	20.78	$F = 12.58$** 2,4>1,3
Grandiose-manipulative	36.93	9.91	41.70	10.86	31.09	8.74	41.00	11.36	$F = 5.38$** 2,4>3
Callous-unemotional	29.03	7.41	35.75	7.54	26.83	5.89	31.35	8.59	$F = 7.02$** 2>1,3
Impulsive-irresponsible	32.17	7.13	44.77	7.44	34.91	7.83	45.70	7.25	$F = 21.99$** 2,4>1,3
Aggression									
Total	62.97	13.86	90.70	29.32	75.52	21.37	101.63	22.25	$F = 14.11$** 2,4>1; 4>3
Anger	13.33	4.34	21.53	7.56	17.86	5.65	24.89	5.65	$F = 17.3$** 2,4>1; 4>3
Physical	19.40	5.20	31.27	9.88	21.45	7.65	30.32	7.51	$F = 16.09$** 2,4>1,3
Hostility	16.67	6.39	21.53	8.61	22.18	8.16	27.11	10.00	$F = 6.45$** 4>1
Verbal	13.57	4.31	16.37	6.26	13.45	4.18	19.32	5.38	$F = 6.36$** 4>1,3
BAS	38.23	4.63	38.66	6.03	38.04	5.98	40.65	5.52	$F = 1.00$
Internalising traits:									
State Anxiety	30.59	6.68	36.16	10.69	35.87	13.07	45.45	9.70	$F = 8.48$** 4>1,2,3
Trait Anxiety	36.27	9.74	44.18	10.88	51.93	10.46	57.65	9.84	$F = 20.44$** 3,4>1,2; 2>1
Fearfulness	28.00	19.40	35.60	29.39	68.00	33.74	40.30	28.17	$F = 9.85$** 3>1,2,4
Social Anxiety	13.15	7.75	11.97	6.12	19.07	7.21	20.80	6.54	$F = 9.61$** 4,3>1,2
BIS	18.40	3.75	16.75	3.42	23.09	3.00	22.00	5.03	$F = 15.34$** 3,4>1,2
Depression	3.40	2.81	7.00	3.61	5.17	3.55	7.30	4.16	$F = 7.24$** 2,4>1

**p<0.01, [†]Total number of K-SADS-PL lifetime conduct disorder (CD) symptoms endorsed (out of 15). ADHD = attention deficit/hyperactivity disorder; ADs = anxiety disorders; APSS = adolescent psychotic symptoms screener; BAS = behavioural activation system; BIS = behavioural inhibition system; ICU = inventory of callous-unemotional traits; MDD = major depressive disorder; YPI = youth psychopathic traits inventory.

4.3.2 Do individuals with comorbid CD+ADs present with similar types and levels of externalising psychopathology to individuals with CD alone?

The CD-only and comorbid CD+ADs groups were similar in terms of externalising traits, as well as CD symptoms and diagnoses of ADHD and MDD. Notably, there were no significant differences in CU or psychopathic traits between the two groups. As expected, the comorbid CD+ADs group reported higher levels of state and trait anxiety, social anxiety, and behavioural inhibition than the CD-only group, but both groups reported similarly low levels of fearfulness. Whilst the comorbid CD+ADs and CD-only groups did not significantly differ in full-scale IQ, the comorbid CD+ADs group had higher verbal IQs than the CD-only group.

Whilst there were no significant differences between the CD-only and comorbid CD+ADs groups on externalising traits, the CD-only group tended to have higher scores on the CU subscale of the YPI, and the comorbid CD+ADs group tended to have higher hostility scores. Thus, to examine the relative contribution of these variables to membership of the comorbid CD+ADs vs. the CD-only group, along with the scores on the verbal subtest of the WASI, a three-step logistic regression was conducted (see Table 4.2). The results show that the verbal IQ scores contributed the most to the regression models predicting membership of the comorbid CD+ADs group. Individuals were around 1.1 times more likely to present with comorbid CD+ADs than CD-only with each unit increase in verbal IQ score. However, the addition of the hostility scores reduced the contribution of verbal IQ to the final model. This suggests that IQ may not be independently associated with membership of the comorbid CD+ADs group. Indeed, within the CD-only and comorbid CD+ADs groups, verbal IQ scores were significantly positively correlated with hostility scores ($r = 0.39$, $p < 0.01$).

Table 4.2: Logistic regression models predicting membership of comorbid vs. conduct disorder-only group

	B	S.E.	95% CI for Odds Ratio (O.R.)			R^2
			Lower	O.R.	Upper	
Step 0						
Constant	-0.44	0.30		0.64		
Step 1						0.26**
Verbal subtest	0.11**	0.04	1.03	1.12	1.22	
Constant	-6.02**	2.20		<0.01		
Step 2						0.29**
Verbal subtest	0.11*	0.04	1.02	1.11	1.21	
YPI CU subscale	-0.05	0.04	0.88	0.95	1.04	
Constant	-4.21	2.70		0.01		
Step 3						0.34**
Verbal subtest	0.08†	0.05	0.99	1.09	1.19	
YPI CU subscale	-0.08	0.05	0.84	0.93	1.02	
BPAQ Hostility subscale	0.06	0.04	0.98	1.07	1.16	
Constant	-3.53	2.71		0.03		

*p<0.05, **p<0.01, †p = 0.07. R^2 is reported as Nagelkerke's R^2. *Note:* Changes in R^2 from steps 1 to 2 and from steps 2 to 3 were non-significant. BPAQ = Buss-Perry aggression questionnaire; CU = callous-unemotional; YPI = youth psychopathic traits inventory.

4.3.3 Do individuals with comorbid CD+ADs present with similar types and levels of internalising psychopathology to individuals with ADs alone?

The comorbid CD+ADs group differed from the ADs-only group on a number of key variables. There was a higher proportion of females in the ADs-only group. The comorbid CD+ADs group reported a higher level of state anxiety during the testing session. The prevalence of fear-based ADs was higher in the ADs-only group, and the ADs-only group reported a higher level of fearfulness than the comorbid CD+ADs group. However, there were no significant differences between the ADs-only and comorbid CD+ADs groups in terms of trait anxiety, social anxiety or behavioural inhibition system sensitivity. In addition, there were no significant differences between the ADs-only and comorbid CD+ADs groups in terms of age, IQ (both groups were similar in terms of total, verbal and performance IQ), neighbourhood disadvantage or rates of MDD.

To examine the relative contribution of the demographic and internalising variables to the membership of the comorbid CD+ADs versus the ADs-only group, a three-step hierarchical logistic regression was conducted predicting membership of the comorbid CD+ADs group from gender, state anxiety, and presence of a fear-related AD (fearfulness score was highly correlated with the presence of a fear-related AD, p < 0.01, therefore only the former variable was included for parsimony). The results of the logistic regression are presented in Table 4.3. The addition of variables at each step significantly improved the model. At step 1, males were 5.4 times more likely to present as comorbid CD+ADs than ADs-only. These

odds increased at step 2, where males were 8.2 times more likely to present as comorbid CD+ADs than ADs-only. Included in this model were state-anxiety scores, which also significantly predicted membership of the comorbid CD+ADs group: at each unit increase in score, individuals were 1.1 times more likely to present as comorbid CD+ADs than ADs-only. This was independent of gender (i.e., both males and females in the comorbid group had elevated state-anxiety scores). In the final model, the addition of fear disorder as a predictor significantly improved the prediction of membership of the comorbid CD+ADs group. However, the results suggest that while state-anxiety scores and gender remained independently associated with group membership, fear disorder presence was not. This was confirmed by conducting a further logistic regression model predicting fear-disorder presence from gender: females were 13.7 times more likely to have a fear disorder than not (95% CI for Odds Ratio = 1.58 – 119.21; $R^2 = 0.27$, $p < 0.01$; B = 2.18, $p = 0.02$).

Table 4.3: Logistic regression models predicting membership of comorbid vs. anxiety disorders-only group

	B	S.E.	95% CI for Odds Ratio (O.R.)			R^2
			Lower	O.R.	Upper	
Step 0						
Constant	*-0.14*	*0.31*		*0.87*		
Step 1						*0.19**
Gender (male)	1.69*	0.68	1.42	5.40	20.52	
Constant	*-0.81*	*0.42*		*0.44*		
Step 2						*0.40***
Gender	2.11*	0.82	1.65	8.23	40.98	
State Anxiety	0.10*	0.04	1.02	1.10	1.19	
Constant	*-5.01***	*1.80*		*0.01*		
Step 3						*0.48***
Gender	2.03*	0.88	1.42	7.57	40.50	
State Anxiety	0.10*	0.04	1.01	1.10	1.20	
Fear Disorder (present)	-1.61†	0.84	0.04	0.20	1.03	
Constant	*-4.30**	*1.93*		*0.01*		

*p < 0.05, **p < 0.01, †p < 0.06. R^2 is reported as Nagelkerke's R^2.
Note: Change in R^2 from steps 1 to 2 and steps 2 to 3 were significant at p < 0.05.
Terms in parentheses indicate the reference category for binary variables.

4.3.4 In what way are different types of anxiety related to CU traits and CD severity?

Table 4.4 shows that trait anxiety was not significantly related to CU traits, psychopathic traits and the numbers of total, aggressive and non-aggressive CD symptoms (all $p > 0.53$). Both fearfulness and social anxiety were negatively related to CU traits, psychopathic traits and CD symptoms (all $rs \leq -0.18$), but only the negative correlations between fearfulness and social anxiety and all of the measures of CD symptoms (total, aggressive and non-aggressive) reached statistical significance ($p < 0.05$).

Table 4.4: Correlations between callous-unemotional (CU) and anxiety-related traits within the two conduct disorder (CD) groups (n = 51).

	1	2	3	4	5	6	7
1. CU traits	–						
2. Psychopathic traits	0.67**	–					
3. CD symptoms	0.47**	0.45**	–				
4. Aggressive CD symptoms	0.43**	0.38**	0.83**	–			
5. Non-aggressive CD symptoms	0.37*	0.33*	0.86**	0.49**	–		
6. Trait anxiety	0.04	-0.09	-0.04	0.01	-0.01	–	
7. Fearfulness	-0.19	-0.20	-0.37**	-0.34*	-0.24	0.07	–
8. Social anxiety	-0.18	-0.18	-0.35**	-0.28*	-0.32*	0.54**	0.37**

* $p < 0.05$, ** $p < 0.01$

4.4 Discussion

The present study investigated the clinical, personality and demographic characteristics of adolescent males and females with CD alone, ADs alone, comorbid CD+ADs, and typically developing controls. First, we investigated whether the CD-only and the comorbid CD+ADs group were similar in terms of externalising psychopathology. We found that these groups were similar in terms of CU traits, aggression and CD severity: the presence of a comorbid AD did not appear to affect the clinical profile of CD. This contradicts previous research illustrating both the attenuating (e.g., DeWall et al., 2010; Walker et al., 1991) and exacerbating (e.g., Ialongo et al., 1996; Kendall et al., 2001; Sourander et al., 2007) effects of anxiety on conduct problems and aggression. However, Hodgins et al. (2011) also found that the presence of a comorbid AD was unrelated to the severity of CD symptoms, or the number of violent and non-violent convictions of adolescents with CD. Contrary to our hypothesis, our follow-up regression analyses suggested that the presence of a comorbid AD may protect against verbal IQ deficits in CD: individuals were 1.1 times more likely to belong to the comorbid group than the CD group with each point increase in verbal IQ. However, this may also result from the presence of distinct developmental pathways to CD and comorbid CD+ADs, rather than representing a true protective effect of anxiety. Also, given the cross-sectional nature of the present study, it is possible that individuals with CD and higher IQs are more likely to develop a comorbid AD. Therefore, longitudinal studies are required to test these relationships.

Second, we investigated whether the ADs-only and comorbid CD+ADs groups were similar in terms of internalising psychopathology. We found that these groups differed in the types of ADs displayed: individuals with ADs only were more likely to have a fear-related AD than the comorbid CD+ADs group, whilst the prevalence of worry-based ADs was similar in the two groups. Our follow-up regression analyses, however, suggested that this difference may be due to the higher proportion of females in the ADs-only group compared to the comorbid

CD+ADs group, and the increased vulnerability of females to fear-based ADs (e.g., Bourdon et al., 1988; Merikangas et al., 2010).

Third, we investigated the relationships between different types of anxiety, CU traits, and CD symptom severity. We found that both CU and psychopathic traits were only weakly (and non-significantly) negatively correlated with fearfulness and social anxiety, and were unrelated to trait anxiety. CD severity (as indexed by numbers of *DSM-IV* total, aggressive and non-aggressive CD symptoms), however, showed stronger negative associations with fearfulness and social anxiety (whilst remaining uncorrelated with trait anxiety). These results suggest that it is important to differentiate between fear-related anxiety and worry-related anxiety as they show different associations with features related to CD. To our knowledge, no previous study has examined these different types of anxiety, CD severity, and CU traits together. Therefore, it is possible that contradictory findings regarding both the effect of anxiety on the presentation and outcomes of CD, and the presence of primary and secondary psychopathy subtypes in CD youth, may be explained by unmeasured fearfulness and/or social anxiety.

Fourth, we investigated whether there were differences between the groups in socio-demographic variables. We found that the CD-only group had lower IQs and reported higher levels of neighbourhood disadvantage than the controls. This is consistent with findings from studies of the general population: research has consistently found that having a low IQ is a risk factor for CD (Farrington, 1995; Frick et al., 1991; Lynam et al., 1993; Moffitt, 1990; Moffitt et al., 1981; Moffitt & Silva, 1988). We also found that there was a higher proportion of females in the ADs-only group than the other three groups. Again, this may be representative of the general population: epidemiological research has shown that males are more likely to have CD (e.g., Moffitt et al., 2001; Nock et al., 2006); and females are more likely to have ADs (e.g., Kessler et al., 2005; McLean & Anderson, 2009).

4.4.1 Limitations

The above results are affected by a number of limitations. First, rates of major depressive disorder (MDD) were high in all of the clinical groups, although there was no difference between the groups in this respect. Future research may benefit from recruiting purer clinical groups, but this may be difficult to achieve given the high prevalence of AD+MDD comorbidity (e.g., Brady & Kendall, 1992; Kendall et al., 2001), the presence of shared causal mechanisms between generalised anxiety disorder and MDD (Hettema et al., 2005; Kendler et al., 2003), and the high prevalence of CD+MDD comorbidity (e.g., Loeber et al., 2000; Nock et al., 2006). One option might be to merge MDD with ADs to form an "internalising disorders" group, however converging evidence suggests that there are different temporal relationships between CD and ADs, and between CD and MDD, therefore this may not be appropriate (Angold et al., 1999; Maughan et al., 2004; Rowe et al., 2010a). Second, the CD-only group still had elevated rates of trait anxiety even though they

screened negative for ADs in the context of a diagnostic interview. It is possible that this reflects a general increase in distress among individuals with CD, which may also account for the elevated rates of MDD in the CD-only group. Third, there was a higher proportion of females in the ADs-only group, compared to the CD-only and comorbid CD+ADs groups. This may reflect the gender distribution among individuals with CD and ADs in the general population: males are more likely to have CD, and females are more likely to have ADs (Kessler et al., 2005; Moffitt et al., 2001; Nock et al., 2006). Our sample may therefore be representative of sex differences in vulnerability to psychopathology in the general population. However, this may affect the interpretation of the finding that our ADs-only group differed from our comorbid CD+AD group on the proportion of fear-based anxiety disorders. Future research should attempt to match groups on gender, or recruit sufficient numbers of participants to enable between-gender comparisons. Fourth, given the nature of our recruitment procedures, severely anxious individuals may not have volunteered to take part in the study, and we may have missed those with severely impairing ADs (i.e., by not recruiting from child and adolescent mental health services). However, our sample may be more representative of CD and ADs in the adolescent population as a result of recruiting a community-based, non-referred sample from school, colleges and youth offending services. In addition, it is unlikely that our results are affected by Berkson's bias (see Berkson, 1946; Du Fort et al., 1993; Roberts et al., 1978), a phenomenon whereby individuals with multiple diseases are over-represented in a hospital setting compared to the general population. If an individual has two disorders, they are more likely to seek treatment than individuals with only one (as they may seek treatment for either disorder). Fifth, the significant correlations among the questionnaire measures may have been inflated by the fact that the questionnaires were all self-report, i.e. a common method bias. Podsakoff et al. (2003) report that a number of effects may be produced by using data from a common rater, such as: a desire to appear consistent, social desirability, acquiescence (i.e., the propensity to agree or disagree with questionnaire items, independent of their content), and the rater's current mood. Whilst it would be preferable to include observer-rated questionnaire measures in future studies, it should be noted that internalising traits may be difficult for observers to assess (e.g., DiBartolo & Grills, 2006; Youngstrom et al., 2000), which would introduce other potential biasing effects.

4.4.2 Conclusions

In the present study, we extended previous work on the effects of comorbid ADs on the clinical, personality and demographic characteristics of CD by examining various types of anxiety and fear-related traits, CD symptom severity, aggression and CU traits. We found that comorbid ADs did not affect the clinical presentation of CD (as defined by number of CD symptoms, etc.). However, the finding that the comorbid CD+ADs group had a higher verbal IQ than the CD-only group indicates the presence of a developmental moderation effect: CD individuals with higher IQs may be more self-aware, and more likely to develop additional problems because of the consequences of their CD behaviours (e.g. peer rejection or school

exclusion). However, longitudinal studies are required to test this. We also found that individuals with comorbid CD+ADs were less likely to have a fear-related AD than individuals in the ADs-only group, suggesting that CD is primarily linked to worry/distress-related ADs such as generalised anxiety disorder. However, this finding may have been modulated by gender: females were more likely to have a fear-related AD than males, and the majority of the ADs-only group was female. Furthermore, we surprisingly found that CD symptom severity, rather than CU or psychopathic traits, was negatively associated with fearlessness and social anxiety, and this relationship held for all three measures of CD symptoms.

In the next chapter (Chapter 5), we will consider the effects of comorbid ADs on threat processing in CD.

Chapter 5 Threat processing in CD and anxiety disorders

5.1 General Introduction

Chapter 4 examined the similarities and differences in clinical, personality and demographic characteristics of adolescents with CD, ADs, and comorbid CD+ADs relative to typically-developing controls. We found that individuals with comorbid CD+ADs were similar to their CD-only counterparts in terms of CD severity, CU traits, aggressive traits, IQ, and socio-economic status (SES). Conversely, individuals with comorbid CD+ADs differed from their ADs-only counterparts in terms of the types of ADs displayed (there were more fear-based ADs in the ADs-only group), as well as gender ratio – there was a higher proportion of females in the ADs-only group. The present set of experiments aimed to examine threat processing in these groups to establish whether comorbid CD+ADs individuals would show similar patterns of early-stage information processing to CD-only or ADs-only individuals, or a distinct neurocognitive profile compared to both of the pure groups.

As described in Chapter 2, altered threat-related processes have been reported in both adults and children with psychopathology, including ADs and CD, and these are evidenced by studies of selective attention (Bar-Haim et al., 2007; Baskin-Sommers et al., 2011; de Castro et al., 2002; Vitale et al., 2007). Behavioural measures of selective attention tend to employ reaction time (RT) measures to assess interference and/or facilitation effects of visual (and auditory) stimuli. Other tasks that measure selective attention can show both RT interference and RT facilitation effects. One popular task, which measures both types of effects of stimuli, is the dot-probe (or “visual probe”) task. In a typical dot-probe task, two stimuli (one experimental, e.g., emotional, and one control, e.g., neutral) are presented simultaneously, followed by a probe (typically a dot) in the same position as one of the stimuli. The participant is then required to respond to the probe; either by pressing a button indicating the probe’s presence (probe detection task; MacLeod et al., 1986), or by pressing a button corresponding to the position (up, down, left or right; *probe position task*) or type of probe (e.g., “is the arrow pointing up or down?”; *probe classification task*). The assumption in this type of task is that if the probe is in the same position as an attended stimulus, the response to the probe will be quicker (Posner, 1988). In other words, on average, faster responses to the probe that appears in the position of a particular type of stimulus indicates a bias towards that stimulus type. The opposite is also true: slowed responses to the probe indicate interference from stimuli presented in the non-probe position.

One of the most widely-used measures of interference is the Stroop task (Stroop, 1935). In its basic form, the Stroop task requires the participant to name the ink colour of a word, whilst ignoring the meaning of the word itself. The word stimuli consist of meaningless letter strings and colour names. Typically, participants take longer to respond, for example, to the word “blue” depicted in red text than to a meaningless letter string depicted in red text (see MacLeod, 1991). Subsequent modifications of the Stroop task have demonstrated

interference effects of other words, including emotionally salient, compared to neutral, words (see Williams et al., 1996). In addition, Stroop-like tasks (e.g., the emotional Stroop task) have been used to study the effects of psychopathology on interference by comparing the performance of disordered participants with that of controls on emotional words that are highly relevant to the psychopathological disorder under investigation, such as illness-related words in those with health anxiety (e.g., Owens et al., 2004).

One issue with using these tasks to measure selective attention is that they typically employ word stimuli. This is potentially problematic for several reasons. First, the use of words assumes a level of reading ability that may not be present in certain samples (e.g., children). Second, it is often difficult to select individual words that represent a construct relevant to the disorder under investigation. Third, word stimuli may not be ecologically valid: for example, an individual with spider-phobia, whilst afraid of spiders, may not be afraid of the word "spider" (as it is only abstractly related to object of the phobia). Images, on the other hand, communicate complex information effectively, and have greater ecological validity. Moreover, images of faces may be processed automatically by face-specific brain regions (Britton et al., 2006; Kanwisher et al., 1997).

As discussed in Chapter 2, there are a number of theories that attribute problems with selective attention in both anxious and antisocial individuals to deficient attentional control mechanisms. For example, Eysenck and colleagues (Derakshan & Eysenck, 2009; Eysenck & Derakshan, 2011; Eysenck et al., 2007) suggest that anxious individuals have difficulty controlling their attentional focus in the presence of threat-related stimuli. In contrast, Newman and colleagues (Lorenz & Newman, 2002; MacCoon et al., 2004; Newman & Lorenz, 2003) suggest that psychopathic individuals are less able to shift the balance of top-down and bottom-up attentional mechanisms to take into account information that is not the primary focus of either the current goal-directed behaviour (i.e., the balance is tipped in favour of top-down attentional control), or the dominant response activated by particular stimuli (i.e., the balance is tipped in favour of bottom-up stimulus features). These theories therefore posit qualitatively different impairments in attentional mechanisms in anxiety compared with psychopathy – the former is marked by difficulties in ignoring task-irrelevant, threatening stimuli, whereas the latter is characterised by an excessively goal-focused information processing style.

In the present study, we used three different tasks to assess selective attention to emotional stimuli in adolescents with CD-only, ADs-only, comorbid CD+ADs, and typically-developing controls. Consistent with the idea that ADs and CD may be associated with altered uncontrolled and controlled selective attention, our tasks varied in the level of priority given to attentional control. In Experiment 1, we used two versions of a standard visual probe (classification) task to measure RT interference and facilitation effects of emotional faces. Participants were asked to classify the direction of an arrow that appeared on the screen after being presented with a display containing emotional and/or neutral faces (see

Figure 5.1, top panel). The faces were presented for 500ms (version 1) and 17ms (version 2). These presentation times were used to assess the effects of supraliminal versus subliminally-presented emotional faces, respectively. These tasks were used to measure uncontrolled attentional biases towards and interference caused by emotional faces; however, they did not assess whether individuals were able to modulate their attention on the basis of task instructions (i.e., when explicitly asked to ignore certain stimuli). In order to assess the differences in attentional control between our groups, we used two further tasks: a threat distractor task, and an Extrinsic Affective Simon Task (EAST). The threat distractor task (Experiment 2) required participants to assess whether a target image pair was identical, whilst ignoring a distractor image pair (see Figure 5.1, middle panel). Participants were required to match houses in the presence of distractor faces, or vice versa, in different orientations (vertical or horizontal). The EAST (Experiment 3) required participants to complete two separate, but interleaved, tasks: either to categorise greyscale images of various scenes by valence (positive, or negative), or to categorise emotional and neutral faces by colour (green or blue; see Figure 5.1, bottom panel). This task assessed whether individuals were able to ignore the valence of the faces in order to complete the colour-categorisation task.

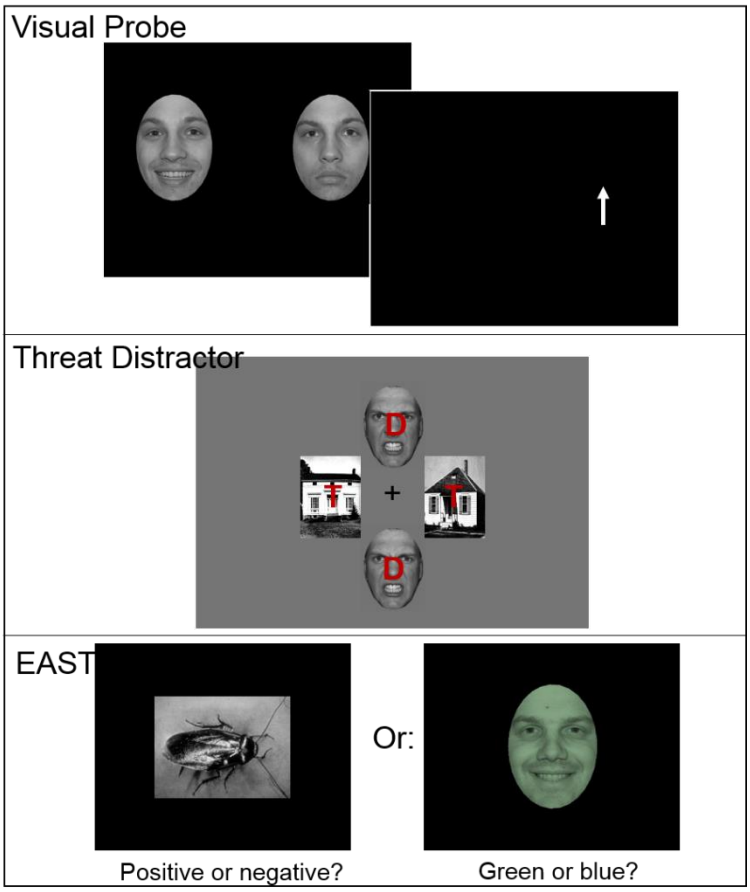

Figure 5.1: The threat-processing tasks: Visual probe (top), showing an invalid trial; Threat-distractor (middle), showing houses as targets (T) and faces as distractors (D); and the Extrinsic Affective Simon Task (EAST; bottom), showing the two task-types (valence categorisation of greyscale pictures and colour categorisation of faces).

Whilst both the threat-distractor task and the EAST rely upon the use of attentional control strategies in order to complete the required task, they differ in the degree of visual

separation between the distracting/task-irrelevant and the task-relevant features. Previous studies have shown that the level of interference caused by task-irrelevant stimuli decreases as the degree of visual separation between the task-irrelevant and task-relevant features increases (e.g., MacLeod, 1998). Thus, one would expect to show greater interference effects of task-irrelevant stimuli in the EAST than in the threat-distractor task. This distinction may be particularly relevant to individuals with psychopathy, who have been shown to display increased attentional control in the presence of task-irrelevant emotional stimuli in picture-word Stroop tasks (where the pictures and words are visually separate), but normal patterns of interference in colour-word Stroop tasks (where the words and colours are integrated in the same stimulus, see Hiatt et al., 2004). A further difference between the two tasks is that the EAST is able to differentiate between interference caused by positive or negative automatic evaluations of the emotional stimuli. This is potentially important, given the previously-described social information processing attributional biases seen in both ADs and aggression (see Chapter 2), as well as the theories of ADs that propose the presence of an automatic valence/threat evaluation system (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998).

5.2 Experiment 1: Visual probe task

5.2.1 Introduction

As described in Chapter 2, cognitive theories of ADs hold that biases in processing and allocating attention to threat are critically involved in the aetiology and maintenance of anxiety (Beck & Clark, 1997; Beck et al., 1985; Hofmann et al., 2012; Mathews & Mackintosh, 1998; Mogg & Bradley, 1998). For example, Beck suggests that individuals with ADs have dysfunctional cognitive schemata that disproportionately facilitate the processing of threat-related information (Beck & Clark, 1997; Beck et al., 1985). Evidence to support these theories has largely emerged from studies of selective attention in adults and children with ADs or high levels of trait anxiety, and have largely shown biases towards threat-related stimuli in these groups (e.g., Bar-Haim et al., 2007; Garner, 2010; Hadwin & Field, 2010; Lau et al., 2012; Muris & Field, 2008). However, the majority of these studies have used words or affectively-laden images. Few studies have examined selective attention to emotional faces in children or adolescents with ADs, and results have been mixed (see Garner, 2010). Some studies have reported attentional biases in AD individuals (Monk et al., 2006; Roy et al., 2008; Waters et al., 2013), whereas others have not (Monk et al., 2008; Waters et al., 2010). Furthermore, studies have been inconsistent in terms of the direction of such biases. For example, Monk et al. (2006) found avoidance of angry faces in individuals with ADs, whereas Roy et al. (2008) found that AD individuals were biased towards angry faces, and Waters et al. (2013) reported that individuals with generalised anxiety disorder (GAD) showed attentional biases towards anger, whereas individuals with fear-related disorders were avoidant of anger.

Whilst selective attention to emotional faces has not been assessed to date in individuals with CD, a similar task using emotional pictures from the International Affective Pictures System (Lang et al., 2008) has been used to examine attentional biases in male adolescent offenders with varying levels of CU traits, aggression and anxiety (Kimonis et al., 2012; Kimonis et al., 2007, 2008). Consistent with the idea that individuals with psychopathy are insensitive to distress cues (Blair, 1995, 2005a), results from the above studies showed reduced vigilance to distressing pictures in children and adolescents with CU traits and elevated aggression (Kimonis et al., 2006; Kimonis et al., 2007). Furthermore, Kimonis et al. (2012) found that male offenders with CU traits and high levels of anxiety (i.e., 'secondary' psychopathy) showed an attentional bias towards images conveying distress relative to those with CU traits and low levels of anxiety (i.e., 'primary' psychopathy). However, as no control group was included in these studies (all subjects were juvenile offenders), it is not known whether highly antisocial adolescents show attentional biases relative to typically-developing teenagers, irrespective of their level of CU traits. Individuals with CD have been found to show deficits in recognising facial expressions of fear, sadness, anger, disgust, surprise and happiness (e.g., Short et al., 2016; Sully et al., 2015), which may reflect a general insensitivity to others' emotions in CD.

A number of methodological issues may have also contributed to the variability in findings to date. For example, the attentional bias typically measured in visual probe tasks is a compound measure of two processes: (i) initial orientation/vigilance towards emotional stimuli; and (ii) disengagement from emotional stimuli (e.g. Koster et al., 2004). Typical studies of attentional biases compare the reaction times (RTs) for valid trials (probes appearing in the location of the *emotional* stimulus) with RTs for invalid trials (probes in the location of the *neutral* stimulus). Faster RTs on valid, compared to invalid, trials are considered to reflect an attentional bias towards emotional stimuli. However, this RT difference could be driven by *slower* RTs on invalid trials (i.e., reflecting delayed disengagement from the emotional stimulus, which captures attention even though it is irrelevant to task performance), or *faster* RTs on valid trials (i.e., reflecting early attentional capture by the emotional stimulus). Indeed, there is evidence to suggest that the attentional bias towards threat seen in anxious individuals may be due to delayed disengagement from threat or fear-relevant stimuli (e.g., Cisler & Koster, 2010; Eysenck et al., 2007; Fox et al., 2002; Georgiou et al., 2005), rather than faster orienting towards these stimuli. One method for separating out these two processes in visual probe tasks involves including control trials in which there is no emotional stimulus (i.e., two neutral stimuli are presented). Reaction times for these 'neutral' trials can then be compared to the RTs for valid and invalid trials containing emotional stimuli, to assess vigilance and disengagement processes, respectively.

Furthermore, the majority of studies of selective attention in children and adolescents using visual probe tasks have employed relatively long stimulus presentation times (e.g., 500ms). This relatively long stimulus duration allows participants to engage in elaborate, strategic,

processing of the threat, in addition to making multiple eye movements, which may interfere with task performance. In contrast, the use of briefly-presented (e.g., 17ms) stimuli, followed by a mask to limit conscious awareness of the stimuli, has been found to enhance the effects of threatening facial expressions on attentional biases in individuals with high levels of trait anxiety (Fox, 2002). In addition, children with CU traits have been found to exhibit pre-attentive fear and disgust recognition deficits using a continuous flash suppression paradigm that suppresses awareness of the face stimuli (Sylvers et al., 2011b).

In addition, it is possible that reaction time measures on their own are not sufficient to detect attentional biases. For example, Mogg et al. (2000) used eye-tracking methods to determine the participants' initial fixations during a visual probe task. The authors found that individuals with GAD were more likely to fixate on the threatening face first than controls – a difference that was not evident from the RT data in that study.

We examined threat processing using a visual-probe task with emotional and neutral faces in adolescents with comorbid CD+ADs, with CD-only, ADs-only, and in typically-developing controls. Our study addressed several of the limitations of previous studies: first, we used pictures of emotional faces, which are preferable over words or pictures of complex scenes as they are processed automatically (e.g., Kanwisher et al., 1997; Pessoa, 2005) and their use is not confounded by potential group differences in literacy or reading ability, which is important when studying CD populations that frequently have low verbal ability (Burke et al., 2002; Moffitt, 1993b). Second, we used control trials (neutral-neutral face pairs) and were therefore able to separate out the vigilance and disengagement components of attentional bias. Third, we included both standard visual probe trials that allowed us to assess attentional biases during the 500ms after face onset (i.e., conscious trials), and trials in which face stimuli were presented briefly (17ms) and followed by a high contrast visual mask to limit conscious processing (e.g., Öhman, 1997). The purpose of this manipulation was to investigate whether CD or ADs (or their combination) are related to biases arising from early (pre-attentive) or late processing stages, or whether threat processing is altered in CD or ADs in both instances. Lastly, we measured the participants' horizontal eye movements during the standard task to examine the direction of the initial fixation.

Previous results from visual-probe tasks involving emotional faces in children and adolescents with anxiety have been mixed, and only a small number of studies have used face stimuli with a design that allows the assessment of both vigilance and disengagement processes. It is difficult, therefore, to make clear directional predictions. However, based on the adult literature, we hypothesised that adolescents with ADs would show attentional biases towards angry and fearful faces, as suggested by studies reporting both enhanced vigilance towards (Bar-Haim et al., 2007; Ehenreich & Gross, 2002; Puliafico & Kendall, 2006), and delayed disengagement from these threatening stimuli (Georgiou et al., 2005). We also hypothesised that individuals with CD-only would show reduced vigilance towards emotional facial expressions, but that this pattern of vigilance might be modulated by CU

traits: based on the findings of Kimonis and colleagues (Kimonis et al., 2006; Kimonis et al., 2007), we hypothesised that elevated CU traits would be associated with reduced vigilance towards angry and fearful faces. Conversely, we predicted that individuals with comorbid CD+ADs (putatively similar to 'secondary psychopathy') might show increased vigilance towards angry and fearful faces relative to typically-developing controls and the CD-only group (Kimonis et al., 2012). Whilst disengagement has not been measured previously using dot or visual probe tasks in antisocial individuals, there is prior evidence for delayed disengagement from threatening words in healthy adults scoring low on the personality trait of agreeableness (Wilkowski et al., 2006). We therefore predicted that CD-only individuals, as well as individuals with comorbid CD+ADs, would show delayed disengagement from angry faces, although we note that this hypothesis was speculative, given the limited evidence in this area.

5.2.2 Method

5.2.2.1 Participants

Please see Chapter 3 for a detailed description of the sample and recruitment procedures. The clinical, personality and demographic characteristics of the participants are presented in Chapter 4.

5.2.2.2 Assessment of attentional biases to threat

A visual-probe (VP) task was used to assess attention to emotional, compared to neutral, facial expressions. Digital photographs of facial expressions were selected from the NimStim MacArthur Network Face Stimuli Set (Research Network on Early Experience and Brain Development, http://www.macbrain.org/resources.htm, Tottenham et al., 2009). Neutral, happy, fearful and angry facial expressions posed by four male actors were employed, giving a total of 16 images. An oval mask was applied to each image to remove non-facial features (e.g., hair, neck, ears), and all images were presented in greyscale, resized to 4.9 x 7.2 cm and matched for mean luminance and contrast (Gray et al., 2013; Hedger et al., 2015a). Stimuli were presented on a 15-inch CRT monitor (at a distance of 60cm to the participant) linked to a Microsoft Windows XP computer, using Inquisit software (Draine, 2004).

Participants completed two versions of the VP task (see Figure 5.2): a standard version in which face pairs were presented for 500ms, and a masked version in which face pairs were presented for 17ms and replaced by a high contrast masking stimulus presented for 70ms. In both versions, participants were instructed to classify (via keyboard button press) the direction (up or down) of a target arrow that appeared in the location of one of the preceding face stimuli. Four types of face pairs were presented across 104 experimental trials (presented in random order): neutral-angry (n = 32), neutral-fearful (n = 32), neutral-happy (n = 32) and neutral-neutral (n = 18, including two buffer trials; i.e., "warm-up" trials not included in the data analysis). On each trial the arrow target was either presented in the position of

the emotional face (valid) or the neutral face (invalid). The location of the emotional face, and the location, direction and validity of the target arrow were counterbalanced for each emotion. Participants completed the standard task first, followed by a short break during which further instructions were given, and followed by the masked task. The visual probe tasks were followed by an awareness measure in which participants were presented with either a face stimulus (57 trials) or a blank screen (57 trials) for 17ms followed by a mask (70ms) and asked to report whether they had seen a face (yes/no).

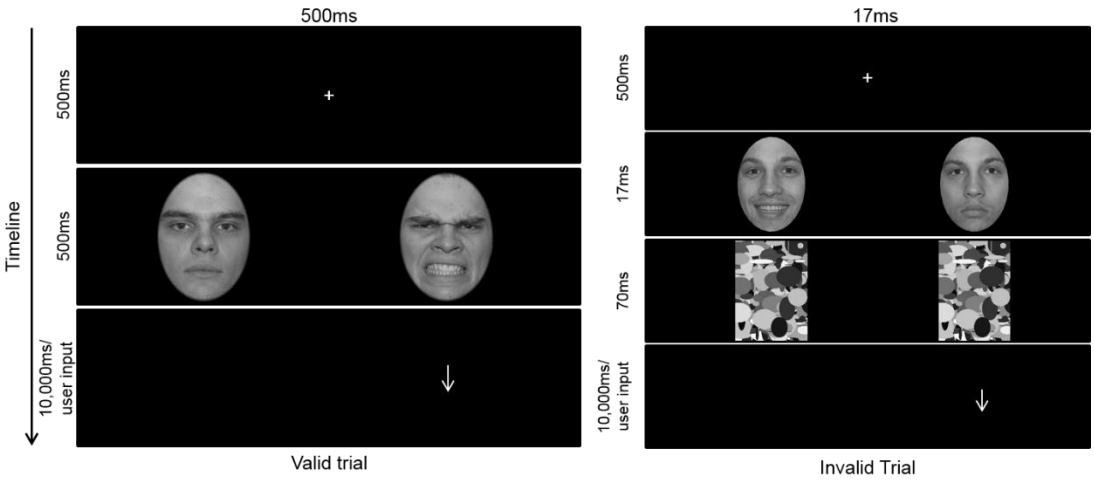

Figure 5.2: Schematic representation of a valid (left) and invalid (right) trial in the standard and masked tasks, respectively.

5.2.2.3 Electrooculogram (EOG) recording

As an additional measure of attentional bias, horizontal eye-movements were collected from two 8 mm Ag-AgCl shielded electrodes, connected to a Biopac EOG100C amplifier (Biopac Systems, Inc), set to a gain of 1000 dB. The electrodes were filled with an isotonic electrode gel and placed on the participant's right and left outer canthi; the cathode on the right, and the anode on the left. The electrodes were secured in place using 8 mm adhesive disks. The EOG data were recorded on a Microsoft Windows XP computer running AcqKnowledge 4.0 (Biopac Systems, Inc.), at a sampling rate of 1000 Hz.

5.2.2.4 Data preparation and analysis

Awareness measure

To verify the effectiveness of the mask in limiting the conscious processing of the stimuli in the masked VP task, participants' ability to detect masked face stimuli (expressed as d prime, or d') was calculated on the basis of Hits (correct detection of a face) and False Alarms (i.e. reporting the presence of a face on face-absent trials). A mixed ANOVA examined the effects of facial emotion (angry, happy, fearful, neutral), CD status (present, +; absent, -) and AD status (present, +; absent, -) on ability to detect faces (d').

Visual Probe tasks

Reaction times (RTs) on incorrect trials were removed (4.4% and 3.8% for the standard and masked task, respectively), as well as RTs below 150 ms (see Whelan, 2008). The frequency distribution of the raw RTs was positively skewed, therefore any RTs greater than 2000ms, as well as RTs that were greater than three standard deviations (SD) above or below each participant's log-transformed mean RT were removed (1.0% and 1.1% of correct responses for the standard and masked task, respectively). The removal of unusually slow RTs, as well as log-transforming the RTs, before the calculation of the three SD cut-off reduces the impact of longer RTs on the mean (e.g., Bradley et al., 1999). The RTs were then transformed back to milliseconds for ease of interpretation.

To investigate the effects of CD and ADs on task RTs, two separate 3 (emotion: anger vs. fear vs. happy) x 2 (trial validity: valid, invalid) x 2 (CD status: present, CD+/not present, CD-) x 2 (AD status: present, AD+/not present, AD-) mixed ANOVAs were conducted for each of the two VP tasks.

Consistent with previous studies, for each emotional expression we calculated reaction time measures of: i) vigilance: RT(neutral-pair) - RT(valid trials); and ii) disengagement: RT(invalid trials) - RT(neutral-pair). Positive scores reflect greater vigilance and delayed disengagement, respectively. Vigilance and disengagement scores were entered into separate 3 (emotion: happy vs. fear vs. angry) x 2 (CD status: present, CD+/not present, CD-) x 2 (AD status: present, AD+/not present, AD-) mixed ANOVAs.

We also examined whether the presence of high CU traits moderated vigilance and disengagement to emotional faces within a combined CD group (i.e., CD-only and comorbid CD+ADs individuals). CD individuals were classified as high or low in CU traits on the basis of a median split (CU+ ≥30 on the ICU).

Finally, in order to estimate the effects of possible confounding factors (i.e., IQ, gender and depressive symptoms), hierarchical regression analyses were used to examine the influence of confounding variables that differed between groups and correlated significantly with outcome variables associated with CD or AD.

EOG data

EOG data were analysed using AcqKnowledge 4.1 (Biopac Systems, Inc.) for the standard VP task only (the stimuli presentation time in the masked version was too short to reliably elicit eye-movements). The waveforms for each participant were 1-interval difference transformed, and then an IIR low-pass filter was applied to pass data that fell below 20 Hz. Eye-movements were extracted using automated processes in Acqknowledge 4.1. Specifically, the minimum and maximum amplitudes and their respective onset times were extracted from sampling windows of between 100ms and 500ms from image onset. These data were then matched to the Inquisit data, to ascertain the trial type for each EOG measurement line. An eye-movement was defined as any maximum amplitude above 1 V or

any minimum amplitude below -1 V. The direction of the initial eye-movement for each trial was therefore the first maximum or minimum amplitude that was considered an eye-movement. Positive and negative amplitude values indicated eye-movements to the right and left, respectively. The proportion of trials for which the first fixation was on the emotional face for each emotion-neutral pairing (i.e., anger-neutral, fearful-neutral and happy-neutral) was calculated for each participant. These data were entered into a 3 (emotion: anger vs. fear vs. happy) x 2 (CD status: present, CD+/not present, CD-) x 2 (AD status: present, AD+/not present, AD-) mixed ANOVA.

5.2.3 Results

5.2.3.1 Awareness check

The ability of participants to detect masked faces was not affected by stimulus emotion, CD status, AD status, nor were there any significant interactions between these factors (all $F < 1.49$, $p > 0.22$). One-sample *t*-tests comparing d' scores against zero suggest that all four groups were above chance at discriminating face present vs. absent trials (irrespective of face emotion; all $t > 4.79$, $p < 0.01$). This suggests that our brief (17ms) masked presentation did not fully suppress the awareness of face stimuli. We note that our measure of awareness was highly conservative, i.e., discriminating the presence vs. absence of face stimuli. Alternative tasks, however, e.g., identifying the emotion of a masked face, with the same 17ms duration, have previously produced above chance performance in some observers (see Hedger et al., 2015b for a review and meta-analysis of threat-related biases for stimuli presented without awareness; Pessoa et al., 2005).

5.2.3.2 Confounding factors

Given group differences in IQ, gender and depressive symptoms, bivariate correlations were conducted between IQ, gender and depressive symptoms, and VP task RTs, vigilance and disengagement scores. Neither IQ nor depressive symptoms correlated significantly with any of the VP task measures, and were, therefore, not controlled for in any of the analyses presented below. Gender (where male = 1 and female = 2), however, was significantly correlated with a number of measures in the masked VP task (RTs in valid and invalid trials containing fearful faces, $r = 0.21$, $p = 0.04$, and $r = 0.19$, $p = 0.05$, respectively; vigilance to fearful faces, $r = -0.30$, $p = 0.03$; and disengagement from fearful faces, $r = 0.25$, $p = 0.01$). Therefore, the analyses for the masked VP task below were repeated with gender as an additional factor.

5.2.3.3 Attentional bias

Standard VP task

There were no main effects of emotion or validity on RTs, and no significant interactions between emotion, validity and CD and AD group status (see Figure 5.3). There was, however, a significant CD x AD interaction (F (1, 100) = 9.81, $p < 0.01$, $r = 0.35$). In general,

the CD-only and ADs-only groups had longer RTs than the comorbid CD+ADs and control groups. Individual contrasts showed that CD-only individuals had significantly longer RTs than comorbid CD+ADs individuals (F (1, 100) = 8.87, $p < 0.01$, $r = 0.30$), and controls (F (1, 100) = 14.14, $p < 0.01$, $r = 0.35$).

Masked VP task

There was a main effect of trial validity on RTs (F (1, 100) = 8.33, $p < 0.01$, $r = 0.28$). Participants were faster to respond to the valid trials across both tasks, suggesting a general attentional bias towards emotional stimuli. There was also a significant emotion x AD interaction (F (2, 200) = 4.57, $p < 0.01$): individuals with ADs had shorter RTs when the display contained happy, compared to angry, faces (F (2, 100) = 3.80, $p = 0.05$, $r = 0.19$). In contrast, individuals without ADs had longer RTs when the display contained happy, compared to angry (F (2, 100) = 4.09, $p = 0.05$, $r = 0.20$) and fearful (F (2, 100) = 6.19, $p = 0.02$, $r = 0.24$) faces. There was also a significant CD x AD interaction effect (F (1, 100) = 7.87, $p < 0.01$, $r = 0.27$). In general, the CD-only and ADs-only groups had longer RTs relative to the comorbid CD+ADs and control groups. Individual contrasts showed that CD-only individuals had significantly longer RTs than comorbid CD+ADs individuals (F (1, 100) = 5.00, $P = 0.03$, $r = 0.22$) and controls (F (1, 100) = 11.85, $p < 0.01$, $r = 0.33$). In addition, ADs-only individuals tended to have longer RTs than controls, although this effect was only marginally significant (F (1, 100) = 2.97, $p = 0.08$, $r = 0.17$). Repeating this analysis with gender added as a factor did not change these effects of psychopathology on RTs.

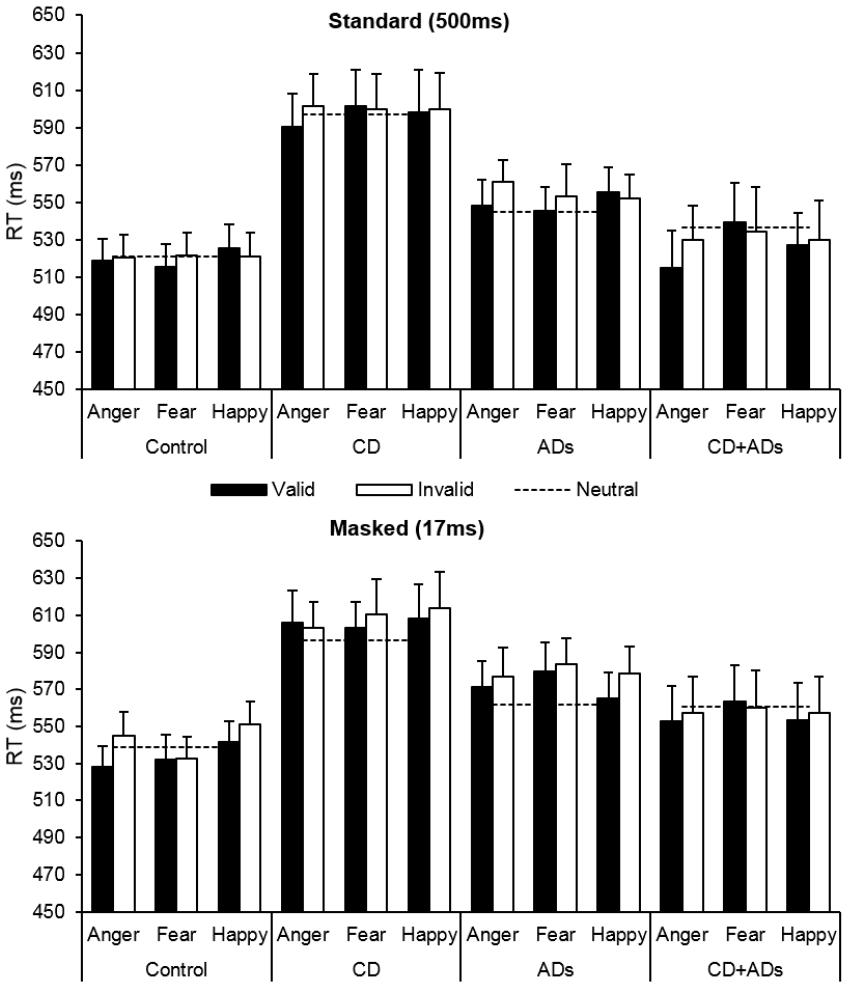

Figure 5.2: Mean reaction times (RTs) for valid and invalid trials compared to the neutral-neutral trials (dashed horizontal lines) for each version of the visual probe task, expressed in milliseconds. Error bars represent +1 S.E.M. *Note:* ADs = anxiety disorders; CD = conduct disorder.

CU traits

When we examined the effect of CU traits within a combined group of CD-only and comorbid CD+ADs individuals by including CU traits as a between-subjects factor (high versus low CU), there was no main effect of CU traits nor any interactions involving CU traits for either version of the task.

5.2.3.4 Vigilance to emotional faces

Standard VP task

There were no significant main effects or interactions for vigilance.

Masked VP task

There was a significant CD x AD interaction ($F(1, 100) = 5.42$, $p = 0.02$, $r = 0.23$): control and comorbid CD+ADs individuals showed increased vigilance towards emotional faces compared to CD-only and ADs-only individuals (F (1, 102) = 5.69, $p = 0.02$, $r = 0.23$). Individual contrasts approached significance, with controls showing increased vigilance compared to CD-only (F (1, 100) = 3.19, $p = 0.08$, $r = 0.18$), and ADs-only (F (1, 100) = 3.08,

p = 0.08, *r* = 0.17) individuals. The interaction effect is displayed in Figure 5.4 (left panel). Adding gender as a factor to the analyses did not change these effects.

CU traits

Repeating these analyses within the CD-only and comorbid CD+ADs groups and including CU traits as a factor did not reveal any additional effects of CU traits or any interactions involving CU traits for either version of the task.

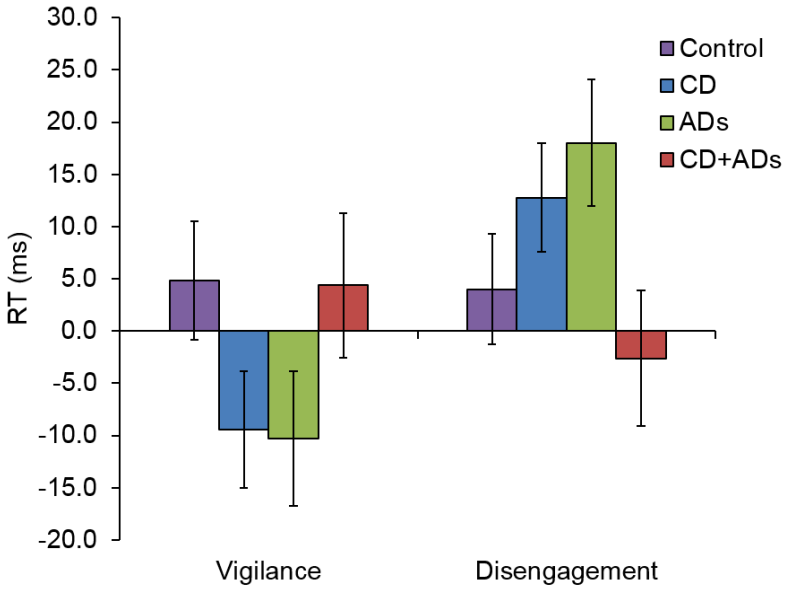

Figure 5.3: Graphs showing interaction effects of conduct disorder (CD) and anxiety disorders (ADs) on vigilance and disengagement scores, respectively, for the masked visual probe task (group means with error bars representing +/- 1 S.E.M.). RT = reaction time.

5.2.3.5 Disengagement from emotional faces

Standard VP task

There were no significant main effects or interactions on disengagement scores.

Masked VP task

There was a significant CD x AD interaction (*F*(1, 100) = 6.44, *p* = 0.01, *r* = 0.25): CD-only and ADs-only individuals showed slower disengagement from emotional faces compared to control and comorbid CD+ADs individuals (*F* (1, 102) = 5.79, *p* = 0.02, *r* = 0.23). Individual contrasts showed that comorbid CD+ADs individuals were quicker to disengage from emotional stimuli than ADs-only (*F* (1, 100) = 5.40, *p* = 0.02, *r* = 0.23) and CD-only (*F* (1, 100) = 3.42, *p* = 0.07, *r* = 0.18) individuals. The interaction effect is displayed in Figure 5.4 (right panel). Adding gender as a factor to the analysis did not change these effects.

CU traits

Repeating these analyses within the CD-only and comorbid CD+ADs groups and including CU traits as a factor did not reveal any additional effects of CU traits or any interactions involving CU traits for either version of the task.

5.2.3.6 EOG data

EOG data were unavailable for 16 participants due to either equipment malfunction or participant refusal. The remaining EOG data are presented in Table 5.1.

Table 5.1 Rates of initial fixation on emotional face, by group.

	Control (N = 27)		CD (N = 28)		ADs (N = 16)		Comorbid (N = 17)	
Emotion	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Anger	0.55*	0.09	0.51	0.10	0.50	0.09	0.53	0.10
Fear	0.48	0.10	0.50	0.09	0.52	0.09	0.50	0.14
Happy	0.53	0.11	0.50	0.11	0.53	0.09	0.49	0.07

*One-samples t-test significant (compared to change, i.e., 0.50) at the $p < 0.05$ level.

In general, it was equally likely for all groups that their initial fixations were directed towards the emotional face as the neutral face, with the exception of the control group: control participants were more likely to fixate the angry face in an angry-neutral display (t (26) = 2.78, p = 0.01, r = 0.47). Entering the EOG data into a 3 (emotion: anger vs. fear vs. happy) x 2 (CD status: present, CD+/not present, CD-) x 2 (AD status: present, AD+/not present, AD-) mixed ANOVA did not reveal any effects or interactions involving CD or AD status, nor any effects of emotion on initial fixation.

5.2.4 Discussion

We investigated attentional bias, vigilance and disengagement during the processing of emotional and neutral faces in adolescents with CD-only, ADs-only, and comorbid CD+ADs. Several key findings emerged: First, whilst we did not find a threat-related attentional bias in individuals with ADs (for either version of the VP task), we found that the masked presentation of a happy face resulted in shorter RTs (i.e., enhanced performance) for the ADs-only and comorbid CD+ADs groups, and interfered with task performance in the CD-only and control groups. However, there were no differential effects of specific emotions on attentional vigilance or disengagement. It is possible that the threat value of the angry and fearful faces was insufficiently strong to elicit an attentional bias towards these stimuli in the standard task (i.e., there were no significant differences in RTs between valid and invalid trials across participants). Studies have found a non-linear effect of stimulus threat value on attentional bias towards threat: very mild and high threat-value stimuli elicit quicker responses to probes presented in the same position, whereas mild/moderate threat-value stimuli do not (Mogg & Bradley, 1998; Wilson & MacLeod, 2003). The fact that we found a

general attentional bias towards the masked images supports previous studies that have found stronger bias effects for subliminally-presented versus consciously-presented stimuli (e.g., Fox, 2002).

Second, there were significant CD x AD interaction effects on RTs in both versions of the task, and on vigilance and disengagement scores in the masked task. In each case, individuals with comorbid CD+ADs displayed normal patterns of results (i.e., similar to the control group), compared to those with pure versions of either disorder: the CD-only and ADs-only groups displayed longer overall RTs, and also showed decreased vigilance towards and increased difficulty disengaging from masked emotional stimuli than the comorbid CD+ADs and control groups. This slowing of performance (i.e., interference) in the presence of emotional stimuli is typically shown in studies employing Stroop-like tasks (see Algom et al., 2004), and tends to be greater in adults with anxiety than those without anxiety (see Williams et al., 1996). Eysenck et al. (2007) suggest that emotional (and particularly threat-related) stimuli automatically capture attentional resources (disproportionately so, in the case of anxiety), at the expense of higher-order processing resources involved in completing the primary (non-threat-related) task. Similar interference effects have been found in individuals with high levels of trait anger (van Honk et al., 2001a; van Honk et al., 2001b), and reactive aggression (e.g., Chan et al., 2010), and may explain the interference effect of emotional stimuli in our CD-only group. However, the fact that there appears to be an attenuating effect (rather than an exacerbating effect) of CD+ADs comorbidity on both vigilance and disengagement suggests that the effects seen in CD and ADs may not reflect the same types of deficits in selective attention. For example, it is possible that the effects seen in ADs-only individuals are partly due to hypersensitivity towards emotional stimuli, whereas those seen in CD-only individuals are partly due to a general lack of task engagement. Future research should aim to include measures relating to state-level motivation.

Third, our analyses of horizontal eye-movements in the standard VP task did not shed any light on the factors driving the CD x AD interactions: direction of initial fixation was not modulated by group status. Furthermore, our finding that the control group were more likely to initially fixate the angry face in an angry-neutral image pair was not reflected in the RTs shown by the control group: RTs were not significantly shorter for valid than invalid angry-neutral trials.

Fourth, within the CD and comorbid CD+ADs groups, there were no significant effects or interactions involving CU traits. This was unexpected given the results of Kimonis et al. (2012), who found that individuals with primary psychopathy (high CU traits and low anxiety) showed avoidance of distressing images, and individuals with secondary psychopathy (high CU traits and high anxiety) showed vigilance towards distressing images in a visual probe task. Furthermore, previous research has found that individuals with psychopathy show reduced Stroop interference compared to non-psychopaths (Hiatt et al., 2004; Newman et

al., 1997; Vitale et al., 2007). Indeed, Newman and colleagues suggest that psychopaths are less likely to be distracted by task-irrelevant information (Lorenz & Newman, 2002; MacCoon et al., 2004; Newman & Lorenz, 2003) – this forms a key element of the response modulation hypothesis of psychopathy. It is possible that the range of CU traits in our sample was not sufficiently wide to modulate the effects of CD and ADs on attentional biases. However, psychopathy scores in our high- and low-CU-traits CD groups were comparable to those in Kimonis et al. (2012).

In summary, this is one of the first studies to investigate attentional biases in adolescents with CD and comorbid anxiety disorders, and is the first of its kind to use emotional faces as target stimuli and distinguish between measures of attentional vigilance and disengagement rather than using a compound attentional bias measure. The results showed that individuals with CD alone show a different pattern of attentional vigilance and disengagement compared to typically developing adolescents. These data also suggest that the presence of comorbid ADs may modulate the pattern of attentional biases seen in CD, leading to normalisation of such biases in individuals with comorbid CD+ADs.

5.3 Experiment 2: Threat distractor task

5.3.1 Introduction

In Experiment 1, we used a visual-probe task to measure attentional biases towards emotional faces. We found that individuals with ADs showed facilitated task performance in the presence of happy faces, and that the presence of an emotional face resulted in slowed performance (i.e., an interference effect) in the CD-only group – an effect that was not seen in the control and comorbid CD+ADs groups. Whilst the visual-probe task is effective at measuring uncontrolled attentional biases towards, and interference caused by, emotional faces, it does not assess whether individuals are able to deliberately modulate their attention on the basis of task instructions (i.e., when explicitly asked to ignore certain stimuli). Thus, the visual-probe task is not optimal for testing theories of selective attention that are based on top-down attentional control mechanisms, which are relevant to individuals with ADs (e.g. attentional control theory, ACT; Eysenck et al., 2007) and CD (e.g., the response modulation hypothesis; Lorenz & Newman, 2002; MacCoon et al., 2004; Newman & Lorenz, 2003). In order to test whether individuals with CD, ADs and comorbid CD+ADs showed differential levels of attentional control, we used a second task that focused on matching either houses or faces (depending on task instructions) in the presence of distractor faces or houses, respectively. The valence of the distractor faces was also manipulated such that some faces were threatening (e.g., angry) and others were neutral.

This task has typically been used in functional magnetic resonance imaging (fMRI) studies investigating the effect of task-irrelevant emotional faces on the activation of specific brain areas, such as the amygdala (Bishop et al., 2004a; Bishop et al., 2004b; Ewbank et al., 2009; Vuilleumier et al., 2001). However, it has also shown some interesting behavioural

effects in healthy individuals as well as in individuals with elevated anxiety. Vuilleumier et al. (2001) found that the presence of fearful (both task-relevant and task-irrelevant), compared to neutral, faces slowed task performance in healthy adults. Moreover, this effect may have been driven by task-irrelevant fearful faces (i.e., individuals were slower to match houses in the presence of fearful faces compared to neutral faces). Similarly, Bishop et al. (2004b) found that performance was slowed when the display contained fearful faces, regardless of whether these were task-relevant or -irrelevant. The effects of anxiety on task performance have been mixed: Ewbank et al. (2009) found that increased state- and trait-anxiety were related to greater interference (reflected by longer RTs) from task-irrelevant fearful faces (and there was no relationship between anxiety and interference from task-relevant fearful faces). However, Bishop et al. (2004b) found no effect of state- or trait-anxiety on task performance. One reason for these inconsistent results may be the sub-clinical level and limited range of anxiety within the participants of both of these studies: it is possible that individuals with clinical levels of anxiety (i.e., with ADs) would show stronger task effects (i.e., increased interference from task-irrelevant threatening faces). Another possibility is that the results were modulated by individual differences in attentional control: given that in both studies increased anxiety was related to increased amygdala activation in the presence of fearful faces, increased voluntary attentional control may explain why some of the anxious participants were able to remain focused on the task (see Derryberry & Reed, 2002).

This specific task has not been used previously to study interference from emotional distractors in individuals with CD, CU traits, psychopathy or aggression. However, similar Stroop-like tasks have been used with these groups. From a response modulation perspective, low-anxious psychopaths would be expected to show reduced interference compared to controls on Stroop-like tasks because they should be less affected by task-irrelevant stimuli. However, the evidence for this is mixed and findings vary depending on the nature of the task employed. For example, studies employing standard colour-word Stroop tasks have shown that psychopaths show similar patterns of interference to non-psychopaths (Hiatt et al., 2004; Smith et al., 1992). On the other hand, studies employing picture-word Stroop tasks (i.e., asking participants to name line drawings of familiar objects, which are presented concurrently with words that are either related or unrelated to the drawings) have shown that psychopathic individuals show reduced interference compared to non-psychopaths (Hiatt et al., 2004; Newman et al., 1997; Vitale et al., 2007). Hiatt et al. (2004) suggested that the discrepancy in findings between these tasks was due to the relationship between the irrelevant cues and the goal-relevant information. Specifically, in colour-word Stroop tasks, the cues (i.e., the words) are integrated with the attended information (i.e., the ink colour), whereas in picture-word tasks the cues (i.e. the words) are spatially separated from the attended information (i.e., the pictures). It is possible that this spatial separation makes it easier for the subjects to ignore the task-irrelevant cues (MacLeod, 1998), and thus psychopathic individuals are more likely to ignore the cues in favour of the stimuli relating to the task goals. Given that the ignored stimuli in the present

threat distractor task are indeed spatially separate from the attended information, high CU traits individuals may show reduced interference from the task-irrelevant stimuli compared to controls, or low CU traits individuals.

As described previously, there is some evidence that aggressive or angry individuals display attentional biases towards threat in the form of angry/threatening words (Cohen et al., 1998; Eckhardt & Cohen, 1997; van Honk et al., 2001b) or angry faces (van Honk et al., 2001a). Specifically, Stroop-like tasks have shown increased interference from threatening stimuli in individuals scoring high on measures of trait anger (van Honk et al., 2001a; van Honk et al., 2001b), and reactive aggression (e.g., Chan et al., 2010). Therefore, it is possible that in the present task, increased trait-level aggression will be associated with increased interference from task-irrelevant threatening stimuli.

We examined interference effects from task-irrelevant threatening stimuli in individuals with CD-only, ADs-only, comorbid CD+ADs and typically developing controls. Given that this task had not previously been used in healthy adolescents, one question was whether our control group would perform similarly to the adults included in previous studies. We expected that typically developing adolescents would show interference effects (increased errors and/or slowed RTs) from task-irrelevant threatening faces. We also expected that individuals with ADs would have decreased attentional control and would therefore show greater interference effects from task-irrelevant threatening (and especially fearful) faces compared to controls. We hypothesised that CD-only individuals would show reduced interference from task-irrelevant emotional faces compared to controls, and that this would be modulated by CU traits and/or aggression: high CU traits would be associated with decreased interference and high levels of aggression would be associated with increased interference. Consistent with the idea that the presence of anxiety in CD is associated with the presence of increased levels of aggression/hostility (compared to CD alone), we hypothesised that the comorbid CD+ADs group would show increased interference from task-irrelevant threatening faces compared to the CD-only group. Again, however, we predicted that this might be modulated by individual differences in CU traits, with high CU individuals displaying increased attentional control compared to low CU individuals.

5.3.2 Method

5.3.2.1 Participants

Participants were the same as for Experiment 1 (see Chapter 3). However, six participants (2 CD-only, 1 comorbid CD+ADs, 2 ADs-only, and 1 control) found the task difficult to complete due to the flashing nature of the brief images in the task, and their data were subsequently excluded. This resulted in a total sample of 98 participants.

5.3.2.2 Task design

A simple matching task was used to assess the effect of task-irrelevant facial expressions in CD and ADs. The task was adapted from the one used by Ewbank et al. (2009). Participants

were required to decide whether two spatially-related images matched, in the presence of a second pair of task-irrelevant images. Participants were cued to match either a horizontal or a vertical pair of “target” images. The image pairs were faces and houses, and participants were asked to respond, using a button press, when the target image pair was identical. Stimuli consisted of 10 greyscale images of houses, and 30 faces. Facial stimuli consisted of 5 male and 5 female actors from both the NimStim MacArthur Network Face Stimuli Set (Research Network on Early Experience and Brain Development, http://www.macbrain.org/resources.htm, Tottenham et al., 2009) and the Karolinska Directed Emotional Faces image set (Lundqvist et al., 1998), each depicting angry, fearful and neutral facial expressions. The images were converted to greyscale, and were cropped to remove hair and other non-facial background items, as described in Ewbank et al. (2009). The image pairs were presented horizontally and vertically around a central fixation cross. Participants were directed to attend to either the horizontal or vertical pair of images via a visual cue (see Figure 5.5), which was presented at the beginning of each block of 18 trials. There were 8 blocks of trials in which the faces were in the target position (4 horizontal, and 4 vertical), and 8 blocks of trials in which the faces were in the distractor position (4 horizontal, and 4 vertical), resulting in a total of 288 trials. The blocks were presented in a pseudo-randomised order, and within each block the emotion of the face pair varied on a trial-by-trial basis in a pseudo-randomised order. Within each trial, both faces always expressed the same emotion (angry, fearful or neutral), but they had either the same or different identities. Stimuli were presented for 250ms (to avoid eye-gaze shifts away from the central fixation cross), and the participants’ responses were recorded up to the next trial (3 s). There were six trial types: i) angry target; ii) fearful target; iii) neutral target; iv) angry distractor; v) fearful distractor; and vi) neutral distractor. Reaction time (RT) and accuracy data were collected throughout. An example trial is shown in Figure 5.5.

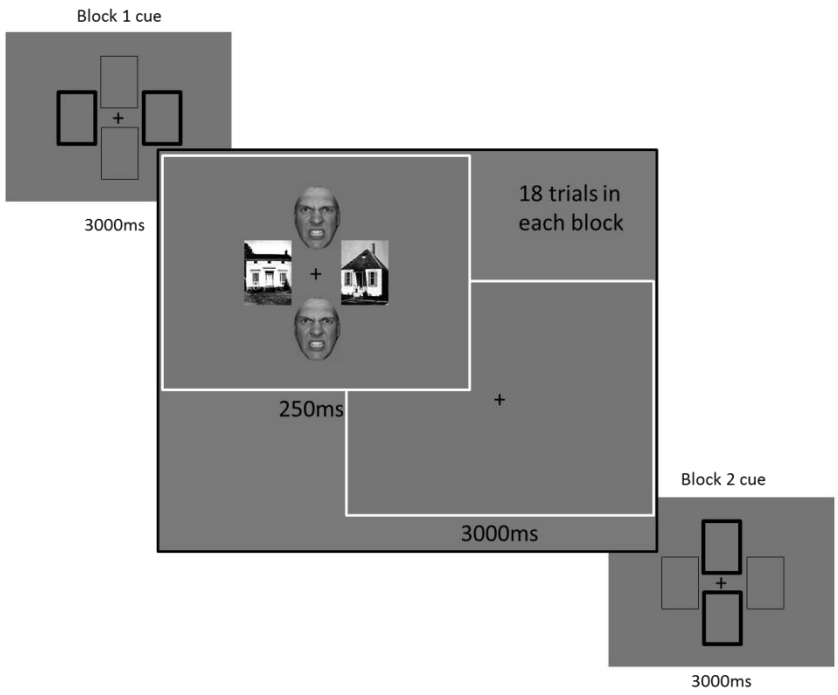

Figure 5.4: An example trial in which the subject has to decide whether the houses are identical in the presence of irrelevant threat-related stimuli (angry distractor condition).

5.3.2.3 Data preparation

There were two types of correct response: a button-press when the target image pair was identical, and no button-press when the target image pair was different. A mean accuracy score was computed for each condition for each participant.

Only the RTs for correct responses were used in the RT analyses, which resulted in the removal of 22% of trials in which a response was required. These raw RT frequency distributions were very similar to those in the visual probe tasks, therefore we employed the same method for the removal of outliers. RTs that were quicker than 150 ms or greater than 2000 ms were removed, as were any RTs that were greater than 3 standard deviations above or below each participant's log-transformed mean RT. This resulted in the removal of a further 1.8% of trials. For ease of interpretation, the RTs were then transformed back to milliseconds, and the mean RTs for each condition for each participant were computed.

5.3.2.4 Data analysis

To examine whether the same pattern of interference was observed in healthy adolescents as has previously been reported in adults, we first tested for condition and emotion effects in the control group alone. We performed a 3 (emotion: anger, fear, neutral) x 2 (condition: face distractor, face target) repeated-measures ANOVA on accuracy and RTs, respectively.

To investigate the effects of CD and ADs on task performance, two 3 (emotion: anger, fear, neutral) x 2 (face type: distractor, target) x 2 (CD status: present, CD+/absent, CD-) x 2 (AD status: present, AD+/absent, AD-) mixed ANOVAs were conducted on accuracy and RTs, respectively. Significant main effects and interactions were followed-up with simple effects analyses.

In order to estimate the effects of possible confounding factors (i.e., IQ, gender and depressive symptoms), hierarchical regression analyses were used to examine the influence of confounding variables that differed between groups and correlated significantly with outcome variables associated with CD or ADs.

5.3.3 Results

5.3.3.1 Sample characteristics

The cognitive, demographic and clinical variables of the sample are presented in Table 5.2. These were similar to those for the sample included in Experiment 1.

Table 5.2: Demographic and clinical characteristics of the sample included in the distractor task experiment.

	Control[1] N = 28, 22 males		CD[2] N = 30, 24 males		ADs[3] N = 21, 5 males		Comorbid[4] N = 19, 11 males		F
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Age	16.20	1.47	16.75	1.42	16.32	1.92	16.91	1.07	0.50
IQ	109.69	11.92	95.03	9.39	102.91	11.69	102.79	13.41	8.04** 1>2
CU traits	20.07	6.69	31.27	9.16	18.84	7.09	26.76	9.76	13.21** 2,4>1,3
Aggression	60.83	16.11	81.29	34.77	70.73	24.46	98.67	29.07	8.04** 2,4>1, 4>3
STAI Trait Anxiety	36.10	9.87	44.18	11.06	51.61	10.59	57.32	9.92	18.66** 2,3,4>1, 4>2
HADS Depression	3.52	2.90	7.34	4.42	5.64	4.05	7.42	4.19	5.94** 2,4>1

*$p < 0.05$, **$p < 0.01$. ADs = anxiety disorders; CD = conduct disorder; CU = callous-unemotional; HADS = Hospital Anxiety and Depression Scales; IQ = intelligence quotient; STAI=State-Trait Anxiety Inventory.

5.3.3.2 Control group

The mean accuracy and RTs for the control group for each task condition are shown in Figure 5.6. In terms of accuracy, there were main effects of condition (F (1, 28) = 142.12, $p < 0.01$, $r = 0.91$) and emotion (F (2, 56) = 5.24, $p < 0.01$), as well as a significant emotion x condition interaction (F (2, 56) = 6.17, $p < 0.01$). Specifically, participants were more accurate in matching houses than faces (i.e. in the face-distractor condition), across all emotions (all $p < 0.01$, $r > 0.76$). In addition, participants were more accurate when matching angry than fearful (F (1, 28) = 13.89, $p < 0.01$, $r = 0.58$) or neutral faces (F (1, 28) = 13.27, $p < 0.01$, $r = 0.57$) in the face-target condition, but there was no effect of emotion on matching houses in the face-distractor condition.

In terms of RT, there was a main effect of condition, with participants responding more quickly when matching houses than faces (F (1, 28) = 6.63, $p = 0.02$, $r = 0.73$), but no other significant effects or interactions.

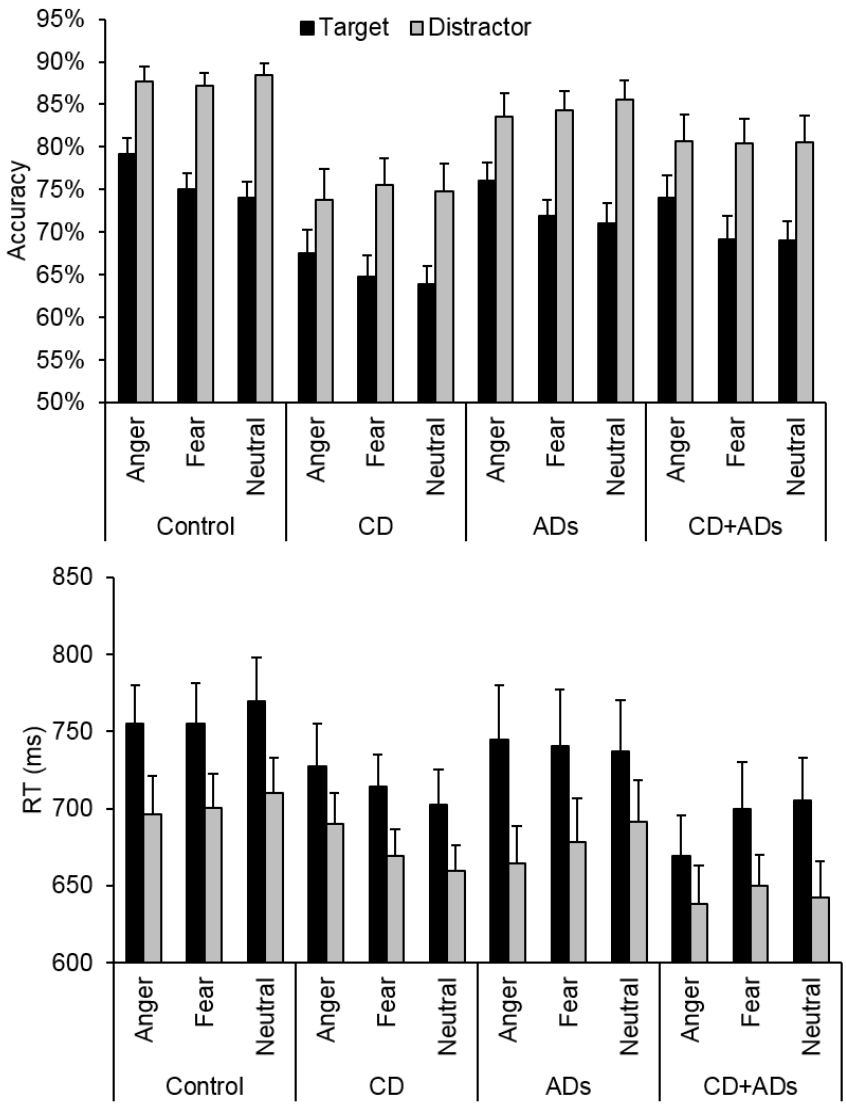

Figure 5.5: Mean accuracy (top panel) and reaction times (RTs; bottom panel) for each condition (face-target, face-distractor), by emotion, separated by group. Error bars represent +1 S.E.M

5.3.3.3 Effects of psychopathology

The mean accuracy data for all four groups are shown in Figure 5.6. There were main effects of emotion (F (2, 188) = 7.03, $p < 0.01$), condition (F (1, 94) = 149.32, $p < 0.01$, $r = 0.77$), and a significant emotion x condition interaction (F (2, 188) = 14.27, $p < 0.01$). Similar to the results for the control group, participants were more accurate when matching houses than faces. Participants were generally more accurate when matching angry faces, compared to neutral or fearful faces (F (1, 94) = 34.52, $p < 0.01$, $r = 0.52$, and F (1, 94) = 25.00, $p < 0.01$, $r = 0.46$, respectively), but there were no effects of emotion on accuracy of matching houses (i.e., in the face-distractor condition). There was also a main effect of CD status (F (1, 94) = 11.57, $p < 0.01$, $r = 0.33$), and a significant CD x AD interaction (F (1, 94) = 3.96, $p = 0.05$, $r = 0.20$; see Figure 5.7). Specifically, CD+ individuals had lower accuracy than CD- individuals (F (1, 94) = 11.65, $p < 0.01$, $r = 0.33$), but the interaction indicated that this was driven by the CD-only group, specifically ($F_{\text{CD vs. Controls}}$ (1, 94) = 18.06, $p < 0.01$, $r = 0.40$; $F_{\text{CD vs CD+ADs}}$ (1, 94) = 3.06, $p = 0.08$, $r = 0.18$).

To check whether there were effects of RT on accuracy (i.e., a speed-accuracy trade-off effect), baseline RT (i.e., mean RTs for each participant across all trials) was added as a covariate to the above analysis. The addition of this covariate did not alter the effects of psychopathology reported above.

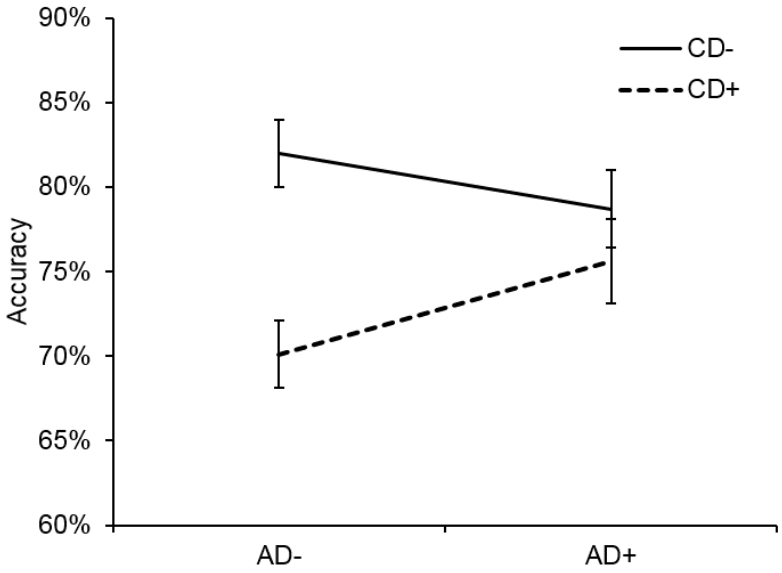

Figure 5.6: Conduct disorder status (CD) x anxiety disorder status (AD) interaction effect on overall accuracy (error bars represent ±1 SEM)

Confounding factors

Given the group differences in IQ, gender and depressive symptoms, bivariate correlations were conducted between IQ, gender and depressive symptoms, and overall task accuracy. IQ showed a significant positive correlation with accuracy (r = 0.49, p < 0.01), and depressive symptoms were negatively correlated with accuracy (r = -0.27, p < 0.01). Gender was not correlated with accuracy (r = 0.02, p = 0.88). Thus, a three-step hierarchical regression analysis was performed on overall task accuracy with the following predictors: step 1, IQ and depression scores; step 2, addition of CD and AD status; step 3, addition of a CD*AD interaction term. These results are presented in Table 5.3. IQ remained a significant predictor of performance (as measured by task accuracy) across the three models, with higher IQ resulting in increased accuracy. Depression, AD status and the CD*AD interaction term were not significant predictors of accuracy. However, CD status was a marginally significant predictor of accuracy (standardised β = -0.19, p = 0.06), with the presence of CD resulting in lower accuracy. The final regression model accounted for 30% of the variance in accuracy (R^2 = 0.30, F = 7.68, p < 0.01). Repeating this analysis removing the non-significant predictors (depression, AD and CD*AD) resulted in a more efficient regression model, with both IQ and CD as significant independent predictors of task accuracy: β^{IQ} = 0.41, p < 0.01, β^{CD} = -0.21, p = 0.03, R^2 = 0.28, F = 18.25, p < 0.01. Furthermore, the addition of CD

resulted in a significant increase in the degree of explained variance for accuracy (ΔR^2 = 0.04, p = 0.03).

Table 5.3: Results of the hierarchical regression analyses on overall accuracy for the distractor task

		Accuracy			
		b	SE b	β	R^2
Step 1					0.26**
	IQ	<0.01	<0.01	0.45**	
	Depression	<0.01	<0.01	-0.15	
Step 2					0.29**
	IQ	<0.01	<0.01	0.39**	
	Depression	<0.01	<0.01	-0.11	
	CD	-0.04	0.02	-0.19†	
	AD	0.01	0.02	0.05	
Step 3					0.30**
	IQ	<0.01	<0.01	0.37**	
	Depression	<0.01	<0.01	-0.10	
	CD	-0.04	0.02	-0.19†	
	AD	0.01	0.02	0.06	
	CD*AD	0.04	0.04	0.08	

**p < 0.01, †p = 0.06. AD = anxiety disorder status; CD = conduct disorder status; IQ = intelligence quotient. *Note:* b = unstandardized coefficient; β = standardised coefficient.

5.3.3.4 RT data

The mean RT data are shown in Figure 5.6. The results of the ANOVA indicated that there was a main effect of condition (F (1, 94) = 75.50, p < 0.01, r = 0.66): participants were generally slower to match faces than houses. In addition, there was a significant CD x AD x emotion interaction (F (2, 188) = 3.75, p = 0.03). This interaction is shown in Figure 5.8. CD-only participants had longer RTs in trials containing angry faces compared to those containing neutral (F (1, 94) = 7.51, p < 0.01, r = 0.27) or fearful faces (F (1, 94) = 3.84, p = 0.05, r = 0.20). Conversely, comorbid CD+ADs individuals had shorter RTs in trials containing angry, compared to fearful, faces (F (1, 94) = 3.99, p = 0.05, r = 0.20). In addition, control individuals had marginally longer RTs in trials containing neutral faces than CD-only individuals (F (1, 94) = 3.53, p = 0.06, r = 0.19).

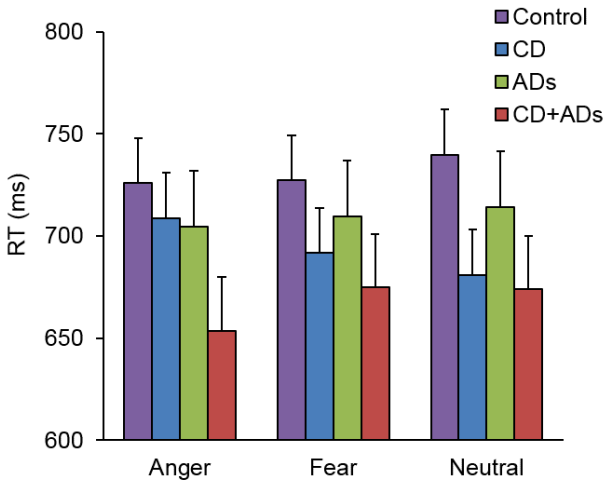

Figure 5.7: Graph showing conduct disorder (CD) x anxiety disorders (ADs) x emotion interaction effect on mean reaction times (RT). Error bars represent +1 S.E.M.

Confounding factors

Given the group differences in IQ, gender and depressive symptoms, bivariate correlations were conducted between IQ, gender and depressive symptoms, and mean RTs for angry, fearful and neutral trials (averaged across conditions). Gender was uncorrelated with the RT measures (all $r < 0.1$). IQ was significantly positively correlated with the RT measures (all $r > 0.4$), and depressive symptoms were significantly negatively correlated with the RT measures (all $r < -0.26$). Thus, a three-step hierarchical regression analyses was performed for each RT measure with the following predictors: step 1, IQ and depression scores; step 2, addition of CD and AD status; step 3, addition of a CD*AD interaction term. These results are presented in Table 5.4. IQ was a significant predictor of RTs for all emotions, with a higher IQ associated with longer RTs for all emotions. Depression, AD-status and the CD*AD interaction term were not significant predictors of RTs. The models did not improve significantly on the addition of CD-status, AD-status, or the CD*AD interaction term. However, CD was a significant predictor of RTs in trials containing fearful, and trials containing neutral faces. In both cases, the presence of CD was associated with a decrease in RTs.

Table 5.4: Results of the hierarchical regression analyses on reaction times for each emotion, averaged across conditions, for the distractor task.

		Anger		Fear		Neutral	
		β†	R^2	β	R^2	β	R^2
Step 1			0.24**		0.21**		0.28**
	IQ	0.43**		0.39**		0.47**	
	Depression	-0.14		-0.15		-0.14	
Step 2			0.27**		0.24**		0.31**
	IQ	0.38**		0.33*		0.41**	
	Depression	-0.11		-0.10		-0.10	
	CD	-0.16		-0.20*		-0.19*	
	AD	0.06		0.04		0.05	
Step 3			0.28**		0.25**		0.31**
	IQ	0.35*		0.31*		0.39**	
	Depression	-0.10		-0.10		-0.09	
	CD	-0.18		-0.21*		-0.20*	
	AD	0.07		0.04		0.06	
	CD*AD	0.09		0.07		0.06	

* $p < 0.05$, ** $p < 0.01$, † standardised coefficient. AD = anxiety disorder status; CD = conduct disorder status; IQ = intelligence quotient

5.3.3.5 CU traits and aggression

In order to investigate the separate effects of CU and aggressive traits within the CD groups (i.e., CD-only and comorbid CD+ADs groups combined), two sets of partial correlations were conducted: the first correlated accuracy and RTs from face-distractor trials with CU traits and an AD*CU interaction term, whilst controlling for aggression, and the second correlated error rates and RTs from face-distractor trials with aggression and an AD*aggression interaction term, whilst controlling for CU traits. The results of these correlations are presented in Table 5.5. There was a significant positive correlation between CU traits and RTs in trials containing angry distractor faces ($r = 0.37$, $p = 0.02$; i.e., there was *increased* interference from task irrelevant threat-stimuli in those with CD and higher CU traits). Interestingly, the direction of this effect runs counter to the predictions of the response modulation hypothesis.

Table 5.5: Partial correlations of threat distractor task indices with callous-unemotional (CU) traits, anxiety disorders (ADs) and aggression

	Emotion	CU[a]	ADs*CU[a]	Aggression[b]	AD*Aggression[b]
Error Rates	Anger	-0.15	-0.09	0.21	-0.25
	Fear	-0.16	-0.07	0.22	-0.25
	Neutral	0.00	0.02	0.24	-0.25
Reaction Times	Anger	0.37*	0.03	-0.18	-0.13
	Fear	0.30	0.13	-0.02	-0.14
	Neutral	0.15	0.08	0.04	-0.25

[a] Controlling for aggression, [b] controlling for CU traits, *$p < 0.05$.

5.3.4 Discussion

We investigated attentional interference from task-irrelevant emotional faces, via a threat distractor task, in adolescents with CD alone, ADs alone, comorbid CD+ADs and controls. First, we tested whether our control group of typically-developing adolescents would perform similarly to the typical adults in previous studies (given that this task has not been used previously in adolescents). Contrary to the results of previous studies in adults (Bishop et al., 2004b; Vuilleumier et al., 2001), we did not find any RT interference effects of task-irrelevant fearful faces. However, similar to those studies, our controls were slower and less accurate when matching face stimuli than houses (i.e., when faces, rather than houses, were targets). Our control group was similar in size to these previous studies, therefore it is unlikely that our study was underpowered to detect similar effects. However, our task differed in that it additionally contained angry face stimuli, and we found that the control group was more accurate when matching angry, compared to fearful or neutral, faces. Indeed, this latter finding was replicated across our groups, and this is consistent with the results of Ewbank et al. (2009). Our task was identical to that used in Ewbank et al. (2009) study, therefore it is possible that the angry facial expressions across the different actors are more different from each other than the fearful or neutral facial expressions. Alternatively, the threatening nature of the angry stimuli may have led to increased emotional arousal, which facilitated task performance in the control group.

Second, we tested whether there were any effects of psychopathology (CD or AD status) on the interference caused by task-irrelevant facial expressions. We did not find any evidence of increased interference from task-irrelevant threat stimuli in individuals with ADs, which is inconsistent with previous findings in high anxious normative adults (Ewbank et al., 2009). This suggests that adolescents with CD-only, ADs-only or comorbid CD+ADs do not have specific deficits/alterations in attentional control, at least when considering them at a group level. This is consistent with the results of Experiment 1, which did not show any CD- or ADs-related attentional biases towards threatening facial expressions. However, similar to the effects observed on overall RTs in Experiment 1, we did find a CD x AD interaction effect on overall task accuracy: the presence of comorbid CD+ADs resulted in enhanced accuracy over CD alone, and reduced accuracy in comparison with ADs alone. This suggests that the presence of ADs in those with CD counteracts the effects of CD on overall engagement with the task. However, unlike Experiment 1, our follow-up analyses suggested that this may have been partially due to group differences in IQ. We also found a significant CD x AD x emotion interaction effect on RTs (irrespective of condition). Specifically, comorbid CD+ADs individuals had quicker RTs in trials containing angry compared to fearful faces, whereas CD-only individuals had slower RTs in trials containing angry compared to fearful or neutral faces. This suggests that comorbid CD+ADs individuals may show a RT enhancement in trials containing angry faces, similar to the RT enhancement shown in Experiment 1 (although this latter effect was across emotional expressions). However, there were no

significant between-group differences in RTs. Furthermore, our follow-up analyses suggested that this effect may have been partially due to group differences in IQ.

Third, we examined whether there were any differential effects of CU and aggressive traits within the combined CD-only and comorbid CD+ADs groups. We found that CU traits were positively associated with interference from task-irrelevant angry faces (i.e., longer RTs). This appeared to be independent of presence of ADs, or level of aggressive traits. This was unexpected, given previous studies showing that individuals with psychopathy or high CU-traits are insensitive to both task-relevant and task-irrelevant emotional stimuli (see MacCoon et al., 2004; Newman, 1998). It was also inconsistent with the results of Experiment 1, which showed that high CU traits were associated with facilitated disengagement from angry faces (independent of the presence of ADs). Furthermore, there was no significant association between aggression and interference from task-irrelevant threatening faces, which is inconsistent with previous studies using Stroop-like tasks (e.g., Chan et al., 2010).

In summary, this was the first study to examine interference from task-irrelevant threatening stimuli in adolescents with CD-only, ADs-only, comorbid CD+ADs, and typically-developing controls. The results showed that there were no specific AD- or CD-related deficits/alterations in attentional control: all participants were able to ignore the presence of distracting emotional faces. We did find an attenuating effect of ADs on overall task accuracy, but this may have been modulated by group differences in IQ.

5.4 Experiment 3: Extrinsic Affective Simon Task

5.4.1 Introduction

In Experiment 2 we used a threat-distractor task to assess attentional control mechanisms in adolescents with CD, ADs, comorbid CD+ADs and typically developing controls. We found that all participants were able to ignore threatening faces such that no interference effects were seen (either in error rates or RTs). Given that the task-irrelevant stimuli in the threat-distractor task were spatially separate from the task-relevant stimuli (and on a different plane, i.e., horizontal versus vertical), it is possible that this separation was sufficient to limit the effects of threat on attentional control. Furthermore, it was not possible to assess, either from Experiment 1 or Experiment 2, whether any dysfunctional or biased automatic evaluations of valence/threat were present in the groups. This may help to further characterise the effects of threatening facial expressions on selective attention.

During the last two decades there has been an increased interest in using measures that test individuals' automatic associations. Popular tasks of this type include: the Implicit Association Test (IAT; Greenwald et al., 1998); the Affective Simon Task (AST; De Houwer & Eelen, 1998); and the Extrinsic Affective Simon Task (EAST; De Houwer, 2003). These tasks typically require participants to complete two separate, but interleaved, categorisation tasks. In an IAT, participants may be asked to categorise proper nouns as being "flowers" or

"insects" using two keys, and to categorise emotional words as being "positive" or "negative" using the same two keys. Thus, participants are likely to respond more quickly when the response key and proper noun share the same perceived valence (e.g., negative). In an AST, participants are shown positive and negative words that are coloured either green or blue and are asked to make the verbal response "positive" to green words and "negative" to blue words. Similarly, trials in which green words are perceived to be positive show facilitated RTs: there is a facilitation effect from the previous learning of the association between a colour and the valence of the word. The EAST combines elements of both tasks by asking participants to evaluate the valence (positive or negative) of words when they appear in black and white using two keys, and to evaluate the colour of the words (e.g., green or blue) when they appear in colour, using the same two keys. Thus, by examining the responses from the colour-matching task, an inference regarding the perceived valence of the words can be made: colour matching is typically quicker when the perceived valence of the word and its colour are mapped onto the same response key (i.e., on congruent trials). When the valence and colour are mapped onto different response keys (on incongruent trials), responses are correspondingly slowed. As colour is presumably unrelated to valence, it is likely that any interference effects are due to the automatic/implicit processing of the emotional content of the stimuli. For example, Stahl and Degner (2007) suggest that these EAST interference effects are a result of three competing factors: i) automatic processing of task-irrelevant information (i.e., the valence of the coloured words, in the above example); ii) the controlled processing of task-relevant information (i.e., the colour of the words) and; iii) response biases (i.e., individual preference for the left or right response keys).

As described previously, anxiety is characterised by threat-related information processing biases, which are evidenced by interference from and facilitation towards threat in selective attention tasks (see Bar-Haim et al., 2007; Cisler et al., 2009). According to attentional control theory (ACT; Eysenck et al., 2007), this threat-related bias in anxiety is related to deficits in attentional control both in terms of inhibition (i.e., supressing automatic/dominant responses) and shifting (i.e., switching attentional focus depending on task demands) (see Eysenck et al., 2007). This means that individuals with anxiety are more likely to be distracted by threatening stimuli, even when instructed to ignore them (i.e., they are unable to inhibit their dominant response – to attend to the threat), and are less efficient in tasks that involve the deliberate shift of attention to task-relevant features in the presence of threatening stimuli. Therefore in the word-based EAST example above, from an ACT perspective, individuals with anxiety are less likely to be able to ignore word valence when colour-categorising threatening words, and will show impairments when the task shifts from valence-categorisation to colour-categorisation. In addition, some theories of selective attention in anxiety suggest that anxious individuals may have lower thresholds for detecting threat in the environment (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998). Taken together, EAST interference/facilitation effects in anxious individuals are likely to be greater in magnitude when threatening stimuli are used.

Few studies have used the EAST to assess interference from threat in anxious individuals, and these have tended to focus on anxiety associated with specific concepts (e.g., spider phobia), rather than generalised anxiety disorder or high trait anxiety. However, one study using positive, negative and spider pictures reported stronger interference effects of semantic content for spider-phobic individuals, regardless of the type of stimuli (spider vs. non-spider; Huijding & de Jong, 2005b). Other studies using related, but different, tasks have found that anxious groups show stronger interference effects in the presence of threat-related stimuli (e.g., Li et al., 2008; Teachman et al., 2001; Williams et al., 1996).

As described previously, individuals with psychopathy and aggressive individuals have been found to show differential patterns of selective attention: whereas psychopaths have a highly goal-directed attentional style, which means that they are able to ignore task-irrelevant information (see MacCoon et al., 2004; Newman, 1998), aggressive individuals have been found to show attentional biases towards anger-related stimuli (Cohen et al., 1998; Eckhardt & Cohen, 1997; van Honk et al., 2001a) as well as hostile attribution biases (de Castro et al., 2002; Dodge et al., 1990). This suggests that psychopaths may show reduced EAST effects compared to non-psychopaths: they would be less likely to attend to task-irrelevant information, and especially task-irrelevant emotional information. Although EASTs have not been used to study psychopathic groups, research using other implicit measures has reported that psychopathic murderers displayed weaker associations between unpleasant and violent words in a violence-peace IAT compared to non-psychopathic murderers (Snowden et al., 2004), psychopaths show reduced interference from positive and negative primes in affective priming tasks (e.g., Blair et al., 2006a), and reduced interference in picture-word Stroop tasks (Hiatt et al., 2004; Newman et al., 1997; Vitale et al., 2007; Vitale et al., 2005). Aggressive individuals, on the other hand, are likely to display increased interference from anger-related stimuli in EAST tasks, given the anger-related biases described above.

One issue with the standard EAST is the use of word stimuli. Picture stimuli, in contrast, are more ecologically valid (e.g., a person with spider phobia may be afraid of a picture of a spider, rather than the word “spider”), and may capture the essence of concepts that are difficult to describe in single words (Huijding & de Jong, 2005b). In the present study, we used a pictorial version of the EAST to measure both interference effects from, and implicit valence evaluations of, emotional faces (angry, fearful, happy and neutral) in four groups of adolescents: those with CD-only, those with ADs-only, those with comorbid CD+ADs, and a typically developing control group.

We hypothesised that individuals with ADs would show greater interference effects from emotional faces, particularly for facial expressions of anger and fear, than those without ADs. This is likely to be reflected in quicker response times (and decreased error rates) to congruent trials and slower response times (and increased error rates) on incongruent trials involving negative facial expressions. In terms of CD, we expect that interference effects

from emotional faces will be modulated by CU traits (CD individuals with higher CU traits will show reduced interference and facilitation effects), as well as by individual differences in aggression (CD individuals with higher levels of aggression will show increased interference and facilitation effects for angry facial expressions). Our hypotheses for the comorbid CD+ADs group are more speculative, given the lack of research in this area, but it is possible that these individuals will show an additive effect of ADs, given the similarity of the biases observed in each of the separate conditions (i.e., hostile attribution biases, coupled with hypersensitivity to threat). However, similar to the CD-only group, this may be modulated by individual differences in CU traits and aggression.

5.4.2 Method

5.4.2.1 Participants

Participants were the same as in Experiment 1, however eight participants (2 CD-only, 1 comorbid CD+ADs, and 5 ADs-only) did not complete the task due to either computer malfunction or the presence of specific phobias related to the images in the task. Data from three further participants (2 CD-only, 1 comorbid CD+ADs) were excluded following data preparation procedures (see below). This resulted in a total sample of 93 participants.

5.4.2.2 Extrinsic Affective Simon Task (EAST)

A pictorial version of the EAST (De Houwer, 2003) was used to assess implicit valence evaluations of emotional faces. Participants were asked to evaluate the *valence* of positive or negative greyscale images of scenes, and the *colour* of green or blue images of emotional faces.

Stimuli

Eight scenes with positive valence and eight with negative valence were selected from the International Affective Picture System (IAPS; Lang et al., 2008), and were converted to greyscale following the procedure described in Gray et al. (2013). Four male actors, each depicting happy, fearful, angry or neutral facial expressions, were selected from the NimStim MacArthur Network Face Stimuli Set (Research Network on Early Experience and Brain Development, http://www.macbrain.org/resources.htm, Tottenham et al., 2009). An oval mask was applied to each image to remove non-facial features, and blue and green tinted versions were created for each (the images for one male actor are shown in Figure 5.9).

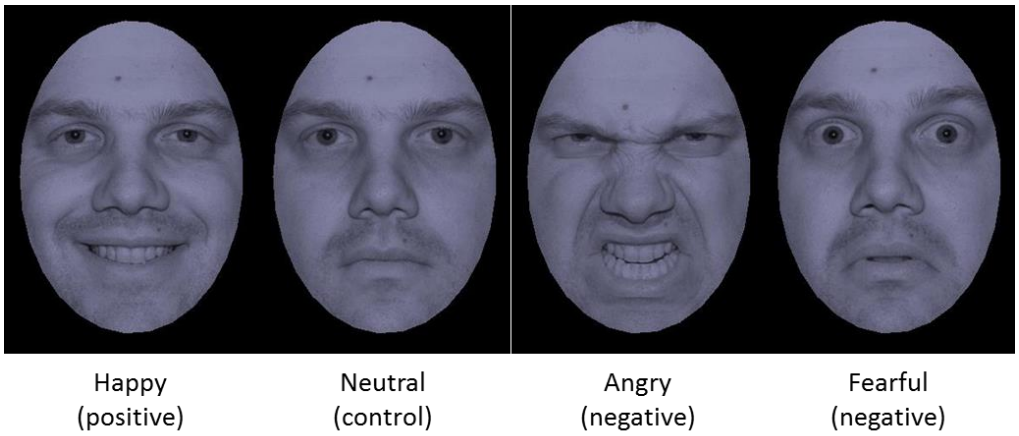

Figure 5.9: Example faces included in the Extrinsic Affective Simon Task with valence shown in parentheses.

Task design and procedure

Stimuli were presented in five blocks of trials: one valence training block, one colour training block and three experimental blocks. In the valence training block, participants were presented with the greyscale IAPS images and were instructed to press the positive key (Q on a keyboard) if the valence of the image was positive, and the negative key (P on a keyboard) if the valence of the image was negative. Images remained on the screen until the correct response key was pressed. Participants were instructed to respond as quickly as they could, without making errors. Each image was presented twice, with order randomised across all stimuli, resulting in a total of 32 trials. In the colour training block, participants were presented with the coloured faces and were instructed to press the blue or green keys if the faces were blue or green, respectively. The keys that were assigned “blue” or “green” were counterbalanced according to the participant’s identification number. For odd-numbered participants, “green” was assigned to the positive key, and “blue” to the negative key, and vice versa for even-numbered participants. Each image was presented twice (once in blue and once in green), with order randomised across all stimuli, resulting in a total of 32 trials. For the remaining three experimental blocks, the IAPS images and the coloured faces were presented in a random order and participants were instructed to press the positive or negative key in response to a greyscale image, and the blue or green key in response to a coloured face. Each image was presented three times in each block, resulting in 96 trials per block and a total 352 experimental trials. Reaction time (RT) and accuracy data were collected. A pictorial representation of the EAST is shown in Figure 5.10.

Stimuli were presented on a 19-inch VGA II YAMA Vision Master 500 monitor, with a refresh rate of 75Hz and a resolution of 1152x870 pixels. The task was administered using MATLAB® (The Mathworks, 2012), running on a Macintosh computer (OS X Version 10.6.8). Participants were instructed to fixate on the centre of the screen and respond as quickly and accurately as possible.

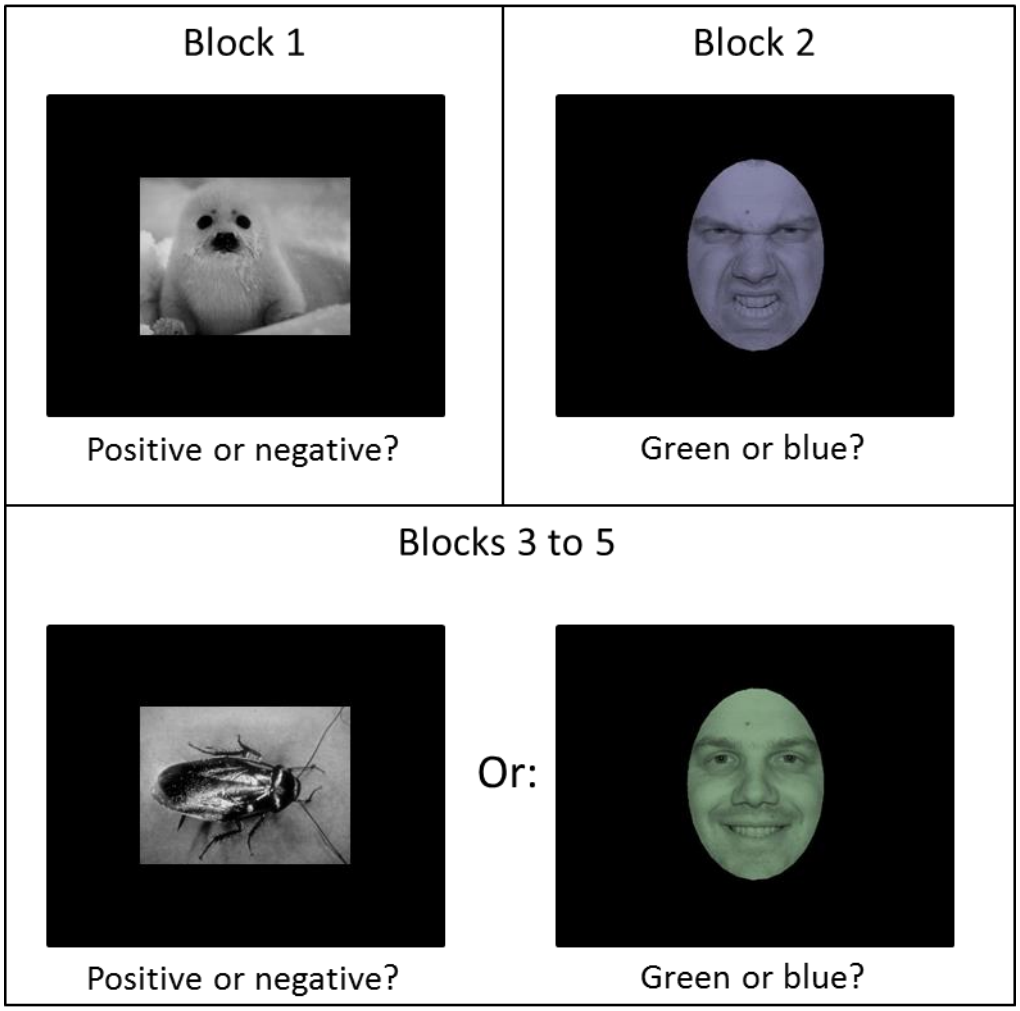

Figure 5.10: Schematic representation of the Extrinsic Affective Simon Task procedure

5.4.2.3 Data preparation

Given that we were interested in the interference effect of task-irrelevant facial emotion, only data from the facial stimuli in the experimental blocks (blocks 3 to 5) were analysed. The error rates for each of the 8 face trial types were calculated. Two types of errors could be made: positive errors (where the incorrect response was the positive key) and negative errors (where the incorrect response was the negative key). These positive and negative error rates were then used to calculate error interference (EI) scores for each facial expression, according to the following equation:

$$EI = Positive\ Error\ Rate - Negative\ Error\ Rate$$

Thus, a positive EI score indicated that more positive errors were made than negative errors, and therefore the valence of the facial expression was evaluated as positive. Three participants had mean error rates of greater than 35% and were removed from the analyses.

The RT data were derived from correct face trials in blocks 3 to 5. Inspection of the raw RT frequency distribution indicated significant positive skew. In addition, the distribution was shifted to the right, compared to the distributions of the visual probe and threat distractor tasks. This suggested that participants generally found the EAST more challenging and, therefore, took longer to respond. We therefore removed RTs that were quicker than 150ms or slower than 4000ms. RTs were then log-transformed (to correct for positive skew), and any RTs that were greater than 3 standard deviations above or below each participant's log-transformed mean RT were also removed. RTs were then transformed back to milliseconds for ease of interpretation. As with the error rates, two types of RTs were possible: positive RTs (RT to press the positive key) and negative RTs (RT to press the negative key). These positive and negative RTs were used to calculate RT interference (RTI) scores for each facial expression, according to the following equation:

$$RTI = Mean\ Negative\ RT - Mean\ Positive\ RT$$

Thus, a positive RTI score indicated that positive correct responses were quicker than negative correct responses, and therefore the valence of facial expression was evaluated as positive.

We would expect an individual to associate a happy face with a positive valence, and therefore expect them to show positive EI scores (i.e., making more positive than negative errors), and positive RTI scores (i.e., responding more quickly when using the positive than the negative correct response keys).

5.4.2.4 Data analysis

Two 4 (emotion: anger, fear, happy, neutral) x 2 (CD+/CD-) x 2 (AD+/AD-) mixed ANOVAs were conducted on EI and RTI scores, respectively. Significant main effects and interactions were followed-up with simple effects analyses.

In order to estimate the effects of possible confounding factors (i.e., IQ, gender and depressive symptoms), dependent variables that showed significant effects of CD/AD, or any interactions involving CD/AD, were correlated with IQ score, gender (as a dichotomous variable, with 1 = male and 2 = female) and the depression subscale of the Hospital Anxiety and Depression scales questionnaire. Significant correlations were followed-up with regression analyses, when the potentially confounding variable was also significantly correlated with CD/AD status.

5.4.3 Results

5.4.3.1 Sample characteristics

The sample characteristics are presented in Table 5.6. These were similar to those for the sample in Experiment 1.

Table 5.6: Demographic and clinical characteristics of the sample included in the Extrinsic Affective Simon Task.

	Control[1] N = 29, 23 males		CD[2] N = 28, 21 males		ADs[3] N = 18, 5 males		Comorbid[4] N = 18, 11 males		F
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Age	16.31	1.48	16.66	1.45	16.59	1.68	16.80	1.10	0.50
IQ	108.59	12.21	96.10	10.41	106.33	7.67	102.79	13.41	6.72** 1,3>2
CU traits	20.14	6.82	28.65	12.31	17.92	6.88	27.76	9.68	7.55** 2,4>1,3
Aggression	61.38	16.56	75.23	39.34	67.11	24.65	94.84	36.27	4.87** 4>1,3
STAI Trait Anxiety	36.10	9.87	43.72	10.80	50.81	11.38	56.95	9.75	17.29** 2,3,4>1, 4>2
HADS Depression	3.66	3.06	7.03	4.57	5.67	4.23	7.58	3.99	5.03** 2,4>1

*$p < 0.05$, **$p < 0.01$. ADs = anxiety disorders; CD = conduct disorder; CU = callous-unemotional; HADS = Hospital Anxiety and Depression Scales; IQ = intelligence quotient; STAI=State-Trait Anxiety Inventory.

5.4.3.2 Confounding factors

Given group differences in IQ, gender and depressive symptoms, bivariate correlations were conducted between IQ, gender and depressive symptoms, and EAST scores for each emotion. None of these variables correlated significantly with any of the EAST scores. Thus, IQ, gender and depressive symptoms were not controlled for in any of the analyses presented below.

5.4.3.3 EAST

Error Interference (EI) scores

The mean EI scores for each group are shown in Figure 5.11 (top panel). There was a significant emotion x CD x AD interaction (F (3, 267) = 3.13, p = 0.03). Simple effects analyses indicated that ADs-only individuals showed greater positive EI from happy faces compared to the other emotions (all $p < 0.05$, effects ranged from r = 0.23 to r = 0.25). In addition, ADs-only individuals showed greater positive EI from happy faces, compared to comorbid CD+ADs individuals (F (1, 89) = 6.15, p = 0.2, r = 0.26). In other words, individuals with ADs alone made more positive than negative errors when colour-matching happy faces, compared to comorbid CD+ADs individuals, who made more negative than positive errors (see Figure 5.11, top panel). However, whilst the EI scores for happy in the ADs-only group were significantly greater than 0 (t (17) = 2.47, p = 0.02), those for the comorbid CD+ADs group were only marginally less than 0 (t (18) = -1.86, p = 0.08). In addition, the CD-only group were significantly more likely to make negative errors in the presence of angry faces (t (29) = -2.08, p = 0.05). There were no other significant effects or interactions.

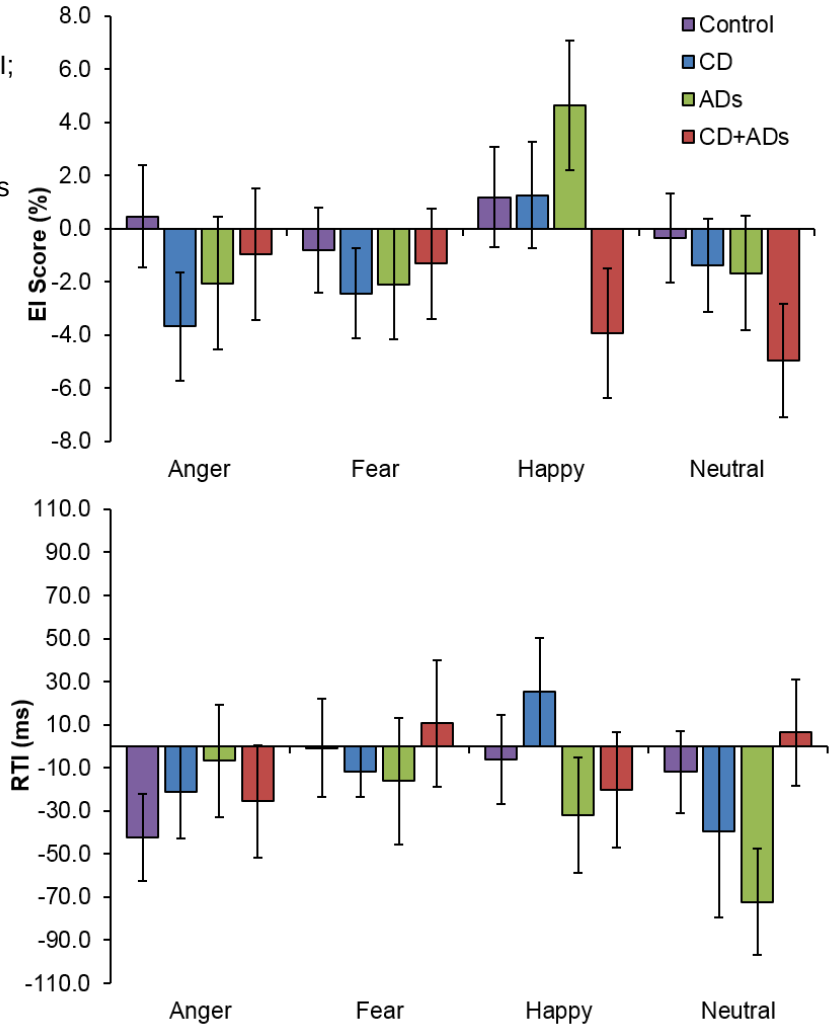

Figure 5.8: Mean error interference (EI; top panel) and reaction time interference (RTI; bottom panel) scores for each group, for each emotion in the Extrinsic Affective Simon task. Error bars represent +/- 1 SEM. *Note*: ADs = anxiety disorders; CD = conduct disorder.

RT Interference (RTI) scores

The mean RTI scores are shown in Figure 5.11 (bottom panel). There were no significant main effects or interactions. However, there was a trend towards a significant emotion x CD x AD interaction (F (3, 267) = 2.28, p = 0.08). Follow-up simple effects analyses indicated a CD x AD interaction specific to neutral faces. Specifically, ADs-only individuals displayed a greater negative RTI for neutral faces than comorbid CD+ADs (F (1, 89) = 5.12, p = 0.026, r = 0.23), and control individuals (F (1, 89) = 3.76, p = 0.06, r = 0.20), although this latter difference was only marginally significant. One-sample t-tests indicated that the neutral RTI scores were significantly less than 0 in the ADs-only group (t (17) = -2.71, p = 0.02), indicating that they were prone to evaluating neutral faces as negative. In addition, the RTI scores for anger in the control group were significantly less than 0 (t (28) = -2.64, p = 0.01).

5.4.3.4 Effects of CU and aggressive traits within the CD groups

In order to investigate the separate effects of CU and aggressive traits within the combined CD-only and comorbid CD+ADs groups, two sets of partial correlations were conducted: the first correlated EAST scores with CU traits and an AD*CU interaction term, whilst controlling for aggression, and the second correlated EAST scores with aggression and an

AD*aggression interaction term, whilst controlling for CU traits. The results of these analyses are shown in Table 5.7. Neither CU nor aggressive traits correlated significantly with the EAST scores. However, the AD*CU interaction term correlated significantly with anger EI scores (r = 0.45, p < 0.01), such that the presence of ADs and higher CU traits were associated with higher (i.e., more positive) anger EI scores. In addition, the AD*aggression interaction term correlated significantly with fear EI scores (r = 0.37, p = 0.01), such that the presence of ADs and higher aggression was associated with higher fear EI scores.

Table 5.7: Partial correlations of Extrinsic Affective Simon Task measures with callous-unemotional (CU) traits, anxiety disorders (ADs) and aggression within the conduct disorder groups.

		CU traits[a]	ADs*CU[a]	Aggression[b]	ADs*Aggression[b]
EI score	Anger	-0.05	0.45**	0.05	0.21
	Fear	0.11	0.14	0.08	0.37**
	Happy	-0.03	0.07	-0.08	0.10
	Neutral	-0.08	0.04	-0.02	-0.11
RTI score	Anger	0.10	-0.13	-0.20	0.06
	Fear	0.25	0.15	-0.16	0.14
	Happy	0.17	0.15	-0.10	0.09
	Neutral	0.01	0.16	0.02	0.05

[a] controlling aggression, [b] controlling CU traits, **p < 0.01. EI = error interference; RTI = reaction time interference.

5.4.4 Discussion

We used an image-based Extrinsic Affective Simon Task (EAST) to assess interference due to automatic valence evaluation of emotional faces in adolescents with CD-only, ADs-only, comorbid CD+ADs and typically-developing controls. In addition, we tested the separate effects of CU and aggressive traits on interference from emotional faces within the combined CD-only and comorbid CD+ADs groups.

We found a number of interesting effects related to psychopathology. First, individuals with ADs-only presented the opposite pattern of results for certain emotions than individuals with comorbid CD+ADs. Specifically, individuals with ADs-only made more positive than negative errors when colour-categorising happy faces, whereas comorbid CD+ADs individuals made more negative than positive errors. This suggests that while there were interference effects from happy faces in both groups, one effect was due to the happy faces being perceived as positive (in the ADs-only group) and the other was due to the happy faces being perceived as negative (in the comorbid CD+ADs group). Whilst studies on attentional bias in ADs are primarily focused on attention towards threat, there is evidence from visual probe tasks of an attentional bias towards happy stimuli in anxious individuals (e.g., Bradley et al., 1999), as well as recent event-related potential evidence of enhanced early processing of happy faces in individuals with high trait anxiety compared to those with low trait anxiety (Morel et al., 2014). These results are also supported by the results of Experiment 1, where the ADs-only

and comorbid CD+ADs groups showed an attentional bias towards happy faces. The results of Experiment 3 suggest that while comorbid CD+ADs individuals also show an attentional bias towards happy faces, the presence of CD means that they are prone to evaluating happy faces as being negative, which is potentially consistent with previous research on hostile attribution biases in individuals with antisocial behaviour and CD (de Castro et al., 2002). However, this literature would predict that any misinterpretation of stimuli would be most pronounced for ambiguous stimuli, such as neutral facial expressions, rather than clearly positive stimuli, such as happy facial expressions.

Individuals with ADs alone and comorbid CD+ADs individuals also differed in their responses to neutral faces: the ADs-only group showed RT facilitation effects when colour-categorising neutral faces that were not mirrored by the comorbid group. Specifically, individuals with ADs alone made faster negative responses when colour-matching neutral faces, whereas the average RTI score was not significantly different from zero for the comorbid CD+ADs individuals. This suggests that individuals with ADs-only perceived neutral faces as negative, and comorbid CD+ADs individuals were equally likely to assess neutral faces as positive or as negative (and did not differ significantly from controls or the CD-only group). Our results therefore suggest that individuals with ADs-only show a biased interpretation of neutral stimuli. This is supported by previous research on facial emotion recognition, which has shown that anxious individuals display biased interpretations of neutral stimuli: labelling neutral faces as angry (Bell et al., 2011) or negative (Yoon & Zinbarg, 2008), and showing an increased sensitivity to fear in emotionally ambiguous faces (Richards et al., 2002). It is also supported by theories of selective attention in anxiety, which suggest that anxious individuals are more likely to automatically evaluate ambiguous or mildly negative stimuli as threatening (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998).

Contrary to our hypotheses, and to previous findings, we did not find any interference effects of anger or fear (neither in terms of RT or error-rate) in individuals with ADs-only or comorbid CD+ADs individuals. Indeed, all four groups performed similarly on these emotions, in keeping with the results of Experiments 1 and 2. Previous work using an image-based EAST with healthy adults has shown that they are sensitive to positively and negatively-valenced stimuli (i.e., displaying positive EI and RTI scores for positive stimuli and negative EI and RTI scores for negative stimuli: Gray et al., 2013; Huijding & De Jong, 2005a). However, our control group's EI and RTI scores tended to be close to zero, apart from the RTI scores for anger, which were significantly lower than zero. This suggests that the EAST may be less sensitive when used in adolescent samples.

Our additional analyses within the CD-only and comorbid CD+ADs groups revealed some interesting effects of CU traits and aggression. Specifically, comorbid CD+ADs individuals with high CU traits were more likely to display higher EI scores when colour-categorising angry faces, whilst controlling for aggression. This supports previous research examining primary (low anxious) and secondary (high anxious) subtypes of psychopathy, with

emotional hyporeactivity being a hallmark of primary, but not secondary psychopathy (Lykken, 1995). However, the fact that these individuals appeared to make more positive errors in response to angry faces suggests that they associated anger with a positive valence. This could suggest a deficit in automatic anger recognition, or that they differ in their automatic responses to angry stimuli (e.g., approach vs. avoidance). In addition, comorbid CD+ADs individuals with high levels of aggression were more likely to display higher EI scores when colour-categorising fearful faces, whilst controlling CU traits. These results suggest that while CU traits and aggression on their own may not affect patterns of interference in CD, the relationships of CU and aggression with interference may be modulated by the presence of ADs.

In summary, this is the first study to examine interference from emotional faces using an EAST in adolescents with CD-only, ADs-only and comorbid CD+ADs. We found error-rate interference from happy faces in both the ADs-only and comorbid CD+ADs groups. However, these effects were of different kinds: the ADs-only group was more likely to evaluate happy faces as positive (than negative), whereas the comorbid CD+ADs group was more likely to evaluate happy faces as negative (than positive). Furthermore, ADs-only (but not comorbid CD+ADs) individuals evaluated neutral faces as negative, which caused RT interference. This again suggests that the presence of CD modulates patterns of emotional processing observed in those with ADs.

5.5 General discussion

The extant literature on attention to and interference from emotional stimuli in adolescents has focused on anxiety, aggression, or CU traits separately, or has investigated samples of individuals with high CU traits and varying levels of trait anxiety (i.e., primary and secondary psychopathy). There has been no investigation of attentional biases in a broader group of individuals with CD, and there has been no examination of the effects of comorbid ADs on attention in CD, despite the evidence for significant comorbidity among these disorders (e.g., Polier et al., 2012; Zoccolillo, 1992). Furthermore, many studies in this area have lacked a control group: comparing high and low CU traits offenders, or comparing prisoners high and low in aggression. Given these gaps in the literature, we implemented a series of selective attention tasks in experiments with adolescents with CD-only, ADs-only, comorbid CD+ADs and typically-developing controls. We measured: attentional biases towards angry, fearful and happy faces using a visual probe task; interference from task-irrelevant angry, fearful and neutral faces using a threat distractor task; and interference due to automatic evaluation of task-irrelevant angry, fearful, happy and neutral faces using an extrinsic affective Simon task (EAST).

Experiment 1 (the visual probe tasks) showed that, among all the task measures, comorbid CD+ADs resulted in normalised performance, compared to the presence of either disorder alone. However, there were no threat-specific effects on task performance, but only an AD-related performance enhancement (reduced RTs) in trials that contained a masked happy

face. In addition, within the combined CD-only and comorbid CD+ADs groups, there were no additional effects of CU traits (inconsistent with the primary vs. secondary psychopathy findings in Kimonis et al., 2012).

Consistent with Experiment 1, Experiment 2 (the threat-distractor task) did not show psychopathology-related interference effects from task-irrelevant threatening faces (neither angry nor fearful). However, somewhat similar to the pattern of RTs in Experiment 1, Experiment 2 showed an attenuating effect of ADs on general task accuracy: the comorbid CD+ADs group showed improved performance compared to the CD-only groups. However, this effect of CD on task accuracy may have been partially driven by group-differences in IQ. We also found that, within the combined CD-only and comorbid CD+ADs group, CU traits were positively associated with interference from task-irrelevant angry faces – contrary to our predictions that CU traits would be associated with reduced interference from threat stimuli.

Consistent with Experiment 1, in Experiment 3 (the EAST), both ADs-only and comorbid CD+ADs individuals showed increased interference (indexed by error rates) from happy faces. However, the interference effect in the ADs-only group appeared to be due to positive automatic evaluations of happy faces, whereas the interference effect in the comorbid CD+ADs group was due to automatic *negative* evaluations of happy faces. This is a potentially important distinction between ADs-only and comorbid CD+ADs individuals: the automatic misinterpretation of a positive social situation in the best case may contribute towards an increase in negative feelings, and in the worst case may lead to a hostile response in comorbid individuals. Experiment 3 also showed that ADs-only individuals showed interference (indexed by RTs) from neutral faces (compared to the comorbid CD+ADs group), which was due to negative automatic evaluations of neutral faces. This is consistent with previous studies showing that individuals with ADs show negative interpretations of ambiguous facial expressions (Bell et al., 2011; Richards et al., 2002; Yoon & Zinbarg, 2008). In addition to these effects of psychopathology, there were differential effects of CU traits and aggression on task performance within the combined CD-only and comorbid CD+ADs groups. Specifically, the presence of ADs and high CU traits resulted in greater interference (based on error-rates) from angry faces, consistent with previous research on the differences between primary (low anxiety) and secondary (high anxiety) psychopathy (e.g., Lykken, 1995). This interference appeared to be due to angry faces being mistakenly evaluated as positive, suggesting a possible automatic deficit in anger recognition. We also found that the presence of ADs and high levels of aggression was associated with increased interference from fearful faces, consistent with previous research showing increased interference from threat-related stimuli in aggression (e.g., Chan et al., 2010).

Across all three tasks there was a general lack of significant effects (either interference or facilitation) from threatening facial expressions in individuals with CD-only, ADs-only, or comorbid CD+ADs. However, relatively few studies have examined selective attention to

threatening facial expressions in adolescents with ADs, and these results are mixed (for a review, see Hadwin & Field, 2010). Furthermore, no study has examined these effects in adolescents with CD. It is possible that null effects of anxiety on selective attention to threat in child and adolescent samples compared to adult samples may be due to developmental differences in selective attention. For example, Kindt and Van den Hout (2001) suggest that anxious and non-anxious children display the same levels of threat bias, but non-anxious children learn to inhibit this bias as they age, whereas anxious children do not. This may explain why attentional biases are more reliably found in adults versus children.

5.5.1 Limitations

The present results should be viewed in the light of several limitations. First, the groups differed on both IQ and gender. Whilst we did not find that IQ or gender significantly affected our main findings (although IQ may have partially driven the decrease in accuracy within the CD-only group in the threat-distractor task), it is difficult to statistically control for these variables, given the differences between the groups. However, our groups appear to be largely representative of the broader CD and AD populations; individuals with CD have frequently been found to have lower IQs than controls (Farrington, 1995; Frick et al., 1991; Lynam et al., 1993; Moffitt et al., 1981; Moffitt & Silva, 1988), and ADs tend to be more common among females than males (e.g., Kessler et al., 2005; McLean & Anderson, 2009). Second, our sample size was modest, which may explain why some of the group comparisons or interactions did not reach conventional levels of statistical significance. This is, nevertheless, the largest and most comprehensive experimental study of its kind and provides a foundation for future research exploring selective attention in those with comorbid CD+ADs. Subsequent research might further explore the effects and interactions associated with additional comorbidity that is common in these groups. For example, three individuals in our CD groups had Oppositional Defiant Disorder plus sub-threshold CD (N.B., we note that exclusion of ODD-only individuals did not affect the key results of the current study). The considerable comorbidity (as well as DSM-IV symptom overlap) between these disorders (see Maughan et al., 2004), presents a challenge in identifying “pure” cases of CD. In addition, depression was common among our clinical groups. It is possible that depression and anxiety differentially impact upon selective attention (Mogg & Bradley, 2005), although neither the level of depressive symptoms nor the rate of MDD diagnoses differed among our clinical groups and depressive symptoms did not correlate with any of the measures of selective attention.

5.5.2 Conclusions

This is the first study to investigate selective attention to emotional faces in individuals with CD-only, ADs-only, and comorbid CD+ADs using a variety of tasks. In general we did not find that task performance was affected by the presence of threatening facial expressions, irrespective of whether they were relevant or irrelevant to the task. However, the presence of ADs appeared to protect comorbid CD+ADs individuals from slowed performance in the

visual probe tasks, as well as from decreased accuracy in the threat-distractor task. This suggests that there may be a different developmental pathway, which is unrelated to impairments in emotion processing, for individuals with comorbid CD+ADs. We also found that individuals with ADs-only tended to evaluate happy faces as positive and neutral faces as negative (according to the EAST), and individuals with comorbid CD+ADs tended to evaluate happy faces as negative.

In Chapter 6, we will study facial emotion recognition to test whether the ADs-only, CD-only and comorbid CD+ADs groups show enhanced or impaired performance in more explicit forms of emotion processing.

Chapter 6 Emotion recognition in adolescents with conduct disorder and anxiety disorders

6.1 Introduction

In Chapter 5 we investigated attention to emotional faces in adolescents with CD, and tested whether the presence of anxiety disorders (ADs) modulates these processes. According to social information processing theory (e.g., Crick & Dodge, 1994), both the allocation of attention to and the interpretation of a stimulus event (for example an emotional face) are key determinants of the behavioural response to that event (e.g., a child crying in response to a parent's display of anger). As such, this chapter will focus on the interpretation of emotional stimuli in adolescents with CD and whether the presence of ADs impacts on emotion recognition in CD.

Facial expressions provide a channel for the rapid, non-verbal, communication of emotional information (Blair, 2003). The ability to recognise different facial expressions assists in the understanding of another person's state of mind and can be used to guide behaviour in social interactions (Gao & Maurer, 2009). Indeed, correct identification of facial expressions has been linked to prosocial behaviour (Marsh et al., 2007), and an increased ability to empathise with others (Carr & Lutjemeier, 2005). Conversely, evidence for deficits in facial expression recognition has been found in children and adolescents with CD (Fairchild et al., 2010; Fairchild et al., 2009a), conduct problems (Bowen et al., 2014; Woodworth & Waschbusch, 2008), CU traits (Blair & Coles, 2000; Blair et al., 2001; Dadds et al., 2006; Stevens et al., 2001) and emotional difficulties (Leist & Dadds, 2009; Simonian et al., 2001; Walker, 1981). This evidence suggests that impairments in facial expression recognition may contribute towards the development of behavioural, temperamental and mood-based difficulties.

Consistent with the idea that they are insensitive to others' distress cues, a meta-analysis found specific deficits in fear recognition in individuals displaying antisocial behaviour (Marsh & Blair, 2008). CD is also associated with deficits in a broader set of emotions including anger, disgust and surprise (Fairchild et al., 2010; Fairchild et al., 2009a; Sully et al., 2015), although see Pajer et al. (2010) for a null finding. Adolescents with psychopathic/CU traits, which are often associated with CD, show impaired fear and sadness recognition (Blair & Coles, 2000; Dadds et al., 2006). However, given the extensive overlap between CD and CU traits, isolating their unique impact on emotion recognition is difficult. Within CD samples, psychopathic traits have been associated with deficits in sadness (Fairchild et al., 2010; Fairchild et al., 2009a) and fear recognition (Fairchild et al., 2009a). It has been suggested that the fear recognition deficits seen in those with CU traits may be due to impaired attention to the eye-region of the face: Dadds et al. (2006) found that fear recognition in high CU trait adolescents normalised when they were instructed to fixate the eye-region of the faces, and in a follow-up study using eye-tracking, Dadds et al. (2008) found that

adolescents with psychopathic traits showed reduced eye-fixation in an emotion recognition task.

Altered facial emotion recognition has also been reported in ADs, although findings are inconsistent, with different studies reporting normal (Guyer et al., 2007; Manassis & Young, 2000; McClure et al., 2003; Melfsen & Florin, 2002), enhanced (Button et al., 2013; Jarros et al., 2012; Joormann & Gotlib, 2006; Reeb-Sutherland et al., 2015), and inferior performance in those with ADs relative to controls (Battaglia et al., 2010; Easter et al., 2005; Simonian et al., 2001). Individuals with ADs may also be hypersensitive to stimuli conveying threat, however this typically manifests as an attentional bias towards threat (e.g., Bar-Haim et al., 2007). Unfortunately, comorbidity has rarely been considered in these studies and some of the effects attributed to ADs may have been explained by the presence of other disorders (e.g., unmeasured CD). For example, a study on emotion recognition in depressed children with comorbid CD found that comorbid individuals did not display the same biases as their depressed counterparts (Schepman et al., 2012), suggesting that comorbid CD may attenuate the effect of depression on the negative evaluation of low-intensity facial expressions.

There are a number of methodological issues that may have contributed to the variation in findings to date. First, typical assessments of emotion recognition tend to use prototypical facial expressions (i.e., expressions presented at full/100% intensity). However, in normal social interactions a wide range of expression intensities may be displayed, some of which may be relatively subtle. In addition, it is likely that a large proportion of the faces that are seen in everyday life display neutral expressions, and it is the recognition of these expressions that may be more affected by pre-existing biases (e.g., Schönenberg & Jusyte, 2014). The labelling of neutral facial expressions may therefore give an insight into an individual's attributional biases. For example, an individual with a hostile attributional bias may interpret neutral or ambiguous faces as threatening, and as a result they may be more likely to react in a hostile manner (Crick & Dodge, 1994).

Second, eye-gaze tends to be left uncontrolled in studies of emotion recognition – i.e., participants are able to freely direct their gaze to preferred areas of the face (the stimuli are viewed under free gaze conditions). Dadds and colleagues (Dadds et al., 2008; Dadds et al., 2006) suggest that the fear recognition deficits generally found in adolescents with CU traits may be explained by impairments in attentional allocation to salient regions of the face. Specifically, they showed that instructing participants to focus on the eyes significantly improved fear recognition accuracy in boys with CU traits (Dadds et al., 2006). In a separate eye-tracking study, they found that adolescents with CU traits displayed fewer fixations on the eye-region of the faces in an emotion recognition task (Dadds et al., 2008). Consequently, future studies of facial expression recognition in antisocial populations should attempt to control eye gaze to evaluate whether recognition deficits stem from attentional or interpretational difficulties.

Third, studies tend to use a standard accuracy measure based on the number or proportion of correct identifications. However, according to signal detection theory, accuracy (or "sensitivity") is dependent on both the number of correct identifications ("hits; e.g., the number of times anger is recognised as anger), as well as the number of misidentifications ("false-alarms", e.g., the number of times all other emotions are identified as anger). One method of taking into account both hits and false-alarms is by calculating an index measure of sensitivity, namely d-Prime (d'; e.g., Miller, 1996). Whilst response bias may also be estimated using a compound measure of hits and false alarms (MacMillan & Creelman, 2005), it is possible to assess response bias by including neutral faces in the task without the option of selecting "neutral" from the responses (as described above).

The present study is the first to examine facial emotion recognition in adolescents with both CD+ADs, those with pure versions of each condition, and typically-developing controls. We predict that CD will be associated with a reduced ability to discriminate between emotions in general (reflected by poorer performance compared to controls), which is especially pronounced for distress cues (fear and sadness). In contrast, we hypothesise that individuals with ADs will show hypersensitivity (i.e., improved recognition performance, especially at low intensities) to threat-related expressions (anger and fear). Our hypothesis regarding comorbid CD+ADs is somewhat more speculative and is based on the idea that the enhanced sensitivity in ADs may counteract the deficits observed in CD, producing a "protective" effect with comorbid CD+ADs individuals performing similarly to controls.

Our study addressed a number of methodological limitations present in previous studies: emotional faces were morphed at different intensities, allowing evaluation of subtle deficits and biases in the appraisal of emotional expressions; we controlled fixation location, to assess whether this modulates emotion recognition; and we assessed both sensitivity (i.e., the ability to discriminate between stimuli) and bias (i.e., the tendency to make a particular response); response accuracy is dependent on both factors.

6.2 Method

6.2.1 Participants

Participants were the same as in Chapter 4, however five participants (4 CD-only and 1 control participant) were unable to complete the task due to either computer malfunction (n = 1) or participant refusal (n = 4). This resulted in a total sample for this task of 99 adolescents. All participants attended a testing session at the University of Southampton, during which the remainder of assessments presented in Chapter 2 were administered, as well as the emotion recognition task and the Benton Face Recognition Test (BFRT; both outlined below).

6.2.2 Assessment of emotion recognition

We assessed anger, fear, happiness, sadness and disgust recognition using a five-alternative-forced-choice task. Face stimuli were selected from the NimStim MacArthur Network Face Stimuli Set (Research Network on Early Experience and Brain Development,

http://www.macbrain.org/resources.htm, Tottenham et al., 2009). Images of the actors were combined to create one male and one female face for each emotional and neutral expression, using a morphing algorithm implemented in MATLAB® (The Mathworks, 2012) (see Adams et al., 2010). Faces were converted to greyscale and matched on contrast and luminance. Averaged emotional faces were combined with averaged neutral faces in varying proportions to produce expressions of different intensities. Fearful, disgusted, angry and sad faces were created with 18.75%, 37.50%, 56.25% and 75.00% intensities. Pilot data indicated that happy faces were more easily discriminated than the other emotions. Thus, to avoid ceiling effects, happy faces were created with 12.5%, 25.0%, 37.5% and 50% intensities (see Figure 6.1, top panel). In total, 42 images were used in the task (5 emotions x 4 intensities x 2 genders, plus 1 male and 1 female neutral face). An oval mask was used to remove non-facial features (e.g. hair). Stimuli were presented on a monitor at a viewing distance of 65cm and subtended 7.8 x 11.6 degrees of visual angle.

To initiate trials, participants used the mouse to click on a central fixation cross. A face was then immediately presented at one of three vertical locations: the fixation position corresponded to the eyes, nose or mouth. After 250ms a mask was shown; this presentation time prevented multiple fixations (Rayner, 1998). The participant used the mouse to identify the facial emotion by selecting one emotion label (see Figure 6.1, bottom panel). Each emotional face was presented three times, and each neutral face was presented six times, in each of the three fixation positions (396 trials in total). Trials were presented in a random order in four blocks of 99 trials.

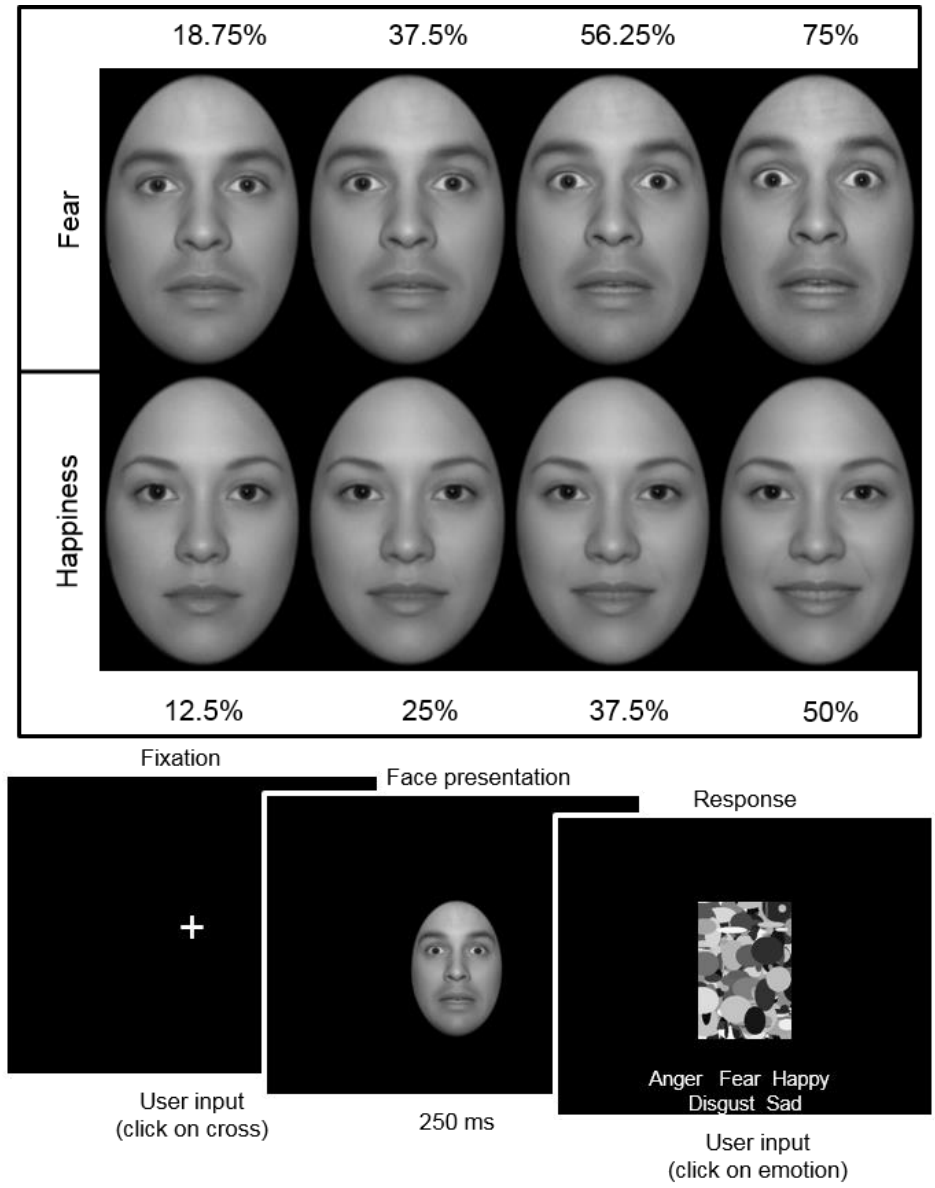

Figure 6.1: Example stimuli (top) and a schematic representation of a trial (bottom), showing a fearful male face presented at the eye fixation position, followed by a visual mask.

6.2.3 Data preparation

Correct identification rates (hit rates) and misidentification rates (false alarm rates) were calculated for each emotion at each intensity level and each fixation position. False alarm rates were calculated by averaging the misidentifications for an emotion at a particular intensity level and fixation position. For example, the false alarm rate for anger at 75% intensity and with an eye-area fixation position was the proportion of times the other emotions at this intensity and fixation position were misidentified as angry. Using a signal detection theory approach (e.g., Miller, 1996), d-Prime (*d'*) scores were calculated for each emotion at each intensity and fixation position using the formula:

$$d' = z_{hits} - z_{false\ alarms}$$

Where *d'* was impossible to calculate, i.e., when hit- and false alarm-rates were 0 or 1, these were converted to 1/2*N* and 1-1/2*N*, respectively, where *N* was the total number of trials for that particular emotion, intensity level and fixation position (i.e., 6), in line with Miller (1996).

In order to assess response bias, the proportions of neutral faces that were classified as each emotion were calculated for each participant.

6.2.4 The Benton Facial Recognition Test (BFRT; Benton et al., 1994)

The short form of the BFRT was used to assess the participants' basic facial recognition skills. It comprises 13 items and has total possible score of 27 points. For each item, the participant is presented with a photograph of a target face, with an array of six photographs of faces presented below it. The first part of the task (6 items) involves selecting an identical picture of the target from the array. The second part of the task (7 items) involves selecting three images of the target from the array. These are either presented in different orientations (see Figure 6.2), or in different lighting conditions. Short-form scores are converted to long-form scores (out of a total of 54), and scores in the range of 41 to 54 are considered normal, 39 to 40 are borderline, 37 to 38 indicate moderate impairment and 37 or less indicate severe impairment. Whilst there has been criticism that individuals may score in the normal range solely by focusing on hairlines and eyebrows (Duchaine & Weidenfeld, 2003), Tranel et al. (2009) reported that patients with lesions in face-specific brain areas had impaired ability on the BFRT.

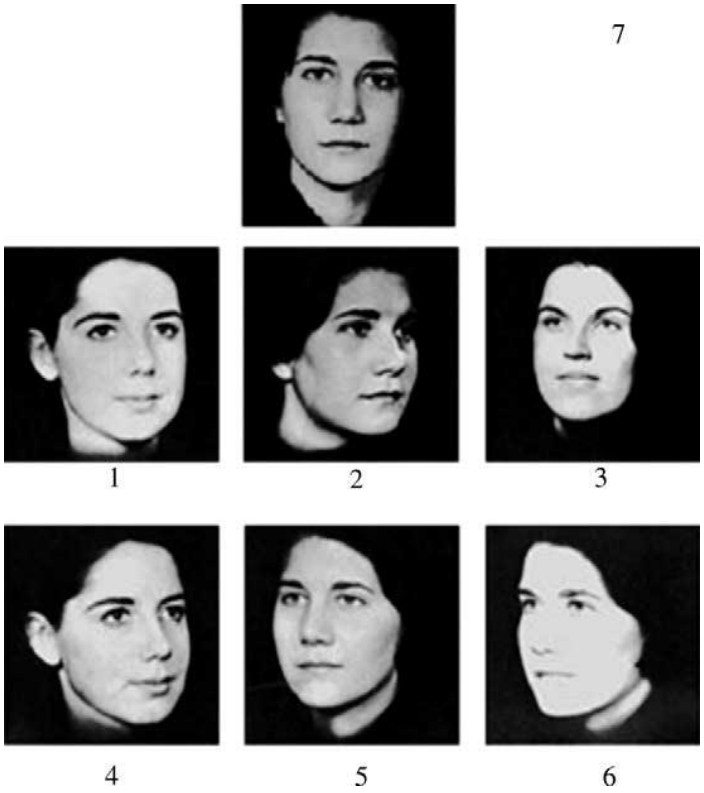

Figure 6.1: An example item from the Benton Facial Recognition Test. The task is to select three photographs of the target image from the array (i.e., 2, 5 and 6).

6.2.5 Data analysis

First, we performed preliminary analyses to test whether morph strength and fixation position interacted with either CD or AD in terms of emotion recognition. Where this was not the case, these were dropped from further analysis to promote easier interpretation of the core results. In these analyses, *d'* was the dependent variable in a 5 (emotion) x 4 (morph strength) x 3 (fixation position) x 2 (CD: present, CD+/absent, CD-) x 2 (AD: present, AD+/absent, AD-) mixed-design ANOVA. Where fixation position did not interact with CD or AD status, *d*' scores were re-calculated and entered into a 5 (emotion) x 4 (morph strength) x 2 (CD) x 2 (AD) mixed ANOVA. Third, separate two-way ANOVAs investigated the effects of CD (present or absent) and AD (present or absent) on the misclassification of neutral faces, for each emotion. Bonferroni-corrected post-hoc simple effects analyses were conducted to explore any resultant interaction effect. Effect sizes for the simple effects analyses are reported as Pearson's *r* (small $\geqslant$0.1, medium $\geqslant$0.3, large $\geqslant$0.5; Cohen, 1992). Fourth, to examine the effects of CU traits within the CD groups (i.e., across the CD-only and comorbid CD+ADs groups), we conducted a 5 (emotion) x 4 (morph strength) x 3 (fixation position) x 2 (AD) x 2 (CU: high, CU+/low, CU-) repeated-measures ANOVA. Given the non-linear relationship between CU traits and emotion recognition, individuals were classified as high/low CU traits on the basis of a median split (CU+ ≥30 on the ICU). Hierarchical regression analyses were used to examine the influence of confounding variables that differed between groups and were significantly correlated with outcome variables associated with CD or ADs.

6.3 Results

6.3.1 Sample characteristics

See Table 6.1 for the demographic and clinical characteristics of the sample. These were similar to those for the sample included in Chapter 4. In addition, there were no differences in basic facial recognition (the BFRT) among the groups.

Table 6.1: Demographic and clinical characteristics of the sample included in the emotion discrimination task.

	Control[4] N=28, 22 males		CD[1] N=28, 23 males		ADs[3] N=23, 5 males		Comorbid[2] N=20, 12 males		F
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Age	16.20	1.47	16.74	1.49	16.42	1.93	16.84	1.08	0.92
IQ	109.69	11.92	95.59	9.23	102.78	11.44	103.15	13.16	7.12** 4>1
BFRT	44.83	5.56	45.52	3.72	47.39	3.92	49.55	11.60	2.39
CU traits	20.07	6.69	30.02	9.94	19.02	6.98	27.23	9.72	10.18** 1,2>3,4
STAI Trait Anxiety	36.10	9.87	43.33	10.94	51.93	10.46	57.35	9.66	20.28** 1,2,3>4, 2,3>1
HADS depression	3.52	2.90	7.81	4.29	5.78	4.02	7.25	4.15	6.72** 1,2>4

**$p < 0.01$. ADs = anxiety disorders; BFRT = Benton Facial Recognition Test; CD = conduct disorder; CU = callous-unemotional; HADS = Hospital Anxiety and Depression Scales; IQ = intelligence quotient; STAI=State-Trait Anxiety Inventory.

6.3.2 Emotion recognition accuracy

6.3.2.1 Preliminary analyses

There were main effects of emotion (F (3,257) = 110.22, $p < 0.01$), morph strength (F (2,165) = 474.67, $p < 0.01$), and an emotion x morph strength interaction (F (8,730) = 39.92, $p < 0.01$); see Figure 6.3. Happiness was the easiest to recognise. Fear and sadness were more easily recognised than anger and disgust, but only for the two lowest morph strengths (all $p < 0.01$). At the highest morph strength, anger and fear were more easily recognised than sadness and disgust (all $p < 0.01$), and sadness was more easily recognised than disgust ($p < 0.01$). More intense emotional expressions were easier to recognise for all emotions apart from disgust and sadness, where recognition only improved up to the third level morph strength, and then decreased for the highest morph strength (sadness: $F_{65.25\% \text{ vs. } 75\%}$ (1,93) = 7.83, $p = 0.04$, $r = 0.28$; disgust: $F_{65.25\% \text{ vs. } 75\%}$ (1,93) = 7.76, $p = 0.04$, $r = 0.27$). Morph strength interacted with CD and ADs and was therefore retained in the analyses (see below).

There was also an effect of fixation position (F (2,190) = 20.00, $p < 0.01$), and an emotion x fixation interaction ($F = 3.61$, $p < 0.01$). Mouth fixation resulted in the poorest performance for all emotions, except for disgust where there were no differences. For the other emotions, central/nose fixation resulted in the best performance, except for fear where eye fixation led to enhanced performance (see asterisks in Figure 6.4).

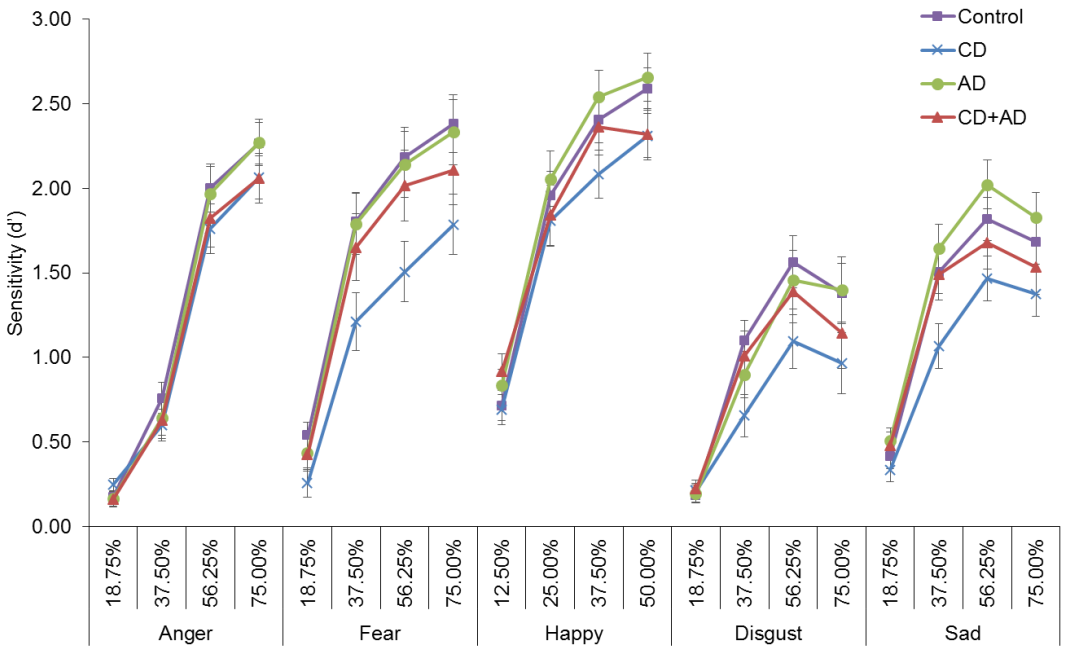

Figure 6.3: Effect of morph strength and group on emotion recognition sensitivity, averaged across fixation position, and expressed as d-Prime (*d'*). Error bars represent ± 1 S.E.M. CD = conduct disorder, AD = anxiety disorder.

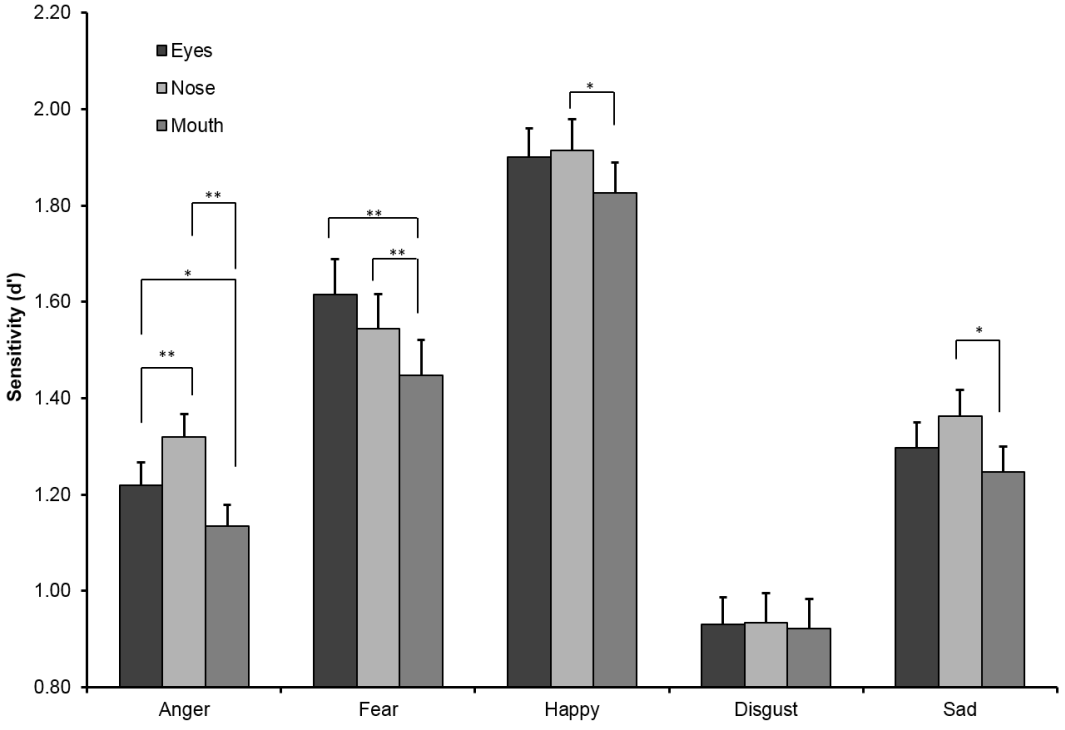

Figure 6.4: Effect of fixation position on emotion recognition sensitivity (expressed as d-Prime, d') for each emotion, averaged across groups. Error bars represent ±1 S.E.M. * $p < 0.05$, ** $p < 0.01$.

6.3.2.2 Effects of CD and ADs

Individuals with CD performed worse than their non-CD counterparts across emotions (see Figure 6.5; F (1,95) = 4.97, p = 0.03, r = 0.22). This effect was strongest for the two strongest morphs (F (2,165) = 4.23, p = 0.02; see Figure 6.6). There was no main effect of AD status (F (1, 95) = 1.17, p = 0.28, r = 0.11) on emotion discrimination. Although the interaction between CD and AD status was non-significant (p = 0.27), the CD-only group tended to show larger deficits than the comorbid CD+ADs group (F (1,95) = 2.87, p = 0.09, r = 0.17). In fact, neither the ADs-only nor the comorbid CD+ADs group differed from controls ($F_{\text{ADs vs. controls}}$ (1,95) = 0.03, p = 0.87, r = 0.02; $F_{\text{CD+ADs vs. controls}}$ (1,95) = 0.63, p = 0.43, r = 0.08), whereas the CD-only group performed worse than controls (F (1,95) = 6.78, p = 0.01, r = 0.26). The three-way CD x AD x emotion interaction was non-significant (F (4,380) = 1.31, p = 0.26). However, Figure 6.5 illustrates a degree of unevenness in the effect across emotions, with the largest CD-related deficits seen for fear.

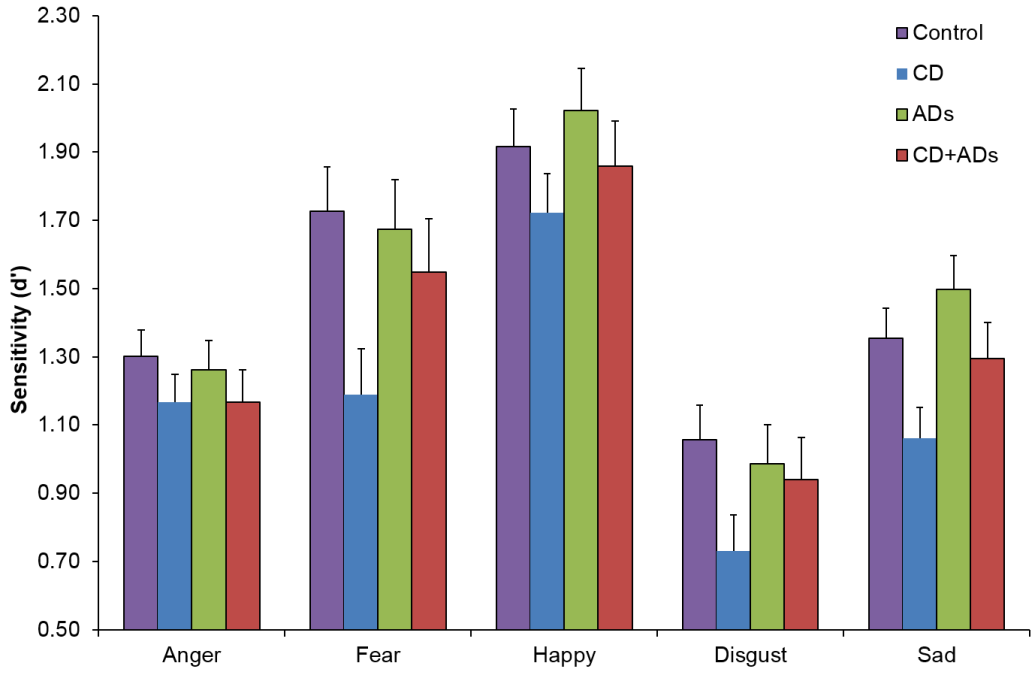

Figure 6.5: Effect of group on emotion recognition sensitivity (expressed as d-Prime, *d'*), averaged across fixation position and morph strength. Error bars represent ±1 S.E.M. ADs = anxiety disorders; CD = conduct disorder.

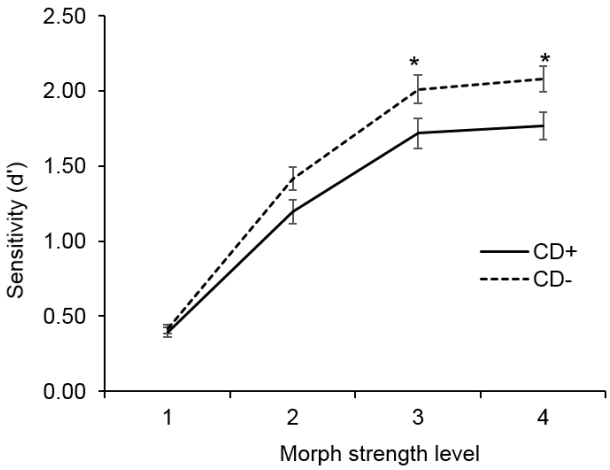

Figure 6.2 Interaction between conduct disorder status (CD+ vs. CD-) and morph strength. Error bars represent ± 1 S.E.M. *p < 0.05.

There was a significant AD x emotion x morph interaction (F (6,596) = 2.71, p = 0.01). For happiness, disgust and sadness, AD+ individuals performed better than AD- individuals but only for the lowest intensity emotions (all p < 0.05). Conversely, for low-intensity anger, AD+ individuals performed worse than AD- individuals (p < 0.01); see Figure 6.7.

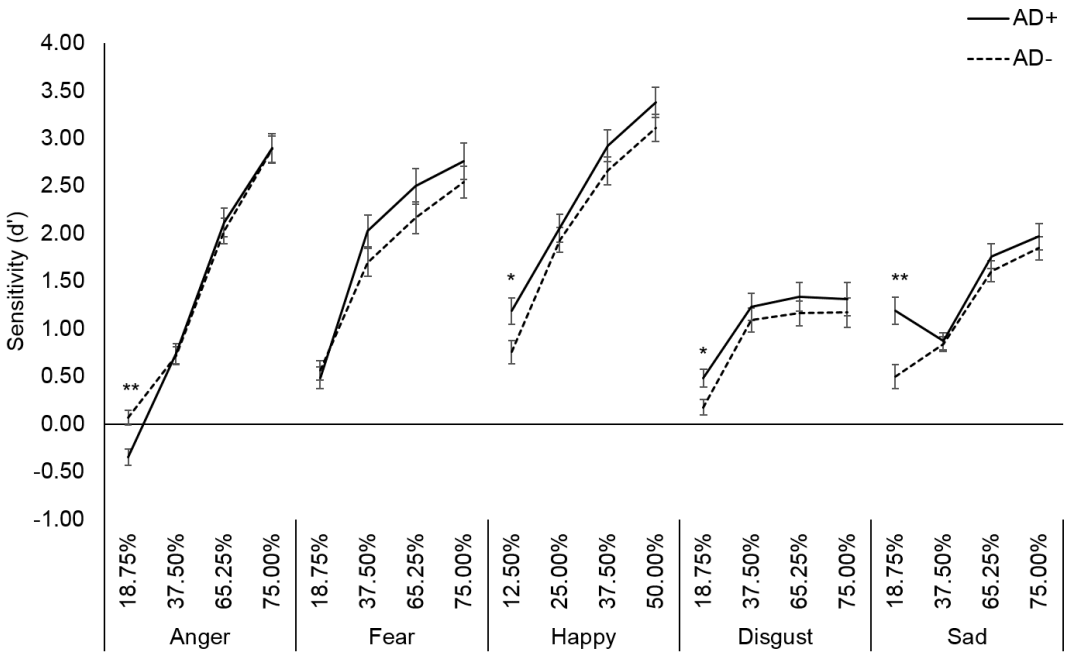

Figure 6.7: Interaction between anxiety disorder status (AD+ vs. AD-), emotion and morph strength, on emotion recognition sensitivity, expressed as D-prime (*d'*). Error bars represent ± 1 S.E.M. *p < 0.05, **p < 0.01.

6.3.3 CU traits

To test whether the main effects of fixation seen in Section 6.3.2.1, and specifically the improvements seen in the eye-region fixation condition, could be accounted for by variation in CU traits (in line with the results of Dadds et al., 2006), a 5 (emotion) x 4 (morph strength) x 3 (fixation position) x 2 (AD) x 2 (CU: high, CU+/low, CU-) repeated-measures ANOVA was conducted on *d'* scores within the combined CD-only and comorbid CD+ADs groups. There was a main effect of CU status (F (1,41) = 4.41, p = 0.04, r = 0.31; CU- > CU+), as well as a significant CU x emotion interaction (F(3,107) = 5.28, p < 0.01). CU+ individuals performed worse than CU- individuals for fear (r = 0.37), happiness (r = 0.35) and sadness (r = 0.38) recognition. However, there was no significant interaction between CU traits and fixation position (F (2, 82) = 0.12, p = 0.89; see Figure 6.8).

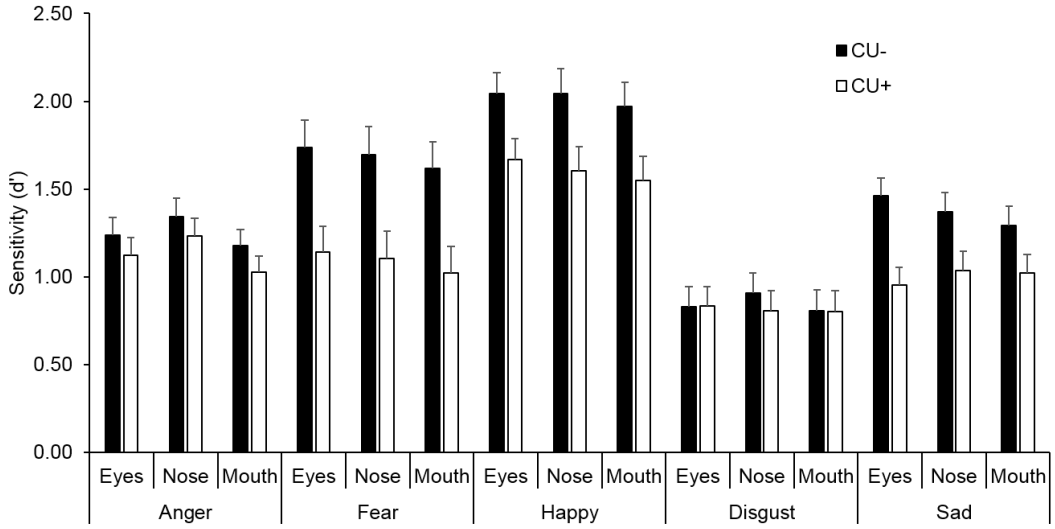

Figure 6.8: Non-significant interaction between callous-unemotional traits (split at the median: CU-; ≤29 vs. CU+; ≥30) and fixation position for recognition of emotions (expressed as d-Prime; d') within the conduct disorder groups. Error bars represent ± 1 S.E.M.

6.3.4 Response biases

Overall, participants were most likely to label neutral faces as sad (see Figure 6.9). Individuals without ADs were significantly more likely to classify neutral faces as angry than those *with* ADs (F (1, 95) = 5.48, p = 0.02, r = 0.23). Participants with CD were more likely to classify neutral faces as fearful (F (1, 95) = 8.30, p < 0.01, r = 0.28), and less likely to classify neutral faces as sad than those without CD (F (1, 95) = 4.56, p = 0.04, r = 0.21). Individuals with ADs were more likely to classify neutral faces as sad than those without ADs, although this difference was only marginally significant (F (1, 95) = 3.52, p = 0.06, r = 0.19). There were no significant CD x AD interactions for response biases for any emotion.

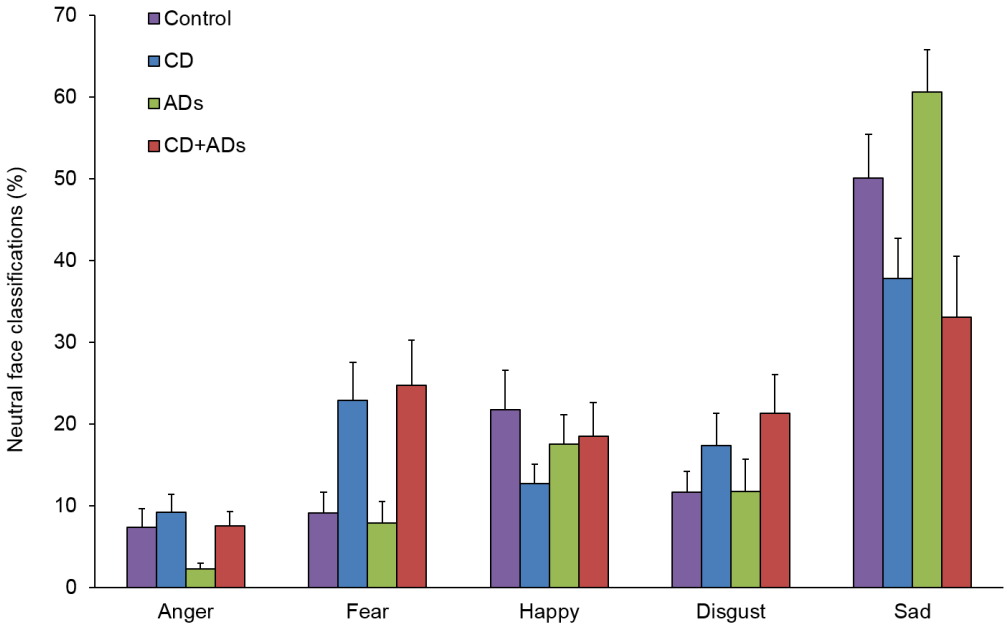

Figure 6.9: The effects of conduct disorder (CD) and anxiety disorders (ADs) on the misclassification of neutral faces (error bars represent ±1 SEM).

6.3.5 Confounding factors

There were group differences in IQ, gender and depressive symptoms. All of the outcome variables that were modulated by CD or AD status, apart from the classification of neutral faces as angry, were significantly correlated with one or more of these confounding variables. IQ was positively correlated with overall emotion recognition, and the tendency to categorise neutral faces as fearful or sad (all $p < 0.01$). Females (vs. males) performed significantly better on low-intensity happiness, sadness and disgust faces (averaged, $r = 0.35$, $p < 0.01$), but significantly worse on low-intensity anger ($r = -0.32$, $p < 0.01$), with an increased tendency to categorise neutral faces as sad ($r = 0.26$, $p = 0.01$) and a reduced tendency to categorise them as fearful ($r = -0.22$, $p = 0.03$). The results of five separate hierarchical regression analyses, which explored these relationships further, are presented in Table 6.2.

The inclusion of IQ as a predictor reduced the effect of CD on overall emotion recognition, as well as the tendency for CD participants to label neutral faces as fearful or sad. Given that IQ was significantly related to CD the effect of CD on emotion recognition may be partly explained by lower IQ. The inclusion of gender as a predictor also reduced the effect of ADs on the categorisation of neutral faces as sad. However, whilst gender was also a significant predictor of low-intensity emotion recognition performance, this was no longer the case when AD status was added as a predictor.

Table 6.2: Results of the hierarchical regression analyses

	Recognition accuracy (*d'*)		Low-intensity happy, sad & disgust[a]		Low-intensity anger[b]		Neutral as fear		Neutral as sad	
	β[†]	R^2	β	R^2	β	R^2	β	R^2	β	R^2
Step 1		0.15**		0.15**		0.12**		0.19**		0.14**
IQ	0.39**		0.17		-0.10		-0.38**		0.28**	
Gender	-		0.37**		-0.34**		-0.26**		0.29**	
Step 2		0.19**		0.21**		0.17**		0.20**		0.16**
IQ	0.35**		0.14		-0.06		-0.33**		0.24*	
Gender	-		0.24*		-0.20		-0.23*		0.23*	
CD	-0.13		-0.35		0.94		0.15		-0.09	
AD	0.13		0.28**		-0.26*		0.01		0.09	
Step 3		0.19**		0.21**		0.18**		0.21**		0.16**
IQ	0.35**		0.13		-0.05		-0.32**		0.25*	
Gender	-		0.25*		-0.21		-0.23*		0.23*	
CD	-0.13		-0.03		-0.96		0.15		-0.09	
AD	0.13		0.27**		-0.26*		0.01		0.09	
CD*AD	0.01		0.03		-0.03		-0.01		-0.03	

*p<0.05, **p<0.01, [†]standardised coefficient, [a] ΔR^2 from step 1 to step 2: p = 0.03, [b] ΔR^2 from step 1 to step 2: p = 0.04. AD=anxiety disorder, CD=conduct disorder.

6.4 Discussion

We investigated sensitivity and bias in emotion recognition in adolescents with CD-only, ADs-only and comorbid CD+ADs. Several key findings emerged: First, individuals with CD showed reduced sensitivity to all emotions, irrespective of comorbid ADs, supporting our hypothesis that CD individuals would show generalised emotion recognition impairments. This is consistent with previous studies on emotion recognition in both CD (Fairchild et al., 2010; Fairchild et al., 2009a; Sully et al., 2015) and CU traits/psychopathy (Marsh & Blair, 2008). However, these results may have been driven, at least in part, by group differences in IQ.

Second, participants with ADs showed increased sensitivity to low-intensity sadness, happiness and disgust compared to those without ADs. This partially supports previous research in which anxious adults were shown to be hypersensitive to ambiguous stimuli (e.g., Richards et al., 2002). However, participants with ADs showed decreased sensitivity to low-intensity anger compared to those without ADs. This was unexpected, given that anxious individuals are considered to be hypersensitive to threat (e.g., Bar-Haim et al., 2007). Our regression analyses suggested that these effects were not modulated by gender.

Third, our manipulation of fixation position was successful: mouth-region fixation generally resulted in poorer performance, and fear was best recognised given eye fixation, as expected. However, there were no significant interactions between fixation and either CD status or CU traits; deficits in fear recognition in the CD-only group (across high and low CU traits) were not ameliorated when these participants fixated the eyes. Importantly, this runs counter to Dadds et al. (2006), where high CU traits were associated with fear recognition

deficits, except when individuals were instructed to fixate the eye region of the face. This may be due to our CD sample not showing the full range of scores on the ICU, however we did find that CU traits were related to deficits in fear, happiness and sadness recognition, in line with previous research (e.g., Blair & Coles, 2000).

Fourth, the comorbid CD+ADs group did not significantly differ from controls on any emotion. This suggests that the ADs emotion processing style (heightened sensitivity to threat) may counteract the impairments associated with CD. It also suggests that antisocial behaviour in this group may result from factors other than emotion recognition deficits (e.g., emotional dysregulation, see Frick & Morris, 2004). However, longitudinal studies are needed to test this hypothesis. Further work should ascertain the extent to which the apparent protective effect of comorbid ADs is explained by an increased proportion of females and higher IQ (albeit non-significantly so) in the comorbid CD+ADs relative to the CD-only group.

Fifth, group effects on response bias were less marked than sensitivity effects. All participants, regardless of CD or AD status, were most likely to label neutral faces as sad compared to the other emotions. This is consistent with previous research with healthy adults (e.g., Gur et al., 2002). In terms of psychopathology, individuals with CD were less likely to label neutral faces as sad, consistent with previous findings in adults (Hoaken et al., 2007). In addition, CD individuals (collapsed across AD status) were more likely to classify neutral faces as fearful. This was unexpected, given the well-documented relationship between antisocial/aggressive behaviour and hostile attributional biases (e.g., Dodge et al., 1990; Lochman & Dodge, 1994), and contradicted our initial hypotheses regarding response bias. However, very few studies have examined attributional biases via classification of neutral faces and results have been mixed: one study found that violent offenders were more likely to label neutral faces as disgusted compared to non-violent offenders (Hoaken et al., 2007), whereas another found that violent offenders were more likely than controls to label ambiguous faces as angry (Schönenberg & Jusyte, 2014). It is also important to note that the observed group differences in response bias may be related to differences in IQ. Contrary to theories relating anxiety to threat biases (e.g., Beck & Clark, 1997), individuals with ADs were *less* likely to label neutral faces as angry, and more likely to label them as sad, compared to individuals without ADs, although the latter effect may have been driven by group differences in gender.

Limitations

The results of the present study should be interpreted in the light of several limitations. First, group differences in IQ may have been responsible for the emotion recognition deficits seen in CD. However, a large number of studies have found that CD is associated with lower IQ (Farrington, 1995; Frick et al., 1991; Lynam et al., 1993; Moffitt et al., 1981; Moffitt & Silva, 1988), suggesting that our CD group is broadly representative of the CD population, and previous studies with IQ-matched controls also observed deficits in emotion recognition in CD (Fairchild et al., 2009a). Whilst future studies may address this issue by matching groups

on IQ, caution should be taken to avoid reducing the construct validity of CD by recruiting higher IQ CD participants. Second, our sample size was not sufficiently large to detect subtle differences in emotion recognition between the CD-only and comorbid CD+ADs groups. However, this is the largest study of its kind, and provides a foundation for future work. Third, three individuals in our CD groups had ODD plus sub-threshold CD. There is a high level of comorbidity (as well as *DSM-IV* symptom overlap) between these disorders (see Maughan et al., 2004), therefore it would be very difficult to find "pure" cases of CD. Importantly, removal of ODD-only individuals from the analyses did not affect the results. Fourth, it is possible that our method for ascertaining a research diagnosis of CD and ADs may have led to symptom inflation. However, the K-SADS-PL was used only to assign our participants to groups, and most of our CD and ADs participants had more symptoms than required to meet diagnostic criteria. Fifth, depression was common among our clinical groups. It is possible that depression and anxiety differentially impact emotion recognition (e.g., Demenescu et al., 2010), however, neither the level of depressive symptoms nor the rate of MDD diagnoses differed among our clinical groups and depressive symptoms did not correlate with emotion recognition.

Conclusions

This is the first study to investigate emotion recognition in individuals with CD and ADs using a sensitive task involving morphed facial expressions and controlled fixation location. We found that CD was associated with impaired recognition of emotional expressions, although these effects appear to be related to lower IQ in the CD-only group. In addition, ADs were associated with increased sensitivity to low-intensity happiness, disgust and sadness, which was not accounted for by group differences in gender. The comorbid CD+ADs group did not differ from controls in recognition of any of the emotions, suggesting that comorbid ADs may counteract the effects on CD on emotion recognition.

Chapter 7 General Discussion

The primary aim of this thesis was to investigate the effect of comorbid anxiety disorders (ADs) on the clinical presentation and emotion processing style of adolescents with conduct disorder (CD), by comparing groups of adolescents with CD-only, ADs-only, comorbid CD+ADs and a typically-developing control group. This chapter will firstly present a summary of the key empirical findings from the present research. It will then consider the clinical and theoretical implications of the findings for individuals with CD, ADs, and comorbid CD+ADs. It will then describe the strengths and weaknesses of the study, along with considerations for future research.

7.1 Summary of key findings

Previous research on the effects of comorbid anxiety on the clinical presentation and severity of behaviour seen in CD has been mixed. In the first empirical chapter (Chapter 4), we tested two competing models of these effects: an attenuating hypothesis (based on Gray's reinforcement sensitivity theory; Gray, 1987; Gray & McNaughton, 2000), and an exacerbating hypothesis (based on social information processing theory; Crick & Dodge, 1994; Dodge, 1986). We found that our comorbid CD+ADs group was similar in terms of CD symptom severity (based on the numbers of aggressive and non-aggressive CD symptoms), callous-unemotional (CU) traits and aggression, to the CD-only group. Whilst this did not support an attenuating or exacerbating hypothesis, we also found that the comorbid CD+ADs group differed from the ADs-only group in terms of the types of ADs displayed, and associated temperamental factors: the individuals in the comorbid CD+ADs group were less likely to have fear-related ADs, and showed less trait-level fearfulness than those in the ADs-only group. It is, therefore, possible that increased fear, rather than worry or distress, may protect against the development of antisocial behaviour.

Previous theories of the development of psychopathy have posited an inverse relationship between anxiety and psychopathic or CU traits (e.g., Blair, 2013; Frick, 2012; Lykken, 1957). However, previous studies have not distinguished between different types of anxiety (i.e., worry versus fear), and have not examined the potentially confounding effects of the severity of associated antisocial behaviour. In Chapter 4, we also tested whether a similar inverse relationship would be seen in adolescents with CD. We were able to extend previous research by examining the relationships between CU traits, CD severity, and different types of anxiety. We found that trait anxiety (a measure of dispositional stress and worry) was unrelated to both CU traits and CD severity. In addition, whilst fearfulness and social anxiety were inversely related to both CU traits and CD severity, the relationships with CD severity were stronger from a statistical perspective. Our results suggested that the previously-found inverse relationship between anxiety and psychopathy may be better explained by the levels of fearfulness and/or social anxiety, rather than by worry (this may also explain some of the variation in findings to date). Furthermore, our results highlighted the importance of

controlling for the severity of antisocial behaviour when investigating the relationships between psychopathy and anxiety.

The remainder of the present thesis focused on whether individuals with comorbid CD+ADs would show the same patterns of selective attention towards, and sensitivity to, various emotional facial expressions, as either CD-only or ADs-only individuals. Therefore, we used a series of tasks to examine selective attention towards and recognition of emotional facial expressions.

Previous research has highlighted an increased salience of threat in individuals with high levels of anxiety and ADs. This has been characterised by an attentional bias towards threat in anxious, compared to non-anxious, individuals (e.g., Bar-Haim et al., 2007). Similarly, individuals with high levels of anger and aggression have been found to show attentional biases towards threat (Cohen et al., 1998; Eckhardt & Cohen, 1997; van Honk et al., 2001a). However, individuals with psychopathy (which is also common in CD), have been found to be hyposensitive to emotional stimuli (Blair & Mitchell, 2009; Lykken, 1995). In the first experiment of the second empirical chapter (Chapter 5), we used two visual probe tasks to examine attentional biases towards emotional faces: a standard version, in which the faces were presented for 500ms; and a masked version, in which faces were presented briefly in an attempt to limit conscious processing. We tested whether comorbid CD+ADs individuals would show the same pattern of attentional biases towards threat as ADs-only and CD-only individuals. Contrary to expectations, the ADs-only and CD-only groups did not show attentional biases towards threat. Rather, both groups demonstrated a general slowing of performance in the presence of subliminally-presented emotional, compared to neutral, stimuli. This suggests that both CD-only and ADs-only individuals show interference from emotional faces, which is not modulated by specific emotions. In addition, and contrary to expectations, the comorbid CD+ADs group performed similarly to controls in terms of reaction times, and did not show any interference effects from emotional stimuli. This suggests that comorbid CD+ADs individuals show a distinct pattern of emotion processing relative to those with pure forms of each of these disorders.

As well as showing attentional biases towards threat, individuals with ADs have also been found to have problems with controlling their attention in the presence of threatening stimuli (see Derakshan & Eysenck, 2009; Eysenck et al., 2007). This has been characterised by demonstrating interference effects from irrelevant emotional stimuli (Bar-Haim et al., 2007; Williams et al., 1996). Individuals with aggression have also shown similar effects (e.g., Eckhardt & Cohen, 1997). Again, individuals with psychopathy have been found to show the opposite effect, with increased attentional resources allocated to goal-directed behaviour (Baskin-Sommers et al., 2011; Lorenz & Newman, 2002; MacCoon et al., 2004; Vitale et al., 2007). However, this appears to be modulated by the degree of spatial separation of the irrelevant stimuli from the relevant stimuli: when the task-relevant stimuli are integrated with the task-irrelevant stimuli, individuals with psychopathy show normalised patterns of

interference (Hiatt et al., 2004). In the second and third experiments of Chapter 5 we tested whether individuals with comorbid CD+ADs would show similar levels of attentional control as individuals with CD-only and ADs-only. We used two tasks to assess attentional control: a threat distractor task (Experiment 2), and an Extrinsic Affective Simon Task (EAST; Experiment 3) that also assessed automatic evaluations of facial valence. Whilst both tasks measured interference from task-irrelevant stimuli, they differed in the level of separation between the relevant and irrelevant stimuli: the threat distractor task presented spatially separate irrelevant stimuli concurrently with the relevant stimuli, whereas in the EAST the relevant stimuli also contained task-irrelevant features (i.e., facial expressions). In the threat distractor task, and contrary to expectations, we found that all groups were able to control their attention such that irrelevant facial expressions did not interfere with task performance. This was perhaps due to the level of spatial separation between the relevant and irrelevant stimuli.

The EAST experiment showed that attentional control is more likely to be modulated by stimuli that contain task-irrelevant emotional information. However, these effects were relatively subtle, and tended to contradict previous findings. For example, we found that the ADs-only, the comorbid CD+ADs, and the CD-only groups did not show any attentional control impairments in the presence of threatening stimuli (i.e., angry or fearful facial expressions). Conversely, we did find that both ADs-only and comorbid CD+ADs individuals showed interference effects from happy facial expressions, but these effects were of different kinds: while ADs-only individuals implicitly evaluated happy faces as positive (resulting in increased errors), comorbid CD+ADs individuals implicitly evaluated happy faces as negative (also resulting in increased errors). Furthermore, ADs-only individuals tended to evaluate neutral faces as negative (which interfered with task performance), whereas comorbid CD+ADs individuals evaluated these (correctly) as neutral.

Taken together, the results from our threat processing tasks (Chapter 5) suggest that visual attention in CD and ADs is largely unmodulated by the presence of threatening facial expressions. However, there seems to be a general “freezing” response (reflected by increased reaction times) to masked emotional facial expressions in CD-only and ADs-only individuals, which is attenuated in comorbid CD+ADs individuals. Furthermore, whereas both happy and neutral faces interfere with task performance in ADs-only individuals, comorbid CD+ADs individuals show the opposite effects.

The majority of previous research on emotion processing in CD has focused on facial emotion recognition, and studies tend to show a general emotion recognition deficit in CD, which is particularly marked for negative facial expressions (Fairchild et al., 2010; Fairchild et al., 2009a; Marsh & Blair, 2008; Sully et al., 2015). Previous work in adolescents with CU traits suggests that the deficits in emotion recognition, and in particular the recognition of fear, may be due to reduced eye-region fixation (e.g., Dadds et al., 2008; Dadds et al., 2006). The research on emotion recognition in ADs is mixed, although there is some

evidence that anxious individuals show biased interpretations of ambiguous facial expressions (Bell et al., 2011; Richards et al., 2002). In the third empirical chapter (Chapter 6), we investigated whether individuals with comorbid CD+ADs would show similar deficits in facial expression recognition to individuals with CD alone. Furthermore, we investigated whether individuals with ADs-alone would show any emotion recognition deficits or enhancements, given the variability in findings to date. We developed a sensitive task that employed faces expressing the primary emotions (anger, fear, happiness, disgust and sadness) at varying intensity levels or "morph strengths". In addition, the faces were presented briefly (250 ms), and at different positions on the screen to investigate the effects of fixation on salient regions of the face (eye- vs. nose- vs. mouth-areas) on emotion recognition performance. Furthermore, we attempted to examine attributional biases by displaying neutral faces without the option of a "neutral" response, and asking the participants to label them as one of the five primary emotions.

We found that, consistent with previous research (Fairchild et al., 2010; Fairchild et al., 2009a; Sully et al., 2015), individuals with CD showed reduced sensitivity to all emotions (irrespective of presence of ADs). Despite this, the comorbid CD+ADs group performed similarly to controls. In addition, individuals with ADs showed increased sensitivity to low-intensity sadness, happiness and disgust compared to those without ADs (irrespective of the presence of CD), although they also showed reduced sensitivity to low-intensity anger compared to those without ADs. Whilst this was unexpected, given the previously-found threat biases in ADs, it was consistent with the results from our threat-processing tasks, which did not reveal any attentional biases towards anger in individuals with ADs. Our manipulation of fixation position was successful: mouth fixation resulted in the poorest performance for all emotions, and central/nose fixation resulted in the best performance, except for fear where eye-fixation was optimal. However, these effects were not modulated by group status or by the presence of CU traits. In terms of response biases, the effects were less marked. Whilst there were general effects of CD and ADs, the majority of participants tended to label neutral faces as sad, which is consistent with previous work. In addition, individuals with comorbid CD+ADs tended to perform most similarly to the CD-only group. However, it is likely that the results associated with CD were modulated by group differences in IQ. Taken together, the results of our emotion recognition task suggest that the presence of ADs may counteract the emotion recognition deficits seen in CD.

7.1.1 Callous-unemotional (CU) traits

Throughout all of the empirical chapters, we also examined the effects of CU traits on task performance within the CD groups. In general, these effects were subtle, and were not always in the expected direction. For example, we found that high CU traits were associated with increased, rather than reduced, interference from distracting angry faces in the threat distractor task. This is inconsistent with previous studies, which have reported reduced interference from emotional stimuli in adolescents with high CU traits (e.g., Kimonis et al.,

2012). The distinction between primary (i.e., low anxiety and high CU traits) and secondary psychopathy (i.e., high anxiety and high CU traits) was also not always supported: in all but one task measure, CU traits did not interact with ADs status (i.e., the effects of CU traits were the same in both the CD-only and comorbid CD+ADs groups). However, we did find that CU traits in those with comorbid CD+ADs were associated with a more positive error interference score from angry faces in the EAST. This suggests that individuals with secondary psychopathy are more likely to show interference from irrelevant angry faces, although similar effects were not seen in the threat distractor or visual probe tasks.

When examining facial emotion recognition in individuals with CD and high or low CU traits, we found that high CU traits individuals were less sensitive to facial expressions of fear, happiness and sadness than individuals with low CU traits. This is consistent with previous studies (e.g., Fairchild et al., 2010; Fairchild et al., 2009a; Kosson et al., 2002; Marsh & Blair, 2008). However, we did not find that cueing the participants to fixate the eye-regions of the faces improved recognition performance in those with high CU traits. This suggests that the fear recognition deficit seen in CU traits is not necessarily accounted for by reduced fixation to the eye-region of the face, as posited by Dadds and colleagues (Dadds et al., 2008; Dadds et al., 2006).

It is possible that the range of CU traits in our CD groups was too restricted to observe significant modulating effects of this variable on task performance. Given that we did not select CD participants on the basis of their level of CU traits, there may have been under-representation of both high and low scorers. Extending the analysis of CU traits to the whole sample would have increased the numbers of low-CU traits individuals, but there would have been significant confounding effects of CD (i.e., there were very few high CU traits control individuals in the sample).

Taken together, our results suggest that CU traits were less important in explaining group differences in emotion processing than expected, although we did observe effects of CU traits on the processing of distress cues in our facial emotion recognition task. CD appeared to have effects on emotion processing that were independent of CU traits.

7.2 Implications of emotion processing findings for CD

Our results provide new insights on the emotion processing characteristics associated with CD. Given that emotion processing deficits are at the centre of a number of theoretical models of CD (e.g., Blair, 2013), it is surprising that only a few studies have examined other aspects of emotion processing, outside of explicit facial emotion recognition, in children and adolescents with CD. We have extended previous research by additionally examining threat processing (using a range of tasks), as well as testing emotion recognition in a more sensitive and controlled manner in adolescents with CD.

From a social information processing (SIP) perspective (e.g. Crick & Dodge, 1994; Lemerise & Arsenio, 2000), individuals with CD are hypothesised to show biases in the early stages of

processing emotional information. This is supported by studies showing that aggressive individuals are more likely to attribute hostile intent to ambiguous social signals than non-aggressive individuals (see de Castro et al., 2002), and individuals with CD show emotion recognition deficits that are particularly marked for negatively-valenced expressions (Fairchild et al., 2010; Fairchild et al., 2009a; Sully et al., 2015). In addition, previous studies have found that aggressive individuals show attentional biases towards threatening stimuli (Cohen et al., 1998; Eckhardt & Cohen, 1997; van Honk et al., 2001a). However, another line of research is concerned with the idea that individuals with psychopathic traits are generally hyposensitive to emotional stimuli (Blair & Mitchell, 2009; Lykken, 1995), and they show emotion recognition deficits that are particularly marked for distress cues, such as fear and sadness (Marsh & Blair, 2008). Furthermore, it has been found that their visual attention is unmodulated by peripheral cues (emotional or otherwise) whilst they are engaging in goal-directed behaviour (MacCoon et al., 2004; Newman, 1998). Given that individuals with CD may have high levels of aggressive and/or psychopathic traits (or normal levels of both traits), these two strands of research are difficult to reconcile. From a clinical perspective, adolescents who seek treatment for antisocial behaviour are likely to be assessed with formal clinical diagnostic instruments based on classification systems such as the *DSM* or the *International Classification of Diseases* (World Health Organisation, 1992), both of which yield diagnoses of CD. It is clinically useful, therefore, to investigate whether individuals with CD (rather than individuals with either aggression or psychopathy) show any early-stage information processing biases. This may be useful for the formulation of more general treatments for CD, such as those that modify attentional biases (Bar-Haim, 2010) or improve appraisal mechanisms, thereby enhancing emotion recognition (e.g., Dadds et al., 2012). As such, as well as assessing for the presence of CD, we also measured both CU and aggressive traits to establish whether any observed deficits or alterations were due primarily to the presence of CD, or were more likely to be attributable to the presence of high CU or aggressive traits.

Table 7.1 shows the outcomes of comparisons between our CD-only and control groups, as well as between those with CD (i.e., CD-only and comorbid CD+ADs groups) and without CD (i.e., control and ADs-only groups), for each of the emotion processing tasks. It also shows how our results compare to those of previous studies using similar measures. There were significant differences between the CD-only and control groups in all but one of the tasks (the EAST). In general, the results of our threat processing tasks suggest that CD may be characterised by interference from emotional stimuli only when the participants are not instructed to ignore them. In other words, we did not find any evidence of top-down attentional control deficits in CD. Whilst we did not find any effects of specific emotions on selective attention in CD, our results from the masked visual probe task showed differences in performance between trials that contained an emotional face versus trials that contained only neutral faces: CD-only individuals took longer to disengage from, and were less vigilant towards, emotional stimuli than controls. These results provide some support for a bottom-up

attentional deficit in CD, which fits with SIP theory (e.g., Crick & Dodge, 1994). These results may also be interpreted in the context of Blair and colleagues' Integrated Emotion Systems (IES) model (Blair, 2004, 2005a; Mitchell et al., 2006). The model suggests that conditioned stimuli (i.e., stimuli that activate an emotional response, as a result of prior learning and experience) activate basic threat systems in the brain, via the amygdala, which compete with goal-directed executive attentional systems, and result in a freezing/suppression response (see Mitchell et al., 2006). Our results suggest that the emotional faces in our visual probe task activate this competing system more strongly in CD (compared to controls), thus interfering with their responses.

Table 7.1: Differences between conduct disorder (CD)-only and control adolescents, and between those with and without CD, in each of the emotion processing tasks, compared to previous studies.

Task	CD-only vs. controls	CD+ vs. CD-	Supports previous studies	Novel findings
Standard Visual Probe	↑RTs	=	✓	✓
Masked Visual Probe	↑RTs ↓vigilance ↑disengagement	=	✓	✓
Threat distractor	↓accuracy	↓accuracy	N/A	✓
EAST	=	=	N/A	✗
Emotion recognition task (sensitivity)	↓sensitivity (all emotions)	↓sensitivity (all emotions)	✓	✓
Emotion recognition task (bias)	=	↑neutral recognised as fearful ↓neutral recognised as sad	✗	✓

Note: EAST = Extrinsic Affective Simon Task; RTs = reaction times.
↑ or ↓ denotes increase or decrease in CD-only or CD+ vs. controls or CD-
= denotes non-significant difference between groups; N/A = not available.

The results of our facial emotion recognition task suggest that CD may be characterised by general deficits in emotion recognition, consistent with previous studies of CD (Fairchild et al., 2010; Fairchild et al., 2009a; Sully et al., 2015). According to the IES model, individuals learn moral socialisation through the recognition of distress cues in others. These cues (such as a fearful facial expression) activate a violence inhibition mechanism (VIM; see Blair, 1995; Blair et al., 1997), which results in increased autonomic activity and the activation of basic threat systems (as above). The individual finds this increased arousal aversive, and learns to pair distress cues with the acts causing the distress. As a consequence, the acts causing distress (and even the thought of committing such acts) also become aversive to the individual. In healthy individuals, the activation of the VIM acts as a "stop" mechanism that inhibits the behaviour causing the other's distress. Blair argues that a deficit in recognising

distress cues disrupts this system, such that acts that cause distress in others do not become triggers for the VIM (Blair et al., 1997). On the one hand, our results suggest that individuals with CD have difficulty recognising distress cues, which means that there are fewer mechanisms inhibiting their aggressive acts than are present in typically developing children. On the other hand, however, our threat processing results suggest that emotional stimuli may activate the same systems (according to the IES) that act as stop mechanisms to behaviour. Taken together, these results suggest that CD individuals may have problems with learning to pair the cues that cause the activation of their basic threat systems with the acts causing the cues. This is supported by studies showing impaired fear conditioning in individuals with CD (e.g., Fairchild et al., 2008; Syngelaki et al., 2013). Alternatively, the increased autonomic reactivity associated with the activation of basic threat systems may not be aversive to CD individuals, and therefore the classical conditioning involved in learning does not take place. In this latter case, an argument for the implementation of different learning or disciplinary strategies during childhood can be made. For example, strategies based on reward rather than punishment may be more effective in children with behavioural difficulties.

In conclusion, our study has identified that individuals with CD show emotion processing deficits beyond those affecting facial expression recognition. This not only highlights the importance of examining different stages of emotion processing, but also of examining these processes in CD: until now, the study of selective attention in CD has largely been overlooked due to the continued and somewhat narrow focus on CU traits. However, CD places a great burden on society (Romeo et al., 2006; Snell et al., 2013), and is a significant treatment need. Furthermore, the majority of young people with CD do not have elevated levels of CU traits (Herpers et al., 2012). Therefore, understanding the link between emotion processing and behaviour in CD will enable the development of targeted treatments for antisocial adolescents.

7.3 Implications of emotion processing findings for ADs

One of the strengths of our study was the presence of a psychiatric control group (the ADs-only group). This allowed us to investigate the effects of CD on ADs (rather than just the effects of ADs on CD), as well as to attempt to replicate the results of previous studies using similar tasks in individuals with ADs. This was especially useful and important, given that our threat processing tasks had previously not been used with individuals with CD.

Similar to CD, from a SIP perspective, individuals with ADs are posited to show biases at early stages of information processing (Daleiden & Vasey, 1997; Hadwin & Field, 2010). This is primarily supported by studies in anxious adults, who have been found to show attentional biases towards threatening stimuli (Mathews & Mackintosh, 1998; Mogg et al., 1987; Wilson & MacLeod, 2003) and tend to interpret ambiguous stimuli as threatening (Constans et al., 1999; Richards et al., 2002). To some extent, these findings have been replicated in child and adolescent samples, but the existing body of research is relatively small (compared to

the research in adults) and findings are inconsistent, especially with respect to emotion recognition.

Table 7.2 shows the comparisons between our ADs-only and control groups, as well as between participants with (i.e., the ADs-only and comorbid CD+ADs) and without ADs (i.e., the control and CD groups). Surprisingly, the ADs-only group only differed from controls in two of the four threat processing tasks. Similar to the CD-only group, the ADs-only group showed reaction time (RT) interference from emotional faces in the masked visual probe (VP) task: they took longer to disengage from, and were less vigilant towards, emotional stimuli than controls.

In addition, the ADs-only group showed more negative RT interference from neutral faces in the EAST than controls. In other words, ADs-only individuals showed faster responses to neutral faces when the correct response was associated with a negative valence, suggesting that ADs-only individuals automatically evaluated neutral faces as negative. This was supported by the results from our emotion recognition task, which showed that individuals with ADs were more likely than those without ADs to label neutral faces as sad. These results are somewhat consistent with the idea that individuals with ADs show biases at evaluative stages of information processing, and are also consistent with models of attention that involve pre-attentive threat evaluation mechanisms. Mathews and Mackintosh (1998) suggests that an individual's basic threat response system is activated as a result of output from a threat evaluation system (TES). In healthy individuals, the threat response system is only activated when the output from the TES reaches a certain threshold. In anxious individuals, this threshold is lower, such that potential threats (rather than certain threats) are sufficient to activate a fight/flight/freeze response. It is possible that, given the shorter face presentation time in the masked VP task, the potential threat from the emotional faces was sufficient to activate the basic threat response system in the ADs-only group, causing RT interference. This effect was reduced in the standard VP task given that there was sufficient time for higher-order executive processes to re-evaluate the faces as non-threatening and regain attentional control. However, faces signalling threat were included in the task (i.e., facial expressions of anger and fear), therefore it is possible that the threat value of these faces was not sufficiently high to elicit a threat response.

Table 7.2: Differences between anxiety disorders (ADs)-only and control adolescents, and between those with and without ADs, in each of the emotion processing tasks, compared to previous studies.

Task	ADs-only vs. controls	AD+ vs. AD-	Supports previous studies	Novel findings
Standard Visual Probe	=	=	✕	✕
Masked Visual Probe	↑RTs ↓vigilance ↑disengagement	=	✓	✕
Threat distractor	=	=	✕	✕
EAST	↓RTI from neutral faces	=	N/A	✓
Emotion recognition task (sensitivity)	=	↑low-intensity sad, happy & disgust.	✕	✓
		↓low-intensity anger	✓	
Emotion recognition task (bias)	=	↓neutral recognised as angry	✕	✓
		↑neutral as sad	✓	

Note: EAST = Extrinsic Affective Simon Task; RTI = reaction time interference; RTs = reaction times.
↑ or ↓ denotes increase or decrease in ADs-only or AD+ vs. controls or AD-
= denotes non-significant difference between groups

As well as being capable of identifying biases in the labelling of neutral faces as threatening or emotional, our emotion recognition task had the benefit of allowing us to examine the recognition of facial expressions at a range of intensities. We found that individuals with ADs had increased sensitivity to low-intensity expressions of sadness, happiness and disgust, but decreased sensitivity to low-intensity anger, compared to individuals without ADs. Given that we measured sensitivity, rather than accuracy, these results were unaffected by response bias. The evidence for enhanced emotion recognition (rather than a specific response bias) in ADs is limited. Button et al. (2013) found that adult females with high levels of social anxiety had a lower threshold for discriminating facial expressions, but at the same time made more misclassifications of low-intensity emotions. However, studies that have found no differences between anxious individuals and controls have not necessarily examined recognition of very low-intensity facial expressions (Allen et al., 2006; McClure et al., 2003; Melfsen & Florin, 2002). There is more evidence for a deficit in recognising angry facial expressions in ADs: Battaglia et al. (2010) found that children with high levels of social phobia had higher thresholds for recognising anger than those with lower levels of social phobia; Jarros et al. (2012) found that children with ADs showed impaired recognition of anger compared to controls; and lastly, Gilboa-Schechtman et al. (2008) found that adults with social phobia were less sensitive to anger compared to controls. Some authors argue that this deficit in anger recognition may be associated with social anxiety, specifically. For example, if a child is unable to recognise anger, approaching an angry peer may lead to

rejection. This deficit may, therefore, impede the child from learning appropriate social behaviours (see Simonian et al., 2001). However, it is unlikely that our results for the ADs-only group are due to social anxiety, given that only one participant had social phobia.

In conclusion, our results do not support a threat-related attentional bias in ADs. Neither do they fully support a negative interpretation bias in ADs. Therefore, the reliance upon early threat-detection mechanisms to explain the development of ADs may be misplaced. It is possible that individuals with ADs develop biased threat-detection mechanisms over time, which may explain why studies of threat processing in adult samples report stronger effects than those conducted on child or adolescent samples.

7.4 Characterising comorbid CD+ADs

One of the primary aims of this thesis was to characterise individuals with comorbid CD+ADs in terms of their clinical and emotion processing characteristics, in order to better understand the effects of comorbid ADs on the neuropsychological profile of CD. As discussed previously, past research in this area has been mixed, with different studies showing attenuating, exacerbating and no effects of comorbid ADs or anxiety on CD (DeWall et al., 2010; Hodgins et al., 2011; Walker et al., 1991). Our results may shed some light on the reasons for these discrepancies.

In terms of clinical and personality characteristics, our results suggest that there is neither an attenuating nor an exacerbating effect of ADs on CD. Similar to the study on adolescents with CD and ADs by Hodgins et al. (2011), we found that the comorbid group were similar to the CD-only group in terms of CD symptom severity, CU traits and level of aggression. However, our comorbid CD+ADs group did have higher verbal IQ scores than our CD-only group, suggesting a protective effect of ADs on verbal intelligence, although longitudinal studies are required to test this hypothesis: we do not know, from our data, which came first – CD, ADs or verbal IQ deficits. The differences between the comorbid CD+ADs and ADs-only group, on the other hand, were more striking: individuals in the comorbid CD+ADs group were less likely to have a fear-related disorder (e.g., phobias, panic disorder, obsessive-compulsive disorder) than the ADs-only group. In addition, fearfulness was negatively associated with CD severity, whereas trait anxiety/worry (associated with generalised anxiety disorder) was unrelated to CD severity. This suggests that the presence of a fear-related disorder may protect against developing CD, and that increased levels of fearfulness may protect against the development of severe CD. This is consistent with a model of antisocial behaviour based on the fearlessness hypothesis (e.g., Lykken, 1957, 1995), which suggests that a low level of fear reduces the impact of classical conditioning (i.e., the ability to learn from fear-inducing experiences of stimuli associated with punishment) and may result in antisocial behaviour. Our results did not fully support models of CD and ADs based on ideas of behavioural inhibition/activation system (BIS/BAS) activity (Quay, 1993), whereby CD is characterised by an overactive BAS (leading to excessive reward seeking behaviour) and an underactive BIS (leading to reduced sensitivity to

punishment or the omission of reward), and vice versa for ADs. Whilst BIS scores were elevated in the comorbid CD+ADs and ADs-only groups, as would be predicted, BAS scores were equivalent across groups (including the control group), suggesting no elevation in reward seeking behaviour in those with CD-only or comorbid CD+ADs.

In terms of emotion processing, we did not find significant differences between the comorbid CD+ADs groups and controls in any of the tasks (see Table 7.3). In addition, contrary to Bubier and Drabick's (2009) conceptual model for the co-occurrence of anxiety and disruptive behaviour disorders (see Chapter 2), our results largely suggest an interactive effect of ADs on CD. Specifically, whilst Bubier and Drabick's (2009) model suggests that anxiety and DBDs co-occur due to shared risk factors (e.g., hypervigilance to threat, negative emotionality, irritability), our comorbid CD+ADs group at times showed the opposite pattern of information processing to both the CD-only and ADs-only groups. For example, in the masked VP task, both the CD-only and ADs-only groups showed RT interference from emotional, compared to neutral, faces. The comorbid CD+ADs and control groups, on the other hand, did not. In addition, the comorbid CD+ADs group showed a unique pattern of results in the EAST: these individuals showed a negative error interference from happy faces, whereas the other groups (and especially the ADs-only group) tended to show interference effects that were greater than zero. In other words, the comorbid CD+ADs group were more likely to make negative errors (i.e., to press the key that had been previously associated with a negative valence) on happy face trials. This suggests that comorbid CD+ADs individuals were more likely to evaluate happy faces as negative, even though they did not show any specific deficits in recognising happy facial expressions in the emotion recognition task. In addition, the ADs-only group showed significantly more negative RT interference from neutral faces in the EAST compared to the comorbid CD+ADs group. In other words, whilst the ADs-only group tended to evaluate neutral faces as negative, the comorbid CD+ADs group scores were close to zero, suggesting normal (and accurate) implicit evaluation of neutral faces.

Considering the threat distractor task, we found that the CD-only group committed more errors (irrespective of task condition) than the comorbid CD+ADs group. This suggests that the comorbid CD+ADs group may not share the same motivational deficits as the CD-only group, although this may be due to a higher verbal IQ in the comorbid CD+ADs group.

The results of the emotion recognition task point towards a protective effect of ADs on the emotion recognition deficits in CD. However, there were no significant differences between the comorbid CD+ADs group and any of the other groups, and the CD x ADs interaction effect was non-significant. A larger, better matched sample is required to test these effects in more detail, but if confirmed, the apparent protective effect of ADs on emotion recognition in CD may have clinical implications and would suggest that distinct interventions are needed for CD-only versus comorbid CD+ADs individuals.

Table 7.3: Differences between the comorbid and control, conduct disorder (CD)-only and anxiety disorders (ADs)-only groups for each of the emotion processing tasks.

Task	Comorbid vs. controls	Comorbid vs. CD	Comorbid vs. ADs	Comorbidity model
Standard visual probe	=	↓RTs	↓RTs	Independent disorders
Masked visual probe	=	↓RTs ↑vigilance ↓disengagement	↓RTs ↑vigilance ↓disengagement	Independent disorders
Threat distractor	=	↑accuracy	=	Closer to ADs-only
EAST	=	=	↓EI from happy faces ↑RTI from neutral faces	Independent disorders
Emotion recognition (sensitivity)	=	=	=	Inconclusive
Emotion recognition (bias)	=	=	=	Inconclusive

Note: EAST = Extrinsic Affective Simon Task; EI = error interference; RT = reaction time; RTI = reaction time interference. ↑ or ↓ denotes increase or decrease in the comorbid vs. control, CD or ADs groups. = denotes non-significant difference between groups.

Taken together, our results show that individuals with comorbid CD+ADs do not exhibit the same emotion processing deficits that are seen in individuals with CD-only or ADs-only. This seems counter-intuitive: one would expect that if these types of deficits are characteristic of both CD and ADs, their effects would be amplified when these two classes of disorders co-occur. There are a number of potential reasons for this discrepancy. First, the interference effects seen in CD may not be due to information processing biases, but to a general lack of motivation in the CD group (as evidenced by poorer performance in the threat distractor task), whereas the interference effects seen in ADs may reflect true information processing biases. Therefore, the presence of ADs in CD may counteract the general motivational deficits in CD, and the presence of CD in ADs may counteract the information processing biases in ADs. This latter effect may reflect the differences in the types of ADs between the ADs-only and comorbid CD+ADs groups: the ADs-only group had a higher proportion of fear-related ADs than the comorbid CD+ADs group, who were more likely to have generalised anxiety disorder. Second, it is possible that a comorbid CD+ADs presentation actually represents a separate disorder with a different aetiology from the pure forms of CD and ADs, and therefore it affects different information processing mechanisms. There are various examples of this in the medical field (see Rutter, 1997), however this idea is difficult to test in relation to psychopathology given that psychiatric disorders tend to have multiple aetiologies.

In conclusion, the weight of evidence from our emotion processing tasks suggests that the co-occurrence of CD and ADs may not represent a true comorbidity. Rather, it is more likely, given our results, that CD+ADs represents an independent disorder. However, given that this is the first study of its kind, future work is required to replicate and extend our findings. It will also be important to study additional neurocognitive domains that have been shown to be

altered or deficient in CD, such as reward processing, decision-making and executive functions (Matthys et al., 2012).

7.5 Strengths

Our study had a number of advantages over previous research in this area. The main strength is that this is the first study to examine the effects of comorbid ADs on the emotion processing characteristics of CD. As discussed previously, CD and ADs co-occur at a rate that is higher than would be expected by chance (e.g., Angold et al., 1999). However, previous studies of emotion processing in both CD and ADs have tended to disregard the presence of heterotypic comorbidity (i.e., comorbidity with disorders outside of the disorder "family" under examination).

Second, most studies of emotion processing in CD have focused on facial emotion recognition, but we have extended this previous research by examining a range of emotion processing tasks (in particular, by using tasks that have been commonly used in the anxiety literature such as visual probe tasks). Furthermore, studies of emotion recognition in CD tend to have employed high-intensity facial expressions, and studies of selective attention in CD/antisocial behaviour have predominantly used word-based stimuli (e.g., Loney, 2003; Loney et al., 2003), which are problematic for use in adolescent populations with limited reading ability. We have extended these previous findings by using more ecologically-valid stimuli to investigate emotion processing: we presented facial expression stimuli in the threat-processing tasks, and used facial expressions morphed at varying intensities in the emotion recognition task, in an attempt to increase the sensitivity and validity of the task. We also manipulated fixation location to examine whether deficits in emotion recognition were related to attentional or appraisal mechanisms.

Third, our sample was extremely well-characterised from a clinical perspective: we used interview-based assessments of CD and ADs (using both young person and carer-reports, although we note that a carer-report was not obtained in all cases) and thus have included individuals with clinically significant behavioural problems and levels of anxiety. This is an improvement over studies that have used groups recruited from the community and derived them on the basis of questionnaire measures. In addition, we measured a broad range of internalising and externalising traits, including fearfulness and behavioural inhibition, and distinguished between fear-related and worry-related ADs.

Fourth, our study also had the advantage of including a psychiatric control group (the ADs-only group), to help interpret the effects of different forms of psychopathology, rather than simply looking at the effects of ADs within CD. This extends previous studies investigating the effects of comorbidity on emotion processing in CD (e.g., Schepman et al., 2012), or the effects of anxiety on emotion processing in individuals with CU traits (e.g., Kimonis et al., 2012).

7.6 Limitations

Despite the considerable strengths of the present study, a number of limitations should be taken into account. First, the groups were not matched on IQ or gender: the CD-only group had significantly lower full-scale IQs than the control group, lower verbal IQs than the control, ADs-only and comorbid CD+ADs groups, and there was a higher proportion of females in the ADs-only group than the control, CD-only and comorbid CD+ADs groups. This is consistent with findings from epidemiological studies: individuals with CD have frequently been found to have lower IQs than controls (Farrington, 1995; Frick et al., 1991; Lynam et al., 1993; Moffitt et al., 1981; Moffitt & Silva, 1988), and ADs tend to be more common among females than males (e.g., Kessler et al., 2005; McLean & Anderson, 2009). Thus, our sample is relatively representative of the general population. We dealt with these issues in our analyses by performing hierarchical regression analyses in cases where IQ and gender were significantly related to the dependent variables, in order to estimate the amount of variance that can be explained by CD or ADs after controlling for IQ and/or gender. However, we note that these analyses are not ideal as the existing relationships between IQ and CD, as well as between ADs and gender, may result in shared variance that cannot be separated. For example, consider the relationships between CD, IQ and the dependent variable (DV) in Figure 7.1. The left panel shows an appropriate case for statistically controlling for a covariate: IQ and CD are independent, therefore the removal of variance in the DV shared by IQ (area 1, left panel) is effective for reducing noise in assessing the relationship between CD and the DV. The right panel, on the other hand shows an inappropriate case for this: entering IQ first in the regression removes the variance that IQ shares with CD (areas 3 and 4, right panel), as well as the variance it shares with the DV (areas 1 and 4, right panel), leaving area 2 (right panel). This not only changes the variance shared between CD and the DV, but also alters CD as a variable. Therefore, this regression adjustment may remove part of the effect of CD on the DV, or produce a spurious effect of CD (see Miller & Chapman, 2001).

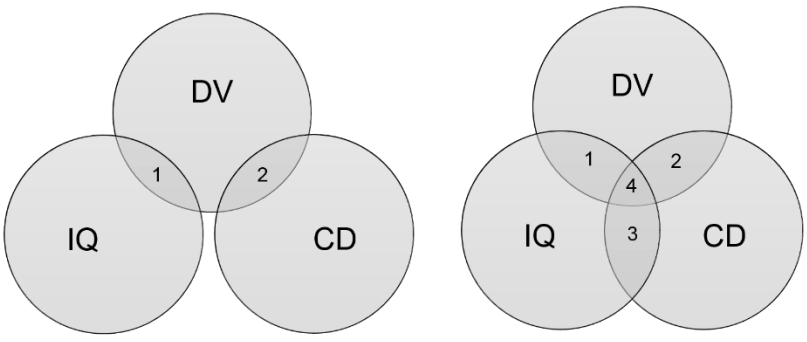

Figure 7.1: Two examples of hypothetical relationships between covariates (IQ), group (CD) and the dependent variable (DV).

One method by which future researchers may deal with this issue is to match clinical and control groups on covariates such as IQ and gender. However, this may also be problematic: there is a strong association between CD and low IQ, therefore selecting CD individuals with higher IQs would have implications for the construct validity of CD. This would be akin to selecting individuals with normal blood-sugar levels in a study of the relationship between

obesity and heart disease. The opposite is also true: selecting healthy controls with below-average IQs would alter the construct validity of the control group.

Second, our CD-only group was actually a mixture of pure CD, pure oppositional defiant disorder (ODD), and comorbid CD+ODD cases. This may be problematic given that there may be different relationships between CD and ODD and specific ADs: CD may be primarily associated with GAD (Marmorstein, 2007), and ODD may be related to both GAD and fear-related anxiety disorders (Egger & Angold, 2006). However, the identification of a "pure" CD group would be difficult given the fact that CD and ODD are highly comorbid (see Maughan et al., 2004). In addition, the hierarchical nature of the *DSM-IV* (whereby a diagnosis of CD overrules ODD) means that many of our "pure" CD cases would also have met criteria for ODD, although this would not have been assessed for, given the presence of a CD diagnosis.

Third, there was a high prevalence of major depressive disorder (MDD) among our clinical groups. Whilst this is unsurprising, given the significant level of comorbidity between CD and MDD, as well as between ADs and MDD (e.g., Kessler et al., 2005), MDD is also associated with deficits in information processing: studies have found that individuals with MDD are more likely to show negative interpretation biases than those MDD (e.g., Joormann & Gotlib, 2006). However, our clinical groups did not differ on the proportion of MDD diagnoses, nor the level of depressive symptoms. Furthermore, depressive symptoms were uncorrelated with performance in the majority of tasks included in this thesis.

Fourth, our sample size may not have been sufficiently large to detect small differences between the comorbid CD+ADs and CD-only group, or between the comorbid CD+ADs and ADs-only group. Therefore, it is possible that we would have been able to demonstrate additional CD x ADs interactions, had we been able to recruit a larger sample. However, this is the largest experimental study of its kind, and it provides a basis for future work to build upon nonetheless.

7.7 Future work

There are a number of ways in which future research can build upon our findings. First, the results of the first empirical chapter (Chapter 4) suggests that while comorbid CD+ADs individuals are similar to CD-only individuals in terms of externalising traits and severity of behavioural problems, they differ from ADs-only individuals in that they were less likely to present with fear-related ADs. It would be interesting to test, in future studies, whether a gender-matched sample would show similar differences. We also found that increased verbal IQ was related to membership of the ADs-only group versus the comorbid CD+ADs group. Future longitudinal studies on the development of CD and ADs are required to test whether a lower IQ increases the probability of developing comorbid CD+ADs in those with pure CD or ADs.

Second, the results from our threat processing tasks (Chapter 5) suggested that adolescents with ADs-only did not show attentional biases towards threatening facial expressions. Future studies employing tasks that assess attentional biases towards threat in ADs would benefit from the use of a range of threatening stimuli (not solely facial expressions), at a range of different intensities. Furthermore, it would be beneficial to use tasks with a low cognitive load to maximise any effects of threat (Berggren et al., 2012).

Third, we found different effects of comorbid CD+ADs in different emotion processing tasks. This suggests that the comorbid CD+ADs condition may represent a separate disorder, associated with different patterns of information processing compared to CD-only and ADs-only individuals. It would be beneficial for future cross-sectional research to replicate our findings in a sample large enough to allow for IQ- and gender-based stratification. Longitudinal research would then be required to test the theory that comorbid CD+ADs may be a separate disorder: by employing repeated emotion processing tasks along with repeated clinical assessments it may be possible to establish whether distinct emotion processing styles are associated with the development of CD-only, ADs-only and comorbid CD+ADs. Furthermore, it would be interesting to test the effects of comorbid CD+ADs on alternative neuropsychological domains, for example executive functioning or reward processing.

Establishing a more complete characterisation of CD+ADs comorbidity may also assist in the formulation of treatments and the identification of new treatment targets for this group of individuals. For example, if the presence of an AD increases risk for CD in the future, it is possible that an effective treatment for the AD itself may reduce the emergence of CD symptoms. Furthermore, future research can test whether different treatment approaches work differently for pure CD versus comorbid CD+ADs individuals. For example, treatments that modulate selective attention to emotional stimuli, and treatments that enhance emotion recognition may be more effective for pure CD individuals, rather than for those with comorbid CD+ADs (given the CD x AD interaction effects in our threat-processing tasks, as well as the normal emotion recognition performance of our comorbid CD+ADs group).

7.8 General conclusion

Previous research has identified a significant overlap between conduct disorder (CD) and anxiety disorders (ADs). However, the reasons for this comorbidity, as well as its effects on behavioural outcomes, have not been determined. Furthermore, little is known regarding the effects of this comorbidity on emotion processing, which is considered a key component in theories of the development of both CD and ADs.

We used a well-characterised and relatively large sample to examine the effects of comorbid ADs on the clinical, personality and emotion-processing characteristics of adolescents with CD. We found that whilst the presence of comorbid ADs in CD had little effect on the clinical and personality characteristics of CD, individuals with comorbid CD+ADs performed

differently on a range of emotion processing tasks compared to individuals with CD alone (and compared to individuals with ADs alone). These included tasks measuring threat processing at different timescales and different levels of awareness of the stimuli (from conscious to subliminal), as well as an explicit facial emotion recognition task. Considered together, these results suggested that comorbid CD+ADs may represent a distinct disorder from CD-only, with its own specific pattern of emotion processing characteristics, which may have implications for the clinical treatment of individuals with CD and the development of tailored interventions for different groups within the CD population.

Appendix A. Materials used in the study

A.1 Participant information sheet (Youth Offending Teams)

UNIVERSITY OF Southampton

Participant Information Sheet (Version 1; 20/04/12)

Study Title: Understanding the relationship between anxiety and behavioural difficulties

Researcher: Roxy Short

ERGO Study ID number: 1793

Please read this information carefully before deciding to take part in this research. If you are happy to participate you will be asked to sign a consent form.

What is the research about?

This research aims to add to our understanding of how feelings of worry or anxiety affect teenagers' behaviour. We will compare groups of teenagers with and without behavioural difficulties, on different things like face recognition, emotion and learning. We are also interested in studying how worry and anxiety affect these processes by comparing teenagers who worry a lot about things with those who don't worry very much.

Why have I been chosen?

We are recruiting teenagers aged between 11-18 years through secondary schools, colleges, Education Centres and the Southampton and Hampshire Youth Offending Teams. We are inviting teenagers with and without behavioural difficulties to take part in the study. Our sample is what is called an 'opportunity' sample – anyone who chooses to take part can do so, providing they meet the inclusion criteria for the study. It is up to you to decide whether or not to take part. You will have been asked to take part in this study by your caseworker.

What will happen to me if I take part?

If you agree to take part in this study, we will come and visit you at home and we will interview you and your parent or carer in separate rooms. We will be asking you and your parent or carer questions about your typical thoughts, feelings and behaviours, both now and when you were younger. Any information you give will be strictly confidential, not discussed with your parent or carer, and you can leave out

questions you are not comfortable with. However, if we are concerned about your well-being, we may suggest that you talk to someone else, such as your GP. We will also ask you to fill in some questionnaires and do a quick intelligence test; this will involve explaining the meaning of some words and trying to work out patterns in a series of shapes. Altogether, this will take about an hour and a half, and we will reimburse you and your parent or carer £10 each for giving up your time. We would be able to work around your school or work schedules, by meeting up with you in the evening or at the weekend.

If you fit the inclusion criteria for the study, we will arrange an appointment for you to come to the University of Southampton to do some computer-based tasks and fill in some more questionnaires. This part of the study will take about 3 hours, and we will give you £20 for your time, as well as reimbursing your travel expenses. You will be able to take breaks in between the tasks if you wish.

There will be two sets of computerised tasks. The first will involve looking at pictures of faces and trying to decide where they are on the screen, or what emotion they are showing.

The second set of tasks will involve measuring your heart rate, sweat production and eye movements during various tasks. Measuring these physical reactions is easy and painless. We will attach stickers to your wrist that will help us measure your heart rate and sensors to your fingertips to measure tiny changes in sweat production. After we have attached these sensors, we will ask you to sit in a relaxed position for a few minutes. If you feel uncomfortable during this time and you decide you want us to remove any/all of the sensors, that is fine. If you are OK to continue with the final tasks, we will show you some pictures and objects, and you will hear some loud noises through headphones. One of the tasks involves putting another set of sensors on your face, just above your eyes, for about 20 minutes. We have used similar tasks with teenagers in our previous research, and most young people find the tasks quite interesting and not too difficult.

Are there any benefits in me taking part?

Although you might not benefit directly from taking part, you will be helping us to gain a better understanding of the relationship between anxiety and behavioural difficulties, which might help us to develop treatments for individuals who are affected by anxiety.

Are there any risks involved?

Some of the images that we are going to show you might make you feel a little bit scared (for example, we might show you pictures of snakes), but we will ask you beforehand if there is anything that scares you a lot and we won't show you these pictures if you really don't like them.

Will my participation be confidential?

Your participation in this study will be kept confidential. Your personal information will only be accessed by the research team at the University of Southampton. Your

data will be given a unique ID number and personally-identifiable information, such as your name, will not be written on any of the questionnaires that you complete. All the consent forms, questionnaires and assessments that you complete will be kept in a secure filing cabinet in a locked office within the School of Psychology. Any data that is stored electronically will also be number-coded and stored on an encrypted file on the University of Southampton computer network. If the results are published, no personally-identifiable information will be included in any of the papers.

What happens if I change my mind?

You have the right to withdraw from this study at any stage and this will have no effect on your legal rights, your Youth Offending Service order, or your care.

What happens if something goes wrong?

If you have any concerns or wish to make a complaint with regards to the way in which you have been approached or treated throughout this study please contact the chair of the ethics committee at the University of Southampton, Roger Ingham (ri@soton.ac.uk).

Where can I get more information?

If you require further information regarding this study or have any questions regarding your participation in this study please contact:

Roxy Short (roxy.short@soton.ac.uk;

02380 594594)

Supervisors:

Graeme Fairchild (g.f.fairchild@soton.ac.uk)

Wendy Adams (w.adams@soton.ac.uk)

A.2 Consent form (under 16s)

UNIVERSITY OF Southampton

CONSENT FORM – Participants aged under 16 (*Version 1; 20/04/12*)

Study title: Understanding the relationship between anxiety and behavioural difficulties

Researcher name: Roxy Short
ERGO study reference: 1793

To be completed by the participant's parent or carer.

Please initial the box(es) if you agree with the statement(s):

I have read and understood the participant information sheet (Version 1; 20/04/12) and have had the opportunity to ask	☐
I agree for my child to take part in this research project and agree for my child's data to be used for the purpose of this study	☐
I understand my child's participation is voluntary and he/she may withdraw at any time without his/her legal rights being	☐

Data Protection
I understand that information collected about my child during his/her participation in this study will be stored on a password protected computer and that this information will only be used for the purpose of this study. All files containing any personal data will be number-coded and password-protected so they can only be accessed by members of the research team.

Name of parent/carer (print name) .....

Signature of parent/carer .....

Date .....

Please turn over

ASSENT FORM – for participants aged under 16.

To be completed by the participant.

Please initial the box(es) if you agree with the statement(s):

I have read and understood the participant information sheet (Version 1; 20/04/12) and have had the opportunity to ask	☐
I agree to take part in this research project and agree for my data to be used for the purpose of this study	☐
I understand my participation is voluntary and I may withdraw at any time without my legal rights being affected	☐

Data Protection
I understand that information collected about me during my participation in this study will be stored on a password protected computer and that this information will only be used for the purpose of this study. All files containing any personal data will be number-coded and password-protected so they can only be accessed by members of the research team.

Name of participant (print name) .....

Signature of participant .....

Date .....

A.3 Consent form (over 16s)

UNIVERSITY OF Southampton

CONSENT FORM – Participants aged 16 and above
(*Version 1; 20/04/12***)**

Study title: Understanding the relationship between anxiety and behavioural difficulties

Researcher name: Roxy Short
ERGO Study reference: 1793

Please initial the box(es) if you agree with the statement(s):

I have read and understood the participant information sheet (Version 1; 20/04/12) and have had the opportunity to ask ☐

I agree to take part in this research project and agree for my data to be used for the purpose of this study ☐

I understand my participation is voluntary and I may withdraw at any time without my legal rights being affected ☐

Data Protection
I understand that information collected about me during my participation in this study will be stored on a password protected computer and that this information will only be used for the purpose of this study. All files containing any personal data will be number-coded and password-protected so they can only be accessed by members of the research team.

Name of participant (print name) .....

Signature of participant .....

Date .....

Name of parent/carer (print name) .....

Signature of parent/carer .....

Date .....

A.4 K-SADS SCREEN - Preliminary interview YOUTH

*We would like to ask you a few questions about how you've been feeling **over the last 12 months**. It isn't a test of any kind. There are no right or wrong answers – all I'd like you to do is tell me as honestly as you can how you've been feeling. The information you give us today is **confidential** and will go no further. However, if we think that you are having problems at the moment which could benefit from help, then we will discuss the possible options with you, e.g. referring you to a doctor. If you provide information that makes me concerned about your safety or the safety of another person in your family, I may be duty bound to refer you or them on to someone who can help, e.g., your GP. We will not pass on this information to anyone outside the research team without telling you first.*

The first thing I'd like to ask is whether you have ever seen a healthcare professional (e.g. a GP, an Educational Psychologist, a Psychiatrist or a counsellor) for any other reason apart from routine illness? This could include emotional difficulties or mood changes.

Have you ever been prescribed medication for anything apart from routine illness (e.g. colds, coughs or flu)?

1) MAJOR DEPRESSIVE EPISODE

At least 1 from the following 3 symptoms present for more than half the time for a period of at least 2 weeks:

DEPRESSION	Current	Yes/No	Onset:
Everyone has good days and bad days, but in the past 6 months has there been a time when you've felt down, miserable or depressed for days on end? How long did this feeling last? Do you feel like this at the moment? Have you ever gone through a time in your life when you felt like this?	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:

IRRITABILITY	Current	Yes/No	Onset:
Has there been a time when you've felt irritable or angry for most, or all of the time, for days on end? How long did this last? What about recently? Is there a reason why you felt angry?	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:

LOSS OF INTEREST/PLEASURE	Current	Yes/No	Onset:
What about a time when you completely lost interest in doing things or stopped going out? Or felt you couldn't have fun or enjoy the things you used to? How long? What about now?	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:

2) <u>GENERALISED ANXIETY DISORDER</u>	Current	Yes/No	Onset:
Would you describe yourself as a 'worrier'? Have you been worrying a lot about things that have happened to you or might happen? What sort of things? Does the worrying affect your everyday life? Is it difficult to control? How long have you felt like this?	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:

3) <u>PANIC DISORDER</u>	Current	Yes/No	Onset:
Have you ever had a panic attack (that's when you suddenly feel very afraid, or even feel you might die, when there's no reason to feel like that)? Did you ever feel like you couldn't breathe, or that you were having a heart attack? When did this happen? How many times has it happened to you in the last 6 months? ***If endorsed for lifetime, frequency of lifetime panic attacks?***	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:

4) <u>SOCIAL PHOBIA</u>	Current	Yes/No	Onset:
Some people feel very shy when they are in social situations. Have you ever found it very hard to talk to people you don't know? Even if it was someone your own age? Would you ever avoid social situations (e.g. parties) because you felt so uncomfortable around strangers or worried what people would think about you? Would it really scare you to have to speak in front of people or answer questions in class?	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:

5) <u>SPECIFIC PHOBIAS</u>	Current	Yes/No	Onset:
Has there ever been a time when you were really scared of spiders, snakes, dogs, insects, heights, the dark or something like that? What would happen if you saw ___? Would your heart beat faster? Or would you find yourself unable to move? Would you feel so afraid by _____ that you wouldn't do things or go out? Is it like that now or only when you were younger?	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:
6) <u>OBSESSIONS/COMPULSIONS</u>	Current	Yes/No	Onset:
Have you ever been bothered by thoughts or images that make no sense to you, but keep coming into your head for no reason? What about habits that make no sense to you, like counting things several times? Or do you repeat things over and over, like washing your hands or checking whether your door is locked? Are you bothered by this at the moment?	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:
7) <u>POST-TRAUMATIC STRESS DISORDER</u>	Current	Yes/No	Onset:
Has anything traumatic or tragic happened to you in the last year? I mean something serious like being attacked or in car accident, or in some other sort of serious danger or nearly dying? Have you witnessed something like that happening to someone else? When? If yes, get details of the event in question. *How scared were you at the time? How did you act? Did you find you couldn't think straight? Were you shaky or jittery or restless? How did you feel afterwards? Did you find it difficult to think about anything else? How long did this go on for (i.e. weeks, months or years)? How about now?*	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:

8) <u>ALCOHOL USE/ABUSE</u>	Current	Yes/No	Onset:
How much alcohol do you drink in a typical week? What do you drink – beer, wine or spirits? How often? Do you get drunk? Has using alcohol ever caused you to have any health problems (physical/psychological)? Have you ever had to go to a doctor or hospital because of drinking too much? Have you ever missed school/work because you've been too hungover or drunk?	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:

9) <u>SUBSTANCE USE/ABUSE</u>	Current	Yes/No	Onset:
Have you ever tried recreational drugs (e.g., cannabis)? Which drugs have you tried? If you regularly take drugs, how often do you do this? Have you ever had any health problems (physical/psychological) as a result of using drugs? Have you ever had to go to a doctor or hospital because of taking drugs? Have you ever missed school/work because you've been high or on a comedown?	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:
N.B. Establish which drugs and pattern of drug-taking (i.e., at least five times for any one group of drugs).			

10) <u>OPPOSITIONAL DEFIANT DISORDER</u>	Current	Yes/No	Onset:
In the last 12 months have you been in trouble a lot at school, or at home? Have you ever been suspended or excluded from school? Do you lose your temper easily? Do you get into a lot of arguments, maybe with teachers or parents? What about at the moment?	Past 12 months	Yes/No	Onset/dur:
	Lifetime	Yes/No	Dates/dur:

A.5 State-trait anxiety inventory (Trait)

A number of statements which people have used to describe themselves are given below. Read each statement and then mark the appropriate number to the right of the statement to indicate HOW YOU GENERALLY FEEL. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

		Not at all	**A little**	**Somewhat**	**Very much so**
1	I feel pleasant	1	2	3	4
2	I feel nervous and restless	1	2	3	4
3	I feel satisfied with myself	1	2	3	4
4	I wish I could be as happy as others seem to be	1	2	3	4
5	I feel like a failure	1	2	3	4
6	I feel rested	1	2	3	4
7	I am “calm, cool, and collected”	1	2	3	4
8	I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
9	I worry too much over something that really doesn’t matter	1	2	3	4
10	I am happy	1	2	3	4
11	I have disturbing thoughts	1	2	3	4
12	I lack self-confidence	1	2	3	4
13	I feel secure	1	2	3	4
14	I make decisions easily	1	2	3	4
15	I feel inadequate	1	2	3	4
16	I am content	1	2	3	4
17	Some unimportant thought runs through my mind and bothers me	1	2	3	4
18	I take disappointments so badly that I can’t put them out of my mind	1	2	3	4
19	I am a steady person	1	2	3	4
20	I get in a state of tension or turmoil as I think over my recent concerns and interest	1	2	3	4

A.6 State-trait anxiety inventory (State)

A number of statements which people have used to describe themselves are given below. Read each statement and then mark the appropriate number to the right of the statement to indicate how you FEEL RIGHT NOW, that is AT THIS MOMENT. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

		Not at all	A little	Somewhat	Very much so
1	I feel calm	1	2	3	4
2	I feel secure	1	2	3	4
3	I feel tense	1	2	3	4
4	I feel strained	1	2	3	4
5	I feel at ease	1	2	3	4
6	I feel upset	1	2	3	4
7	I am presently worrying over possible misfortunes	1	2	3	4
8	I feel satisfied	1	2	3	4
9	I feel frightened	1	2	3	4
10	I feel uncomfortable	1	2	3	4
11	I feel self-confident	1	2	3	4
12	I feel nervous	1	2	3	4
13	I feel jittery	1	2	3	4
14	I feel indecisive	1	2	3	4
15	I am relaxed	1	2	3	4
16	I feel content	1	2	3	4
17	I am worried	1	2	3	4
18	I feel confused	1	2	3	4
19	I feel steady	1	2	3	4
20	I feel pleasant	1	2	3	4

A.7 Inventory of callous-unemotional traits

Please read each statement and decide how well it describes you. Mark your answer by circling the appropriate number (0-3) for each statement. Do not leave any statement unrated.

		Not at all true	Somewhat true	Very true	Definitely true
1	I express my feelings openly	0	1	2	3
2	What I think is “right” and “wrong” is different from what other people think	0	1	2	3
3	I care about how well I do at school or work	0	1	2	3
4	I do not care who I hurt to get what I want	0	1	2	3
5	I feel bad or guilty when I do something wrong	0	1	2	3
6	I do not show my emotions to others	0	1	2	3
7	I do not care about being on time	0	1	2	3
8	I am concerned about the feelings of others	0	1	2	3
9	I do not care if I get into trouble	0	1	2	3
10	I do not let my feelings control me	0	1	2	3
11	I do not care about doing things well	0	1	2	3
12	I seem very cold and uncaring to others	0	1	2	3
13	I easily admit to being wrong	0	1	2	3
14	It is easy for others to tell how I am feeling	0	1	2	3
15	I always try my best	0	1	2	3
16	I apologize (“say I am sorry”) to persons I hurt	0	1	2	3
17	I try not to hurt others’ feelings	0	1	2	3
18	I do not feel remorseful when I do something wrong	0	1	2	3
19	I am very expressive and emotional	0	1	2	3
20	I do not like to put the time into doing things well	0	1	2	3
21	The feelings of others are unimportant to me	0	1	2	3
22	I hide my feelings from others	0	1	2	3
23	I work hard on everything I do	0	1	2	3
24	I do things to make others feel good	0	1	2	3

A.8 Autism quotient

Read each of the following 50 statements very carefully and state how strongly you agree or disagree with it by ticking one of the boxes next to the statements.

		Definitely agree	Slightly agree	Slightly disagree	Definitely disagree
1.	I prefer to do things with others rather than on my own.	1	2	3	4
2.	I prefer to do things the same way over and over again.	1	2	3	4
3.	If I try to imagine something, I find it very easy to create a picture in my mind.	1	2	3	4
4.	I frequently get so strongly absorbed in one thing that I lose sight of other things.	1	2	3	4
5.	I often notice small sounds when others do not.	1	2	3	4
6.	I usually notice car number plates or similar strings of information.	1	2	3	4
7.	Other people frequently tell me that what I've said is impolite, even though I think it is polite.	1	2	3	4
8.	When I'm reading a story, I can easily imagine what the characters might look like.	1	2	3	4
9.	I am fascinated by dates.	1	2	3	4
10.	In a social group, I can easily keep track of several different people's conversations.	1	2	3	4
11.	I find social situations easy.	1	2	3	4
12.	I tend to notice details that others do not.	1	2	3	4
13.	I would rather go to a library than a party.	1	2	3	4
14.	I find making up stories easy.	1	2	3	4
15.	I find myself drawn more strongly to people than to things.	1	2	3	4
16.	I tend to have very strong interests, which I get upset about if I can't pursue.	1	2	3	4
17.	I enjoy social chit-chat.	1	2	3	4
18.	When I talk, it isn't always easy for others to get a word in edgeways.	1	2	3	4
19.	I am fascinated by numbers.	1	2	3	4
20.	When I'm reading a story, I find it difficult to work out the characters' intentions.	1	2	3	4
21.	I don't particularly enjoy reading fiction.	1	2	3	4
22.	I find it hard to make new friends.	1	2	3	4
23.	I notice patterns in things all the time.	1	2	3	4
24.	I would rather go to the theatre than a museum.	1	2	3	4
25.	It does not upset me if my daily routine is disturbed.	1	2	3	4

		Definitely agree	Slightly agree	Slightly disagree	Definitely disagree
26.	I frequently find that I don't know how to keep a conversation going.	1	2	3	4
27.	I find it easy to "read between the lines" when someone is talking to me.	1	2	3	4
28.	I usually concentrate more on the whole picture, rather than the small details.	1	2	3	4
29.	I am not very good at remembering phone numbers.	1	2	3	4
30.	I don't usually notice small changes in a situation, or a person's appearance.	1	2	3	4
31.	I know how to tell if someone listening to me is getting bored.	1	2	3	4
32.	I find it easy to do more than one thing at once.	1	2	3	4
33.	When I talk on the phone, I'm not sure when it's my turn to speak.	1	2	3	4
34.	I enjoy doing things spontaneously.	1	2	3	4
35.	I am often the last to understand the point of a joke.	1	2	3	4
36.	I find it easy to work out what someone is thinking or feeling just by looking at their face.	1	2	3	4
37.	If there is an interruption, I can switch back to what I was doing very quickly.	1	2	3	4
38.	I am good at social chit-chat.	1	2	3	4
39.	People often tell me that I keep going on and on about the same thing.	1	2	3	4
40.	When I was young, I used to enjoy playing games involving pretending with other children.	1	2	3	4
41.	I like to collect information about categories of things (e.g. types of car, types of bird, types of train, types of plant, etc.).	1	2	3	4
42.	I find it difficult to imagine what it would be like to be someone else.	1	2	3	4
43.	I like to plan any activities I participate in carefully.	1	2	3	4
44.	I enjoy social occasions.	1	2	3	4
45.	I find it difficult to work out people's intentions.	1	2	3	4
46.	New situations make me anxious.	1	2	3	4
47.	I enjoy meeting new people.	1	2	3	4
48.	I am a good diplomat.	1	2	3	4
49.	I am not very good at remembering people's date of birth.	1	2	3	4
50.	I find it very easy to play games with children that involve pretending.	1	2	3	4

A.9 Youth psychopathic traits inventory

Instructions: This sheet consists of a number of statements that deal with what you think and feel about different things. Read each statement carefully and decide how well the particular statement applies to you. You can choose between four different alternatives on each statement. **Answer each statement as you most often feel and think, not only how you feel right now.**

- **Answer ALL statements.**
- **Do not put a mark between the alternatives.**
- **Only one answer per statement.**

IMPORTANT!!! There are no answers that are “Right” or “Wrong”. You cannot score worse or better than anyone else. We are interested in what you think and feel, not in what is “Right” or ”Wrong”.

		D	D	A	A
1.	I like to be where exciting things happen.	1	2	3	4
2.	I usually feel calm when other people are scared.	1	2	3	4
3.	I prefer to spend my money right away rather than save it.	1	2	3	4
4.	I get bored quickly when there is too little change.	1	2	3	4
5.	I have probably skipped school or work more than most other people.	1	2	3	4
6.	It's easy for me to charm and seduce others to get what I want from them.	1	2	3	4
7.	It's fun to make up stories and try to get people to believe them.	1	2	3	4
8.	I have the ability not to feel guilt and regret about things that I think other people would feel guilty about.	1	2	3	4
9.	I consider myself as a pretty impulsive person.	1	2	3	4
10.	I'm better than everyone on almost everything.	1	2	3	4
11.	I can make people believe almost anything.	1	2	3	4
12.	I think that crying is a sign of weakness, even if no one sees you.	1	2	3	4
13.	If I won a lot of money in the lottery I would quit school or work and just do things that are fun.	1	2	3	4
14.	I have the ability to con people by using my charm and smile.	1	2	3	4
15.	I am good at getting people to believe in me when I make something up.	1	2	3	4
16.	I have often been late to work or classes in school.	1	2	3	4
17.	When other people have problems, it is often their own fault, therefore, one should not help them.	1	2	3	4
18.	It often happens that I talk first and think later.	1	2	3	4
19.	I have talents that go far beyond other people's.	1	2	3	4
20.	It’s easy for me to manipulate people.	1	2	3	4
21.	I seldom regret things I do, even if other people feel that they are wrong.	1	2	3	4
22.	I like to do things just for the thrill of it.	1	2	3	4
23.	It’s important to me not to hurt other people’s feelings.	1	2	3	4

		D	D	A	A
24.	Sometimes I lie for no reason, other than because it's fun.	1	2	3	4
25.	To be nervous and worried is a sign of weakness.	1	2	3	4
26.	If I get the chance to do something fun, I do it no matter what I had been doing before.	1	2	3	4
27.	When someone asks me something, I usually have a quick answer that sounds believable, even if I've just made it up.	1	2	3	4
28.	When someone finds out about something that I've done wrong, I feel more angry than guilty.	1	2	3	4
29.	I get bored quickly by doing the same thing over and over.	1	2	3	4
30.	The world would be a better place if I were in charge.	1	2	3	4
31.	To get people to do what I want, I often find it efficient to con them.	1	2	3	4
32.	It often happens that I do things without thinking ahead.	1	2	3	4
33.	Pretty often I act charming and nice, even with people I don't like, in order to get what I want.	1	2	3	4
34.	It has happened several times that I've borrowed something and then lost it.	1	2	3	4
35.	I often become sad or moved by watching sad things on TV or film.	1	2	3	4
36.	What scares others usually doesn't scare me.	1	2	3	4
37.	I'm more important and valuable than other people.	1	2	3	4
38.	When I need to, I use my smile and my charm to use others.	1	2	3	4
39.	I don't understand how people can be touched enough to cry by looking at things on TV or movie.	1	2	3	4
40.	I often don't/didn't have my school or work assignments done on time.	1	2	3	4
41.	I am destined to become a well-known, important and influential person.	1	2	3	4
42.	I like to do exciting and dangerous things, even if it is forbidden or illegal.	1	2	3	4
43.	Sometimes I find myself lying without any particular reason.	1	2	3	4
44.	To feel guilty and remorseful about things you have done that have hurt other people is a sign of weakness.	1	2	3	4
45.	I don't let my feelings affect me as much as other people's feelings seem to affect them.	1	2	3	4
46.	It has happened that I've taken advantage of (used) someone in order to get what I want.	1	2	3	4
47.	I like to spice up and exaggerate when I tell about something.	1	2	3	4
48.	To feel guilt and regret when you have done something wrong is a waste of time.	1	2	3	4
49.	I usually become sad when I see other people crying or being sad.	1	2	3	4
50.	I've often gotten into trouble because I've lied too much.	1	2	3	4

A.10 Fear survey schedule for children - revised

A number of statements that boys and girls use to describe the fears they have are given below. Read each statement carefully and circle the number that best describes how much you are afraid of each item. There are no right or wrong answers.

	Not at all	Somewhat	A lot
1. Giving an oral report	0	1	2
2. Riding in the car or bus	0	1	2
3. Getting punished by mother	0	1	2
4. Lizards	0	1	2
5. Looking foolish	0	1	2
6. Ghosts or spooky things	0	1	2
7. Sharp objects	0	1	2
8. Having to go to the hospital	0	1	2
9. Death or dead people	0	1	2
10. Getting lost in a strange place	0	1	2
11. Snakes	0	1	2
12. Talking on the telephone	0	1	2
13. Roller coaster or carnival rides	0	1	2
14. Getting sick at school	0	1	2
15. Being sent to the principal	0	1	2
16. Riding on the train	0	1	2
17. Being left at home with a sitter	0	1	2
18. Bears or wolves	0	1	2
19. Meeting someone for the first time	0	1	2
20. Bombing attacks – being invaded	0	1	2
21. Getting a shot from the nurse or doctor	0	1	2
22. Going to the dentist	0	1	2
23. High places like mountains	0	1	2
24. Being teased	0	1	2
25. Spiders	0	1	2
26. A burglar breaking into our house	0	1	2
27. Flying in an airplane	0	1	2
28. Being called on by the teacher	0	1	2
29. Getting poor grades	0	1	2
30. Bats or birds	0	1	2
31. My parents criticizing me	0	1	2
32. Guns	0	1	2
33. Being in a fight	0	1	2
34. Fire – getting burned	0	1	2
35. Getting a cut or injury	0	1	2
36. Being in a big crowd	0	1	2
37. Thunderstorms	0	1	2
38. Having to eat some food I don’t like	0	1	2
39. Cats	0	1	2

	Not at all	Somewhat	A lot
40. Failing a test	0	1	2
41. Being hit by a car or truck	0	1	2
42. Having to go to school	0	1	2
43. Playing rough games during recess	0	1	2
44. Having my parents argue	0	1	2
45. Dark rooms or closets	0	1	2
46. Having to put on a recital	0	1	2
47. Ants or beetles	0	1	2
48. Being criticized by others	0	1	2
49. Strange looking people	0	1	2
50. The sight of blood	0	1	2
51. Going to the doctor	0	1	2
52. Strange or mean looking dogs	0	1	2
53. Cemeteries	0	1	2
54. Getting a report card	0	1	2
55. Getting a haircut	0	1	2
56. Deep water or the ocean	0	1	2
57. Nightmares	0	1	2
58. Falling from high places	0	1	2
59. Getting a shock from electricity	0	1	2
60. Going to bed in the dark	0	1	2
61. Getting car sick	0	1	2
62. Being alone	0	1	2
63. Having to wear clothes different from others	0	1	2
64. Getting punished by my father	0	1	2
65. Having to stay after school	0	1	2
66. Making mistakes	0	1	2
67. Mystery movies	0	1	2
68. Loud sirens	0	1	2
69. Doing something new	0	1	2
70. Germs or getting a serious Illness	0	1	2
71. Closed spaces	0	1	2
72. Earthquakes	0	1	2
73. Terrorists	0	1	2
74. Elevators	0	1	2
75. Dark places	0	1	2
76. Not being able to breathe	0	1	2
77. Getting a bee sting	0	1	2
78. Worms or snails	0	1	2
79. Rats or mice	0	1	2
80. Taking a test	0	1	2

A.11 Fear of negative evaluation

Please read each statement carefully and answer True (T) if best describes how you feel most of the time, and False (F) if it does not. Please try to answer every question.

1	I rarely worry about seeming foolish to others.	T	F
2	I worry about what people will think of me even when I know it doesn't make any difference.	T	F
3	I become tense and jittery if I know someone is sizing me up.	T	F
4	I am unconcerned even if I know people are forming an unfavourable impression of me.	T	F
5	I feel very upset when I commit some social error.	T	F
6	The opinions that important people have of me cause me little concern.	T	F
7	I am often afraid that I may look ridiculous or make a fool of myself.	T	F
8	I react very little when other people disapprove of me.	T	F
9	I am frequently afraid of other people noticing my shortcomings.	T	F
10	The disapproval of others would have little effect on me.	T	F
11	If someone is evaluating me I tend to expect the worst.	T	F
12	I rarely worry about the kind of impression am making on someone.	T	F
13	I am afraid that others will not approve of me.	T	F
14	I am afraid that people will find fault with me.	T	F
15	Other people's opinions of me do not bother me.	T	F
16	I am not necessarily upset if I do not please someone.	T	F
17	When I am talking to someone, I worry about what they may be thinking about me.	T	F
18	I feel that you can't help making social errors sometimes, so why worry about it.	T	F
19	I am usually worried about what kind of impression I make.	T	F
20	I worry a lot about what my superiors think of me.	T	F
21	If I know someone is judging me, it has little effect on me.	T	F
22	I worry that others will think I am not worthwhile.	T	F
23	I worry very little about what others may think of me.	T	F
24	Sometimes I think I am too concerned with what other people think of me.	T	F
25	I often worry that I will say or do the wrong things.	T	F
26	I am often indifferent to the opinions others have of me.	T	F
27	I am usually confident that others will have a favourable impression of me.	T	F
28	I often worry that people who are important to me won't think very much of me.	T	F
29	I brood about the opinions my friends have about me.	T	F
30	I become tense and jittery if I know that I am being judged by my superiors.	T	F

A.12 Buss-Perry aggression questionnaire

Please rate the following items in terms of how characteristic they are of you. Use the following scale for answering these items:

1	2	3	4	5
Extremely Uncharacteristic of me				Extremely characteristic of me

		Score
1	Once in a while I can't control the urge to strike another person.	
2	Given enough provocation, I may hit another person.	
3	If somebody hits me, I hit back.	
4	I get into fights a little more than the average person.	
5	If I have to resort to violence to protect my rights, I will.	
6	There are people who pushed me so far that we came to blows.	
7	I can think of no good reason for ever hitting a person.	
8	I have threatened people I know.	
9	I have become so mad that I have broken things.	
10	I tell my friends openly when I disagree with them.	
11	I often find myself disagreeing with people.	
12	When people annoy me, I may tell them what I think of them.	
13	I can't help getting into arguments when people disagree with me.	
14	My friends say that I'm somewhat argumentative.	
15	I flare up quickly but get over it quickly.	
16	When frustrated, I let my irritation show.	
17	I sometimes feel like a powder keg ready to explode.	
18	I am an even-tempered person.	
19	Some of my friends think I'm a hothead.	
20	Sometimes I fly off the handle for no good reason.	
21	I have trouble controlling my temper.	
22	I am sometimes eaten up with jealousy.	
23	At times I feel I have gotten a raw deal out of life.	
24	Other people always seem to get the breaks.	
25	I wonder why sometimes I feel so bitter about things.	
26	I know that "friends" talk about me behind my back.	
27	I am suspicious of overly friendly strangers.	
28	I sometimes feel that people are laughing at me behind me back.	
29	When people are especially nice, I wonder what they want.	

A.13 Hospital anxiety and depression scales

Please read each question and place a tick in the box opposite the reply which comes closest to how you have been feeling in the **past week**.

Don't take too long over your replies: your immediate reaction to each item will probably be more accurate than a long thought-out response.

I feel tense or 'wound up':

Most of the time …….	
A lot of the time …….	
From time to time, occasionally…….	
Not at all …….	

I feel as if I am slowed down:

Nearly all of the time …….....	
Very often ……...	
Sometimes ……..	
Not at all …….	

I still enjoy the things I used to enjoy:

Definitely as much …….	
Not quite so much ……...	
Only a little …….	
Hardly at all …….	

I get a sort of frightened feeling like 'butterflies' in the stomach:

Not at all …….	
Occasionally……	
Quite often ……..	
Very often …….....	

I get a sort of frightened feeling as if something awful is about to happen:

Very definitely and quite badly ……..	
Yes, but not too badly ……	
A little, but it doesn't worry me …….	
Not at all …….	

I have lost interest in my appearance:

Definitely…….	
I don't take so much care as I should ….	
I may not take quite as much care……...	
I just take as much care as ever ……..	

I can laugh and see the funny side of things:

As much as I always could …….	
Not quite so much now ……...	
Definitely not so much now……...	
Not at all …….....	

I feel restless as if I have to be on the move:

Very much indeed ……..	
Quite a lot ……...	
Not very much ……	
Not at all …….	

Worrying thoughts go through my mind:

A great deal of the time ……..	
A lot of the time ……..	
From time to time, but not too often …..	
Only occasionally ……...	

I look forward with enjoyment to things:

As much as ever I did …….	
Rather less than I used to ……	
Definitely less than I used to ……..	
Hardly at all ……	

I feel cheerful:

Not at all……..	
Not often……..	
Sometimes…….....	
Most of the time……..	

I get sudden feelings of panic:

Very often indeed ……...	
Quite often ……..	
Not very often ……	
Not at all …….	

I can sit at ease and feel relaxed:

Definitely …….	
Usually …….	
Not often …….	
Not at all …….	

I can enjoy a good book or radio or TV programme:

Often ……...	
Sometimes ……..	
Not often …….	
Not at all …….	

Tick only one box in each section

A.14 Neighbourhood environment scale

The following statements are about your neighbourhood (where you live). Please indicate whether they are true or false by circling one of the numbers on the right.

		True	False
1	Within walking distance of my house there is a park or playground where I like to walk and enjoy myself, playing sports or games.	1	0
2	There are plenty of safe places to walk or play outdoors in my neighbourhood.	1	0
3	Every few weeks, some kid in my neighbourhood gets beat-up or mugged.	1	0
4	Every few weeks, some adult gets beat-up or mugged in my neighbourhood.	1	0
5	In my neighbourhood, I see signs of racism and prejudice at least once a week.	1	0
6	In my neighbourhood, many yards and alleys have broken bottles and trash lying around.	1	0
7	I have seen people using or selling drugs in my neighbourhood.	1	0
8	In the morning or later in the day, I often see drunk people on the street in my neighbourhood.	1	0
9	Most adults in my neighbourhood respect the law.	1	0
10	There are abandoned or boarded-up buildings in my neighbourhood.	1	0
11	I feel safe when I walk around my neighbourhood by myself.	1	0
12	The people who live in my neighbourhood often damage or steal each other's property.	1	0
13	The people who live in my neighbourhood always take care of each other and protect each other from crime.	1	0
14	Almost every day I see homeless people walking or sitting around in my neighbourhood.	1	0
15	In my neighbourhood, the people with the most money are the drug dealers.	1	0
16	In my neighbourhood, there are a lot of poor people who don't have enough money for food and basic needs.	1	0
17	For many people in my neighbourhood, going to church on Sunday or religious days is a very important activity.	1	0
18	The people who live in my neighbourhood are the best people in the world.	1	0

A.15 The behavioural inhibition/activation scales

Each item of this questionnaire is a statement that a person may either agree with or disagree with. For each item, indicate how much you agree or disagree with what the item says. Please respond to all the items; do not leave any blank. Choose only one response to each statement. Please be as accurate and honest as you can be. Respond to each item as if it were the only item. That is, don't worry about being "consistent" in your responses. Choose from the following four response options:

1 = very true for me 2 = somewhat true for me 3 = somewhat false for me 4 = very false for me

1	A person's family is the most important thing in life.	1	2	3	4
2	Even if something bad is about to happen to me, I rarely experience fear or nervousness.	1	2	3	4
3	I go out of my way to get things I want.	1	2	3	4
4	When I'm doing well at something I love to keep at it.	1	2	3	4
5	I'm always willing to try something new if I think it will be fun.	1	2	3	4
6	How I dress is important to me.	1	2	3	4
7	When I get something I want, I feel excited and energized.	1	2	3	4
8	Criticism or scolding hurts me quite a bit.	1	2	3	4
9	When I want something I usually go all-out to get it.	1	2	3	4
10	I will often do things for no other reason than that they might be fun.	1	2	3	4
11	It's hard for me to find the time to do things such as get a haircut.	1	2	3	4
12	If I see a chance to get something I want I move on it right away.	1	2	3	4
13	I feel pretty worried or upset when I think or know somebody is angry at me.	1	2	3	4
14	When I see an opportunity for something I like I get excited right away.	1	2	3	4
15	I often act on the spur of the moment.	1	2	3	4
16	If I think something unpleasant is going to happen I usually get pretty “worked up”.	1	2	3	4
17	I often wonder why people act the way they do.	1	2	3	4
18	When good things happen to me, it affects me strongly.	1	2	3	4
19	I feel worried when I think I have done poorly at something important.	1	2	3	4
20	I crave excitement and new sensations.	1	2	3	4
21	When I go after something I use a "no holds barred" approach.	1	2	3	4
22	I have very few fears compared to my friends.	1	2	3	4
23	It would excite me to win a contest.	1	2	3	4
24	I worry about making mistakes.	1	2	3	4

A.16 The adolescent psychotic-like symptoms screener

Please read each question and circle the number that corresponds to the answer that is best for you.

		Yes, Definitely	Maybe	No
1.	Some people believe that their thoughts can be read by another person. Have other people ever read your mind?	1	0.5	0
2.	Have you ever had messages sent just to you through TV or radio?	1	0.5	0
3.	Have you ever thought that people are following or spying on you?	1	0.5	0
4.	Have you ever heard voices or sounds that no one else can hear?	1	0.5	0
5.	Have you ever felt you were under the control of some special power?	1	0.5	0
6.	Have you ever seen things that other people could not see?	1	0.5	0
7.	Have you ever felt like you had extras-special powers?	1	0.5	0

A.17 Debriefing statement

UNIVERSITY OF Southampton

Understanding the relationship between anxiety and behavioural difficulties

Debriefing Statement (Version 1, 20/04/12)

The aim of this research is to understand the relationship between anxiety and behavioural difficulties in teenagers. We carried out interviews and used questionnaires to find out about your typical feelings, thoughts, and behaviours. We wanted to find out whether you are anxious or worried a lot of the time, and whether you experience difficulties controlling your temper or have other behavioural difficulties.

We know that anxious people tend to focus their attention on things that might be threatening (for example the angry faces, or the spiders that you saw in the experiments). This is called an "attentional bias". We would like to understand whether this bias is the same for all anxious people in the groups that we are studying, and whether we can relate this to any other difficulties the groups may have. For example, are some groups better at recognising facial expressions than others? Or, are some groups more distracted by things like angry faces, and therefore slower at pressing the buttons in the tasks, than others? Also, we looked at how your body responds to different images and objects; we know that when we feel anxious or worried, we start to sweat and our heart starts to beat faster. We measured these changes by using the sensors we attached to your fingers and wrists. We will be using this information to see if there are any similarities or differences in these responses between different groups of teenagers.

It is expected that teenagers with high levels of anxiety are more likely to be distracted by threatening images or objects, and are more likely to have a more extreme physiological reaction to these images, than non-anxious individuals.

We hope that our results will help us to understand how anxiety affects different groups of teenagers and might help researchers to develop better treatments for anxiety in the future. Once again, if the results of this study are published, the papers will not include your name or any other identifying characteristics. You may have a copy of this summary if you wish.

If you have any further questions please contact Roxy or any of the other researchers below.

Thank you for your participation in this research.

Signature _____ Name _____ Date _____

If you have questions about your rights as a participant in this research, or if you feel that you have been placed at risk, you may contact the Chair of the Ethics Committee at the University of Southampton, Roger Ingham (ri@soton.ac.uk).

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