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Are Boys with Psychopathic Tendencies impaired at Emotion Priming?

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Are boys with psychopathic tendencies impaired at emotion priming?

This study investigated the sensitivity of boys with psychopathic tendencies to priming using emotion words and facial expressions. This paradigm provided a test between different theories of the development of psychopathy, namely between executive (general or emotion executive) theories and basic emotion processing theories. Boys with psychopathic tendencies were delineated using the Psychopathic Screening Device (Frick and Hare, in press). Fourteen targets (PSD $\geq$ 23) and seventeen controls (PSD $<$ 15) were drawn from two schools for children with emotional and behavioural difficulties. Levels of Attention Deficit Hyperactivity Disorder (DuPaul Rating Scale, DuPaul, Power, Anastopoulos & Reid, 1998), age and IQ (British Picture Vocabulary Scale II, Dunn, Dunn, Whetton & Burley, 1997) were controlled for. Targets and controls were presented with a computerised slideshow of both faces priming words and words priming faces using a counterbalanced ABBA design. The results were analysed using repeated measures ANOVAs with response time and error rate as the dependent variables. The results indicated that boys with psychopathic tendencies showed significantly greater interference than controls on incongruent trials for faces priming words in the error data. There was a trend for the same finding in the error data for words priming faces. These results were interpreted as supporting the response modulation hypothesis of psychopathic deficit (Patterson & Newman, 1993), that psychopaths have problems processing secondary information once a dominant response set is established. In particular, the difficulty on the emotion priming task may be due to impulsivity and problems with error-monitoring. The roles of the orbito-frontal cortex and the anterior cingulate in error-monitoring are discussed.

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INTRODUCTION

Psychopathy is a severe condition, characterised by antisocial and often violent acts, carried out with a seeming lack of guilt and remorse. The recent psychological interest in the UK has partly been spurred by the political thinking concerning the management of psychopaths. Government white papers (DoH & HO, 1999; DoH & HO, 2000) have put forward the idea of securing dangerous people with a personality disorder in treatment centres, before they have committed crimes. If this were to become law, the need for detailed and accurate assessment would become paramount. Assessment and understanding of the specific psychopathic deficits are also important for developing treatment options for a group that have been seen as 'untreatable' (Hart & Hare, 1996) and where conventional interventions have sometimes had adverse outcomes (Rice, Harris & Cormier, 1992). The management debate wavers between punishment, treatment and individual freedom, challenged by the idea that someone can be impaired in 'morality' – in the ability to restrain themselves from committing antisocial acts.

In this thesis, the evidence will be considered for psychopathy being a distinct developmental disorder involving psychopathic personality traits, which are stable from childhood. If this is true, then, it raises the question of what causes psychopathy to develop. Several theories are discussed that answer this question are from the perspective of cognitive neuroscience, looking at executive, emotion executive and basic emotion processing theories. This study was designed to test between the executive theories and basic emotion processing theories by using a respected executive test, namely the Stroop task, with emotional stimuli to form a novel emotion executive paradigm. The tasks used in the experiments were all Stroop-like priming tasks using combinations of emotion words and faces. Some cognitive theories of the processing involved in the Stroop are discussed, before explaining why emotion words and faces were chosen as stimuli and providing details of the four experiments.

Three pilot experiments involved healthy adults and children. The fourth experiment contrasted children with psychopathic tendencies to those with behavioural problems but few psychopathic tendencies. The experiments were designed to look at the influence of specific emotions, particularly to investigate whether there were specific deficits for sadness and fear, which would suggest a basic emotion impairment in empathy.

The results showed that when needs for basic emotion processing and executive control were combined, the executive deficit predominated for boys with psychopathic tendencies. It was concluded that the results supported the response modulation hypothesis for psychopathic dysfunction (Patterson & Newman, 1993), but as other studies have shown specific deficits for emotion processing, there is a need to comprehend how the two co-exist and interact. It is suggested in this study that research at the neurological level can aid understanding of this problem and the role of the orbito-frontal cortex, anterior cingulate and amygdala are discussed.

What is psychopathy?

> *"superficial charm and good intelligence; ...lack of remorse and shame;...pathological egocentricity and incapacity for love"*
>
> characteristics of the psychopath, Cleckley, 1976

The term 'psychopathy' has been used interchangeably with 'dyssocial' or 'antisocial' personality disorder and 'sociopathy' (Losel, 1998; Millon, Simonsen, Birket-Smith & Davis, 1998). Some researchers have argued against this confusion of terms, noting that psychopathy has a theoretical and clinical research base distinct from that of antisocial personality disorder (APD) (Gacono, Nieberding, Owen, Rubel & Bodholdt, 2000; Hare, Hart & Harpur, 1991). Gacono (2000) noted that although psychopaths fulfil the criteria for antisocial personality criteria, the majority of people with APD are not psychopaths.

Psychopathy research has been built on early clinical descriptions of psychopathic traits and behaviour (Cleckley, 1942; Cleckley, 1976). Cleckley (1976) described psychopaths as having a specific learning impairment that made them respond with inappropriate moods in social situations. Most notably they lacked remorse and empathy. They were considered to be aware of social values, but not motivated by them and this resulted in irresponsibility, impulsivity and aggression. In spite of this learning impairment, Cleckley (1976) said that psychopaths could appear with a "mask of sanity" (book title), good intelligence and even charm. There is a case that 'psychopathy' is a distinct developmental disorder with good predictive and construct validity and the evidence is considered below.

General definitions of antisocial personality disorder have been developed in the American and international classification systems of mental illness (DSM IV, American Psychiatric Association /APA, 1994; ICD-10, 1993). Sociopathy was the term used in the first version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-I, APA, 1952). Dyssocial personality disorder is the term used by the International Classification of Diseases (e.g. ICD-10, 1993). In the more recent Diagnostic and Statistical Manuals of Mental Disorder (DSM-III, APA, 1980 and DSM-III-R, APA, 1987, DSM-IV, APA, 1994, DSM-IV-TR, APA, 2000), a person is said to have antisocial personality disorder (APD) when they frequently and remorselessly violate the norms of society in a deceptive or violent manner (see tables 1 and 2, pp.8 and 9).

Earlier versions of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III, APA, 1980 and DSM-III-R, APA, 1987) classified antisocial personality disorder according to a list of antisocial behaviours and their severity. This was in accordance with a social deviancy model (Robins, 1966). Robert Hare and his colleagues criticised this practice (Hare, Hart & Harpur, 1991), arguing that the DSM criteria lacked content and construct validity. They said validity would be improved if the affective components related to the clinical concept of psychopathy were taken into account. The affective and interpersonal traits, to which they refer, are lack of empathy, selfishness, egocentricity, callousness, arrogance, superficial charm and being manipulative.

The latest versions of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, APA, 1994; DSM-IV-TR, APA, 2000) have shortened some items to make the description of APD broader and added the personality trait of callousness, but have not included a separate diagnosis of psychopathy. Neither have they added the affective traits noted by Hare and other researchers to be part of psychopathic disorder (Hare, 1983; Millon, 1981; Wulach, 1983). This is partly because their addition would have meant APD overlapped with narcissistic personality disorder, reducing discriminant validity (Widiger & Corbitt, 1995). However, as Hare and Hart noted (1995) many of the personality disorders in DSM-IV have some overlap. The DSM-IV criteria for APD were designed to be more comparable to the ICD-10 category of dyssocial personality disorder (ICD-10, 1993), while interpersonal and affective symptoms from theories of psychopathy were relegated to the 'Associated Features and Disorders' section of the manual.

Table 1: ICD-10 criteria for Dyssocial Personality Disorder

1. Callous unconcern for the feelings of others and lack of the capacity for empathy
2. Gross and persistent attitude of irresponsibility and disregard for social norms, rules and obligations
3. Incapacity to maintain enduring relationships
4. Very low tolerance to frustration and a low threshold for discharge of aggression, including violence
5. Incapacity to experience guilt and profit from experience, particularly punishment
6. Marked proneness to blame others or to offer plausible rationalizations for the behaviour bringing the subject into conflict with society
7. Persistent irritability

(Each criterion comes with behavioural exemplars)

From ICD-10 (1993).

Table 2: DSM-IV criteria for Antisocial Personality Disorder

A. There is a pervasive pattern of disregard for and violation of the rights of others occurring since age 15 years, as indicated by three (or more) of the following:

   (1) failure to conform to social norms with respect to lawful behaviors as indicated by repeatedly performing acts that are grounds for arrest

   (2) deceitfulness, as indicated by repeated lying, use of aliases, or conning others for personal profit or pleasure

   (3) impulsivity or failure to plan ahead

   (4) irritability and aggressiveness, as indicated by repeated physical fights or assaults

   (5) reckless disregard for safety of self or others

   (6) consistent irresponsibility, as indicated by repeated failure to sustain consistent work behavior or honor financial obligations

   (7) lack of remorse, as indicated by being indifferent to or rationalizing having hurt, mistreated, or stolen from another

B. The individual is at least age 18 years

C. There is evidence of Conduct Disorder.... with onset before age 15 years

D. The occurrence of antisocial behavior is not exclusively during the course of Schizophrenia or a Manic Episode

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From DSM-IV (1994)

The DSM diagnoses tend to be very broad. Estimates for the prevalence of Antisocial Personality Disorder in the US have ranged from 1-3% in community samples, 3-30% in clinical samples (DSM-IV, APA, 1994, p.648) and 50-80% in male prison samples (Hart & Hare, 1996). Part of the difficulty with diagnosis is co-morbid substance abuse. One study has shown that 50% of a community sample, who had been diagnosed with APD, did not meet APD criteria at a one-year follow-up, which the author attributed to recovery from drug abuse (Robins, Tipp & Przybeck, 1991). This means that a persistent drug user may be classified as having APD only until they recover from their drug addiction. Such transience of symptoms is contrary to the idea that personality disorders are enduring and develop from childhood. The emphasis on antisocial behaviours leads to false positive diagnoses in drug using populations. Grouping together all individuals who engage in illegal and antisocial activities lacks clinical and theoretical utility.

Robert Hare has developed his own means of assessing psychopathy, called the revised Psychopathy Checklist (PCL-R)(Hare, 1991). This is a 20-item scale including affective and interpersonal, as well as behavioural, components. These affective traits have long been part of the clinical description of psychopaths (Cleckley, 1976; Hare, 1970; McCord & McCord, 1964). It is scored using a semi-structured interview and a file review. The inter-rater reliability coefficient has been measured as 0.83 (Hare, 1991). This scale has the advantage of concurrent validity as it measures distinct factors within psychopathic disorder that correlate with expected variables. In addition, it has been shown to have predictive validity in studies of recidivism in forensic populations (Hart, Kropp & Hare, 1988; Hemphill, Hare & Wong, 1998; Serin & Amos, 1995).

Factor analysis revealed two separate, but correlated factors behind the scale. Factor 1 corresponded to affective and interpersonal difficulties, while factor 2 related to impulsive, illegal and aggressive actions. These two factors differ in their associated correlations. Social-economic status, supportive family background and IQ correlated inversely to factor 2, but not to factor 1. Factor 2 also correlated with diagnoses of APD. Factor 1 correlated positively with measures of narcissism and histrionic personality disorder and negatively with empathy and anxiety variables (Harpur, Hare & Hakistan, 1989). In addition, factor 1 scores were more persistent with age (Hare, Hart & Harpur, 1991). The distinctness of factor 1 suggests that it is an important part of identifying a more stable disorder, which may be based on neurological damage.

The PCL-R, which takes emotional difficulties into account, has good predictive validity. Two studies have found higher recidivism rates in psychopathic prisoners compared to non-psychopathic controls (Hart, Kropp & Hare, 1988; Serin & Amos, 1995). In the study by Hart and his colleagues, out of a sample of 231 recently released prisoners, 80% of the psychopathic criminals broke the contract for release within three years compared to 25% of the non-psychopathic offenders. Within a similar time period, in a sample of 299 released prisoners, a new offence was committed by 65% of the psychopathic participants compared to 25% of controls. Hemphill and his colleagues (1998) did a meta-analysis and looked at recidivism within a year of release. Psychopathic individuals had a rate of recidivism three times higher and a rate of violent recidivism four times higher than controls. The PCL-R predicted general recidivism better than six other measures contrasted in this study. The good predictive validity of the PCL-R adds weight to the argument that there is a specific disorder of psychopathy within the category of antisocial personality disorders and that psychopathy is characterised by certain emotional and interpersonal personality traits in addition to the antisocial behaviours.

Psychopathy as a developmental disorder

Antisocial Personality Disorder is essentially an adult disorder, as it can not be diagnosed until the patient is eighteen (DSM-IV, 1994) or sixteen (ICD-10, 1993). However, the nature of APD as a developmental disorder is acknowledged by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, APA, 1994). It includes a criterion stating that there must have been evidence of conduct disorder before the age of fifteen. The diagnosis of conduct disorder in children and adolescents implies that the individual has shown three different types of antisocial behaviour for at least six months (DSM-IV, APA, 1994).

Longitudinal research has demonstrated that antisocial behaviour found in adulthood is often noticeable in childhood (Loeber, 1982, West, 1983), although many diagnosed with conduct disorder do not meet the APD criteria as adults (Robins, 1978; Crowell, Waters, Kring & Riso, 1993). For example, the figure was 50% in one clinical sample (Hart, Forth & Hare, 1992). One risk factor for continuing antisocial acts into adulthood is age of onset. The conduct problems often become apparent before the age of ten for adults with APD (West, 1983). The course of antisocial behaviours is therefore variable, although risk factors for persistence into adulthood can be identified. Does using a stricter definition of psychopathy help clarify the variability?

Harpur and Hare (1994) have examined how measures of psychopathy differ as a function of age. They used the PCL as an assessment instrument and considered how the two underlying factors vary across the life-span. In a cross-sectional study of 889 male prisoners, they found that scores on factor 1 were consistent for all age groups. These varied from the 16 to 20 year olds to the 46 to 70 year olds. Personality and interpersonal characteristics varied little across different ages. In contrast to this, factor 2 measures of antisocial acts declined with age, suggesting there was some reduction of deviant behaviour in later life (also Hare, McPherson & Forth, 1988).

This study did not consider females or children below the age of 16, although the study is useful by defining psychopathy as a disorder that persists throughout male adult life. A difficulty in extending this study to a younger population is that the items in the PCL-R do not have content validity for assessing children. Therefore Hare, in collaboration with Paul Frick, developed a scale suitable for child populations- the Psychopathy Screening Device (PSD, Hare & Frick, in press). This is a 20 item rating scale, designed to be completed by parents, teachers and other adults who know the child well (this measure is described in more detail in the following chapter).

To assess the validity of the PSD, factor analysis was conducted using a clinical sample of 95 children between the ages of 6 and 13 (Frick, O'Brien, Wooton &

McBurnett, 1994). The results of this study confirmed that two discernible factors were evident from the data, which were similar to those found in the adult sample (see table 3, p.16). One factor loaded with interpersonal items, such as lack of guilt and shallow feelings, which they labelled Callous/Unemotional (C/U). The second factor was named Impulsivity/Conduct Problems (I/CP) as it was associated with items like acting before thinking and engaging in risky activities. Again, these two factors correlated with traditional measures of antisocial behaviour, but in subtly different ways.

The I/CP factor was strongly correlated to antisocial behaviour, as measured by DSM III-R diagnoses of conduct disorder (CD) and oppositional defiant disorder (ODD) and as measured by the number of problematic behaviours. The C/U factor was less strongly correlated to measures of deviant behaviours, but did correlate negatively to measures of anxiety, which is consistent with the adult literature (Hare, Hart & Harpur, 1991). Also consistent was the failure of C/U factor to correlate with age, intelligence or racial group. In contrast to adult findings (Harpur, Hare & Hakistan, 1989), there was no inverse relationship between the I/CP factor and social economic status. Also, the C/U scale, rather than the I/CP, was related to sensation seeking behaviour.

Although there are some differences between assessment of psychopathy in adult and child samples, the child data similarly points to a distinct disorder of psychopathy, which includes affective factors. Further support for this was the study's post-hoc analysis that found it was possible to subdivide children with conduct problems using the psychopathic scale (Frick, O'Brien, Wooton & McBurnett, 1994, p.706). For example, children who were high on the PSD and also had a diagnosis of CD or ODD were most likely to have a father with an arrest history. A recent study of validity of the PSD found that a three-factor structure better fitted data from community child samples (Frick, Bodin & Barry, 2000). The three-factor structure included a narcissism scale (see table 3). This study also concluded that children could be divided according to certain subgroups of disorder using the PSD. Those scoring high on all three dimensions were most impaired on indices of behavioural problems. As yet, there are no longitudinal studies tracing the pathways of children, assessed on the PSD to have psychopathic tendencies, into adulthood. This will be important evidence, but even without it, there is a case that the roots of psychopathy are in childhood.

<u>Table 3: Table to show how items on the PSD group according to factor structure</u>
(from Frick, O'Brien, Wooton & McBurnett, 1994 and Frick, Bodin & Barry, 2000)

I/CP	C/U
Acts without thinking	Does not plan ahead
Engages in risky activities	Is concerned about the feelings of others
Blames others for own mistakes	Feels bad or guilty
Gets bored easily	Is concerned about schoolwork
Brags about accomplishments	Does not show emotions
Becomes angry when corrected	Emotions seem shallow
Thinks he/she is more important then others	Acts charming in insincere ways
Teases people	
Engages in illegal activities	
Keeps the same friends	
Uses or cons others	
Lies easily and skilfully	
Is good at keeping promises	

I/CP	Narcissism	C/U
Acts without thinking	**Thinks more important**	Concern for others' feelings
Doesn't plan ahead	**Brags excessively**	
Engages in risky activities	**Uses or cons others**	Feels bad or guilty
Blames others for mistakes	**Can be charming**	Concern for schoolwork
Gets bored easily	**Teases others**	**Keeps promises**
	Emotions seem shallow	Does not show emotions
	Gets angry when corrected	**Keeps the same friends**

Unclassified: **Lies easily and skilfully**
Engages in illegal activities

I/CP: Impulsivity/Conduct Problems factor
C/U: Callous/Unemotional factor
bold = this item has changed factor loading in three-factor structure compared to two.
N.B. Some items are scored inversely

Suggesting that psychopathy is a developmental disorder is fraught with difficulties. It has an extremely negative connotation and currently implies poor prognosis and treatment prospects (Quay, 1987). There is significant stigma attached to the label 'psychopath' and it can seem harsh to put this label on a child. Some have suggested that conduct disorder should be kept as the childhood diagnosis of psychopathy (Lahey, Loeber, Quay, Frick & Grimm, 1992), but this ignores the evidence that affective psychopathic traits delineate a specific group of children and curtails further study. Alternatively, seeing psychopathy as a developmental disorder and searching for specific psychopathic deficits may aid the development of more appropriate treatments.

Theories of psychopathy

Elaboration of psychopathic dysfunction is best couched in terms of the theories that explain the clusters of deficits. Theorising about psychopathy can be broadly divided into executive theories, emotion executive theories and basic emotion processing theories. The latter includes proposed deficits in fear or empathy processing. Each position can account for some of the evidence, but is challenged by other findings.

Impairment of executive functioning

Executive processing has been associated with frontal lobe activity. It involves higher cognitive processing such as abstraction, response selection, monitoring, inhibition and the allocation of attention. One theory of psychopathy is that it is due to impaired executive skills. Deficits in executive functioning could lead to disinhibition which, when violence is modelled in childhood, could lead to disinhibited aggression.

Psychopathy may correlate with frontal lobe dysfunction, which occurs as a result of gross damage to brain structures, such as that caused by large legions. Gorenstein (1982) drew parallels between the perseveration, lack of insight and concrete thinking of patients with psychopathy and those with frontal lobe syndrome. However, he noted (1982, 1991) that psychopaths did not share the apathy or loss of initiative in frontal patients described by Lezak (1976).

The clinical similarities of frontal lobe damage fall short of giving a full picture of psychopathy. This is partly because, as research has advanced, the frontal lobes are no longer considered unitary in function and partly because experimental and neurological evidence have failed to substantiate the theory. Lesions in different areas give rise to varying clinical presentations (Cummings, 1993; Fuster, 1989; Mega & Cummings, 1994). Fuster (1989) differentiated akinetic mutism, apathetic and euphoric syndromes. The DSM-IV-TR (APA, 2000) allows sub-types of personality changes due to medical conditions, such as labile, disinhibited, aggressive, apathetic and paranoid types. So, a theory of general executive impairment lacks specificity regarding which frontal structures might be involved in psychopathic presentation.

Neuropsychological experiments have been designed to investigate the patterns of executive functioning of various clinical groups, including conduct disorder, antisocial personality disorder and psychopathy (for reviews see Kandel & Freed, 1989; Pennington & Ozonoff, 1996). The executive function tasks reviewed included measures of set-shifting, planning, working memory, contextual memory, inhibition and verbal fluency. These experiments found that executive impairments were evident for children with autism, children with ADHD, but not for those with conduct disorder without ADHD. For the adult populations, violent adults had executive difficulties, but not those with APD or psychopathy.

Psychopathic dysfunction of a more specific form of executive processing, called response modulation, has been proposed by Patterson and Newman (Patterson & Newman, 1993). They suggested that psychopaths had difficulty inhibiting actions to aversive, secondary information under conditions involving both reward and punishment. The information is secondary in that the punishing stimulus must be perceived after an initial rewarding stimulus, rather than simultaneously. This allows formation of a "dominant response set", from which is hard to disengage. Punishment may even encourage more impulsive responding, by increasing the desire for relief or reward by action, rather than encouraging pause for reflection and learning from the mistakes. They related the lack of switching to a reflective style to abnormal physiological arousal found in psychopaths, including a reduced electrodermal response (Hare, 1965) and lack of decreased heart rate (Hare, 1978) in response to aversive stimuli. This leads to a continual lack of association between one's punishment-provoking behaviour and the punishing consequences. In other words, it explains psychopaths' repeated failure to learn from experience.

Support for this response modulation model comes from passive avoidance tasks where adult and child psychopaths performed as well as controls in situations involving reward or punishment alone, but more poorly when incentives were mixed (Fisher & Blair, 1998; Fonseca & Yule, 1995; Newman & Kosson, 1986; Newman, Patterson, Howland & Nichols, 1990; Newman, Patterson & Kosson, 1987; O'Brien & Frick, 1996). For example, in one experiment (Newman & Kosson, 1986), participants were shown a two-digit number to which they made a key-press. Four of the numbers led to monetary reward and four to monetary loss. In a second condition, punishment alone was used. Psychopaths committed more passive avoidance errors (failing to inhibit responses to punished stimuli) only on the mixed incentives condition.

This theory was extended when it was discovered that psychopaths responded less to secondary information, even when punishment was not involved (Newman, Schmitt & Voss, 1997). In a Stroop-like task, they asked participants to respond to pairs of words or pictures displayed sequentially. Some trials were congruent (containing pairs of words or pictures that were linked conceptually) and some were incongruent. The incongruent primes had superimposed pictures (in the word condition) or words (in the picture condition), which were either related to the target (e.g. the word rain with picture of a hand, followed by picture of an umbrella) or unrelated (e.g. word soup with picture of hand, followed by umbrella). It was found that control participants were distracted by the related, to-be-ignored primes, whereas psychopaths were much less disrupted by the secondary, contextual cues. This may account for psychopaths' failure to accommodate negative feedback (Fowles, 1980; Hare, 1970; Lykken, 1995) and for their failure to inhibit violent behaviour in the light of contextual information from other people, such as a facial expression of distress or disapproval (Newman, Schmitt & Voss, 1997; Shapiro, 1965).

The response modulation theory has received substantial support, but does not account for all the known deficits in psychopathic functioning. For instance, it does not explain the physiological differences when perceiving sad and fearful images (Blair, Jones, Clark & Smith, 1997; Blair, 1999) and the differences in responding to hypothesised ethical dilemmas (Blair, 1995; 1997; Blair, Sellars, Strickland, Clark, Williams, Smith & Jones, 1995), which are described more fully below (see basic emotion processing theories, p.26).

While increased aggression and damage to the frontal lobes are often associated, neuropsychological studies have found that psychopaths and children with conduct disorder are not impaired in their general executive functioning. Research is beginning to differentiate various types of frontal syndromes and specific kinds of executive functioning. Patterson and Newman (1993) differentiate a specific executive difficulty for psychopaths in responding to secondary information once a dominant response set has been established. Other authors have suggested that the fundamental executive impairment is specifically related to the executive emotion system (Damasio, 1994; Blair & Cipolotti, 2000).

Executive Emotion Theories

It could be argued that the measures used in the above neuropsychological experiments measure "cold cognition", that is cognition devoid of affect. Damasio (e.g. Damasio, 1998a) has observed the tendency for past cognitive research to ignore the role of emotions and has proposed a model of emotional executive processing (Damasio, 1994). His somatic marker theory proposes that the body is continually checking its emotional or "somatic" state in order avoiding damaging extremes and keep itself in equilibrium. The process of homeostasis involves the brain reading "somatic markers", which indicate the body's current status. Information is drawn from the many somatosensory subsystems, such as interoceptive operations, vestibular and musculoskeletal systems and fine touch (Damasio, 2000b). Executive emotion functions in the brain combine this information and modify behaviour and internal functions accordingly. This is a continuous process; as Damasio put it, 'the brain is the body's captive audience'.

Damasio and his colleagues (Bechara, Damasio, Damasio & Anderson, 1994) have tested the somatic marker theory by comparing patients with lesions in the ventromedial prefrontal cortex to controls on the four-pack card playing task. In this experiment two 'risky' packs yield high rewards, but even higher punishments (in the form of play money) and two 'safe' packs yield low rewards with even lower punishments. Patients with the lesions continued to take cards from the packs that gave immediate high reward in spite of the long-term debt. This was in contrast to controls who developed a rewarding long-term strategy by drawing from the safe packs. Further experimentation discovered that the patients lacked a pre-emptive peak in skin conductance response before sampling from the risky pack (Bechara, Tranel, Damasio, & Damasio, 1996). They hypothesised that this somatic marker impairment led to poor decision making, possibly by disrupting attention and working memory processes so that imagined possible future outcomes could not be sustained in memory (Damasio, 1998b).

Damasio and his colleagues (Damasio, 2000a; Damasio, Tranel & Damasio, 1990) argued that this dysfunction could lead to psychopathic disorder. They observed comparable behaviours in patients with lesions in the medial and orbital regions of the prefrontal cortex (jointly known as ventromedial) to those of psychopaths, noting that the former also systematically violate social norms. However, a notable difference was that they were not as violent. It could be that such a deficit in emotion-guided decision-making due to ventromedial prefrontal damage may be behind the failure of psychopaths to avoid risky situations and to end up in socially irresponsible situations, such as being in severe debt. They argued that ventromedial damage would mean a lack of activation of somatic markers, such as skin conductance responses, linked to risky choices. There is some evidence from the domain of neuroscience for this link. A study by Raine and his colleagues (2000) showed a reduced amount of prefrontal grey matter in people with antisocial personality disorder compared to normal, psychiatric and drug- and alcohol-dependent controls. The target group also had reduced autonomic activity, as measured by skin conductance responses, during a socially stressful task.

The somatic marker theory has received some criticism (Rolls, 1998). Rolls and his colleagues (Rolls, Hornak, Wade & McGrath, 1994) studied emotion-related learning in patients with damage to the ventral frontal regions. He found they suffered from deficits in extinction and reversal learning on a visual discrimination task and that these deficits were correlated with the degree of typical frontal behaviour problems reported by staff. The most common error in the target group was continuing to touch a previously rewarded pattern, although it now lost points and the patients were able to say that it was the wrong pattern. This suggests that antisocial behaviour could result from impairment in responding to changes in reinforcements, rather than from an inability to sustain potential future outcomes in memory. If the deficit was in working and short-term memory processes, then one would predict planning problems based on spatial memory as the well as visual memory. Planning related to spatial abilities was preserved in Rolls' ventral patients and has been shown to be linked to dorsolateral prefrontal damage (Goldman-Rakic, 1987; Verin, Partiot, Phillon, Malapani, Agid & BuBois, 1993).

Blair & Cipolotti (2000) developed Rolls orbitofrontal lesion findings (Rolls, Hornak, Wade & McGrath, 1994) to propose a social response reversal theory for the development of antisocial behaviour. This theory distinguishes itself from the somatic marker model in that it is proposed to be activated by social disapproval cues, particularly anger. These cues might be an angry or disgusted expression or situations in which others' anger has been previously experienced. Perception of these cues often leads to curtailing the condemned behaviour, by instigating the freeze response of the threat system instead of the fight or flight responses. Deficits in the processing of angry expressions could lead to increased fight responses and reactive aggression. In support of this, a patient with orbitofrontal lesions has been found to be impaired in processing angry expressions (Blair & Cipolotti, 2000) and right orbito-frontal cortex has been implicated in processing angry expressions in a PET functional imaging study (Blair, Morris, Frith, Perrett & Dolan, 1999).

Blair and Frith (2000) observed that the somatic marker and social response reversal theories do not explain all the developmental deficits involved in psychopathy. They highlighted that the somatic marker model predicted that the lesion patients would fail to show autonomic responses to visually-presented emotional stimuli (Damasio, 1994). This was confirmed in one experimental study (Tranel & Damasio, 1994). In contrast, other experiments have shown that psychopathic populations do respond autonomically to these stimuli (Blair, 1999; Blair, Jones, Clark & Smith, 1997; Patrick, Bradley & Lang, 1993). Most damaging to Damasio's account is that the four-pack card playing task has been tested on a psychopathic population and found them to be unimpaired (Schmitt, Brinkley & Newman, 1999). Instead, they found the level of anxiety, rather than psychopathy, was predictive of participants' responses.

In addition, neither the somatic marker theory (Damasio, 1994) nor the social response reversal theory (Blair & Cipolotti, 2000) can account for the difference in the quality of violent acts committed by patients with ventromedial lesions and by psychopaths (Blair, 2001). The former tend to display reactive aggression, that is violence in response to frustration and threat (Anderson, Bechara, Damasio, Tranel & Damasio, 1999). The antisocial acts of psychopaths can be categorised as instrumental aggression, which is more goal-directed (for example, planned revenge or attempts to obtain respect) (Cornell, Warren, Hawk et al., 1996).

Such findings do not rule out ventromedial impairment in psychopaths. For example, some psychopaths have shown response reversal deficits similar to Rolls' patients (LaPierre, Braun & Hodgins, 1995) and they may have more extensive damage. When considering structural bases for deficits, the extent of the damage is important. For example, damage to the ventral frontal regions theoretically could leave autonomic responding to visual threat stimuli intact, if it was less extensive than the damage found in the lesion patients. Another consideration is that chemical imbalances or damage in one location may affect distant structures because they rely on the same damaged chemical system or structure. Damasio hypothesised that there were several essential structures for the somatic marker network, including the amygdala, the insula, somatosensory cortex and the basal ganglia (Damasio, 1998b). Alternatively, many seemingly unrelated deficits may co-occur due to their brain bases being located in proximal damaged structures. This is where work on basic emotion processing has led (see below on the theory combining basic fear and empathy positions, p.29).

Basic Emotion Processing Theories

These theories have in common that they propose impairment occurs in basic emotion functioning rather than at the executive level. A long line of theorising has thought fear to be the impaired emotion (Eysenck, 1964; Gray, 1971; Lykken, 1995; Patrick, 1994). More recently, Blair and his colleagues (Blair, 1995; Blair, Jones, Clark & Smith, 1997) have suggested that the deficit occurs within the empathic emotional system. This includes the recognition of fear, but also other distress cues like sadness and the experience of moral emotions such as guilt, shame and pity.

Eysenck's (1964) model claimed that psychopathic development was due to general under-arousal. This explained the psychopathic propensity for sensation-seeking activities and insensitivity to punishment. Some support for this model was found with child (Raine & Venables, 1984), but not adult antisocial populations (Raine, 1993). However, conceptually, it has been challenged by Robbins (1997), who argued that arousal was due to several dissociable neurobiological systems. Robbins

(1997) suggested that some noradrenergic systems were implicated in selective attention, some dopaminergic systems were involved in behavioural activation, some cholinergic systems contributed to attentional and mnemonic processes and the serotoninergic systems helped inhibit behaviour. A deficit in arousal would implicate dysfunction in all these neurobiological systems.

Similarly, Gray's (1971) theoretical Behavioural Inhibition System (BIS) concentrated on the psychopath's decreased responsiveness to punishment. In this model, psychopaths feel punished, but fail to inhibit their actions when punished. This is not an executive model as it hypothesises a restricted, basic inhibitory system that responds only to punishment, novelty and innate fear stimuli.

Raine (1993) reviewed the evidence and found impaired classical conditioning for psychopathic individuals. This seemed to be related to difficulties inhibiting behaviour in punishing situations as demonstrated by psychopaths' impoverished performance on the Newman card playing task (Newman & Kosson, 1986, Newman, Patterson & Kosson, 1987). In this study, subjects draw cards from a pack that becomes increasingly less rewarding and more punishing. Psychopaths tended to draw more cards than controls. Yet, the model does not account for all the evidence. A further psychopathic fear deficit, that of the augmented startle reflex, remains unexplained by this model (Patrick, Bradley & Lang, 1993; Patrick, 1994). In contrast to the BIS theory, psychopaths have been shown to exhibit physiological responses to innate fear stimuli (Blair, Jones, Clark & Smith, 1997; Patrick, Bradley & Lang, 1993).

Blair and Frith (2000) have noted that there is a considerable amount of literature questioning the prime role of punishment in moral development (see Miller & Eisenberg, 1988). Rather, helping children to empathise with victims enables them to inhibit aggressive behaviour. Following this line of research, Blair (1995; Blair, Jones, Clark & Smith, 1997) has put forward the Violence Inhibition Mechanism (VIM) model. This is a basic evolutionary system and can be seen in the use of submissive behaviour in animals to stop aggressors. For example, a dog may bare its throat as a sign of submission. In humans, failure to condition images of your own behaviours that cause distress in others with others' distress cues leads to impaired moral behaviour. The model also predicts the psychopathic clinical presentation of lack of moral emotions, such as guilt, remorse and pity.

Some support comes from studies showing that distress cues halt violence (Perry & Perry, 1974), sexual activity (Chaplin, Rice & Harris, 1995) and non-violent arguments (Camras, 1977). Psychopaths fail to respond autonomically to these distress cues (Blair, Jones, Clark & Smith, 1997; Blair, 1999). Further evidence is that children with conduct disorder (Arsenio & Fleiss, 1996) and children and adults with psychopathic tendencies (Blair, 1995; 1997; Blair, Sellars, Strickland, Clark, Williams, Smith & Jones, 1995) have a different pattern of distinguishing between moral (victim-based) and conventional (rule/social-based) ethical dilemmas compared to controls. They are also less likely to attribute guilt to violent aggressors in stories. These differences are not accounted for by differential parenting strategies. Parenting using empathy induction techniques is negatively associated with levels of antisocial behaviour in children, except for children with psychopathic tendencies (Wootton, Frick, Shelton & Silverthorn, 1997).

Possible counter-evidence for the VIM theory consists of the body of work that shows impaired recognition for many different emotions. For example, Williamson and her colleagues (Williamson, Harpur & Hare, 1991) found that controls responded faster for affective words compared to neutral ones when asked to decide whether it was a word. Psychopaths responded with similar reaction times to both neutral and affective words, across several different emotions. However, selective effects of specific emotions were not investigated, so this general effect could be due to influence of specific emotions. It is also hard to imagine how the VIM model could account for psychopathic deficits on card-playing tasks (Bechara, Damasio, Damasio & Anderson, 1994; Newman & Kosson, 1986), although these could be explained by fear impairment models.

Blair and Frith (2000) theorised that the neurological basis for impairment in the VIM system was the amygdala. This is because it has been implicated in fear conditioning (LeDoux, 1995), fear of novelty (Kagan, 1994) and in the recognition of facial distress cues, such as fear (Morris, Frith, Perrett, Rowland, Young, Calder & Dolan, 1996) and sadness (Blair, Morris, Frith, Perrett & Dolan, 1999). Hence, this may be the anatomical structure that could account for deficits in both fear and empathy emotion systems. Patients with lesions to the amygdala show impoverished conditioning to punishing stimuli (Bechara, Tranel, Damasio, Adolphs, Rockland & Damasio, 1995; LaBar, LeDoux, Spencer & Phelps, 1995) and also, deficits in augmented startle reflexes (Angrilli, Mauri, Palomba, Flor, Birhaumer, Sartori & di Paola, 1996).

It must be noted that all these theories suggest that psychopathic behaviour develops as the environment interacts with neurological impairment. For example, Blair (1995) emphasised that impairments in VIM could be as a result of deprived early experience or could interact with environmental experiences to determine the kind of behavioural dysfunction. So, someone with a damaged VIM may not necessarily be violent, unless they had violence modelled for them from an early age so it became a prepotent response.

No one theory accounts for all the evidence, although all the theories make sense of some of the psychopathic deficits and differences. The combination of the fear and empathy positions at a neurological level offers a more inclusive theory. As a recent theory, it begs more experimentation directly testing the theory and comparing between this stance and alternative views.

James Blair's research project- the assessment of psychopathy

This vision, to develop and test theories of psychopathic development, has been taken on by a research project, of which this study is a part. The project is run by James Blair, based at the Institute of Cognitive Neuroscience in London. Ethics approval for all the studies being carried out as part of this project was obtained from the local research ethics committee of Camden and Islington Community Health Services NHS Trust (see appendix four). The aims of the project are to:

- devise and test theories of the causes of psychopathy from a cognitive neuroscience perspective.

- develop a package of neuropsychological assessment tools to identify psychopaths and determine individual's pattern of cognitive deficits.

- understand psychopathy from a developmental perspective by involving both adults and children with antisocial behaviour. Adults are recruited from prison populations and children from schools for those with emotional and behavioural difficulties.

This study aimed to meet these goals by using a new paradigm to test the emotion executive and basic emotion processing stances. The paradigm being developed is a Stroop-like priming task using emotion stimuli, which is discussed more fully below. It is predicted that performance on this test will distinguish psychopaths from non-psychopaths. A large differentiating effect would be needed in order for the paradigm to be potentially useful as an assessment tool. This study focused on a child population, but the emotion priming task was also piloted on adults.

Theories of the Stroop effect and related tasks

The emotion priming task was based on the Stroop task, which was devised almost seventy years ago (Stroop, 1935) and has inspired much research (for a review see MacLeod, 1991). Theories regarding the consistent effects of the Stroop and related tasks will be reviewed. Major theories have been the speed of processing account (Hock & Egeth, 1970; Stroop, 1935; Treisman, 1969), the automaticity theory (LaBerge & Samuels, 1974; Logan, 1978; Posner & Snyder, 1975; Shiffrin & Schneider, 1977), Glaser and Glaser's lexicon and semantic system model (1989) and the parallel distributed processing framework (Cohen, Dunbar & McClelland, 1990). These theories will be linked to parallel debates in the evaluation of emotion, such as the affective versus cognitive primacy of appraisal debate (Buck, 1988; Frijda, 1986; Lazarus, 1991; Zajonc, 1980), LeDoux's dual pathway theory of emotion (1986, 1989) and explanations of affective priming tasks (Bower, 1991; Fazio, Sanbonmatsu, Powell & Kardes, 1986; Murphy & Zajonc, 1993). The Stroop has come to be seen as an executive task and as a means to understanding the mechanisms of attention. Emotion processing plays its part as one of the elements affecting attention.

Stroop (1935) found that in a serial presentation of colour words written in incongruent ink colours, the colour words interfered with ink colour naming, although ink colours did not interfere with reading compared to controls of reading black ink colour words and of naming colour patches respectively. This pattern of interference reversed during eight days of practising colour naming. Stroop's theoretical account of the interference of these two cognitive processes was that word reading had been more practised to produce a quick, specific response. Colour naming evoked several possible responses, which made naming a slower process.

As the test was found to be highly reliable (Jensen 1965), many manipulations of the test have investigated the properties producing the interference. Individual trials were timed, rather than complete lists (Dalrymple-Alford & Budayr, 1966), congruent trials were studied (Dalrymple-Alford & Budayr, 1966) and the competing stimuli were separated in time (Dyer & Severance, 1973) and space (Dyer, 1973). The response was varied, for instance by sorting cards, rather than naming (Tecce & Happ, 1964). Finally, different processes were considered by changing the stimuli type, for example by embedding words in pictures (Hentschel, 1973).

All these changes are important when considering why an emotion priming task is related to the Stroop. Priming can be seen as a manipulation of the time between the presentation of two stimuli (prime, followed by target). The difference is known as stimulus onset asynchrony (SOA). In affective priming, stimuli with emotional content are used, such as emotive pictures or words, but one is still investigating the interference or facilitation of two incongruent or congruent stimuli. This is why theories of Stroop functioning aid comprehension of priming tasks. The colour-word Stroop and related tasks have been used to investigate the many processes involved in processing two dimensions. As Klauer (1998) said of affective priming, Stroop "is an effect not a mechanism".

Early ideas of the mechanisms behind the Stroop effect relied on speed of processing accounts. These assumed that one process was faster and 'beat' the other process in a 'race' to the response-output system either due to differential learning (Stroop, 1935), limited attention capacity (Treisman, 1969) or response-stimulus matching (Posner & Synder, 1975). Such accounts have largely been rejected as they fail to account for the experimental results regarding SOAs (Dyer, 1971; Dyer, 1974; Dyer & Severance, 1973; Glaser & Düngelhof, 1984; Glaser & Glaser, 1982). Generally, it was found that interference of colour naming peaked at an SOA of 100ms, then decreased, until, at an SOA of 2s, it began to increase again (Dyer, 1971; Dyer, 1974; Dyer & Severance, 1973). Facilitation was also found to be greatest at shortest intervals (Thomas, 1977). A similar pattern was found for word-picture tasks (Glaser & Düngelhof, 1984). Negative SOAs (i.e. presenting colour/picture prior to the word) did not reverse the pattern of interference (Glaser & Glaser, 1982; Glaser & Düngelhof, 1984), which is counter to speed of processing theories.

One explanation is that the point of response competition is early, rather than late. In other words, the bottleneck is at the encoding stage rather than the response selection (Hock & Egeth, 1970). Hock and Egeth (1970) suggested that colour words were recognised earlier than colours and therefore interfered in colour encoding at the level of working memory. This account has problems with the sequential effects in the Stroop. If the to-be-ignored word on the previous trial was the to-be-named colour or acoustically similar to the to-be-named colour on the next trial, interference increased (Effler, 1977a) (e.g. blue written in red ink, followed by green written in black ink). Neill (1977) found a similar result with individual trials and labelled the phenomenon the "distractor-suppression effect". Conversely, if the to-be-named ink colour on the previous trial was the irrelevant word on the next trial, interference reduced (Effler, 1977b). Such effects of previous responses to both words and colours are difficult to fit into an account about the earlier encoding of colours.

Another explanation of the effects of SOA manipulation is that word reading is an automatic process, while colour or picture naming requires more attention (LaBerge & Samuels, 1974; Logan, 1978; Posner & Synder, 1975; Shiffrin & Schneider, 1977). This idea makes sense of how little colour naming interferes with word reading. However, the Stroop effect changes as a result of spatial and strategic manipulations. There is more interference in colour naming when the colour and ink are integrated, rather than displayed in different locations (Kahneman & Henik, 1981) and when both incongruent and congruent trials are present (Lowe & Mitterer, 1982). These involve a splitting of attention across location or trial type and a truly automatic process would not be affected by allocation of attention. Describing attention as a continuum, built on learned experience (Kahneman & Chajczyk, 1983; MacLeod & Dunbar, 1988) helps deal with this difficulty, but there has been a lack of independent measures of automaticity to substantiate this view. In other words, this account necessitates a detailed description of the mechanisms of attention.

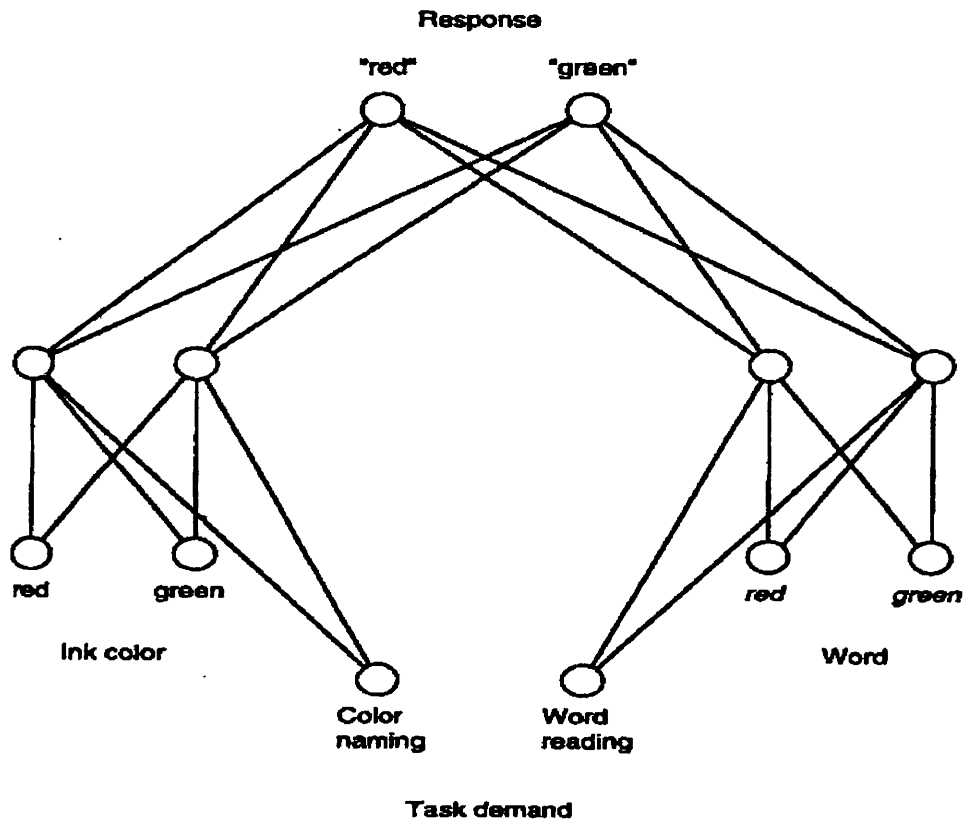
The automaticity account has been related to affective priming (Bower, 1991; Fazio, Sanbonmatsu, Powell & Kardes, 1986; Murphy & Zajonc, 1993) by considering that an automatic spread of activation occurs at an evaluative, as well as, at a semantic level. The 'spread of activation' is the rapid firing of nodes containing information that has been associated to the stimulus. So, seeing the colour red might automatically and rapidly activate the node for perceiving red, the semantic meaning of red, semantic concepts related to red (e.g. communism), the representation of typically red objects (e.g. post boxes) and the feelings associated with red (e.g. fear due to danger). This mechanism has been challenged theoretically by suggesting that the result would be 'cue overload' or the 'fanning effect' - a limited capacity of firing would be stretched among the limitless firing of associations (Anderson & Bower, 1973). Nevertheless, affective priming occurs for a large pool of words (Klauer, Roβnagel & Musch, 1997). More problematic is that this account can only explain facilitation and not interference, but it may illustrate one of several mechanisms involved.

A parallel debate about automaticity has taken place in the field of emotion theory. Zajonc's (1980) ideas of affective primacy, that stimuli are evaluated affectively with little need for prior cognitive processing is contrasted with cognitive appraisal theories of Buck (1988), Frijda (1986) and Lazarus (1991), where cognitive appraisal is needed before the generation of emotion. The discussion has convened on a common ground that there may be either a continuum of appraisal or two routes to appraisal, one direct and one indirect (Parkinson & Manstead, 1992).

In order to account for interference, many models involved a sequential system with a bottleneck in one or several parts of the system. Parallel Distributed Processing frameworks (PDP) have been devised that eliminate the need for a sequence (McClelland, 1979; Rumelhart, Hinton & McClelland, 1986). A weighted network of continually-processing, mutually-influencing units processes information until it has collected enough evidence to produce a clear response. This combines the speed of processing and automaticity theories. It allows interference and facilitation to occur at any part of the process in a non-linear fashion. It produces a response without requiring a bottleneck at the response stage. Cohen and his colleagues (Cohen, Dunbar & McClelland, 1990) have adapted this mathematical framework to describe the Stroop effect (see figure 1, p.38).

In this model, devised by Cohen, Dunbar and McClelland (1990), the degree of automaticity is framed as the strength of pathways between interconnected activation units. These units, which are organised into modules (e.g. colour naming module), continually receive inhibiting and facilitating inputs from other units in the network. Each unit is activated when the weighted sum of its inputs rises above its firing threshold and a response occurs when this happens in a response unit. This means processing within units is non-linear. Some units are shared by different processes. Interference and facilitation result at these points, because of conflicting inputs from different pathways. Attention is seen as a module, which contributes to the network, pushing relevant units closer to their firing threshold. Learning is taken into account by suggesting that pathway strengths change through experience. This is simulated in a 'training phase' of the network, where different patterns of inputs are fed into the network. The actual response is compared to the desired response and the pathway strengths adjust to minimise the difference between the two. An algorithm determines the output of any PDP network, providing certain values are set for parameters, such as the initial resting state of the units. The algorithm produces the number of cycles necessary for an output and this is seen as equivalent to reaction time. This allows models of Stroop manipulations to be compared to experimental data.

Figure 1: Simple Neural Network for the Stroop



The model devised by Cohen and his colleagues (Cohen, Dunbar & McClelland, 1990) fared well in accounting for facilitation and interference and the asymmetry in them between word-reading and colour naming. As such, it stands as a hopeful model for explaining other asymmetrical processes in Stroop-like tasks, such as word-picture studies and affective priming. These are both related to the emotion priming task, which uses a picture of a face along with words and is concerned about influences of specific emotions.

The asymmetry in the model is reminiscent of LeDoux's dual-pathway model of emotion (1986, 1989). This proposes two pathways for emotion processing, namely a short and a long pathway. The short pathway is a direct connection between emotional signals and subcortical structures, such as the amygdala. The long pathway is connected indirectly to the amygdala via sensory and association cortices, which makes processing slower and more accessible to consciousness and language (LeDoux 1996). This suggests a neurological basis for different pathway strengths involved in processing different emotional stimuli. For example, the semantic meaning of emotion words might be processed in the longer pathway, while the evaluation of pictures (and faces) might occur in the shorter pathway.

This theory was tested using a face-word Stroop by Raccuglia & Phaf (1997). They found emotion words primed evaluation of facial expressions, but expressions had no effect on word evaluation. This contradicted LeDoux's model, as they assumed facial expressions were processed in the short pathway. In contrast to this, De Houwer & Hermans (1994) found that incongruent pictures did influence the affective evaluation of words, while words did not affect picture evaluation. This highlights differences between face and picture processing. LeDoux's model (1986, 1989) can explain the above results in picture and word evaluation, but not face evaluation, assuming pictures are processed in the faster pathway. However, linking particular stimuli to direct and indirect pathways can not explain why the findings reverse when the response requirements change. For instance, some studies requiring categorization responses have shown that pictures interfere with word categorisation while words barely affect picture categorisation (Glaser & Düngelhof, 1984; Smith & Magee, 1980).

De Houwer & Herman (1994) were testing an alternative model devised by Glaser and Glaser (1989), which also posits direct and indirect pathways. This states that words have privileged access to a lexicon system, which produces spoken and written language. Pictures are represented in a semantic system, which also controls behavioural actions. This model accounts for findings that picture naming interferes little with word reading, although word reading interferes with picture naming (Glaser & Düngelhof, 1984; Rosinski, 1977), as words have a more direct pathway to speech production via the lexicon. It also explains the reverse finding in picture and word categorisation tasks, that pictures interfere with word categorisation while words barely affect picture categorisation (Glaser & Düngelhof, 1984; Smith & Magee, 1980). In keeping with this model, they proposed that affective information was stored in a semantic network, to which pictures had privileged access. However, Raccuglia and Phaf's results (1997) suggest that face-word priming does not fit into this model.

This all-or-none model suffers as it predicts that those stimuli that do not have privileged access to a certain response system can never interfere with those stimuli that do. This is called the dominance rule. Examples of reverse Stroop findings are less common and less strong than Stroop effects, but they do exist. Words can prime picture categorisation, when presented 300-400ms before the picture (Glaser & Dungelhof, 1984) and prime colour sorting, when the indicators are colour patches (Chimiel, 1984; De Houwer & d'Ydewalle, 1994; Tecce & Happ, 1964). The original experiments by Stroop demonstrated that colours can prime word-reading during eight days of colour naming practice (Stroop, 1935). So, like the speed of processing accounts, the Glaser and Glaser (1989) model fails to account for the reverse Stroop effect. It also has little to say about why behavioural responses, like key-presses on a computer, produce consistently less interference than vocal responses across a range of tasks (MacLeod, 1991).

However, Glaser and Glaser's theory (1989) could guide formation of PDP models, by having increased pathway strength between privileged stimuli and response units (e.g. word reading and spoken responses). Glaser and Glaser (1989) defend their model by arguing that a different type of controlled inhibition is involved in the reverse Stroop effect, whereby people suppress a false prepared response. In a similar manner to the argument regarding the account of automatic spreading activation, these authors appeal to several different mechanisms of attention being involved in the Stroop and related tasks.

In his review, MacLeod (1991) noted 18 consistent findings from Stroop research, such as the asymmetrical interference of colour-naming and word-reading and the reverse Stroop effect. In addition to this, there are results from affective priming evaluation studies, such as the reverse Stroop effect in picture-word categorisation tasks. Above, the speed of processing, automaticity and privileged pathway accounts have been reviewed. These accounts explain some, but not all of the findings and necessitate further additions to the original models, either in terms of several concurrent mechanisms or a continuum of one mechanism. MacLeod (1991) suggested that PDP frameworks were the most hopeful way forward to model the various effects found in the Stroop and related tasks, as they explained most of the 18 listed effects. Although there were still some problems simulating the reverse Stroop effect (Cohen, Dunbar & McClelland, 1990), they capture the non-linearity of the SOA effects and the role of learning on attention. The framework has been successfully used for modelling a selective attention task (Phaf, Van der Heijden & Hudson, 1990), attentional bias in emotional distress (Matthews & Harley, 1996) and another executive task, the Wisconsin Card Sorting Task (Parks, Levine, Long, Crockett et al., 1992). It has yet to be put to the test for affective or emotion priming, but may stand as a good model because they are related to the Stroop task.

Rationale for developing the emotion priming task

As researchers, such as Damasio (1990, 2000), have suggested specific psychopathic deficits in emotional executive functioning, it seemed reasonable to look for more tasks that might draw on this system. One possibility was to adapt a well-known executive task, such as the Stroop (Stroop, 1935), to have an emotional component. As noted above, children with conduct disorder (Pennington & Ozonoff, 1996) and adult psychopaths (Kandel & Freed, 1989) do as well as controls on executive tasks. The former study reviewed one experiment using the Stroop as a measure (White, Moffit, Caspi, Bartusch, Needles & Stouthamer-Loeber, 1994), suggesting that the performance on the Stroop did not correlate with stable, delinquent behaviour. If there was a difference in their performance on an emotion Stroop compared to controls, this could be suggestive of an emotion executive functioning problem. One caveat is that children with conduct disorder and co-morbid ADHD performed less well on the Stroop (Pennington & Ozonoff, 1996), so in this experiment, it was important to measure levels of ADHD and take them into account. Other potential confounds such as age and IQ were also measured.

A priming paradigm was chosen, partly because this allowed comparability with earlier affective priming studies using faces (Murphy & Zajonc, 1993; Niedenthal, 1989; Raccuglia & Phaf, 1997) and partly because it helped address difficulties in previous expression naming studies (Blair & Coles, 2000; Blair, Colledge, Murray & Mitchell, 2001). Reaction times and error rates for congruent and incongruent trials can be compared to each other or relative to neutral trials. The resulting measurement of facilitation or interference could help overcome the ceiling effect for fear found in recent studies that utilized pure expression naming (Blair & Coles, 2000; Blair, Colledge, Murray & Mitchell, 2001). On a practical level, it could also be easily displayed on a computer, using the Superlab Pro software.

This emotion priming paradigm is novel in that it uses facial expressions of emotion presented to conscious awareness, requires a naming response and considers the effects of specific emotions. Previous studies using facial expressions of emotion as primes have presented them outside conscious awareness (Murphy & Zajonc, 1993; Niedenthal, 1989; Raccuglia & Phaf, 1997) and required binary evaluative judgements (e.g. good-bad) to non-affective stimuli or affectively valenced words. None have used emotion words as targets and none have required naming as a response. These studies have provided evidence of an early positive-negative appraisal in affective processing. In contrast, this study looks at the effect of specific emotion sub-systems (fear, anger, happy and sad). This study used the term emotion, rather than affective, priming to illustrate this distinction.

Faces displaying emotional expressions and emotion words were used as the primes and targets. Facial expressions were chosen as they are potent elicitors of emotion across cultures (Ekman, 1992). They are stimuli for basic emotion processing, as infants can distinguish between some emotional expressions (for a review see Nelson & de Haan, 1997), mimic facial expressions (Field, Woodson, Greenberg & Cohen, 1982) and have a predisposition to look at faces (Haith, Bergman & Moore, 1977). Encoding of faces (Leonard, Rolls, Wilson & Bayliss, 1985) and facial signals (Brothers & Ring, 1992) has been located in the amygdala in primates and the amygdala has shown to be involved in the recognition of emotional expressions in humans (Adolphs, Tranel, Damasio & Damasio, 1994). The amygdala is the proposed site of damage in the VIM model. It must be noted that elicitation of emotion does not necessarily imply the conscious experience of the feeling (Damasio, 2000b) and that was not the aim in this experiment.

Emotion words were used as a contrast to the faces. They were initially hypothesised to be less strong elicitors of affect and therefore less powerful emotional primes, although they are sensitive to psychopathic brain functioning (Williamson, Harpur & Hare, 1991). In the study by Williamson and her colleagues (Williamson, Harpur & Hare, 1991), adult psychopaths were slower to make a lexical decision about pleasant and unpleasant words than criminal controls. There was no group difference in the responses to neutral words. They suggested this showed that psychopaths drew less information about affective value in general, but the study did not examine differences between the emotions.

Four particular emotions were chosen in order to test between different theoretical positions on psychopathic development, namely the fear and empathy positions. Deficits in recognition of sad and fearful expressions (distress cues) would support the empathy theory, while deficits in fear alone would support the fear stance. Anger and happy were used to contrast negative and positive emotion. Deficits in recognition of all four emotions would support a general emotion executive theory.

This task was designed to test between executive and basic emotion processing theories of psychopathic development. The questions this study posed are listed below.

Research questions

1) Is there evidence of an emotion priming effect in the normal population, when priming tasks using emotion words and faces are utilised?

2) Are children with psychopathic tendencies slower to respond to and less accurate at emotion priming compared to controls?

General impairment on an emotion priming task is predicted by executive (Patterson & Newman, 1993) and executive emotion theories (Damasio, 1994; Blair & Cipolotti, 2000). However, this task does not specifically test Damasio and his colleague's theory of psychopathic dysfunction (Damasio, 2000a; Damasio, Tranel & Damasio, 1990) as execution of this task is too rapid to allow skin conductance responses to be generated.

3) Are there differences in facilitation and interference for specific emotions, namely empathy emotions (fear and sadness) or fear alone, or anger alone, in children with psychopathic tendencies compared to controls?

Differences in empathy are predicted by Blair's VIM model (1995). Differences in fear alone are predicted by punishment and fear models (Eysenck, 64; Gray, 1971; Lykken, 1995; Patrick, 1994). Differences in anger alone are predicted by Blair and Cipolotti's social response reversal theory (2000), in addition to overall executive difficulties.

In order to address the first research question, several emotion priming tasks were piloted in normal populations, first with adults, then with children. The first three of the following experiments are concerned with this piloting. Once a reliable emotion priming task was found, the task was administered to a clinical child population, as detailed in the fourth experiment. This experiment aimed to address the second and third research question. The next four chapters detail these four experiments.

EXPERIMENT ONE

Experiment one involved testing the priming effects of facial emotional expressions on emotion words with a non-clinical, adult sample.

The aim was to find a test with a reliable emotion priming effect in a normal population that could, then, be taken to a clinical population of boys with emotional and behavioural difficulties. Although the intended clinical population was males only, the task was piloted on both sexes, to increase sample size, on the basis that no sex differences in Stroop interference have been found at any age (Daniel, Pelotte & Lewis, 2000; MacLeod, 1991).

Method

Participants

The face-word emotion priming task was piloted on twenty-five young adults (12 males and 13 females) who were aged between 18 and 42 years. The mean age was 28 years. Four of the participants were left-handed, and all had normal or corrected-to-normal vision and had English as a first language. All the participants were volunteers and were recruited by opportunity sampling. Each participant gave informed consent prior to participation.

Apparatus and stimuli

The emotion priming task was presented using the program, Superlab Pro, version 1.74 on a Power Macintosh G3 laptop, with a View Sonic E655 monitor. The program displays a slide show of frames and records responses and reaction times.

The frames were designed using Adobe Photoshop, version 5.0. The fixation point was a white cross with a font size of 30, on a black background. The photos showed the faces of EM, SW, JJ and MF, from the Ekman and Friesen Pictures of Facial Affect Series (1976), expressing fear, anger, sadness and happiness at the greatest emotional intensity (see appendix two). These stimuli were used in emotion recognition work by Ekman and Friesen (1976) and in many other affective research studies, which lends comparability to this experiment. Each face measured 12 cm by 14.5 cm. The words were white on black background, with a font size of 100 (see appendix 3).

Procedure

For each test, a quiet room was used. The participant sat approximately 50cm away from the laptop so that the stimuli subtended a visual angle of 10 degrees. Participants were given brief instructions about the task. They were told that they would see a series of emotion words and, then, face-word pairs, to which they had to respond. They were asked to do this as quickly and as accurately as possible. The experimenter stayed with the participant until it was clear that they had understood the task.

The face-word emotion priming task:

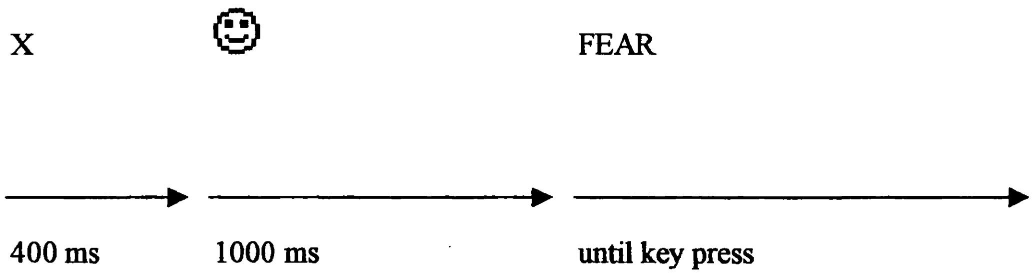
The computerized emotion priming task involved a slideshow of face-word pairs for which the participants had to name the word. The faces and words showed one of four basic emotions- anger, happiness, sadness or fear. So, each trial involved a face-word pair containing either congruent or incongruent emotions.

Every trial consisted of a fixation point for 400ms, a face for 1s and then a word appeared. The word remained on the screen until a key was pressed. (see figure 2, p.51). The computer measured the reaction time from the start of the presentation of the target word until the keypress and the accuracy of this response. These were not fed back to participants.

Responses were made with a keypress (on a QWERTY keyboard). The four keys (R,T,U and I) were labeled with the initial letter of the emotion ('F' for fear, 'A' for anger, 'S' for sad or 'H' for happy). This was to reduce variation due to some participants being more familiar with a computer keyboard. Four different key-order combinations were tested- FASH, HFAS, FSHA and SHFA- to investigate key grouping effects and to help reduce the differences due to differing reaction times for each hand. Participants were asked to use the first two fingers of each hand on the keyboard. As an example, for the key-order FASH, participants placed the left middle finger on 'R' labeled 'F', the left index finger on 'T' labeled 'A', the right index finger on 'U' labeled 'S' and the right middle finger on 'I' labeled 'H'.

Figure 2: Flow diagram to illustrate the sequence of presentation of stimuli

Note: images are icons and not actual images used



The order of stimuli was randomised. There were 104 practice trials, without the faces, so participants could practice responding to the words with the correct keys. For the practice trials the word was displayed for a maximum of 1s. Then, the program ran every word/person/facial expression combination three times, which meant there were 192 main trials (4 words x 4 people x 4 expressions x 3 presentations). The ratio of affectively congruent to incongruent trials was 25:75. The practice lasted four minutes and the main test lasted approximately fifteen minutes.

Data pre-processing

To correct for anticipatory responses or trials where attention was not maintained on the task, trials with latencies less than 250 ms and greater than 1500 ms were considered as errors in the analyses. Data from one participant was excluded as there was a recording error. After excluding errors, the remaining data was 97.0% of all the data.

Results

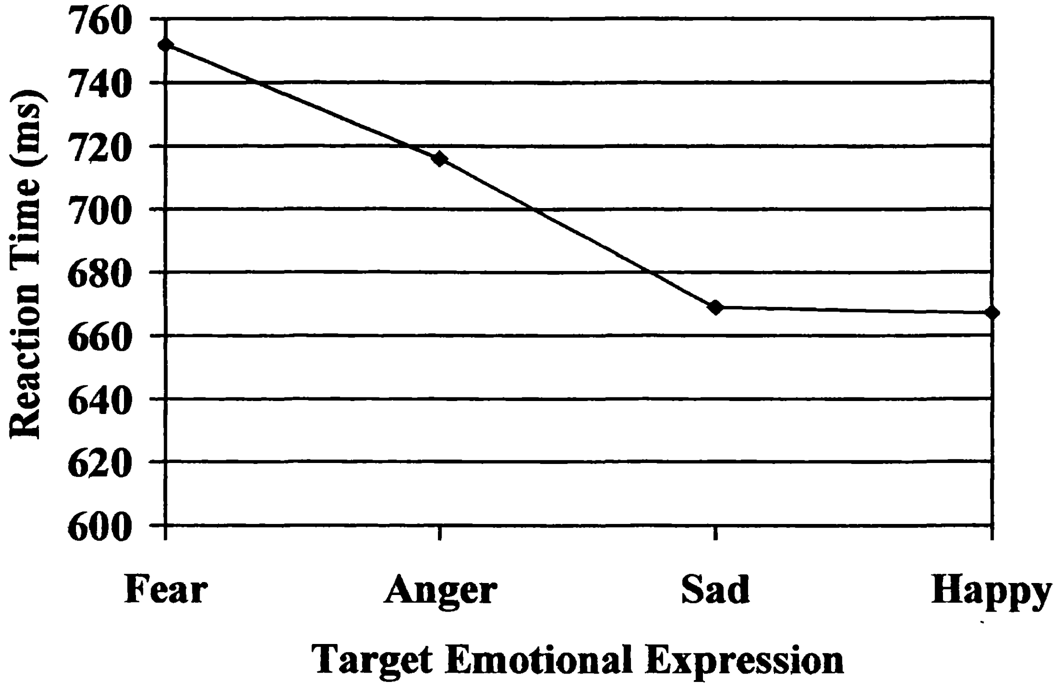
(N.B. All post hoc analysis uses the sidak adjustment to take account of multiple comparisons).

Mean reaction time data are illustrated in graph 1 (p.54) and graph 2 (p.55). A 4 (target word: fear, angry, sad, happy) by 4 (prime expression: fear, angry, sad, happy) repeated measures ANOVA was conducted on the data. Key order (FASH, SHFA, HFAS, FSHA) was included as a between subjects factor. This revealed a main effect of target word ($F(3,18) = 6.9$, $p < 0.003$); participants were fastest responding to the word 'happy' and slowest responding to 'fear' (see graph 1, p.54: mean RT happy = 670 ms, SD = 25; mean RT for sad = 670 ms, SD = 28; mean RT for anger = 720 ms, SD = 33; mean RT fear = 750 ms, SD = 35). Contrary to predictions there was no interaction between prime expression and target word ($F(9,12) = 1.3$, n.s.). There was a significant interaction involving target word and key order ($F(9, 44) = 2.3$, $p < 0.032$) (see graph 2, p.55).

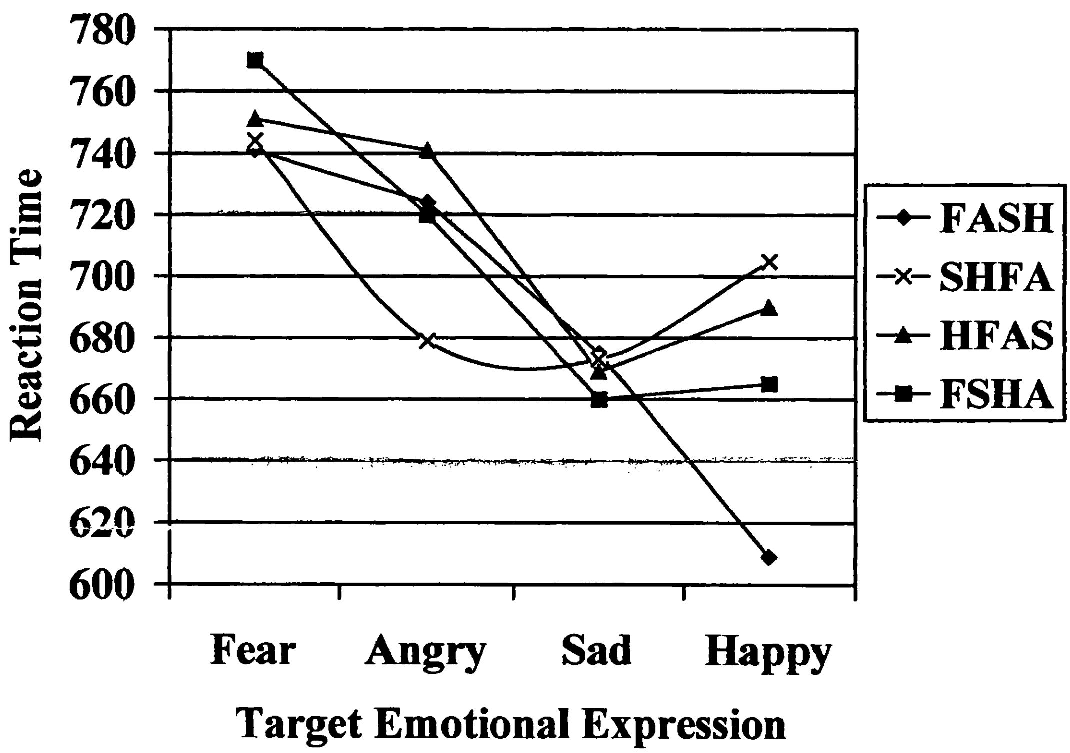
A post hoc comparison of the main effect of target word revealed that two comparisons were significant. These were the difference between fear and sadness (mean difference = 82 ms, SE = 18, $p<0.01$) and the difference between fear and happiness (mean difference = 84 ms, SE = 18, $p<0.01$).

A post hoc comparison of the interaction of word and keyorder was performed. This revealed that for the keyorder FASH, people responded significantly quicker to happy than to the other three target words (compared to fear; mean difference = 130 ms, SE = 31, $p < 0.002$; compared to anger, mean difference = 110 ms, SE = 29, $p<0.005$; compared to sad, mean difference = 66 ms, SE = 15, $p < 0.002$) and for the keyorder FSHA, people responded significantly quicker to happy (mean difference = 110 ms, SE = 36, $p < 0.047$) and sad (mean difference = 110 ms, SE = 36, $p < 0.034$) than to fear.

Graph 1: Graph showing the mean reaction times for the effect of target word



Graph 2: Graph showing the mean reaction times for the interaction between key-order and target emotion



Discussion

Contrary to the proposed hypothesis, the results indicated that emotional facial expressions did not prime reading of emotion words. Reaction time varied according to the target word, irrespective of the face prime. This effect interacted with the keyorder.

Lack of face to word priming is in concordance with the results of a study that was completed as this experiment was in progress. Morrish (2001) found that emotion faces did not prime emotion words in contrast to the priming effect of words on faces. It also concurs with the results of an evaluation study using non-masked faces and words, where word primed face evaluation, but not the opposite way round (Raccuglia & Phaf, 1997). Word reading has been fairly resistant to the effects of primes (MacLeod, 1991). Incongruent ink colours did not interfere with word reading in Stroop's original experiment (1935) and picture-word interference tasks demonstrated that incongruent pictures had only small effects on word-reading (e.g. Rosinski, Golinkoff & Kukish, 1975). The reverse Stroop effect, though reliably documented in the literature, does require serious manipulations of the original Stroop experiment to achieve (MacLeod, 1991) and from this study, it seems that using faces as a prime is not enough.

The differing reaction time according to the specific emotion named is a common finding in recognition of faces (Russell, 1994). However, this is a new finding for the case of words. However, in a similar face to word priming task, Morrish (2001) did not find a significant effect for emotion word, although the order of the reaction times was somewhat similar. Interestingly, it parallels face processing in that happy is the easiest to name and fear is the hardest.

Word reading has often been assumed to be a well-learnt, automatic process that takes place relatively quickly (e.g. LaBerge & Samuels, 1974; Posner & Snyder, 1975). This would suggest that it is little affected by priming or by the emotional significance of the word. Affective priming has often considered to be a unitary phenomenon (for a review see Klauer, 1998), although one study suggested more attention is allocated to negative emotions (Pratto & John, 1991). These results indicate that not only is the emotional valence important in speed of processing words, but possibly also the specific emotion involved.

This study does not definitively show that there are no circumstances in which face to word priming takes place. It may be that different timing of the display of stimuli or different congruency ratios would lead to a priming effect. Associated affective words prime one another, but only at a certain range of stimulus onset asynchronies (SOA) (Hermans, De Houwer & Eelen, 2001). Manipulations of the SOA give insight into the speed of processing various stimuli and inform connectionist models about the different pathways of processing. This was investigated further in experiment two and in a study by Richell (unpublished), which followed on from these results.

It may also be advantageous to shorten the length of display of the prime. Previous priming effects for emotional expressions have been found at very short display times, when the face was processed outside conscious awareness (Murphy & Zajonc, 1993; Niedenthal, 1990; Raccuglia & Phaf 1997). This study is not concerned with subliminal presentation, but shorter display times might facilitate a face-word priming effect.

There was a low ratio of congruent to incongruent trials, 25:75. Stroop experiments typically set the ratio at 50:50 and an increased ratio has been shown to lead to higher interference in classical Stroop tasks (Lowe & Mitterer, 1982).

It is harder to interpret the interaction of key order and target word. Looking at graph 2 (p.55), the results of happy seem to be most widespread. Reactions times were shorter when happy was responded to with the right hand (key-orders FASH and FSHA), compared to responses with the left hand. It is possible that the nature of the test required one side of the brain more than the other and this may have an effect on the response time for each hand. These results would support early theories on the left hemisphere being more involved in positive affect (Alemà & Donini, 1960; Terzian & Cecotto, 1959a,b). It has been suggested that the right hemisphere is more involved in processing emotional expressions (Safer, 1981) and the left hemisphere has been implicated for processing emotion words (Strauss, 1983). However, in a review of the matter, Gainotti and his colleagues (1993) drew a more complicated picture. They noted varying theories of right/left specialization, including a negative/positive, a spontaneous/control and avoidance/approach split. It is not possible to investigate this further from these results, but it could form the basis of future work on face to word priming. As there is an effect of key order and the target word, future experiments would need to take this into account.

Other criticisms of this study that could be addressed in future experiments are the lack of neutral primes and cut-off time for response. Macleod (1991) noted that the inclusion of neutral control primes meant that facilitation as well as interference could be recorded. He added that the degree of facilitation and interference depended on the choice of prime used, citing Dalrymple's (1972) findings of different amounts of classic Stroop facilitation relative to an 'XXXX' control and an unrelated word control. The lack of a cut-off time for the response was reported to encourage participants' use of two different response strategies (Blair- personal communication). Some opted for speed and others for accuracy, producing a bimodal, rather than normal, distribution. This was corrected for in this study by the exclusion of responses over 1500 ms.

The results of this study informed the second experiment and suitable amendments were made to the emotion priming task. Two directions were considered in the search for an emotion priming effect involving facial expressions. The first was to include a word to face priming condition and switch between the two conditions in an ABBA sequence. This was pursued by a colleague, Rebecca Richell, and is discussed in experiment three. The second direction was to use facial expressions for all stimuli and investigate face-to-face priming. This is the subject of experiment two.

EXPERIMENT TWO

Experiment two looked at the priming effects of facial emotional expression on naming facial emotional expression with an adult sample.

The aim was to find a test with a reliable emotion priming effect in a normal population that could, then, be taken to a clinical population of boys with emotional and behavioural difficulties.

Method

Participants

Twenty-four young adults took part in the testing, nine of whom had taken part in experiment one, six months previously. As before, all were volunteers, recruited by opportunity sampling and verbal consent was obtained. An explanation similar to that of experiment one was given, except the mention of emotion words was omitted. There were 16 men and 8 women, ranging in age from 19 to 43 years old. The mean age was 28 years. Five were left-handed, all had English as a first language and all had normal or corrected-to-normal vision.

Apparatus and stimuli

The same computer and software were used as in experiment one.

The stimuli consisted of the same fixation point and sixteen greyscale images as used for the facial expressions in experiment one. In addition, neutral expressions for each of the four people were used (see appendix two). This amendment would help determine if facilitation and interference occurred relative to a neutral point as well as relative to each other.

Procedure

The procedure was identical to experiment one, except that the explanation mentioned face-face pairs, instead of face-word pairs and was displayed in written form as part of the computerized slide show.

The face-face emotion priming task

This experiment was designed to be comparable with a colleague's ABBA, face and word emotion priming task. It also included the amendments suggested from the previous experiment.

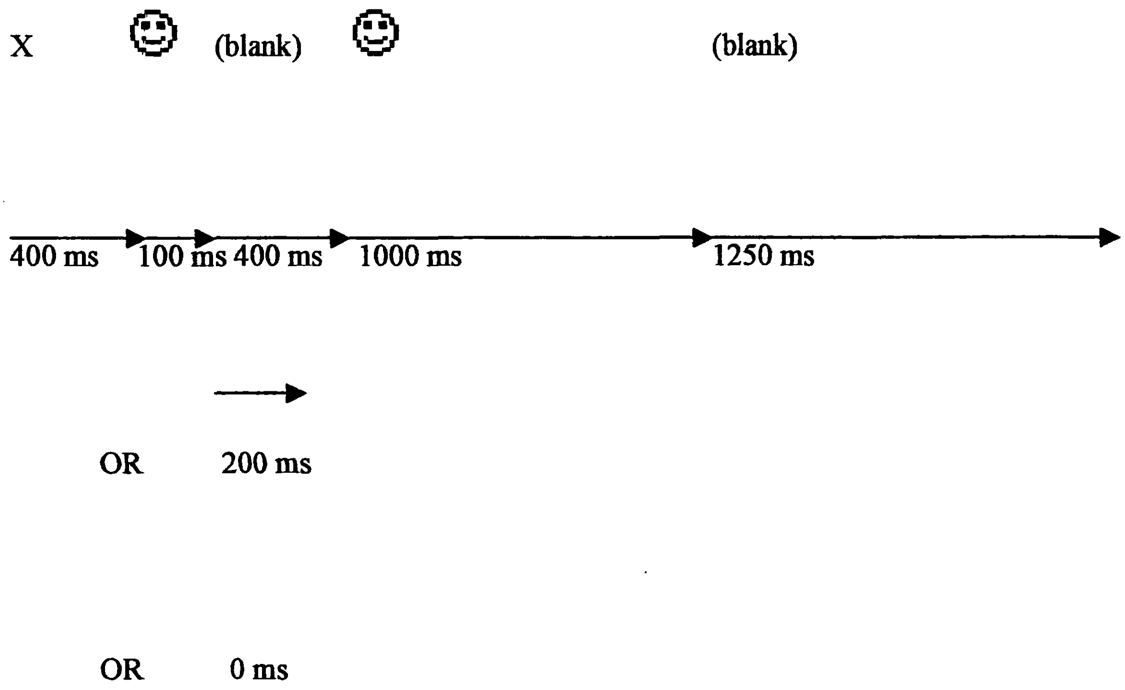
The slide-show on the computer presented trials involving pairs of faces. The target facial expressions showed the same four basic emotions- fear, anger, sadness and happiness. In addition to the emotional expressions, neutral faces were also used as primes, so there were congruent, neutral and incongruent pairings.

The length of the prime was reduced and the effects of stimulus onset asynchrony (SOA) were investigated, as suggested in the discussion about experiment one. The sequence (see figure 3, p.63) was such that a fixation point was displayed for 400ms, followed by a prime face for 100ms. SOAs of 100ms, 300ms and 500ms were tested. In the latter two cases the screen was blank for 200ms and 400ms respectively. Then the target face was presented for 1000ms, followed by a blank screen for 1250ms.

Participants could respond while the target face was on the screen or in the following pause while the screen was blank. This gave a maximum reaction time of 2250ms. If participants responded while the face was on the screen, the display of the face was cut short and the blank screen followed. Pressing a key during the blank did not stop the blank screen being displayed. This last blank ensured a fixed time between trials and a pause between one trial and the next. It also made the task harder in comparison to experiment one as it increased participants' reliance on visual memory.

Figure 3: Flow diagram to illustrate the order of presentation of stimuli

Note: images are icons and not actual images used



The participant responded to the face by pressing the corresponding key. The key layout and the method of using the first two fingers of each hand was identical to experiment one. However, this time a different key combination was used for each participant, so the effects involving key order (that were significant in experiment one) would be randomised across trials.

The computer measured the reaction time from the start of the presentation of the target word until the keypress and the accuracy of this response. These were not fed back to participants.

To allow participants to get used to the finger-to-keyboard mapping and habituate to neutral prime faces, there were 96 practice trials. These consisted of a neutral face presented for 100ms, followed immediately by a face for 1000ms, showing one of the four emotions, and a blank for 1250ms. No pair consisted of the same person for both prime and target expression, to avoid priming effects due to the person. The program ran every person different to prime / prime face / target face combination twice (3 people different to prime x 4 prime facial expressions x 4 target facial expressions x 2 presentations = 96). Then, the main test consisted of 336 trials, with a ratio of congruent: neutral : incongruent trials of 28.5 : 28.5 : 43. There were an equal number of main trials for each SOA. The practice took four minutes and the main test lasted for approximately twenty-five minutes. The order of all stimuli was randomised.

Data pre-processing

Responses with reaction times shorter than 250 ms and greater than 1500 ms were considered as incorrect. Data from one participant was excluded as there was a recording error. This meant 81.25% of the data was included in the analysis.

Results

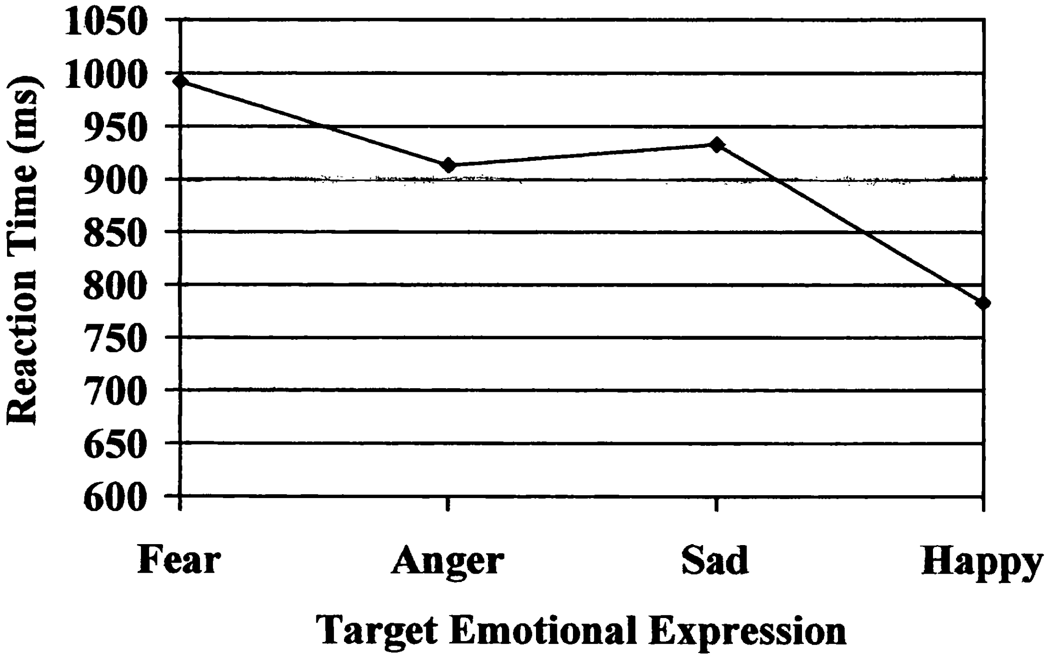
(N.B. All post hoc analysis uses the sidak adjustment to take account of multiple comparisons).

Mean reaction time data are illustrated in graph 3 (p.67). A 5 (prime emotion: neutral, fear, angry, sad, happy) by 4 (target emotion: fear, angry, sad, happy) by 3 (SOA: 100 ms, 300 ms, 500 ms) repeated measures ANOVA was conducted on the data. The only significant effect was that of target emotion ($F(3,10) = 15$, $p < 0.000$). Fear was the hardest to recognise, then sadness, then anger and finally, happy was the easiest (see graph 3, p.67: mean RT for fear = 990, SD = 35; mean RT for sad = 930, SD = 33; mean RT for anger = 910, SD = 26; mean RT for happy = 780, SD = 31). Notably the predicted interaction of prime emotion and target emotion was not significant ($F(12,1) = 1.8$, n.s.).

In a post hoc comparison of the target emotions, it was found that happy was significantly different to fear (mean difference = 210 ms, SE = 33, $p < 0.000$) and sadness (mean difference = 150 ms, SE = 25, $p < 0.000$) and to anger (mean difference = 130 ms, SE = 25, $p < 0.001$).

There were not enough degrees of freedom to calculate the effect of the three-way interaction using multivariate methods. Therefore, the univariate statistics were considered. These were all non-significant (Sphericity Assumed: $F(24,288) = 0.94$, n.s.; Greenhouse-Geisser: $F(7.2,86) = 0.94$, n.s.; Huynh-Feldt: $F(19,230) = 0.94$, n.s.; Lower-bound: $F(1,12) = 0.94$, n.s.).

Graph 3: Graph showing the mean reaction time for the effect of target emotion



Discussion

Facial expressions of emotion did not prime naming of subsequent facial expressions of emotion. The only significant effect was that of target emotion. The lack of face-face emotion priming was contrary to predictions. It seems surprising given the reliability of word-word, picture-picture and affective priming paradigms. There are a number of possibilities as to why face-face emotion priming may not be as reliable an effect. However, this task is novel and it may be that face-to-face emotion priming does occur under different circumstances.

It may be that the nature of this experiment does not readily tap into the emotional expression recognition system. Showing static pictures of expressions and asking for verbal identification is not a common demand in everyday interaction. It may be that the system for expression recognition is sequential and geared to recognizing small changes over brief time periods. In other words, it needs to recognize subtle changes in moment-by-moment interaction, such as a brief wry smile or the momentary "leakage" of down-turned, sad eyes, during a generally cheerful display. The relatively long display of the stimuli and gap between prime and target may mitigate against using such an sequential system.

Some evidence that this may be happening in the emotion priming paradigm, is that affective priming by faces has only been demonstrated at very short, masked display times. Raccuglia & Phaf (1997) found evidence that faces primed positive word evaluation when words were presented to the right visual field and faces to the left and the faces were displayed for 20ms, but not when face primes were displayed for

200ms. Niedenthal (1990) found that cartoons paired with joyful or disgust expressions were responded to faster when they were presented with affect congruent face prime in a recognition memory task. In both learning and test phases, the face primes were displayed for 2 ms. In a second experiment, she found that participants judged cartoons more negatively if they were primed with undetectable faces showing disgust. Similarly, Murphy & Zajonc (1993) found that liking and good-bad evaluation of Chinese ideographs were influenced by a 5 ms presentation of a happy or angry face prime, but not by a 1000 ms presentation. Although, it is questionable whether this affective priming translates to emotion priming. One study investigating discrimination of six specific facial emotions presented suboptimally, found only positive-negative discrimination (Murphy, 1990).

Bruce and Valentine (1986a) differentiate between the pictorial code and expression code, as different sources of information in face processing. The pictorial code is an abstracted representation derived from integrating several viewings of the same picture. It draws on information about lighting, pose and expression as well as details to do with the presentation of the picture, such as flaws in a photo or the sheen of a magazine image. The expression code is derived after further analysis of the pictorial code and structural information. The structural code requires change as well as constancy, like seeing the same expression from several different angles or on different people. They criticize face recognition memory research as being biased to learning about the pictorial code because of the common use of static pictures. The same criticism may apply to this study, that the expression code drew information from the picture code, but was deprived of information from the structural code because of the use of static expressions.

An alternative explanation is put forward by Murphy and Zajonc (1993). They cited evidence from a study by Seamon, Marsh & Brody (1984) that people make affective discriminations of masked stimuli in about 60% of trials. This remains constant as the stimulus exposure time is increased. In contrast, when engaged in recognition memory tasks, people fail at exposures of less than 8ms. As exposure times increase, their ability improves, giving correct answers on about 80% of the trials. This means that affective evaluation may still occur at long exposures of stimuli, but other recognition processes become more important and give greater accuracy.

There is the possibility that face-to-face priming of different attributes occurs more readily than emotion priming, such as priming of the name, sex, age or race of the person. For example, there are several studies indicating a dissociation between recognition of facial expressions and facial identity (for a review, see Etcoff, 1985). One study of face-face priming found identity priming did occur, when naming a celebrity face after prior optimal exposure to the identical picture or to a different picture of the same celebrity (Bruce & Valentine, 1986b). Murphy and Zajonc (1993) contrasted the affective priming effect of faces with that of sex evaluation priming effect. They found that the former took place with suboptimal presentation of the primes and the latter at optimal exposure levels. They suggested this supported the continuum of consciousness model (Öhman, Dimberg & Esteves, 1989), which proposes affect is processed early. Looking at different kinds of face-face priming and their interaction could be a line taken in future research.

Another difference between this emotion priming study and some of the affective priming studies using faces as primes under suboptimal conditions (Murphy & Zajonc, 1993; Niedenthal, 1990) is that the targets in the latter were more ambiguous. The facial expressions were displayed at their most intense and there was clearly a right and wrong answer in the judgement of the expression. An emotion priming effect might have been obtained if target stimuli had been more ambiguous. Murphy and Zajonc (1993) found the affective priming was weaker when evaluating an objective measure of the target- the symmetry of the Chinese figures, compared to a subjective measure- the size of the object the figure stood for.

A final footnote from the study by Murphy and Zajonc (1993) is that they found affective priming strongest in the first pairing of an ideograph with a face. Subsequent pairings that were inconsistent with that first pairing showed a weaker priming effect. If it is the case with affect that "first impressions last", then the continued repetition of the same small set of stimuli may have dampened any emotion priming. Larger response sets could be a further manipulation to study.

The results of this study do not confirm that face-to-face emotion priming occurs. However, as the paradigm is novel, more research would be needed to investigate different circumstances. Some avenues indicated by previous research would be face-face affective priming studies and face-to-face emotion priming contrasting more and less ambiguous expressions, larger response sets and suboptimal exposures of face primes.

The only significant result was that of target emotion. The results approximated the effect of target word seen in the previous experiment in that fear was the hardest to name and happy the easiest. There was also found to be a significant effect in Morrish's (2001) word-to-face priming experiment. In that study, fear was the hardest to name and happy the easiest, but anger took longer to recognize than sadness. As happy was the only emotion different to the others in this study, this could be seen as an effect of positive versus negative valence and not as evidence of specific emotion effects. However, the similarity in the order of response times for fear, anger and happy when responding to both words and faces leaves open the possibility that specific emotion systems are operating.

As a reliable emotion priming effect was not found in the face-to-face condition, research using this paradigm was not pursued. However, Richell (2001) found a priming effect in her study using face-word and word-face priming in an ABBA design, so her experiment was adapted and piloted in a normal male child population. If evidence of a priming effect were to be found among normal boys, then this test would be suitable to take to the clinical population- boys with emotional and behavioural difficulties.

EXPERIMENT THREE

Experiment three was a pilot study, which looked at the priming effects of emotion words on naming facial emotional expression and of emotional facial expressions on reading emotion words, using an ABBA design. It was a replication of the emotion priming task using by Richell (2001) in a male, child sample. Richell (2001) used a mixed, adult sample.

The aim was to see if there was a reliable priming effect, so that the test could, then, be taken to a clinical population of boys with emotional and behavioural difficulties.

Method

Participants

Eight boys between the ages of 11 and 16 years were recruited by opportunity sampling to take part in the test. An explanation similar to experiment one was given (see appendix 1a for letter to parents). Written consent from parents and verbal consent from the participants was obtained. The mean age of the boys was 13 years. All were Caucasian, had English as a first language and normal or corrected-to-normal vision. Four were left-handed.

Apparatus and stimuli

The test was presented on a Macintosh Powerbook 3400c using the same software as in experiment one.

The stimuli were the same fixation point and sixteen greyscale images of facial expressions and four images of emotion words used in experiment one. Four neutral facial expressions were used, as in experiment two. In addition, four neutral words were used to provide a neutral comparison for the word to face condition. The neutral words were matched for word length to the emotion words. They were 'grey', 'shade', 'one' and 'mouth' for 'fear', 'angry', 'sad' and 'happy'.

Procedure

The procedure was identical to experiment one, except that the explanation referred to word-face pairs, as well as face-word pairs. These instructions were given at the start of each block orally and in written form as part of the computer slide show. Another notable difference was that testing took place in participants' homes and this was not always quiet. The experimenter stayed with the children throughout the test.

The ABBA, face and word emotion priming task

The experiment consisted of an ABBA design, with two priming conditions: faces priming words (Condition A: FtW) and words priming faces (Condition B: WtF).

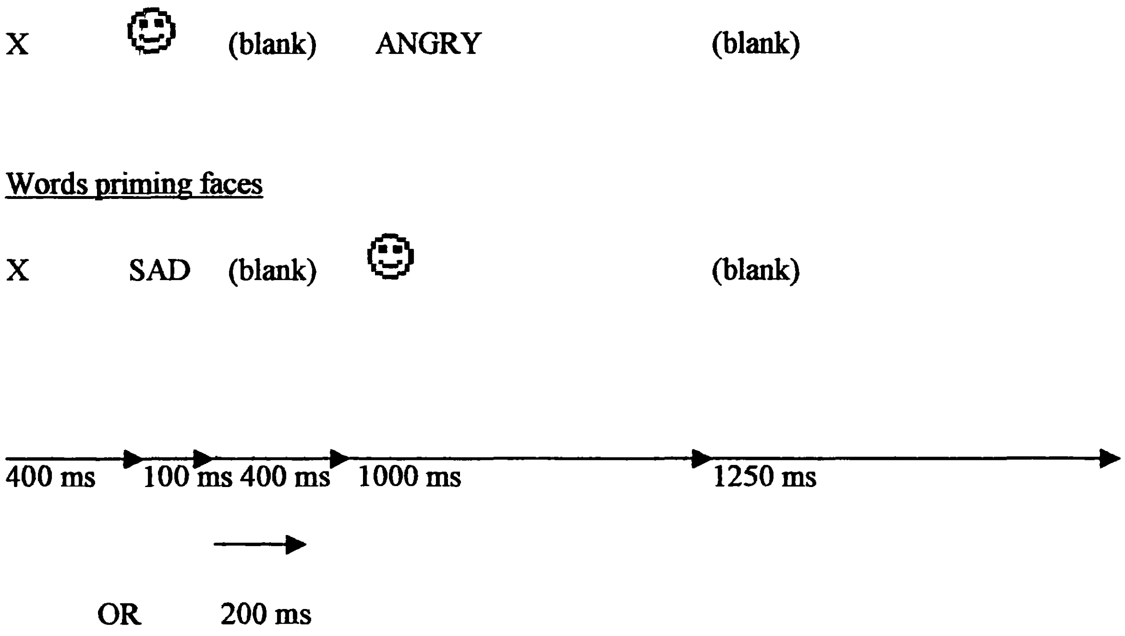
The sequence of presentation was that the participant would see a fixation point for 400ms, followed by a prime face (FtW) or word (WtF) for 100ms. The stimulus onset asynchrony was varied by displaying a blank of 200ms or 400ms. This meant SOAs of 300ms and 500ms were tested. In the original experiment testing the ABBA design, an SOA of 100ms was used. These trials were excluded to shorten the test, in order to lower the attention demand for use with children. This seemed justifiable as Richell (2001) only found the priming effect at SOAs of 300ms and 500ms. Then, the target word (FtW) or face (WtF) was shown for 1000ms, followed by a blank screen for 1250ms (see figure 4, p.76).

Figure 4: Flow diagram to illustrate the order of presentation of stimuli

Note: images are icons and not actual images used

(blank) = blank screen

Faces priming words



The means of responding was similar to experiment two - via a key-press with a maximum response time of 2250ms, measured from the beginning of target presentation. There were differences in key labeling and method of key pressing. The keys were labeled with the full word to make the task easier for the children and, also, to reduce the emphasis on the initial letter as Stroop interference can occur with the initial letter alone (Regan, 1978). Any method of key pressing was allowed. This gave flexibility to the children who were more likely to change their method throughout the test, for instance switching from using two hands to one.

The response time and error rate were recorded by the computer, but not fed back to the participants.

There was an initial practice session of 192 trials. Neutral faces (FtW) or words (WtF) were displayed for 100ms, followed by a target word (FtW) or face (WtF). This meant the SOA for the practice trials was 100ms. The program ran every person/target emotion combination three times in each block (4 people x 4 target emotions x 3 presentations = 48). There were four blocks, two for each priming condition (4 blocks x 48 = 192). The blocks were presented in an ABBA sequence to parallel the main test. The complete order of presentation was $FtW_{practice}$, $WtF_{practice}$, $WtF_{practice}$, $FtW_{practice}$, FtW_{main}, WtF_{main}, WtF_{main}, FtW_{main}.

The main section was comprised of 336 trials, 168 in each condition and 84 in each block. There was an even number of trials spread across the different SOAs. This meant that for each condition, there were 84 trials per SOA. The ratio of congruent: neutral: incongruent trials was 6:6:9. Additional congruent and neutral trials were added to the original test to achieve this ratio. The practice session took 8 minutes to complete and the main test lasted approximately 25 minutes. The order of all stimuli was randomised.

Data pre-processing

Responses that were unanswered, incorrect, shorter than 250 ms or longer than 1500 ms were excluded from the reaction time data, which left 75% of the data. The error data included incorrect answers and trials where no responses were made, which comprised 20% of the data.

Results

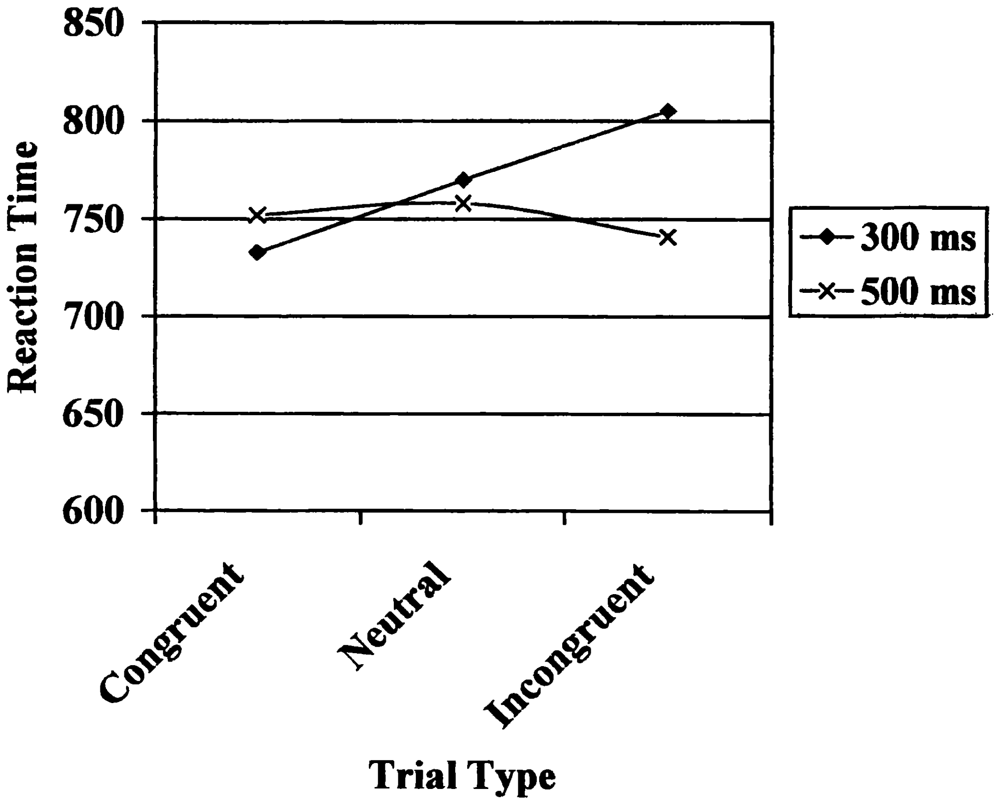
(N.B. All post hoc analysis uses the sidak adjustment to take account of multiple comparisons).

Mean reaction time data are illustrated in graph 4 (p.80). The two priming conditions were analysed separately. A 3 (trial type: congruent, incongruent, neutral) by 2 (SOA: 300 ms, 500 ms) repeated measure ANOVA was conducted on the reaction time data. For faces priming words (FtW), the main effect of SOA was significant ($F(1,7) = 18$, $p < 0.004$). An SOA of 500 ms allowed speedier reading of emotion words than the SOA of 300 ms (SOA = 300 ms, mean = 770 ms, SD = 42; SOA = 500 ms, mean = 750 ms, SD = 42). Also, the interaction of trial type and SOA was significant ($F(2,6) = 8.3$, $p < 0.019$). The above effect that a shorter SOA led to longer reaction times happened mostly for the incongruent trials (see graph 4, p.80). The predicted effect of trial type was not significant ($F(2,6) = 1.6$, n.s.). In the words priming faces condition (WtF), none of the effects were significant, including the predicted effect of trial type ($F(2,6) = 2.7$, n.s.).

A simple post hoc comparison, looking at the significant interaction of SOA and trial type in the FtW condition, found that only the difference between the SOAs of 300 and 500ms for incongruent trials was significant ($p < 0.003$). It took longer to respond to incongruent trials with an SOA of 300 ms. Graph 4 depicts the mean reaction time data for this interaction (p.80).

It can be seen from this graph that with an SOA of 500 ms, the neutral trials did not fall inbetween the congruent and incongruent trials. As this meant they were not acting as a neutral point, it seemed reasonable to re-analyse the data without the neutral trials. A 2 (trial type: congruent, incongruent) by 2 (SOA: 300 ms, 500 ms) repeated measure ANOVA was conducted on the reaction time data. For faces priming words, there was still a significant effect of SOA ($F(1,7) = 10$, $p < 0.015$) and the previously significant interaction of SOA and trial type became a trend ($F(2,6) = 5.1$, $p < 0.058$). As before, the shorter SOA led to longer response times, particularly for incongruent trials (post hoc analysis revealed this was still significant at $p < 0.003$). In addition, there was a trend for trial type type ($F(1,7) = 3.6$, $p < 0.1$) in the predicted direction. Incongruent trials tended to lead to longer response times than congruent trials. There was a trend for this to occur at the shorter SOA of 300 ms, rather than the longer SOA of 500 ms (post hoc analysis: mean difference between incongruent and congruent trials = 72 ms, SE = 32, $p < 0.057$). For words priming faces, none of the effects were significant.

Graph 4: Graph showing the mean reaction times for the interaction of SOA and trial type for faces priming words

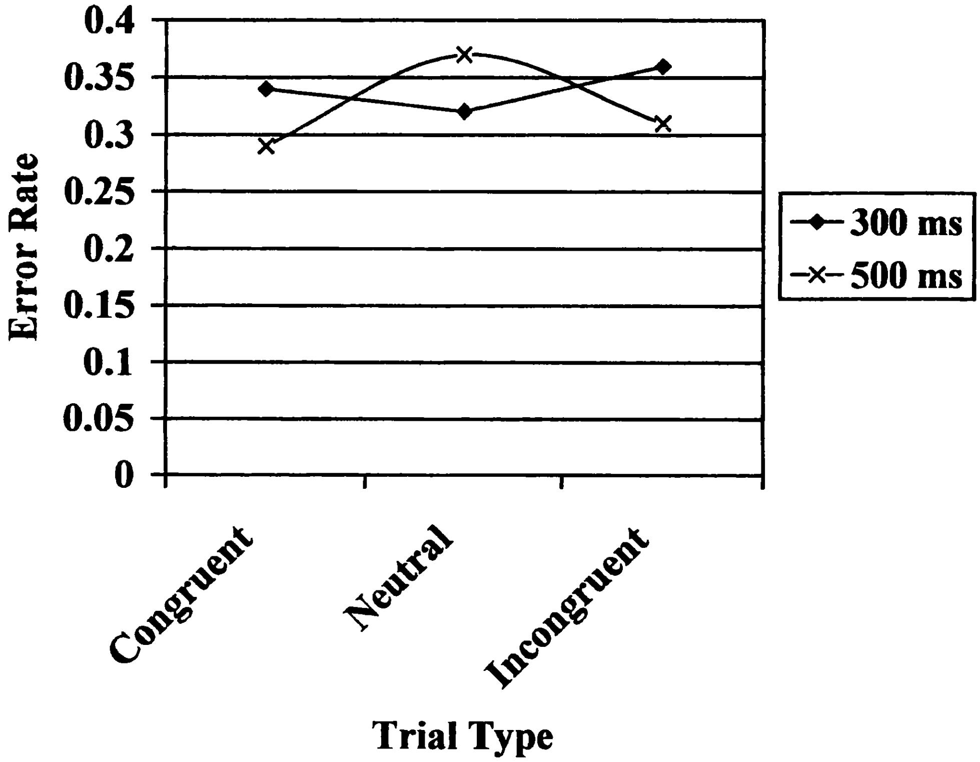


Mean error data are illustrated in Graph 5 (p.82). The two priming conditions were analysed separately. A 3 (trial type: congruent, incongruent, neutral) by 2 (SOA: 300 ms, 500 ms) repeated measure ANOVA was conducted on the error data. For faces priming words (FtW), none of the effects were significant, including the predicted effect of trial type ($F(2,6) = 0.38$, n.s.). In the words priming faces condition (WtF), the interaction of SOA and trial type was significant ($F(2,6) = 17$, $p < 0.004$). It seemed that the participants behaved differently on the neutral trials (see graph 5, p.82). At 300 ms, participants responded more accurately on neutral trials, compared to congruent and incongruent trials and more accurately on neutral trials at an SOA of 300 ms compared to the longer SOA of 500 ms.

Simple post hoc comparisons, looking at the significant interaction of SOA and trial type in the WtF condition, found that at an SOA of 300 ms, incongruent trials produced larger error rates than the neutral trials (mean difference in error rate = 0.076, SE = 0.024, $p < 0.045$) and neutral trials at an SOA of 500 ms led to larger error rates than at 300 ms (mean difference in error rate = 0.083, SE = 0.034, $p < 0.046$). These results are illustrated in graph 5 (p.82).

Again, from this graph it can be seen thatthe neutral trials were not acting as neutral points. Therefore, a 2 (trial type: congruent, incongruent) by 2 (SOA: 300 ms, 500 ms) repeated measure ANOVA was conducted on the error data, excluding neutral trials. None of the effects were significant in either condition, including the predicted effect of trial type (FtW: $F(1,7) = 0.88$, n.s.; WtF: $F(1,7) = 2.0$, n.s.).

Graph 5: Graph showing the mean error rates for the interaction of SOA and trial type for words priming faces



Discussion

With an ABBA, face and word, emotion priming task, emotion priming was not found to occur significantly, although there was a trend for priming to occur in the reaction time data when faces primed words, once neutral trials were excluded from the analysis. This trend had a tendency to happen at the shorter SOA of 300 ms and not the longer SOA of 500 ms.

These results contrast with Richell's (2001) findings for an adult sample, that priming occurred for FtW at both SOAs, for the reaction time data only and for WtF, priming occurred at both SOAs for the reaction time data and the error data. There are several possible reasons for this difference. Firstly, excluding the trials with 100 ms SOA may have made a difference. Although this is unlikely, as one affective priming study found that increasing the number of SOAs reduced the priming effect (Hermans, 1996). Secondly, the sample size in this experiment was small, which made it less likely to find priming effects. The direction occurred as predicted for both conditions in both error and reaction time data, in that the participants responded quicker and made less errors on congruent compared to incongruent trials. It might have been that a larger sample would have produced significant emotion priming effects.

The major effects were that of SOA and its interaction with trial type. SOA was found to have a significant main effect (FtW, reaction time data) and interaction in this experiment (FtW, reaction time data; WtF, error data). It has been highlighted as an important manipulation in affective priming and Stroop tasks (Klauer, 1998;

MacLeod, 1991). For instance, Herman, de Houwer and Eelen (1994) found an affective priming effect in a picture-word task at 300 ms, but not at 1000 ms, as did Fazio and colleagues (1986) in a word-word affective priming task. It was suggested that with an SOA of 1000 ms, the effect of the prime had dissipated or been controlled by the time the target appeared. The lesser interference of a longer SOA was seen in face to word priming in the reaction time data of this experiment, particularly for the incongruent trials. Also, there was a trend for emotion priming to occur at the shorter SOA only. These may be due to the same reason that the longer SOA allows extra preparation time to process or suppress the prime.

However, the results of these affective priming and Stroop tasks are not synonymous with the emotion priming test. Notably, they found priming at 100 ms, whereas Richell (2001) did not and in this experiment, in the error data, for words priming faces the SOA effect was reversed in one instance. For neutral trials, less errors were made at the shorter SOA of 300 ms. One possibility is that this was due to practice with neutral primes at a short SOA. All the practice trials had neutral primes and an SOA of 100 ms. However, it remains unclear why this happened only for words priming faces.

The neutral trials showed different reactions across condition and SOA. Neutral trials were answered significantly more accurately than incongruent trials for words priming faces. In the other conditions, neutrals trials were not answered significantly faster or more accurately. In fact they either fell inbetween responses to congruent and incongruent trials (FtW: error data at 300 ms, FtW: reaction time data at 300 ms) or led to the largest error rates and response times (FtW: reaction time data at 500 ms; WtF: reaction time data; WtF: error data at 500 ms). Choosing a neutral comparison point is hard as various types lead to different amounts of relative interference and priming (MacLeod, 1991). For instance, neutral faces are ambiguous stimuli, as people may perceive some emotion in them. This is shown in experiments where the evaluation of neutral faces can, themselves, be affected by primes (Russell & Fehr, 1987; Surakka, Sams & Hietanen, 1999; Tanaka-Matsumi, Attivissimo, Nelson & D'Urso, 1995). Research using non-affective controls would be helpful in determining whether the response latencies in this experiment are facilitation or interference. This was not pursued further in this study, but these pilot results suggest that particular caution should be taken with regard to neutral trials and analysis excluding the neutral trials may be beneficial.

There was a risk in taking the ABBA, face and word, emotion priming task to the clinical sample, as a significant emotion priming effect did not emerge in the normal child population investigated in this study. However, this sample was very small and it may be that a larger sample would have produced an emotion priming effect. Even with a small sample, a trend did appear in this child population and significant emotion priming effects did occur with a sample of 24 adults (Richell, 2001). Administering the task in a clinical child population with a larger sample would be a further test of whether emotion priming effects for this task are specific to adults, as well as a test of theories of psychopathy, if emotion priming does emerge. This was considered in experiment four.

EXPERIMENT FOUR

In experiment four, boys with psychopathic tendencies and comparison boys were presented with the priming task described in experiment three. The aim was to test between different theories of psychopathy. Executive and executive emotion theories would predict that children with psychopathic tendencies would be slower and make more errors on emotion priming. Basic emotion priming theories propose that there would be group differences in response times and error rates of emotion priming across specific emotions.

"The group of boys with high psychopathic tendencies" is used interchangeably with "the psychopathic group" and "psychopaths" for the sake of brevity, although it must be noted that there is no diagnosis of psychopathy for children under sixteen.

Method

Participants

The participants were 31 boys, aged between 8 and 16 years, selected from a pool of 104 boys across two government schools for children with emotional and behavioural difficulties (EBD). They had all received statements under the Education Act of 1993 as being too problematic for mainstream education. All participants had English as a first language and normal or corrected-to-normal vision. All, but two, were Caucasian. Those with a diagnosis of dyslexia or autistic spectrum disorder were excluded from the study due to potential difficulties with reading words and facial expressions respectively.

All the remaining children whose parents did not object for them to participate were investigated (see appendix 1b for consent form to parents). Children were informed of the study by their class teachers. The experimenters approached each participant during class time and asked whether they would like to do the study tests. The pupils were free to withdraw from the study at any time.

Initially, participants were screened with the Psychopathy Screening Device (PSD: Frick & Hare, in press). Those with a score of 23 or above on the PSD were included in the target group for boys with psychopathic tendencies (N = 14), while those with a score of less than 15 (N = 17) formed the comparison group. Individuals with scores between 22 and 15 were excluded from the study.

The British Picture Vocabulary Scale II (BPVS: Dunn & Dunn, 1997) was administered to give an estimate of intelligence. The degree of Attention Deficit Hyperactivity Disorder (ADHD) was measured by the DuPaul Rating Scale (DuPaul, Power, Anastopoulos & Reid, 1998). It was predicted these would influence performance on the emotion priming task. Measurements on the PSD and DuPaul Rating Scale were the combined scores of two teachers, or a teacher and a classroom assistant (see table 4 for full participant details, p.88). T-tests showed that there were no significant group differences in age or BPVS score, whilst there were differences in the two groups' PSD and ADHD ratings, with the psychopathic group scoring significantly higher in both cases.

Table 4: Table to show participant characteristics: means, standard deviations and significant group differences

		AGE		BPVS		PSD		DuPaul	
Participants	N	M	SD	M	SD	M	SD	M	SD
Targets	14	11:8	1:10	90	13	28	4.4	29	8.5
Comparison	17	12:6	2:5	90	12	12	2.2	15	8.8
Total	32	12:2	2.2	90	12	19	9.2	21	11
T (29)		-1.0		-0.20		13***		4.5***	

Note: BPVS = British Picture Vocabulary Score (IQ estimate). PSD = Psychopathy Screening Device. DuPaul = score on the DuPaul ADHD Rating Scale. T = t-test score.

***p<0.001

Apparatus and stimuli

The test was presented using the same computer and software, displaying the same stimuli as in experiment three.

Procedure

The procedure was identical to experiment three, except that testing took place in mostly quiet rooms at each of the schools. A colleague, Salima Budhani, completed some of the BPVS testing and questionnaire scoring.

The ABBA, face and word emotion priming task

The paradigm described in experiment three was also used in experiment four with the exception of one amendment. The task was completed in two separate testing periods of 20 minutes each. This was because the children could only be released from lessons for that length of time.

As described in experiment four, the task design was four practice blocks in an ABBA design, followed by four main blocks in the same ABBA design. 'A' represents the faces priming words condition and 'B' represents the words priming faces condition. Both the practice and main sections were split, so each test consisted of two practice blocks and two main blocks, with the ABBA design retained. Participants completed the test in two separate parts, namely $A_{practice}$ $B_{practice}$ B_{main}

A_{main} and $B_{practice}$ $A_{practice}$ A_{main} B_{main}. The order of completion of these two tests was counterbalanced across subjects.

This meant that for each test, there were 96 practice trials, followed by 168 main trials. The practice took 4 minutes and the main test 13 minutes.

The Psychopathy Screening Device (PSD; Frick & Hare, in press)

The PSD is a 20-item questionnaire of behavioural and interpersonal traits. Items are scored 0,1 or 2 according to whether the statement is 'not true at all', 'sometimes true' or 'definitely true'. Five items are scored inversely prior to the calculation of total PSD score. The maximum score possible is 40. Each participant's score was the average of ratings by two teachers or a teacher and a carer. Pearson's correlation of the ratings by the two scorers was 0.77 for total PSD score.

As yet, no figures for test-retest, Cronbach's Alpha or split-half reliability have been reported for the PSD. Concurrent validity with DSM criteria and other measures of conduct problems and anxiety have been found. In a clinical sample (Frick, O'Brien, Wooton & McBurnett, 1994), the Impulsivity/Conduct Problems factor has been shown to have a correlation of 0.68 with DSM-III-R (1987) diagnoses of conduct disorder and oppositional defiant disorder and of 0.58 and 0.67 with the Child Behavior Checklist (CBCL; Achenbach, 1991) scales of delinquency and aggressions and of 0.71 with the teacher-completed Comprehensive Behavior Rating Scale for Children (CBRSC; Neeper, Lahey & Frick, 1990). The Callous/Unemotional scale was negatively associated with measures of anxiety. In a multiple regression analysis, R^2 was 0.14 for Sensation Seeking Scale for Children (SSSC; Russo, Lahey, Christ et al., 1991; Russo, Stokes, Lahey et al. 1993), was 0.21 for CBCL Anxiety/Depression scale and was 0.20 for CBRSC Anxiety scale. Moderately strong zero-order correlations were found in a community sample (Frick, Bodin & Barry, 2000) between the PSD and diagnoses of Oppositional Defiant Disorder (0.67), Conduct Disorder (0.59) and ADHD (0.53).

<u>DuPaul's ADHD rating scale (DuPaul, 1991)</u>

The ADHD rating scale is a questionnaire with 14 items subdivided into two scales, which measure impulsivity coupled with hyperactivity and inattention coupled with hyperactivity. A study has demonstrated this two-factor structure underlies the questionnaire (DuPaul, 1991). The scale was based on the diagnostic criteria for ADHD in the DSM-IV (American Psychological Association, 1994). Items are scored from 0 to 3 according to how often the statement is applicable to the child (0 = 'never or rarely', 1 = 'sometimes', 2 = 'often', 3 = 'very often'). The maximum possible score is 42 and scores were judged by two raters. In this experiment, Pearson's correlation of the scores by the two raters were 0.74 for total ADHD score.

In a community sample (DuPaul, Power, McGoey, Ikeda & Anastopoulos, 1998), test-retest reliability for teacher ratings was found to be 0.9 and Cronbach's Alpha was 0.94 for the total scale score. Concurrent validity with the Conners Teacher Rating Scale-39 (CTRS-39; Conners, 1989) yielded high validity coefficients between the DuPaul impulsivity factor and the CTRS hyperactivity (0.79) and between the DuPaul inattention factor and the CTRS daydreams-attention index

(0.85). Criterion validity was lower, but statistically significant. The total ADHD score correlated with classroom observation measures of off-task behaviour, fidgeting and accuracy in school work (0.34, 0.29, -0.47 respectively).

The British Picture Vocabulary Scale II (BPVS; Dunn, Dunn, Whetton & Burley, 1997)

The BPVS gives an estimate of IQ by measuring children's understanding of vocabulary. Individual words are presented orally to the child and the child must chose one from four pictures that best describes the word. There are age-related norms to translate scores into IQ estimates.

Testing on community samples has shown good reliability and construct validity. Split half reliability was found to be 0.86 (Dunn, Dunn, Whetton & Burley, 1997). With regards to construct validity, vocabulary tests have been shown to be good predictors of IQ (Wechsler, 1974). Scores on the American version of the BPVS, the Differential Ability Scales (DAS) correlated with IQ across a range of 0.62 to 0.71 for different ages (Elliott, 1990). The precursor to the BPVS, the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 1981), showed a correlation with the DAS Naming Vocabulary subtest of 0.70, so it can be argued that the BPVS gives a valid measure of IQ.

Data pre-processing

Responses that were unanswered, incorrect, shorter than 250 ms or longer than 1500 ms were excluded from the reaction time data. This meant 63% of the data was considered in the reaction time analyses. Trials which were answered either incorrectly or not at all were considered in the error data, which was 33% of the entire data set.

Pearson's correlations were conducted for mean reaction time and mean error rate and the scores for age, BPVS and ADHD, for each priming condition to determine if age, intelligence or ADHD scores affected performance on the emotion priming task. It was found that BPVS score correlated with mean reaction time for words priming faces. With increasing intelligence, participants took longer to respond (correlation = 0.039, $p < 0.029$). Also for words priming faces, age correlated with mean error rate. With increasing age, less errors were made (correlation = -0.56, $p<0.001$). Therefore, BPVS score and age were used as covariates in the analyses of words priming faces in the reaction time and error data respectively. As previously mentioned, increasing ADHD was associated with PSD, so ADHD was used as a covariate in all analyses.

Results

(N.B. All post hoc analysis uses the sidak adjustment to take account of multiple comparisons).

Reaction Time Data

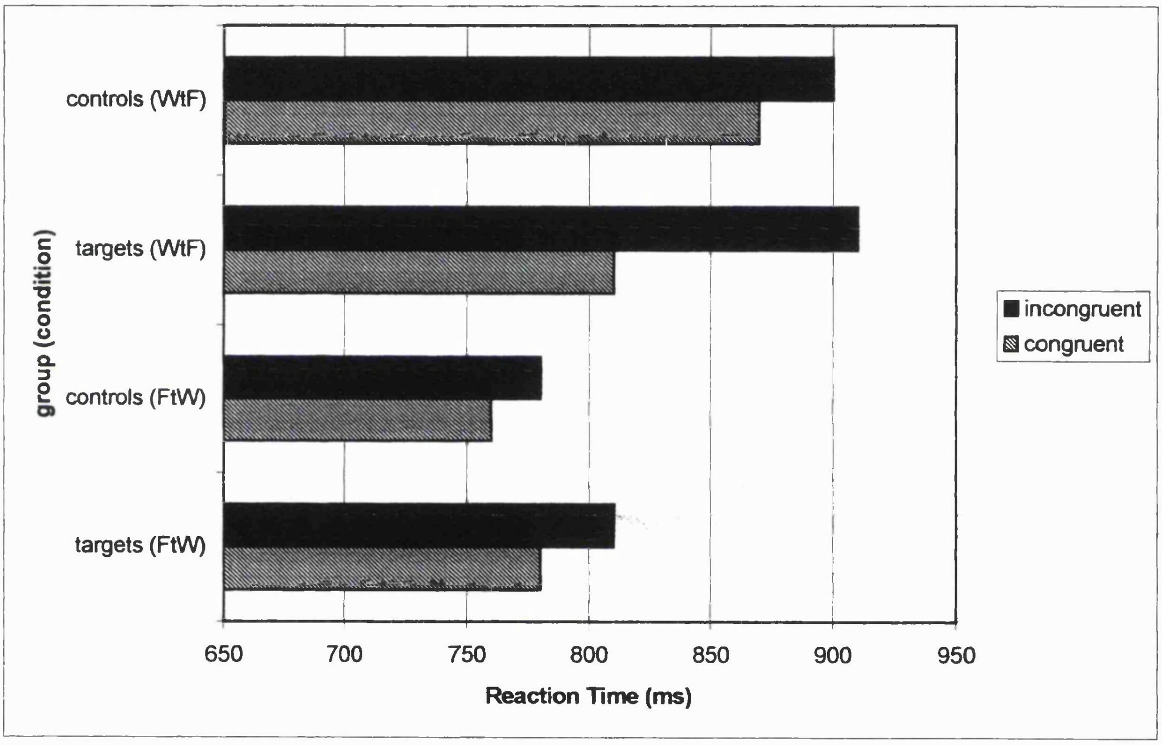
Mean reaction time data are illustrated in Graph 6 (p.96). The two priming conditions were analysed separately, namely faces priming words (FtW) and words priming faces (WtF).

First, it was investigated whether emotion priming occurred. A 2 (group: psychopaths, non-psychopaths) by 2 (SOA: 300 ms, 500 ms) by 3 (trial type: congruent, incongruent, neutral) repeated measures ANOVA was conducted on the reaction time data. ADHD was used as a covariate for faces priming words and ADHD and BPVS were covariates for words priming faces. In neither analysis was the effect of trial type significant (FtW: $F(2,27) = 0.50$, n.s.; WtF: $F(2, 26) = 0.060$, n.s.). The only significant effect was that of BPVS for words priming faces ($F(1,27) = 4.3$, $p < 0.047$), which as noted above, showed that increasing IQ led to longer response times.

As in the previous experiment, the neutral trials did not always act as neutral, so post hoc analyses, excluding neutral trials by looking at the difference between incongruent and congruent trials were conducted. For both priming conditions, incongruent trials had significantly longer response times than congruent trials (FtW: mean difference in reaction time = 23 ms, SE = 9.0, $p < 0.046$; WtF: mean difference in reaction time = 62 ms, SE = 17, $p < 0.003$). This showed that priming occurred in the reaction time data for both priming conditions.

In order to determine if the psychopathic group took longer to respond to these emotional stimuli than controls, a 2 (group: psychopaths, non-psychopaths) by 2 (SOA: 300 ms, 500 ms) repeated measure ANOVA was conducted on the reaction time data. Interference effects (incongruent trials – congruent trials) comprised the dependent variable, so neutral trials were again excluded. As before, ADHD was used as a covariate for faces priming words and ADHD and BPVS were covariates for words priming faces. No effects were significant in either condition, so no group differences in emotion priming were revealed (see graph 6, p.96).

<u>Graph 6: Graph showing the difference in mean response times to congruent and incongruent trials for targets and controls in both priming conditions</u>



Finally, it was examined whether there were group differences in processing different emotions. A 2 (group psychopaths, non-psychopaths) by 5 (prime emotion: neutral, fear, anger, sad, happy) by 4 (target emotion: fear, anger, sad, happy) repeated measures ANOVA was conducted on the reaction time data. ADHD was a covariate for faces priming words and BPVS and ADHD were covariates for words priming faces. For words priming faces, fifteen cases were excluded due to listwise exclusion of missing data. The predicted interactions involving group and emotion were not significant in either priming condition (Prime emotion by group: FtW: $F_{(4,24)} = 0.25$, n.s.; WtF: $F_{(4,9)} = 0.68$, n.s.. Target emotion by group: FtW: $F_{(3,25)} = 1.4$, n.s.; WtF: $F_{(3, 10)} = 0.81$, n.s.. Prime emotion by target emotion by group: FtW: $F_{(12,17)} = 0.47$, n.s.; WtF: $F_{(12,3)} = 2.3$, n.s.). None of the other effects were significant.

Error Data

Mean error data are illustrated in graph 7 (p.100) and graph 8 (p.102). The two priming conditions, faces priming words (FtW) and words priming faces (WtF) were analysed separately.

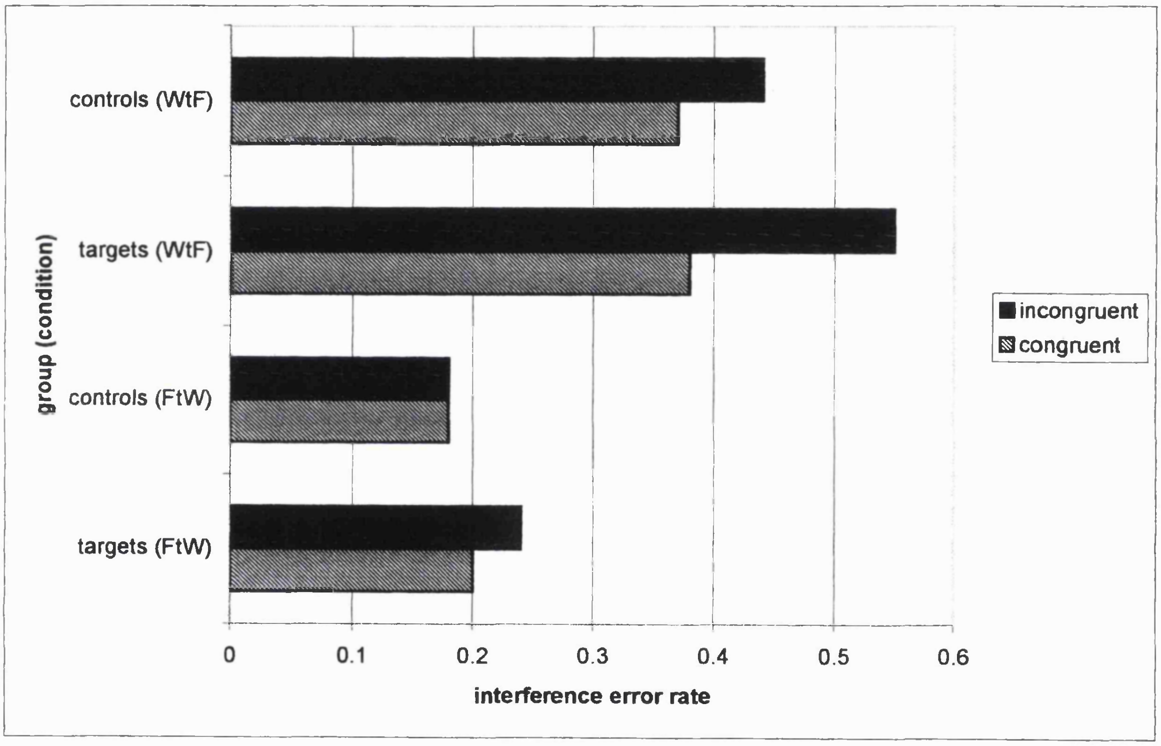
First, it was examined whether emotion priming occurred. A 2 (group: psychopaths, non-psychopaths) by 2 (SOA: 300 ms, 500 ms) by 3 (trial type: congruent, incongruent, neutral) repeated measures ANOVA was conducted on the error data. ADHD was used as a covariate for faces priming words and ADHD and age were covariates for words priming faces. The predicted effects of trial type were not significant, although there was a trend in each priming condition (FtW: $F(2,27) = 3.0$, $p < 0.066$; WtF: $F(2,26) = 2.9$, $p < 0.075$). There were no other significant effects for faces priming words. However, for words priming faces the main effects of SOA ($F(1,27) = 5.4$, $p < 0.029$) and age ($F(1,27) = 11$, $p < 0.003$) were significant, as was their interaction ($F(1,27) = 6.1$, $p < 0.021$).

To investigate this interaction further, a 2 (age group: older than 146 months, 146 months or younger) by 2 (SOA: 300 ms, 500 ms) by 3 (trial type: congruent, incongruent, neutral) repeated measures ANOVA was conducted with PSD and ADHD as covariates. Age group was the between-subjects factor, with subjects over 146 months comprising group one (N=15) and subjects 146 months or less being in group two (N = 16). This showed that the older participants made less errors than younger ones (mean difference in error rate = 0.16, SE = 0,059, $p < 0.011$). The older participants made less errors with an SOA of 500 ms compared to an SOA of 300 ms. (At 500 ms: error rate = 0.36, SE = 0.042; at 300 ms: error rate = 0.41, SE = 0.042; mean difference = 0.052, SE = 0.015, $P < 0.002$), whereas younger participants had a large error rate for both SOAs (At 500 ms: error rate = 0.52, SE = 0.040; At 300 ms: error rate = 0.52, SE = 0.041).

As the neutral was not consistently acting as a neutral, a further post hoc analysis excluding the neutral trials was conducted. This compared incongruent trials with congruent trials to see if emotion priming occurred. Once neutral trials were excluded, significant emotion priming emerged in that incongruent trials led to greater error rates than congruent trials (FtW: mean difference = 0.026, SE = 0.008, $p < 0.007$; WtF: mean difference = 0.12, SE = 0.022, $p < 0.000$).

To discover whether psychopaths made more errors than controls, a 2 (group: psychopaths, non-psychopaths) by 2 (SOA: 300 ms, 500 ms) repeated measures ANOVA was conducted on the error data. Interference error rates, which are the difference between the incongruent and congruent error rates were the dependent variable, so that the neutral trials were not considered. For faces priming words, ADHD was a covariate and ADHD and age were covariates for words priming faces. For faces priming words, the predicted effect of group was significant ($F (1,28) = 4.9$, $p < 0.035$)(see graph 7, p.100) and no other effect was significant. The psychopaths had larger interference errors than controls. For words priming faces, no effects were significant, but there was a tendency for psychopaths to have larger interference errors than controls ($F (1,27) = 3.5$, $p < 0.071$)(see graph 7, p.100).

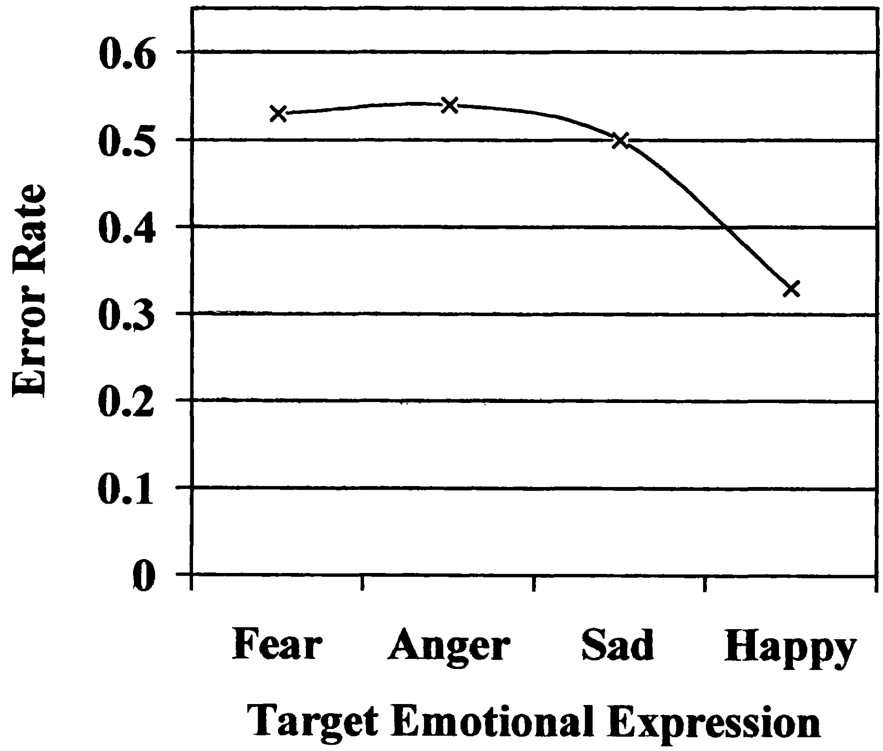
Graph 7: Graph showing the mean error rates on incongruent and congruent trials for targets and controls in both priming conditions



Was this increase in incongruent trials due to priming by specific emotions? In order to investigate this, a 2 (group: psychopaths, non-psychopaths) by 5 (prime emotion: fear, anger, sad, happy, neutral) by 4 (target emotion: fear, anger, sad, happy) repeated measures ANOVA was conducted. As before, ADHD was a covariate for faces priming words and for words priming faces, the covariates were age and ADHD. None of the expected interactions involving group and emotion were significant (Prime emotion by group: FtW: $F (4,25) = 2.2$, n.s.; WtF: $F (4,24) = 0.62$, n.s.. Target emotion by group: FtW: $F (3,26) = 1.2$, n.s.; WtF: $F (3, 25) = 0.19$, n.s.. Prime emotion by target emotion by group: FtW: $F (12,17) = 2.0$, n.s.; WtF: $F (12,16) = 1.1$, n.s.).

For faces priming words, no effects were significant. For words priming faces, the effect of target emotion was significant ($F (3,25) = 4.9$, $P < 0.008$). The happy word seemed to cause less errors than other emotion words (see graph 8, p.102) and this was confirmed in post hoc analysis (happy < fear: mean difference = 0.21, SE = 0.032, $p < 0.000$; happy < anger: mean difference = 0.21, SE = 0.027, $p < 0.000$; happy < sad: mean difference = 0.18, SE = 0.031, $p < 0.000$). Interestingly, there was a trend in the faces priming words data showing that when the happy face was a prime it led to more errors for psychopaths, but not controls (mean difference = 0.13, SE = 0.076, $p < 0.088$). Also, age was a significant variable ($F (1,27) = 12$, $p < 0.002$), as increasing age led to better accuracy.

Graph 8: Graph showing the mean error rates for target emotion for words priming faces



Discussion

Experiment four investigated differences between boys with psychopathic tendencies and controls from EBD schools on the ABBA, words and faces emotion priming task. It investigated two priming conditions- faces priming words and words priming faces. Emotion priming occurred in both conditions, as seen by the significant increase in response time and error rates for incongruent trials compared to congruent ones. The discrepancy in reaction time for word-face priming (62 ms) was about twice that of face-word priming (23 ms). For error rates the discrepancy was even larger, with word-face priming (0.12) almost five times more error-prone than face-word priming (0.026). This suggests that, as in the previous experiment, the word-face condition was harder than the face-word one.

The task successfully tapped emotion priming, as it did with adults (Richell, 2001). (Although, Richell's error data used raw errors rather than error rates, so they may be biased by the higher number of incongruent trials used). The results stand in contrast to experiment three where no emotion priming was found, but as mentioned previously, the small sample means that the data must be treated with caution. This tentatively suggests that emotion priming paradigms could be beneficial for understanding the way different emotions are processed, but more research is needed to see whether this is a reliable effect.

The emotion priming task was used in this experiment to investigate the differences between boys with psychopathic tendencies and those without. Group differences were discovered in the error data. For faces priming words, the psychopathic group made significantly more errors than controls ($p < 0.035$) and there was a trend in the same direction for words priming faces ($p < 0.071$). From graph 7 (p.100), it can be seen that the greater error rates for psychopaths were due mainly to their responses on incongruent trials and not congruent or neutral trials. This indicates that psychopaths did not experience a general problem in processing emotional stimuli.

Such a group difference might have been expected, as suggested by research from Williamson, Harpur and Hare (1991). They found male adult psychopaths did not make a lexical decision about affective words faster than neutral words, in contrast to controls and they concluded that psychopaths did not draw affective information from words. Similar overall group differences were initially found by Blair and Coles (2000) in a facial emotional expression recognition task for children with psychopathic tendencies and controls, but when age, sex and verbal IQ were controlled for, the effect disappeared. Notably, Williamson and her colleagues (1991) did not match IQ between the groups and this may have been behind their group difference in responding to affective stimuli.

Having established that a group difference in emotion priming occurred, the effects of specific emotions can be considered. Basic emotion processing theories (Blair, 1995; Blair, Jones, Clark & Smith, 1997; Eysenck, 1964; Gray, 1971; Patrick, 1994) would predict such effects. However, there was no evidence that the children with psychopathic tendencies performed differently according to the emotion involved, compared to non-psychopathic controls. None of the interactions of group, trial type and target or prime emotion reached levels of significance.

There was a trend for psychopaths to be less accurate than controls when a happy word was the prime ($p < 0.088$). Although not significant, it is intriguing as it is the only interaction with this group effect that approaches significance. Happy expressions are the easiest emotional expression to recognize (Lenti, Lenti-Boero & Giacobbe, 1999; Lapadula, 1996; Russell, Suzuki & Ishida, 1993) and happy words, on one occasion, seemed to parallel this effect (experiment one). This tentatively suggests that for words priming faces, the difficulty with incongruent trials was more marked for those with an easily recognized prime and harder-to-recognize target. Alternatively rather than ease of processing, affect may have a role. The focus may be on a positive prime, with switching to a negative target being problematic for psychopaths. Psychopaths may have focused on the prime face and in the case of the happy expression, processed and responded to it, before they remembered to switch to the target. This would lead to greater errors on incongruent trials and speedier responses on congruent trials involving happy. However, although happy, congruent trials were answered faster by psychopaths than controls (psychopaths: 700 ms, controls 820 ms), post hoc analysis did not find this difference significant (mean difference = 120 ms, SE = 100, n.s.). So, there is no evidence of a specific emotion effect behind the trend for greater interference errors on incongruent trials for psychopaths compared to controls, for words priming faces.

This is not to say that children with psychopathic tendencies do not have specific basic emotion processing deficits, as some evidence points to this (Blair & Coles, 2000; Stevens, Charman & Blair, 2001). For example, children with psychopathic impairments showed impairments in the recognition of sad and fearful facial expressions and sad vocal tone compared to controls (Stevens, Charman & Blair, 2001). However, this task does not tap those deficits and does not support the basic emotion processing deficits models for either empathy (Blair, 1995; Blair, Jones, Clark & Smith, 1997) or fear positions (Eysenck, 64; Gray, 1971; Patrick, 1994).

An alternative explanation is that this emotion priming task tapped executive difficulties in the psychopathic population. These executive difficulties may involve a specific emotion executive or general executive deficit. As no trials were completely emotionally neutral, this can not be easily differentiated from the present study. It was hypothesized that group differences on this task would be suggestive of emotion executive difficulties rather than general executive problems, as children with stable, antisocial behaviour have been shown to perform equally well as controls on the Stroop (White, Moffit, Caspi, Bartusch, Needles & Stouthamer-Loeber, 1994). However, children with conduct disorder and co-morbid ADHD performed less well on the Stroop (Pennington & Ozonoff, 1996) and there were higher levels of ADHD in the psychopathic group in this study. In addition, one recent study (Schmitt, 2001) has shown that adult psychopaths showed less interference from distracting words than controls on a non-emotional, picture-word Stroop. In contrast, the psychopathic group did as well as controls on a normal colour-word Stroop. This means that the results of this study could be interpreted in the light of executive, as well as emotion executive, theories.

With regards to theories of emotion executive deficits in psychopaths, the data does not fit Blair and Cipolotti's social response reversal theory (Blair & Cipolotti, 2000) as this postulated emotion-specific effects. It proposed that the deficient emotion executive system is triggered by others' anger and social disapproval cues. However, no group differences in executive performance were found for angry facial expressions or words as might be expected from this theory.

The data does not coincide with predictions from Damasio's somatic marker theory of psychopathic dysfunction (Damasio, 2000), which argues that the brain's analysis of biological (somatic) indicators of emotion is impaired, leading to faulty decision-making and inability to hold potential consequence of one's actions in memory. Although this paradigm does not involve explicit punishment and reward, one could compare the incongruent trials to the risky packs in the four-pack card playing task (Bechara, Damasio, Damasio & Anderson, 1994). Then, one could hypothesize that the group with psychopathic tendencies developed a "rewarding" strategy of responding correctly to the easier congruent trials, but did not experience a pre-emptive peak in skin conductance warning them of the "punishment" of getting incongruent trials wrong. Hence, their higher error rate on incongruent trials. However, skin conductance responses take at least two seconds to be generated (Blair, personal communication) and so, could not provide an explanation for performance on this brief task. The lack of evidence for the somatic marker deficit theory has been previously highlighted (Blair & Frith, 2000; Schmitt, Brinkley & Newman, 1999) and again, this group difference could be construed in general executive terms, without recourse to punishment and reward.

There are four ways this could be explained in terms of general executive deficits. The psychopathic deficit might involve impulsivity, over-focusing on the prime, difficulties with task switching or error-monitoring problems. The impulsivity element measured by factor two of the PSD could lead to impulsivity on this task.

Although, it seems unlikely that this could be entirely due to impulsivity, as some degree of impulsivity (and inattention) was controlled for, by using ADHD as a covariate. Even with this source of variance removed, it may be that impulsivity and levels of ADHD moderate the effect. Alternatively, the children with psychopathic tendencies might have found it harder to overcome the distractor-suppression effect (Neill, 1977) and suppress the unwanted prime. Another possibility is that the children with psychopathic tendencies found it more difficult to switch attention between the two tasks- responding to faces as targets and responding to words as targets. Finally, there may have been a specific difficulty with error-monitoring, which would account for the group effect showing up in the error data only.

Some explanation involving impulsivity, difficulty switching task or over-focusing on the prime is tentatively suggested by the fact that psychopaths were faster on congruent trials than controls (though the difference was not significant), as it is an unexpected direction. However, there is little evidence of longer reaction times to incongruent trials, which might be expected if lingering on the prime or difficulties with task-switching were occurring. The short time allowed for responding may have been responsible for this, having created a ceiling for incongruent trials (particularly on the words priming faces condition, which is harder).

It would be interesting to investigate between these different possibilities further. For instance, one could see both whether the group effect emerged without the ABBA design, where there would be less demands made on switching attention across tasks. Alternatively, using the PC version of the Superlab programme, data on incorrect responses could be recorded and it could be examined whether incorrect responses on incongruent trials were the emotion of the prime. This research could also look at whether the incorrect answers were due to impulsive responses before the target was processed or whether they were due to continued ambiguity after lengthy reflection.

Some of these general deficits in executive processing concur with studies supporting the response modulation hypothesis (Newman, Schmitt & Voss, 1997; Newman & Kosson, 1986; Patterson & Newman, 1993). The response modulation theory proposed impulsivity and deficits in error-monitoring for psychopaths when they are engaged in goal-directed behaviour. They said that once psychopaths are engaged in a task, they find it hard to pay attention to contextual cues, which might indicate a potential error. Without due attention to such cues, individuals fail to switch a stage of reflection, where they process and learn from their errors. In other words, psychopaths have difficulty in error-monitoring, which explains the clinical picture of their failures to learn from experience.

Such error-monitoring consists of retrospective comparison of one's behaviour and its consequences. This has been measured by the amount of pausing after incorrect, punished responses on passive avoidance tasks (Newman, Patterson, Howland & Nichols, 1990; Nichols & Newman, 1986). Error-monitoring has been described as automatic (Patterson & Newman, 1993) and less sensitivity to secondary information has been shown to occur without punishing feedback (Newman, Schmitt & Voss, 1997). Therefore, it is possible that problems with error-monitoring can occur without specifically informing the participant of their error. Participants can continue processing the stimuli after they have made a response and compare whether this was the correct response and decide whether they have adopted a useful strategy for responding. This process of automatic error-monitoring may have been deficient for the psychopathic group completing the emotion priming task. In accordance with this suggestion, psychopaths have performed as well as controls, when positive and negative feedback were provided during an extended inter-trial interval, which indicates that response modulation difficulties can be overcome when support with error-monitoring is given (Arnett, Howland, Smith & Newman, 1993; Newman, Patterson & Kosson, 1987). Designing an emotion priming task with feedback and extended inter-trial intervals could test this hypothesis of deficiencies in error-monitoring.

Patterson and Newman (1993) tentatively suggested that when those deficient in response modulation are corrected, this may increase goal-directed behaviour, but not encourage pause for reflection, leading to more impulsivity (Patterson & Newman, 1993). This could be the case for psychopaths, given their noted impulsivity in clinical descriptions (Cleckley, 1976) and clinical measures (e.g. PSD; Frick & Hare, in press).

The response modulation theory claimed that psychopaths only have difficulty with processing secondary cues once a dominant response set has been established, in line with psychopaths tendency to over-focus on their own immediate goals and ignore others' needs. To explain the pattern of results in this study, one would have to assume that responding to congruent trials was the dominant response set. Numbers could not have made congruent responding more dominant as incongruent trials outweighed congruent trials in a proportion of nine to six. Yet, it seems possible that congruent responding may have become the dominant response set, as they were the easiest to answer and may have been more rewarding.

Over-focusing on the prime could be in line with response modulation theory, provided the target, rather than the incongruent prime, was seen as secondary and contextual. However, intuitively it is the prime that is contextual as participants were instructed to respond selectively to the target. Kosson and Newman (1986) did not find evidence of a predicted psychopathic over-focus compared to controls on a selective attention task. The same authors in a different experiment tested whether psychopaths over-focused on reward in a go/no go task and failed to confirm this hypothesis (Newman & Kosson, 1986). In contrast, two recent experiments assessing the impact of distracting, contextual cues in a selective attention task, found that psychopaths were less influenced by the distractions and actually performed better than controls (Newman, Schmitt & Voss, 1997; Schmitt, 2001). In Newman, Schmitt and Voss' study, the distracting words (and pictures) occurred concurrently with the prime picture (and word). In Schmitt's study the distracting cues were the primes. This suggests some over-focusing does occur, but only under certain conditions and that appearing first in a sequence (like a prime) is not one of those conditions.

Psychopaths did perform more poorly than controls on a divided attention task when asked to complete a visual search task simultaneously with an auditory probe reaction time task (Kosson & Newman, 1986). However, given appropriate structuring, the psychopaths were able to switch attention without problem. This was seen in the experiment by Newman, Schmitt & Voss (1997) as they presented picture and word conditions in a mixed block. Each trial began with a prompt "P" or "W" to remind participants to respond to either the pictures or the words. Psychopaths performed better than controls. Therefore, according to response modulation theory, it is unlikely that the executive difficulty for the psychopaths on the emotion priming task was in switching between the two conditions.

There are several caveats to the following conclusions. Firstly, this experiment used slightly lower cut-offs for defining high-scorers on the PSD than those used previously in order to have a sufficient sample size. Scores of 27 or above formed the psychopathic group in some research (Blair, 1998; Fisher & Blair, 1998) and 26 or above in other studies (Fisher & Blair, 1998). The current study used a cut-off of 23, which may have led to a broader group with less specific emotional problems and more executive difficulties. Indeed, Colledge and Blair (2001) looked at children across the range of scores on the PSD and found related results linking impulsivity to high levels of PSD. Secondly, there was a high error rate in both conditions. The inter-stimulus interval was too short and not enough time was given for the children to respond. The lack of group differences in the reaction time data may have been affected by this. In particular in the specific emotions analysis of the reaction time data, fifteen cases were excluded because no correct responses were made on one or more prime-target combinations. Thirdly, the task suffered in its content validity in that it was a long task and not exciting enough to maintain interest levels in the child population.

The group difference of greater error rates for boys with psychopathic tendencies on incongruent trials could be explained in terms of the response modulation hypothesis (Patterson & Newman, 1993). There was no evidence to support either theories of executive emotion deficits or deficits in basic processing in emotions, as no group differences were found between the processing of stimuli depicting different emotions. The response modulation theory would suggest that the greater error rate for psychopaths was due to impulsivity and difficulties with error-monitoring. Unfortunately, no further analysis to investigate this prediction was possible, although it was suggested that further research using a program that recorded errors would be profitable. The group difference was significant for words priming faces and a trend for faces priming words. This was found in the error, but not the reaction time, data. This may have been caused by the ceiling effect for incongruent trials, created by the short inter-trial interval, which would be more apparent for the harder words priming faces condition. In spite of this caveat and others (e.g. more inclusive cut-off for psychopathy) the results do concur with predictions and experimental evidence from the response modulation hypothesis.

In addition to the group effects, there were effects of SOA and target emotion. For words priming faces, younger boys did not make use of the extra processing time allowed by the longer SOA (500 ms), whereas older boys did. Consequently, the older boys had lower error rates with an SOA of 500ms, compared to 300 ms, while younger children had high error rates for both SOAs. Also, for the error data in this priming condition, there was a significant effect of target emotion. Post hoc analysis found that this was due to more accurate responses to the happy face compared to the other three emotions. These effects will be discussed further in the conclusions.

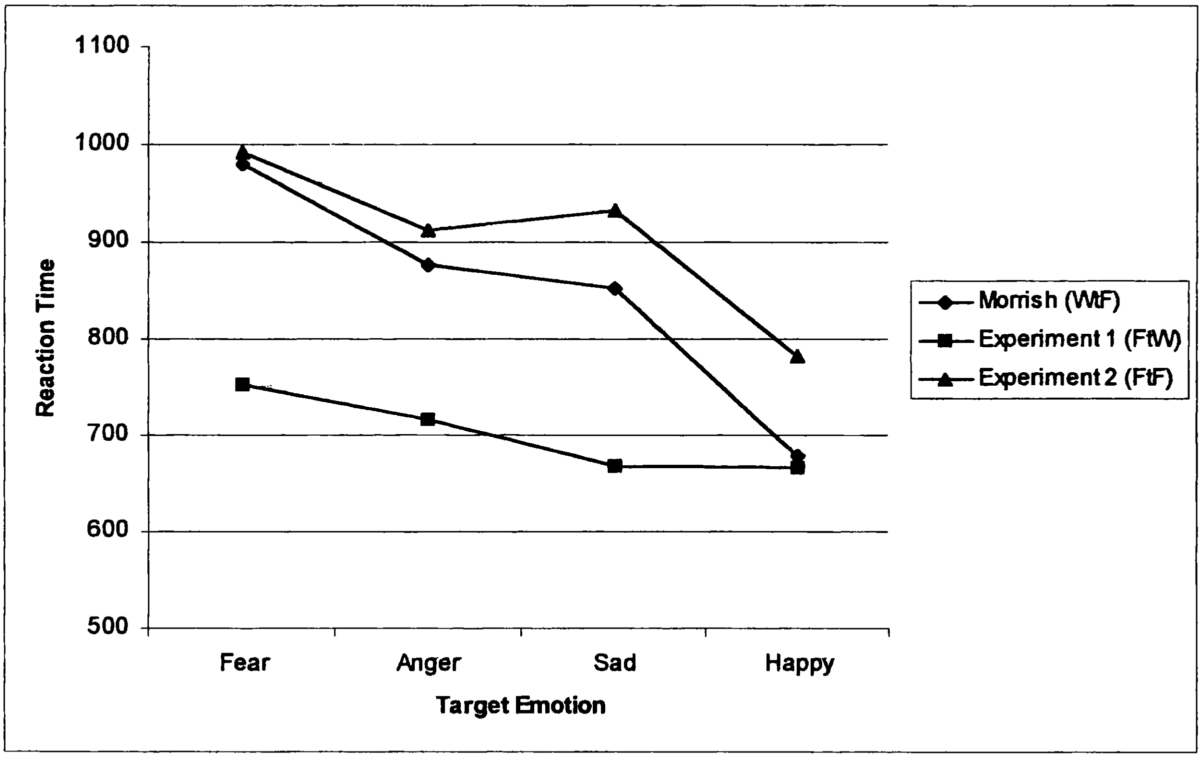
CONCLUSIONS

Target emotion

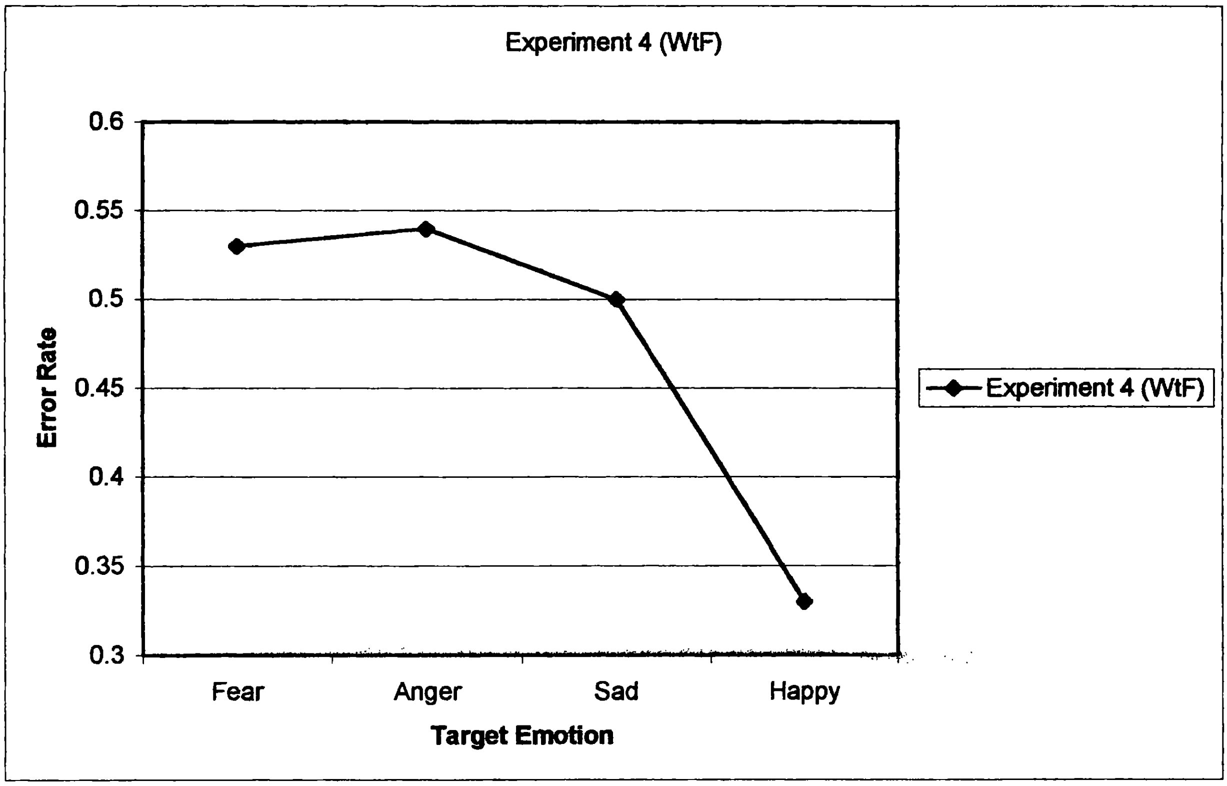
Although not predicted, one of the most consistent significant effects was that of target emotion. It was significant in experiments one, two and four (it was not analysed in experiment three), so it occurred under conditions of faces priming words (FtW), words priming faces (WtF) and faces priming faces (FtF). The results are similar to findings from another emotion priming task (Morrish, 2001). Morrish (2001) found a significant effect of target emotion for words priming faces, although not for faces priming words.

The reaction times and error rates for the target emotions can be seen from the two graphs below (Graph 9, p.115; Graph 10, p.116). Across priming conditions, fear was generally hardest to name, while happy was easiest. In experiments two and four, when faces were the targets, fear, anger and sad facial expressions all led to longer processing times and poorer accuracy compared to happy. In this case, the finding can not be distinguished from affective processing, where the difference is due to the positive or negative valence, rather than the specific emotion involved. However, there was evidence of the influence of specific emotions for both words and faces as targets, as post hoc analysis revealed differences between two negative emotions. Namely, fear was read slower than sad in experiment one (FtW) and fearful facial expressions were named slower than sad and angry ones in Morrish's study (2001, WtF).

Graph 9: Graph showing the mean reaction times of different target emotions across three different priming conditions



Graph 10: Graph showing the mean error rates for different target emotions for words priming faces



As far as I am aware, there are no studies looking directly at the different reaction times involved in reading specific emotion words. However, an effect of target emotion has emerged, unexpectedly, in some priming experiments. Niedenthal and her colleagues (Niedenthal, Halberstadt & Settlerlund, 1997) investigated the priming effect of feeling happy or sad on processing emotion words. Two experiments involved making a lexical decision and the third involved reading as a response. In all three cases there was an effect of target emotion on word processing, irrespective of how the participant felt. Happy and love tended to be processed faster than sad and anger. As happy had a similar reaction time to love and sad was similar to anger, they interpreted this result as an effect of valence. In contrast, Conway and Bekerian (1987), looking at the priming effects of reading emotional sentences on making lexical decisions about emotion words, did not find an effect of target emotion ($F(3,16) = 0.62$, n.s.).

Niedenthal and her colleagues (1997) interpreted their findings as evidence of a two-stage system in processing emotion words. The first stage quickly evaluates valence (from Kitayama, 1990) and the second stage focuses attention on negative emotions (from Hansen & Hansen, 1994; Pratto, 1994; Pratto & John, 1991). This sustained processing for negative stimuli interfered with the lexical decision response processing leading to longer reaction times. However, the findings across experiments are inconclusive. Klauer (1998) concluded as much in his review of affective priming, noting that Rothermund, Wentura and Bak (1995) found that positive personality traits interfered more with colour naming than negative ones. Also, some priming experiments have not elicited a main effect of target emotion (Conway and Bekerian, 1987) and others have found an effect of target emotion that could be due to differences between specific emotions (Experiment one of this study). The latter would imply that some affective priming results could by interpreted in terms of specific emotions.

The findings regarding the effect of target emotion when the targets are faces is less surprising. Several experiments involving recognition of facial expressions have found reaction time and error rate differences between the various emotions for both adults (Kirovac & Dove, 1985; Lapadula, 1996; McAndrew, 1986; Russell, Suzuki & Ishida, 1993) and children (Lenti, Lenti-Boero & Giacobbe, 1999; Sullivan, 1997). The most consistent result was that fear was harder to recognise than happy, which was also the case in this study (experiments one, two and four) and Morrish's study (2001). Again, there is evidence this is not just due to affective priming, but specific emotions have an influence (Morrish, 2001).

The significant findings for emotion word reading are based on only one experiment, but it can be tentatively noted that there appears to be a parallel between emotion word and face recognition, at least in terms of fear being harder to recognise than happy. This could suggest that the process for reading words involves the emotional or affective system. This goes against the theory by Glaser and Glaser (1989) that pictures have privileged access to the affective system, whereas words do not. It may be there are several routes to word processing and different routes are primed by the context. For instance, emotion priming tasks may favour processing of words according to their emotional and affective aspects.

Some of the experiments (experiment one; Morrish, 2001; Niedenthal, Halberstadt & Settlerlund, 1997) suggest a distinctiveness between emotions at psychological and possibly, neurological level. For example, Calder and his colleagues found a distinct impairment in fear recognition in patients with bilateral amygdala damage and concluded that "the recognition of facial emotions may therefore be linked, to some extent, to specific neural substrates" (Calder, Young, Rowland, Perrett, Hodges & Etcoff, 1996, p.742). Such distinctiveness is the basis for looking at selective recognition difficulties in clinical populations, such as children with psychopathic tendencies.

Priming paradigms often choose stimuli that have broadly similar reaction times. One implication of the difference in reaction time to each emotion is that any priming or other effect would have to be large to overcome the target emotion differences. This adds weight to the significance of emotion priming effects found in these experiments.

Stimulus onset asynchrony

Before considering these emotion priming effects, it is noteworthy that another variable emerged as significant. This was the stimulus onset asynchrony (SOA). Comparison with Richell's adult data (2001) and the normal child sample (experiment three) highlights the different effects of SOA in the clinical sample. Richell (2001) found significant main effects of SOA for both priming conditions in the reaction time data. In experiment three, there was a main effect of SOA for FtW in the reaction time data, which was best interpreted in the light of its significant interaction with trial type and there was a significant interaction of SOA with trial type for WtF in the error data. This present experiment found a significant main effect of SOA and significant interaction of SOA with age for WtF in the error data.

Adults seemed to use the extra processing time of the longer SOA to allow speedier responding in both priming conditions (Richell, 2001). For children at mainstream schools, the extra processing time gave some benefits on the incongruent trials and neutral trials (experiment three). The longer SOA (500 ms) allowed speedier responding, but only for faces priming words and only for incongruent trials. There was an increased error rate at an SOA of 500 ms for neutral trials in the other priming condition. In addition, at the shorter SOA (300 ms), incongruent trials caused significantly more errors than neutral trials. For the children with emotional and behavioural difficulties, there was no interaction with trial type and the effect of age was more important (experiment four). Older children made use of the extra processing time available at the longer SOA, whereas younger children did not.

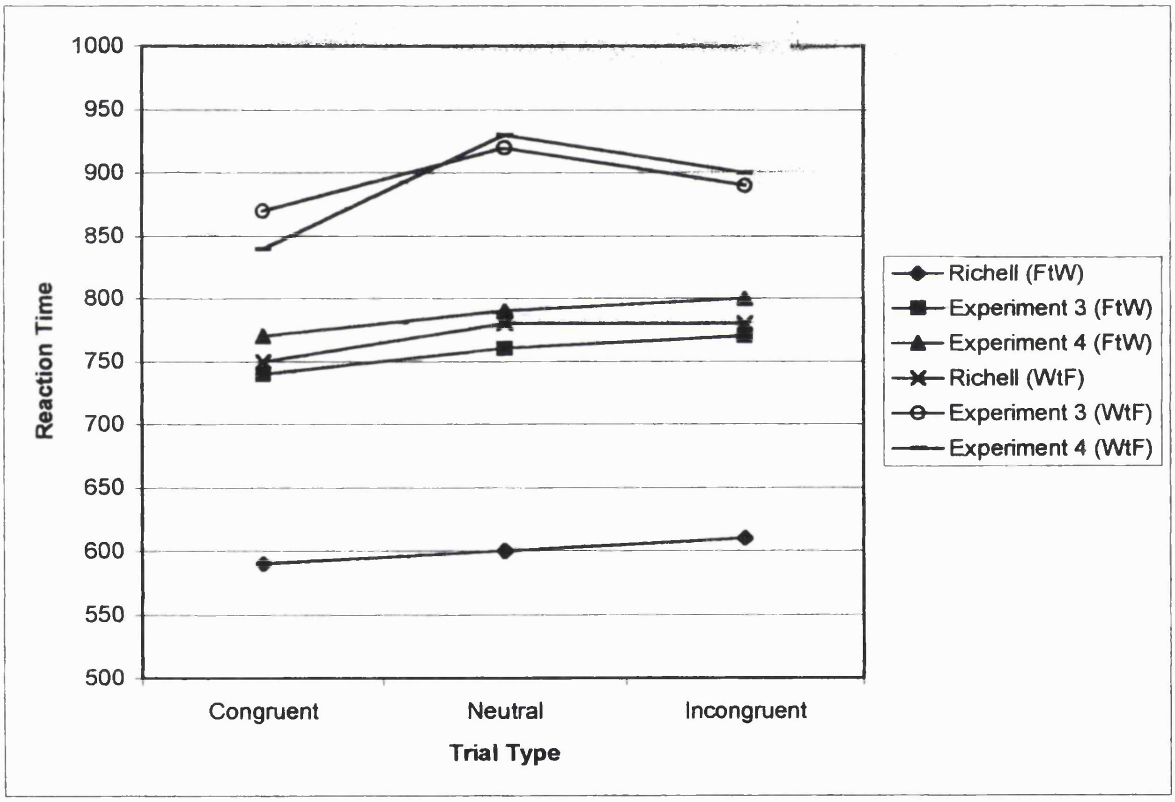
The different effects of SOA for children and adults suggest that there may be some developmental aspects to Stroop-related task performance. The adults were generally faster than the children (by about 200 ms for FtW and 100 ms for WtF: see graph 11, p.123) and less error prone (three times less error prone for FtW and four times less error prone for WtF than children from mainstream schools; four times less error prone for FtW and five times less error prone for WtF for children with emotional and behavioural difficulties: see graph 12, p.124). Part of their increased performance was due to better ability to use the extra processing time allowed by the longest SOA (500 ms). As mentioned previously, the time may be used for processing the distracting prime and suppressing it (Fazio, Sanbonmatsu, Powell & Kardes, 1986; Herman, de Houwer & Eelen, 1994). From the fourth experiment, it can be said that this is a skill learnt with age. Age may have been a factor in the third experiment, but it was not taken into account in the analysis. There may be differences in this skill development according to trial type, as suggested by results from experiment three. Sometimes, the boys benefited from a longer SOA on the harder trials (incongruent and neutral), but did not differ according to SOA for the easier congruent trials.

As far I am aware, there are few studies specifically looking at the changing effects of interference with age for older school-age children and this represents an area for future research. Plaut and Booth (2000) investigated the effect of SOA on word-word priming for eight year olds, eleven year olds and college students, but found that children showed no interference on their task at any SOA. Wainwright (1998) did find children were able to perform her orienting attention task and found they were less able to disengage attention from primed locations at the shorter SOA of 100 ms, compared to 800 ms. However, this was only the case for six year old children, not for ten or fourteen year olds or adults. Without further research on the developmental aspects of the Stroop, it is hard to interpret these different effects of SOA for children and adults.

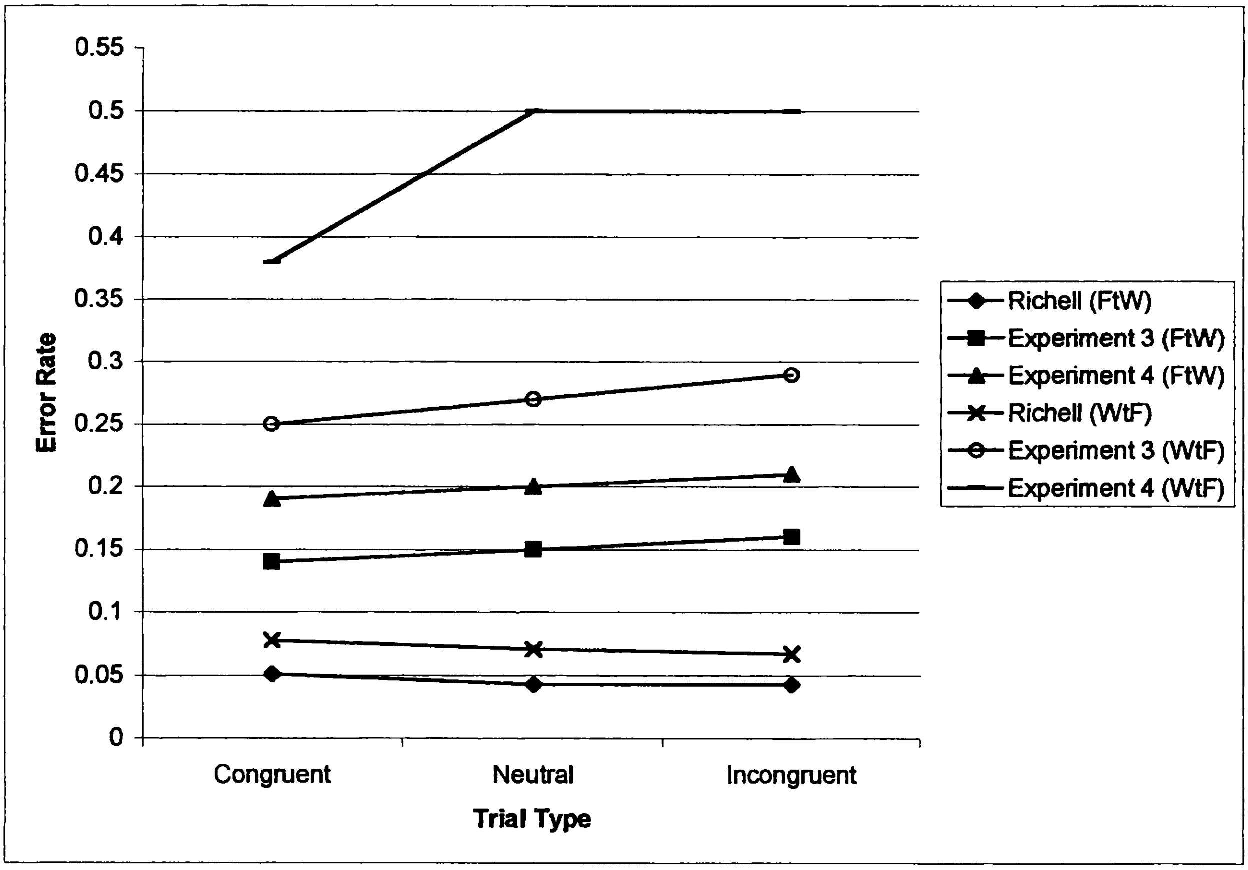
Emotion priming

The effects of target emotion and SOA were not predicted. The predicted result for each experiment was that emotion priming would occur. This was considered, at first, in terms of the differences between emotionally congruent, neutral and incongruent trials, using faces and words as stimuli. In the first two experiments, using a face-to-word and face-to-face priming task respectively, no emotion priming occurred. Richell (2001) developed an ABBA design, mixing face-to-word and word-to-face priming. This showed an emotion priming effect for adult participants in both reaction time and error data (but the error data used raw errors, not error rates). However, a pilot of this task with boys from mainstream schools did not replicate the results (experiment three). The sample was small, so further replication was carried out and the task was taken to boys from schools for children with emotional and behavioural difficulties (experiment four). Trends appeared in the error data for emotion priming. As the neutral trials were not always acting as neutral, these were excluded. Post hoc analyses (using sidak adjustments) found that emotion priming, as defined by the difference between incongruent and congruent trials, occurred for both priming conditions, for both reaction time and error data. (For comparisons of the reaction time and error rates across priming experiments, see graph 11, p.123 and graph 12, p.124).

Graph 11: Graph showing the difference in reaction times by trial type and priming condition across three emotion priming experiments



Graph 12: Graph showing the difference in error rates by trial type and priming condition across three emotion priming experiments



The Stroop and its family of related tasks has been described as a "challenging phenomenon" (McLeod, 1991, p.193), which echoes Neely's (1991) description of word to word semantic priming as a "richly complex mosaic of phenomena" (p.323). These two researchers were reviewing over two decades worth of research on the respective paradigms. Emotion priming tasks involving emotion words and facial expressions of emotion are a relatively new paradigm and, as such, there is little research that could ascertain the reliability of the effect or differentiate the task manipulations that lead to positive emotion priming.

Clearly, the effect is not robust across all conditions. For example, for faces priming words, an effect was found in experiment four and Richell's study (2001), but not in experiment one or Morrish's work (2001), in spite of the similar sample sizes. As can be seen from table 5 (p.127), emotion priming occurred across a child and an adult sample and across a clinical and a normal sample. SOA could also not be the major differentiating factor, as Morrish (2001) tested SOAs of 400 ms and 500 ms, which were similar to the 300 ms and 500 ms SOAs considered by Richell (2001) and experiment four.

The main difference appears to be in the design, the display times for prime and target and the inter-trial interval. Effectively, the two experiments that failed to find emotion priming had no inter-trial interval. One theory is that the pause between trials may be important for processing errors and learning the prime-target associations (Patterson &

Newman, 1993). Alternatively, the long display time for the prime may have allowed complete processing and suppression of the prime, so that it had little effect on responses to target words. This seems unlikely as Morrish (2001) found emotion priming for words to faces and word primes are easier to process than faces. Finally, the ABBA design used by Richell (2001) and experiment four may have been influential in elucidating a priming effect for faces to words, by focusing more attention on face primes because they were also used as targets. Primes have been shown to be more distracting when they are also used as targets in Stroop tests (Klein, 1964), flanker tasks (La Heij, Van der Heijden & Schreuder, 1985) and picture-word priming paradigms (Lupker & Katz, 1981).

Table 5: Table to show the differences in task design between four experiments involving face to word priming

	Richell (2001)	Four	Morrish (2001)	One
Participants:	Normal Adults	Clinical Children	Normal Adults	Normal Adults
Design:	ABBA	ABBA	A, B	A
SOAs (ms):	100,300,500	300,500	400, 500, 600, 700	1000
Prime display:	100ms	100ms	400, 500, 600, 700	1000
Target display:	1000 ms	1000 ms	Until answered	Until answered
ITI:	1250 ms	1250 ms	not fixed	not fixed

ITI = Inter-trial interval

The lack of priming for faces to faces is also intriguing, as it runs against the wisdom that when targets are also used as primes, interference increases. Some suggestions were made in experiment two that emotional expression recognition involves more sequential processing and that dynamic displays of facial expression or briefer, even suboptimal, displays of face targets would cause priming (from Bruce and Valentine, 1986a). Alternatively, other face recognition processes may play a greater part masking the lesser effect of emotion priming (from Murphy and Zajonc, 1993). Greater ambiguity of emotional expression might also reveal an emotion priming effect, as more objective stimuli led to weaker priming effects in Murphy and Zajonc's work (1993). Finally, from the same study, face-to-face priming may be more malleable to conditioning, as the first presentation of a face-ideograph pairing had a more influential effect than subsequent pairings. A larger response set might lessen this effect. Research involving these manipulations would be fruitful for eliciting whether emotional expressions can prime each other.

However, the above theories do not explain why emotion priming occurred with other priming conditions involving faces along with words (Morrish, 2001, Richell, 2001 and experiment four). The faces were still static, unambiguous and presented for 100 ms. The response set was no larger. Pictures and words have often been assumed to be processed in different neural systems (De Houwer & Hermans, 1994; Seymour, 1973; Warren & Morton, 1982) and that in picture-word interference tasks different kinds of priming are operating. For instance, Rayner & Springer (1986) discuss graphemic and semantic routes. Face processing has been theorised to be different from both picture and word systems (Bruce & Valentine, 1986a). It may be that be that pairings of facial expressions are not subject to priming effects or involve very different priming effects to the semantic priming tasks often used in priming research. It is possible that the priming seen in some of the experiments here is related to the emotional information stored in a semantic network, rather than the basic emotion processing systems used for recognition of facial expressions of emotion. This parallels De Houwer and Hermans' (1994) conclusions that picture-word evaluative priming occurs through semantic networks containing affective information (although affective and emotion systems may be distinct). In comparison to examples of face-word and picture-word priming, further replication of the negative result in experiment two would illuminate differing executive functions for the processing of faces, pictures and words.

Group differences between boys with and without psychopathic tendencies

Experiment four looked at the differences in emotion priming between boys with psychopathic tendencies and those with behavioural and emotional difficulties but without psychopathic tendencies. A high level of psychopathic tendencies (PSD $\geq$ 23), as measured by the PSD (Frick & Hare, in press) was significantly positively associated with greater error rates for incongruent trials, but not for congruent trials. This pattern of data could not be explained by the somatic marker theory (Damasio, 1994), the social response reversal theory (Blair & Cipolotti, 2000), by specific deficits in fear processing (Eysenck, 64; Gray, 1971; Lykken, 1995; Patrick, 1994) or by a deficient violence inhibition mechanism (Blair, 1995). The model that best fitted the data was the response modulation hypothesis (Patterson & Newman, 1993). Although in this case, the incongruent trials had to be interpreted as "more risky", "less rewarding" or the "less dominant style of responding". It was suggested that impulsivity and failures with error-monitoring led to greater error rates for the psychopathic group. Alternatively, over-focusing on the prime or difficulties with task switching may have been occurring, but these were less likely on theoretical grounds. Further analysis of the errors to determine between these possibilities would have been profitable, but as the Superlab program did not record errors, this was not an option.

Newman and his colleague (Patterson & Newman, 1993) have elaborated on the biological mechanisms responsible for psychopathic difficulties with response modulation. They postulated that psychopaths experience anomalous dissociation between activation and inhibition. Psychopaths have been shown to have weaker skin conductance responses (SCRs) than controls when anticipating aversive circumstances (Patrick, Bradley & Lang, 1993; Patrick, 1994). Newman and Patterson interpreted this as being caused by less response uncertainty, in contrast to previous theorizing, which has related this to insensitivity to punishment (Fowles, 1980; Hare, 1965). They see the SCR as a measure of electrodermal-mediated inhibition, which is poorly co-coordinated with activation mechanisms (such as those measured by heart rate). Heart rates have been found to be higher for psychopaths than controls anticipating aversive situations (Hare, 1978; Ogloff & Wong, 1990), but not causally linked to electrodermal activity (Ogloff & Wong, 1990). Newman and Patterson (1993) argued that the greater activation is linked to the psychopathic tendency for impulsive, instrumental action, rather than reflective processing.

At a neurological level, Gorenstein and Newman (1980) have considered the orbito-frontal cortex as being involved in response modulation. This has also been linked to recognizing facial affect (Hornak, Rolls & Wade, 1996), so it may be involved in executive responding to faces, as required on the emotion priming task. Fisher and Blair (1998) discussed its potential role as a site for psychopathic dysfunction when they found that children with psychopathic tendencies were jointly impaired in response modulation and moral reasoning. They postulated that proximal systems in the orbito-frontal cortex might be responsible for the dual impairment. Response modulation was considered impaired as damage to the orbito-frontal cortex has shown to lead to difficulties with response reversal and extinction (Rolls, 1997) and moral reasoning was impaired through damage to the violence inhibition mechanism, which included facial expression processing in the orbito-frontal cortex.

Although not discussed by Newman and his colleagues, another locus of control for processing peripheral information that contributes to error-monitoring is the anterior cingulate and its related cortical associations. Newman and his colleagues (Wallace, Vitale & Newman, 1999) cited a study by Jutai and Hare (1983) that collected event-related potentials (ERP) evoked by brief 1000 Hz tones. The N100 ERP was used as an index of attention and this was found to be similar for controls and psychopaths when participants were only listening to tones. In contrast, while participants were engaged in a video game, the amplitude of the N100 ERP fell and was significantly lower for psychopaths compared to controls. The N100 event related potential is also known as the error-related negativity component (ERN) as it has been hypothesized to be related to error detection. Measures of ERN from the anterior cingulate cortex are particularly sensitive to error detection (Carter, McDonald, Ross & Stenger, 2001; Scheffers, 2000).

Performance accuracy has also been linked to metabolic activity in the anterior cingulate cortex and glucose metabolic rate in the anterior cingulate during a PET scan on participants completing a Stroop task (Nordahl, Carter, Salo, Kraft, Baldo, Salamat, Robertson, & Kusubov, 2001). In particular, the right anterior cingulate has shown different levels of regional cerebral blood flow when comparing performance on incongruent and congruent Stroop trials (Pardo, Pardo, Janer & Raichle, 1990). So, anterior cingulate functioning has been linked not only to error detection and monitoring, but also specifically to the monitoring of errors on Stroop performance.

Interestingly, the anterior cingulate has also been implicated as a possible site for psychopathic dysfunction by Colledge and Blair (2001) in a study investigating the relationship between the inattention and impulsivity components of ADHD and psychopathic tendencies. Both components of the DuPaul ADHD Rating Scale (DuPaul, Power, Anastopoulos & Reid, 1998) were correlated to the two factors underlying the PSD (Frick and Hare, in press). Further analysis revealed this was mainly due to the impulsivity factor and not the inattention component. They noted that the impulsivity in ADHD has been linked to early dysfunction in a neural circuit involving the anterior cingulate (Swanson, Posner, Cantwell, Wigal, Crinella, Filipek, Emerson, Tucker & Nalcioglu, 1998) and that the anterior cingulate has rich connections with areas previously hypothesized to be the loci of psychopathic dysfunction (Amaral, Price, Pitkanen & Carmicheal, 1992), namely the amygdala and orbito-frontal cortex (Blair, Morris, Frith, Perret & Dolan, 1999; Blair & Frith, 2000; Damasio, 1994; Hare, 1998). In addition, a polymorphism of the dopamine 4 receptor gene has been associated with ADHD development (Swanson, Sunohara, Kennedy et al., 1998) and both the anterior cingulate and amygdala are rich in dopamine 4 receptors (Seeman & Van Tol, 1994).

From these theories, it can be seen that there are ways to connect the deficits in both executive and basic emotion processing systems. It is possible that dysfunction in the dopamine system could lead to problems with both amygdala-related distress cue processing and anterior cingulate-related executive functioning. Alternatively, primary dysfunction in the amygdala, orbito-frontal cortex or anterior cingulate may cause inefficiencies in processing also relying on the other two sites.

The results from experiment four found significantly increased error rates for boys with psychopathic tendencies when faces primed words and a trend for increased errors when words primed faces. This result would be consistent with a psychopathic response modulation deficit. Response modulation is an action planning process, which is aided by switching to reflective style after errors have been detected. Psychopaths are theorized to have difficulty with response modulation once a dominant response set has been established, as in selective attention tasks, such as the Stroop and Stroop-related tasks. Such a deficit may be related to inefficient anterior cingulate functioning in conditions of selective attention, as shown by decreased error-related negativity components (Jutai & Hare, 1983). Alternatively, the orbito-frontal cortex may be related to poorer accuracy in response modulation, through its joint role in facial expression recognition and response reversal. However, psychopaths have been shown to perform as well as controls in focused attention situations (where no competing stimuli are involved) (Jutai & Hare, 1983; Newman & Kosson, 1986). Therefore, whatever the locus of dysfunction for psychopaths, be it anterior cingulate, orbito-frontal or another network, it remains to be shown why error-monitoring processes are intermittent.

Further research

The above results need further testing to establish the reliability of the psychopathic deficit in responding to incongruent emotion priming trials and the ability of the response modulation hypothesis to explain such results. The conclusions of this study must be seen as tentative, given the broader range of PSD scores used in the psychopathic group and the low inter-trial interval, which led to high error rates for both targets and controls. Further testing of the response modulation hypothesis with priming experiments is one way forward. Congruent trials could be hypothesized to be the dominant response set and this could be encouraged by increasing the percentage of congruent trials (e.g. congruent: neutral: incongruent ratio = 1:1:1). Then it could be tested whether psychopaths continue to perform less accurately only on incongruent trials. In addition, the hypothesis of deficient error-monitoring could be tested using an emotion priming paradigm by investigating whether feedback on trials and extended inter-trial intervals reduces psychopaths' high error rates on incongruent trials.

Another area for further research is experimentation with the emotion priming task, looking at the effects of SOA, specific emotions and emotion priming. It has been suggested that the developmental effects of SOA on emotion priming could be investigated in older school children. From this study's results, a theory that could be tested is that with age, children are able to make more use of the extra processing time given by a longer SOA (around 500 ms) and that this occurs initially for harder trials, such as incongruent and neutral trials.

Considering the effect of target emotion, there has been little research on differences due to specific emotions in reading emotion words. Does this effect occur for reading emotion words alone, or for other priming paradigms, such as word-word tasks? Such differences would provide further evidence for different kinds of processing for the recognition of specific emotions (Calder et al., 1996) and make sense of the conflicting evidence about the effect of valence (Klauer, 1998).

Finally, the conditions influencing the effect of emotion priming could be investigated. From these experiments, it has been suggested that the ABBA design and the inter-trial interval may be crucial in eliciting an emotion priming effect in word-to-face and face-to-word conditions, but this needs further testing. The lack of face-to-face priming also requires further replication and if reliable, may suggest ways that face processing is different to word and picture processing. Further testing with dynamic, suboptimal or less intense expressions and larger response sets was suggested.

Strengths and Weaknesses of the Research Project

This study aimed to develop a task sensitive to emotion priming and then to test whether emotion priming was different for children with high psychopathic tendencies compared to controls. The latter was in order to contribute to the understanding of the development of psychopathy. A task that showed emotion priming was found, although, as mentioned above, the robustness of this effect has been questioned. The previously suggested research ideas would help investigate this. The project also fulfilled its aim of identifying a cognitive deficit that correlated with high psychopathic tendencies and this deficit could be explained by a theory of the development of psychopathy- the response modulation hypothesis (Patterson & Newman, 1993). Some ideas were given about how this deficit might work from the perspective of structural neuroscience, but one weakness of this research is that this was not tested and remains in the realm of the theoretical.

Another weakness of the research is the controversy surrounding the use of the word "psychopathic" to describe children. There is legitimate concern that the word carries a stigma (Quay, 1987) and some have argued that conduct disorder should be seen as equivalent to a childhood diagnosis of psychopathy (Lahey, Loeber, Quay, Frick & Grimm, 1992). However, the diagnosis of conduct disorder is based on assessment of behaviours and ignores the predictive validity of personality factors (callous-unemotional traits) in determining earlier onset, severity and level of violence in juvenile crimes (Frick, Barry & Bodin, 2001). These traits may be unique to a subgroup of children with conduct disorder (Frick & Ellis, 1999) and could be used as an alternative to the term "psychopathic tendencies" for children.

The DSM has not shied away from sub-typing children with conduct disorder. For instance the DSM-IV (APA, 1994) and DSM-IV-TR (APA, 2000) considered childhood-onset (antisocial activity before age ten) and adolescent-onset conduct disorder. This method of sub-typing has good predictive validity for determining which children with conduct disorder will continue to demonstrate antisocial behaviour as adults (Frick & Loney, 1999). Indeed, this group of children are similar to the group identified as having high psychopathic tendencies, as they have higher rates of ADHD (Moffitt, 1993), a cold, callous interpersonal style (Moffitt, Caspi, Dickson, Silva, & Stanton, 1996) and greater stability and severity of antisocial behaviour (Frick & Loney, 1999). However, using age to subtype neither furthers our understanding of the development of psychopathy nor enables research into stability of these personality traits and whether they are precursors of adult psychopathy.

Another concern of using the label "psychopathy" is the idea that it is biologically based and has a poor treatment prognosis. While some research with adolescents shows that poor treatment outcome is currently the case (Gretton, McBride, Hare, O'Shaughnessy, & Kumka (2001); Ridenour, 1996), being more precise about personality traits and cognitive deficits can further research into the development and measurement of interventions, as well as into the relationship between biological and environmental factors. With greater understanding, there is hope to develop more suitable interventions that may alter this perception of poor response to treatment.

In this way, using different descriptions, such as "callous and unemotional traits" and "response modulation deficits" can enable continued research, while lessening the stigma for children. At the same time, continuing the research may eventually challenge the preconceptions about psychopathy and the stigma itself.

Clinical implications

Difficulties with response modulation deficits, such as impulsivity and automatic error-monitoring, do have intuitive appeal for explaining psychopaths' engagement in risky activities and their repeated failure to learn from experience. Cleckley (1976) described psychopathic behaviour as responding to passing urges and whims without restraint. An example would be stealing money to get rich, without thinking of the consequences for oneself or others. Such impulses could be seen as the dominant response set, that secondary information from the environment and particularly from others' reactions does not interrupt. This would leave psychopaths at the mercy of their impulses, without the ability to notice, reflect on or feel guilty about their mistakes.

It seems important to understand the cognitive deficits behind such a lack of moral learning in order to aid assessment and treatment. The research project, of which these studies were a part, aimed to develop tasks that distinguished psychopaths from non-psychopaths and assessed psychopathic profiles of cognitive deficits. I do not think that the emotion priming task would be well suited for assessment of children with psychopathic tendencies. This is mostly due to issues of content validity mentioned earlier. The task was too difficult, long and lacking in appeal for children with attention difficulties. In addition, emotion priming has not been shown to be a robust effect. For example, it did not occur across all conditions used in this study (see p.125-7). If the aim is to tap response modulation deficits, other passive avoidance tasks may be more suited. For instance, the card playing task has been profitably adapted for use with children, by using a computerized version (Fisher & Blair, 1998).

In addition to the lack of content validity, the task does not have good specificity and little is known about its sensitivity. The response modulation deficits did distinguish children with high psychopathic tendencies from those with low psychopathic tendencies, but as a lower cut-off for psychopathic tendencies was used, it seems that the measuring response modulation deficits might not distinguish those children with the highest level of psychopathic tendencies. In other words, it would give false positives. It is hard to tell from this study whether it would also lead to false negatives, but the correlations of age, IQ and degree of ADHD with task results suggest that the task is sensitive to factors other than the level of psychopathic tendencies.

It is difficult considering implications for treatment, as diagnosis of psychopathy is associated with poor treatment outcomes (Rice, Harris & Cormier, 1992). Indeed, Ogloff and Lyon (1998) noted with concern that assessment of psychopathy in children might be used to exclude people from treatment rather than to find interventions tailored to their specific needs. This need to find suitable interventions remains, as most treatment packages for children with conduct disorder have been designed without additional callous-unemotional traits in mind (Frick, 1998). Also, controlled studies of treatment for children with these personality traits have not yet been conducted.

The results of this study were in concordance with theories of response modulation deficits in psychopaths. Wallace, Vitale and Newman (1999) argued that this meant that cognitive techniques would not be beneficial. They posited that during aggressive episodes, psychopaths could not access "contextual" schema-related information, such as social scripts telling them to inhibit their actions. They recommended behavioural techniques and control of the environment. The examples they gave were teaching to pause before acting and staying away from situations where continued self-control would be necessary (such as a bar for adults).

With a child population, appropriate support for addressing problems with impulsivity and error-monitoring might be the techniques used for helping children with ADHD, such as 'Stop and Think' strategies (Kendall, 1992). However, the pattern of symptoms is not identical to that of ADHD. In this study, difficulties in responding to incongruent trials remained even after ADHD had been taken into account.

Although not shown in this study, children with psychopathic tendencies have been found to have deficits in the recognition of emotional signals of distress (Blair & Coles, 2000; Stevens, Charman & Blair, 2001). This area also merits intervention. Possibly, the Stop and Think techniques could be adapted, to encourage children to 'Stop, Look for others' feelings and Think'. Previous group interventions teaching 'victim empathy' have been tried with adult psychopaths and found to be ineffective (Rice, Harris &

Cormier, 1992). Yet, the combination of addressing response modulation difficulties alongside emotion recognition problems may be more successful.

Frick and his colleagues (Frick, Barry & Bodin, 2000) observed that interventions for this patient group need to be multimodal, addressing combinations of interacting factors. They recommended work enhancing parent-child relationships, alongside reward-orientated behavioural interventions and encouraging hobbies and skills, which children would not want to lose as a consequence of antisocial behaviour. Focus on reward-oriented strategies would follow from the response modulation hypothesis. Psychopaths are theorized only to have problems with contextual cues once a dominant response has been set up. The more often pro-social behaviour is reinforced and rehearsed, the more likely it would become the dominant style of responding.

Although work on treatment for children with psychopathic tendencies is in its early stages, it is important, as earlier intervention might lead to greater efficacy than treatments tried with adults. This continuing search for appropriate interventions is a compelling reason to continue to refine the theory and assessment of the development of psychopathy.

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Appendix 1a: Consent Letter to Parents for Experiment Three

Information about the study

I am looking at the way boys recognise emotions in faces, comparing children from emotional and behavioural difficulties schools (EBD) with children at mainstream schools and also (for those at the EBD schools) comparing those described by their teachers as lacking in empathy, with those described as more empathic.

Participants in this study are boys between the ages of 7 and 17 years old, who will be asked to do a computerised test for half an hour. The test is run from a laptop owned by the researcher, so it can be done at any quiet location convenient to the child and their parents. The computer program requires naming the emotions shown in a slideshow of faces and words by pressing the appropriate key. It is a fairly easy test and expertise with computers is not necessary.

The study involves comparing groups, so it does not give any information about individuals- for instance, whether they are particularly good at recognising feelings.

I am hoping to re-test several children after six months. This is to establish the test-retest reliability of the program, which means looking at whether people are consistent in their performance.

Participation in this study is entirely voluntary and I am grateful for your taking time to help me with this research.

Thank you,

Parental Consent Form

I understand what the test of facial expression of emotion involves and I give my consent for my child participating in this research and taking the test.

Name of child:

Signature:

Date: 24/10/01.

I do/ ~~do not~~ give permission to be contacted in 6 months time to arrange a re-test.

Appendix 1b: Information about Study for Teachers and Consent Letter to Parents for Experiment Four

Information about the social and emotional awareness study

I am looking at the way boys recognise emotions in faces, comparing children with different levels of empathic awareness and I am investigating the interaction of ADHD on facial emotion recognition.

Participants in this study are boys between the ages of 7 and 17 years old, who will be asked to do a computerised test for twenty minutes. The test is run from a laptop owned by the researcher, so it can be done at any quiet location convenient to the child and his teacher. The computer program requires naming the emotions shown in a slideshow of faces and words by pressing the appropriate key. It is a fairly easy test and expertise with computers is not necessary.

Some participants will also be asked to complete the British Picture Vocabulary Scale, which is a quiz naming objects shown in pictures. This gives a rough measure of intelligence. This test is quite fun and takes about fifteen minutes.

The study involves comparing groups, so it does not give any information about individuals- for instance, whether they are particularly good at recognising feelings.

This study is part of a larger programme of research, led by James Blair, at the Department of Psychology, Queens Square, London. Children with ADHD are at high risk for developing conduct problems, scholastic underachievement and problematic social relationships. This research programme is focusing on the impairments in cognitive skills (such as different types of attention, facial emotion recognition, reactivity to praise and punishment) and the underlying brain basis of those impairments. Its ultimate objective is to develop a package of assessment tools to define these problem areas in cognition for individuals and we are already some way towards achieving this.

The nature of a child's skill deficits has implications for support programmes helping children to manage their behaviour and fulfil their potential. For example, can empathy training be adapted to draw on intact emotional skills to compensate for those that are impaired? Or is it advisable to give social skills training to people who are not rewarded by another's happiness and hurt by another's pain? These issues of support and treatment are of particular interest to me as I am training to be clinical psychologist. In my experience, the parents to whom I talked as I piloted this study also found these matters interesting.

Participation in this study is entirely voluntary and I am grateful for your taking time to help me with this research. I would be happy to support the school in any way I can. I could present the findings of my research to you or do alternative presentations drawing on my skills as a clinical psychologist that you might find useful. For example, I could talk about the work of clinical psychology or about a particular psychological disorder in which the staff have an interest. Also, I have run group sessions on social skills, relaxation or coping with bullying for children and teenagers and I would like to offer those skills to you, if they would be of benefit.

I appreciate your taking the time to consider my study.

Many thanks,

Clinical Psychologist-in-training
Phone:

Department of Psychology
UNIVERSITY COLLEGE LONDON
GOWER STREET LONDON WC1E 6BT

Tel: 020 7679 1130
Fax: 020 7916 8517
Code from overseas +00 44 20
e.mail: salima.budhani@ucl.ac.uk

13th November 2001

Dear Parent,

I am a Ph.D student at University College London working with Dr. James Blair. I am interested in the development of automatic emotional responses to objects and its relationship with classroom behaviour.

My research involves showing the children objects (such as pictures of animals) on a computer and asking them to make a response. The children will be deciding about values of different animals and which animals are profitable to select.

We are planning to conduct the work at School later on this term with the consent of , the Acting Head Teacher. We would like to invite your child to take part. The work would take just under 20 minutes and, following our experience with other pupils at use who have taken part in similar investigations, we know that most children find the experience enjoyable.

This work is basic research. We will not be looking at individual children's performance but at groups of children. However, we believe that this work will help the provision of classroom teaching in the future.

If you have any questions, please do not hesitate to contact me.

Yours faithfully,

Salima Budhani (B.Sc)

If you do not wish your child to take part, could you please return the slip below. If you are happy with your child's participation, you need do nothing.

I do not wish my child ____________________________ to take part in the research project.

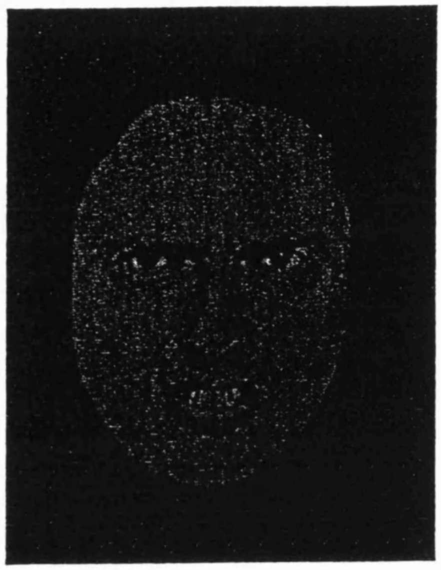
Signature of parent ______________________ Date _____/_____/_____

Appendix 2: Examples of Stimuli showing Facial Emotional Expressions

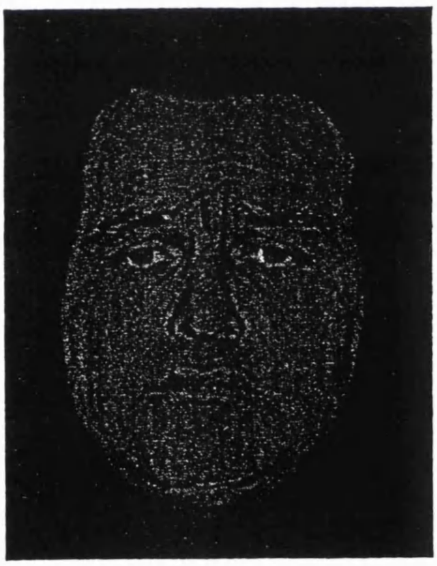
APPENDIX 2

FEAR

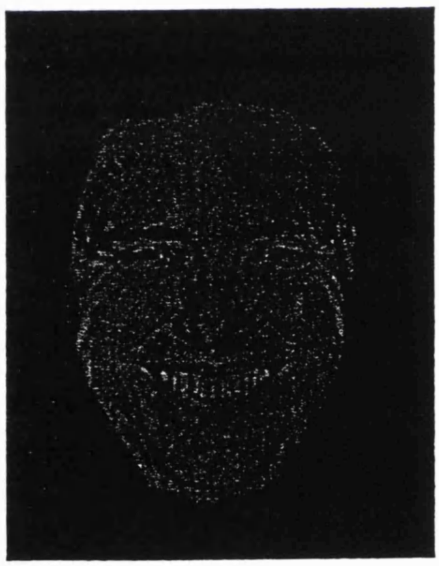
ANGER



SAD



HAPPY



NEUTRAL

Appendix 3: Examples of Stimuli showing Emotion Words

APPENDIX 3

FEAR

ANGER

SAD

HAPPY

Appendix 4: Ethics Approval Form

CAMDEN & ISLINGTON
Community Health Services NHS Trust
Your Partner for Health

LOCAL RESEARCH ETHICS COMMITTEE

Research Office, 3rd Floor, West Wing, St. Pancras Hospital,
London. NWI OPE
tel: 0171 530 3376 fax: 0171 530 3235
e-mail: research.office@dial.pipex.com
Chair: *Stephanie Ellis* Administrator: *Michael Peat*

5th April 2000

Dr James Blair
Institute of Cognitive Neuroscience and Department of Psychology
University College London
Gower Street
London
WC1E 6BT

Dear Dr Blair

Ref: 99/110 (please quote in all further correspondence)
Title: A Study of Children's understanding of Other People's Emotions

Further to your letter dated 29th March 2000, I am writing to confirm that ethical approval has now been granted for the above study to proceed. Please could you write and inform **Angela Williams** of the start date of your project, at the above address.

Please note that the following general conditions of approval apply:

- Investigators must ensure that all associated staff, including nursing staff, are informed of research projects and are told that they have the approval of the Local Research Ethics Committee.

- If data are to be stored on a computer in such a way as to make it possible to identify individuals then the project must be registered under the Data Protection Act 1984. Please consult your department data protection officer for advice.

- The Committee *must* receive immediate notification of any adverse event or unforeseen circumstances arising out of the trial.

- The Committee *must* receive notification: (a) when the study is complete; (b) if it fails to start or is abandoned; (c) if the investigator/s change; and (d) if any amendments to the study are proposed or made.

- The Committee will request details of the progress of the research project periodically (i.e. annually) and require a copy of the report on completion of the project.

Please forward any requested additional material/amendments regarding your study to the Ethics Committee Administrator or myself at the above address. If you have any queries, please do not hesitate to contact Michael Peat at the Research office.

Yours sincerely

Stephanie Ellis
Committee Chair

cc. Essi Colledge, UCL department of Psychology