Evidence of concurrent and prospective associations between facial affect recognition accuracy and children's involvement in antisocial behaviour

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Concurrent and Prospective Associations between Facial Affect Recognition Accuracy and Childhood Anti-Social Behavior

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Abstract

This study examined the concurrent and prospective associations between children's ability to accurately recognise facial affect at age 8.5 and anti-social behavior at age 8.5 and 10.5 years in a sub sample of the Avon Longitudinal Study of Parents and Children cohort (5396 children; 2644, 49% males). All observed effects were small. It was found that at age 8.5 years, in contrast to non-anti-social children; anti-social children were less accurate at decoding happy and sad expressions when presented at low intensity. In addition, concurrent anti-social behavior was associated with misidentifying expressions of fear as expressions of sadness. Children who misidentified expressions of anger as expressions of sadness at age 8.5 years were more likely to engage in anti-social behavior two years later whereas misidentifying fear as anger predicted a decreased risk of anti-social behavior two years later. The study suggests that rather than inaccuracy in facial affect recognition per se increasing risk for anti-social behavior, it is the nature of the errors that is more influential.

Keywords: Anti-social behavior; emotion recognition; longitudinal study; ALSPAC

Concurrent and Prospective Associations between Facial Affect Recognition Accuracy and Childhood Anti-Social Behavior

'Anti-social behavior' refers to a range of behaviors that contravenes societal norms, in addition to illegal or criminal acts that may not have necessarily resulted in prosecution (Rutter, Giller & Hagell, 1998), and includes acts such as fighting, truanting, cruelty to animals or substance use (Dickson, Emerson & Hatton, 2005). Anti-social behavior has been proposed to be a developmental trait that begins early in life, often continues into adulthood, and has particular developmental characteristics (Kelley *et al.*., 1997), and it has been found that even less serious delinquent acts may be precursors for violent and serious offending among a sub-sample of anti-social youth (Lipsey & Durzon, 1998). As these individuals are responsible for a disproportionate level of anti-social behavior and offending (Elliott, Huizinga & Morse, 1986), and such behavior is associated with further negative consequences for the young person (e.g. poor education, criminal record, truancy etc), considerable attention has been paid to identifying risk factors for early involvement in anti-social behavior.

The role of social information processing abilities (e.g. Dodge *et al.,* 1986), particularly the decoding of social cues in the development of anti-social behaviour has received some research attention. Evidence suggests that delinquent and socially rejected children exhibit a range of deficits associated with attributions of causality, interpretations of intent, social perspective taking, moral reasoning and generation of expectations about future events (Dodge, 1993). In particular these children have been found to display (among others) deficits in affective perspective taking (understanding the emotions of others) (Carlo, Eisenberg & Rosenberg, 1991), social perspective taking (Burack *et al.*, 2006) and social reasoning (Reiffe, Villanueva & Terwogt, 2005). Taken together Dodge (1993) argues that these findings are indicative of general deficits in the labelling of emotion in others.

The processes of affective and social perspective taking and understanding other's emotions are also central concepts within models of empathy and social sensitivity (Blair *et al.*. 1999; Borke, 1971; Feschbach, 1983; 1987). For example, Feschbach (1983) considers the affective empathy

reaction to be a function of the ability to identify affective cues in others the ability of assuming the perspective of another person and emotional responsiveness. Within the Violence Inhibition Mechanism Model (VIMM; Blair, 1995) it is proposed that the basic emotion system is activated by sad and fearful facial expressions which results in autonomic arousal and the inhibition of ongoing behavior (Blair, 1995). It is further suggested that in typically developing children sad and fearful expressions act as punishments for behaviors that elicit these expressions (e.g. anti-social/delinquent behavior). It therefore follows that individuals who are less sensitive to these expressions will perceive them to be less punishing, which will in turn decrease the likelihood that individuals will stop behaviors that elicit these expressions.

Some empirical evidence exists to support the idea that emotion recognition accuracy is associated with anti-social and problem behaviours and psychopathic personality traits among children and adolescents, although this appears to be a function of the nature of the stimuli (adult or child faces) employed. When examining the ability to identify emotions posed on adult faces, it has been found that incarcerated delinquent adolescents exhibit deficits when identifying emotions in contrast to non-incarcerated at risk adolescents, particularly for the expressions of sadness, surprise and disgust (McCown Johnson & Austin, 1986; McCown, Johnson & Austin, 1988). Similar findings have also been reported in samples of children diagnosed with either internalizing or externalising disorders. Walker and Leister (1994) found that children in the clinical group (combined internal and external diagnoses) were significantly less accurate than controls across all emotion stimuli. In addition, adolescents with internalizing disorders were significantly less accurate than those with externalising disorders in the recognition of sadness and disgust. It was also found that the recognition accuracy of certain emotions was positively associated with age.

Blair and Coles (2000) examined the relationship between facial affect recognition accuracy and behavioral problems as indexed by teachers ratings of the children on the Psychopathy Screening Device (PSD; Frick & Hare, 2001). A significant negative correlation between recognition accuracy and PSD scores was found indicating that the more behaviorally disturbed adolescents were less accurate in recognising facial affect. In particular it was found that this relationship held in the case of

recognising expressions of anger, sadness and fear. Small group comparisons of children with the highest and lowest teacher PSD ratings (n = 21) found significant differences in the ability of children to recognise sadness only. In a study that examined the association between conduct disorder types (early or adolescent onset) as well as psychopathic traits, and facial affect recognition, Fairchild, Van Goozen, Calder, Stollery and Goodyer (2009) found that both factors were associated with recognition accuracy. Specifically, the early onset group (n = 42) were significantly less accurate than the control group (n = 40) in recognizing the emotions of anger, disgust and happiness, whereas the adolescent onset group (n = 39) were less accurate in decoding fear. Only one difference emerged between the two conduct disorder groups and that was for the recognition accuracy of disgust, with the early onset group showing a relative deficit. When levels of psychopathic traits among the conduct disordered groups was examined (either high or low levels of traits) significant between group differences were identified for the recognition of fear, sadness, and surprise with those high in psychopathic traits achieving lower levels of accuracy. The findings of studies that examine facial affect recognition accuracy in relation to both child and adult faces support the findings of the previous studies, but indicate that such deficits typically arise when processing adult rather than child facial stimuli (Carr & Lujmeier, 2005; Stevens et al, 2001; Strand & Nowicki, 1999). However Strand and Nowicki did find some evidence of deficits for child facial stimuli in their conduct disordered sample.

It has been argued that in addition to identifying general facial affect decoding deficits, the precise nature of errors made when individuals are inaccurate is of equal importance (McCown, Johnson & Austin, 1988). McCown *et al.* (1988) argue that merely identifying global or emotion specific decoding deficits may not lead to the identification of a risk factor for subsequent delinquent behavior, as some errors may be more important than others. For example, errors that involve substitutions with similar emotions are deemed to be less problematic than those that involve substitutions with dissimilar emotions (e.g. happy as angry). Such errors could be taken to indicate severe information processing distortions which might have greater significance when trying to identify risk factors for future behavior. In order to test this possibility McCown *et al.* (1988) presented 84 participants with 100 slides depicting facial expressions. Half of the stimuli were rated

as ‘pleasant’, and the remainder ‘unpleasant’ and represented six basic emotions and some blended emotions. As expected, delinquents were less accurate than non-delinquents. Contrary to expectations delinquents did not make more dissimilar emotion substitutions when inaccurate than did non-delinquents and errors appeared to be more random with no specific patterns identified. Delinquents were also found to more readily misidentify neutral expressions as either unpleasant or pleasant, a finding taken by the authors to reflect either an intolerance of emotional ambiguity or response impulsiveness leading to direct responses even when insufficient information is presented with which to make an accurate judgment.

There are several notable limitations to the extant literature. All of the studies reviewed rely on a cross sectional design whereby facial affect recognition and conduct problems are assessed concurrently. As a result it is difficult to determine the temporal associations between these factors. Moreover it is unclear whether such deficits act as risk factors for problematic future behaviors. The majority of studies also employ very small samples which limit the ecological validity of the findings and render the statistical power inadequate for meaningful analyses. In addition, although there exists some suggestion that the processing of adult and child facial stimuli by children may be affected by the social relations between these groups (Youniss, 1980), studies typically examine the recognition of adult facial stimuli.

Despite credible evidence that females have superior facial affect recognition ability than males (McClure, 2000), and that males are more likely to engage in anti-social behavior (Moffitt, 1993) the majority of studies have used samples of males only, and where mixed gender samples are obtained, the effect of gender is not analysed explicitly. Finally, although engagement in anti-social behavior at an early age is one of the strongest predictors of future chronic and violent offending (Loeber & Farrington, 2000) the majority of studies used samples of adolescent children and offenders. It is theoretically important to examine the association between facial affect recognition ability and anti-social behavior in younger children in order to determine whether such deficits may be considered risk factors for involvement in early onset anti-social behavior.

The present study draws together the aforementioned strands of theory and empirical research

and extends the knowledge base in this area by examining the concurrent and prospective associations between facial affect recognition accuracy and anti-social behavior in a large general population cohort of boys and girls. On the basis of previous literature it is expected that at age 8.5 years, anti-social children will be less accurate at decoding facial affect than non-anti-social children. Moreover it is expected that males will be less accurate at decoding facial affect than females, and that there will be an interaction between anti-social group membership and gender such that anti-social males will exhibit the greatest deficit. An exploratory aim of the study is to examine whether at age 8.5 years anti-social children are more likely than non-anti-social children to make specific emotion misidentifications when inaccurate. Finally it is expected that facial affect recognition accuracy at age 8.5 years will predict involvement in anti-social behavior at age 10.5 years, and a further exploratory aim is to determine whether specific emotion misidentifications at age 8.5 years are associated with anti-social behavior at age 10.5 years.

Method

Design

This study incorporates both case control and longitudinal designs. In order to examine the question of whether anti-social children are less accurate in identifying facial affect than non-anti-social children, gender and anti-social group are treated as independent variables and facial affect recognition ability is the dependent variable. When examining the longitudinal prediction of anti-social behavior at age 10.5 years, facial affect recognition is treated as a predictor variable and antisocial behavior as a criterion variable.

Participants

The Avon Longitudinal Study of Parents and Children (ALSPAC) is a large multi-wave community-based longitudinal study of children and their families. Pregnant mothers' resident within the former county of Avon, with expected dates of delivery between 1.4.91 and 31.12.92 were recruited to the study. In total, 14,541 mothers enrolled in the study, representing an estimated 85%-

90% of the eligible population. There were 14, 062 live births delivered on or after 20 weeks, and 13,971 infants alive after 12 months. Full details of all measures, procedures, sample characteristics and response rates are available (Golding, Pembrey & Jones, *et al.* 2001). The focus of the present study is the 5396 children who provided self-report anti-social behavior data at age 10 in addition to data at age 8 years. Although the assessment sessions were scheduled to coincide with the participant's 8th and 10th birthdays, the average age of the children at the time of these assessments was 8.5 years (range 7.5 – 10.5 years) and 10.5 years (range 9.5 years – 12.5 years) due to individual differences in the ability and willingness to attend scheduled appointments.

Sample bias. In order to examine the possibility of bias within the sample, those children for whom anti-social behavior data were not available at either age 8.5 or age 10.5 (n = 8486) were compared to the remainder of the original cohort (n = 6276) on a variety of socio-economic indicators taken from some of the individual items of a family adversity index (Bowen *et al.*. 2005). These included young maternal age at time of first pregnancy, inadequate housing, low maternal education, financial difficulties, and large family size during pregnancy.

In contrast to those participants for whom there was complete data, those with missing data were born into families that were experiencing greater levels of socio-economic adversity. In particular those with missing data were more likely to have a mother who was under 20 years of age (11.5% v.s 3.8% $\chi^2 = 271.44$; $p < .001$), and who had not achieved a basic education (18.1% vs. 10.0% $\chi^2 = 165.93$; $p < .001$). In addition they were more likely to be living in inadequate housing conditions (10.2% vs. 3.9%; $\chi^2 = 190.33$; $p < .001$), experiencing financial difficulties (12.4% vs. 7.3% $\chi^2 = 85.20$; $p < .001$) and had a larger family size (2.1% vs 0.9%; $\chi^2 = 34.65$; $p < .001$) than were those for whom there were complete anti-social behavior data at both time points.

Ethical approval for the study was obtained from the ALSPAC Law and Ethics Committee and the Local Research Ethics Committees.

Measures

Anti-social Behavior. Children's self reported involvement in anti-social behavior was

recorded when the children were approximately 8.5 and 10.5 years of age. The first wave of data involved the children completing a posting task during which they were asked about the types of anti-social behavior that they had ever participated in. Eleven questions regarding anti-social activities were taken from the self-reported anti-social behavior for young children questionnaire (Loeber *et al*.., 1989). Children were asked whether they had ever participated in the following anti-social behaviors: stealing (bicycles, from a shop, from a house / garden, from a car, entered a building to steal, pick-pocketing); substance use (drunk alcohol, smoked cigarettes), fire setting, carried a weapon and cruelty to animals. Each question was written onto a different envelope. The child was asked to 'post' the envelope into one of two boxes marked as 'ever' or 'never' depending on their answer.

At age 10.5 years, the children participated in a face-to-face structured interview based on the same measures. During the interview children were asked whether they had been involved in 9 different anti-social behaviors (truanting, destruction of property, fire setting, theft, fighting, cruelty to animals, alcohol use, smoking, cannabis use) with a specified time reference of the last 6 months.

Facial emotion recognition. The ability of children to identify specific emotions expressed facially was assessed at age 8.5 years using the child faces subtest of the Diagnostic Assessment of Non-Verbal Accuracy (DANVA; Nowicki & Duke, 1994). This consisted of 24 photographs of child faces, with each face showing one of four emotions: happiness, sadness, anger or fear. Each photograph was displayed on a computer screen for two seconds, and the child had to respond as to whether the person in the photograph is happy, sad, angry or afraid. For each emotion, half of the presented stimuli were of high intensity and the other half were of low intensity in that each emotion was more or less obviously modeled. The intensity of the images had been validated previously by the test developers and is a central component of the DANVA design. The resulting data were the number of errors for each stimuli presented.

Intelligence. The WISC-III (Weschler, Golombok, & Rust, 1992) was used to assess cognitive function. A short form of the measure was employed in which alternative items (starting with item number 1 in the standard form) were used for all sub-tests with the exception of the coding subtest which was administered in its full form. The WISC-III consists of two parts, the first assesses

verbal skills (knowledge, similarities, arithmetic, vocabulary, comprehension sub-tests) and the second part assesses visuo-spatial skills (picture completion, coding, picture arrangement, block design, object assembly sub-tests).

Language comprehension. Language comprehension was assessed using the listening comprehension scale of the Weschler Objective Language Dimensions (WOLD, Rust, 1996) administered at age 8.5 years. The listening comprehension subtest of the WOLD is divided into two parts of which only the second was used due to conceptual overlap between the first part and the vocabulary subtest of the WISC-III. Alternate items from the standard test were used except in cases where the item had American cultural loading, in which case the next item was used. A total score, reflecting the number of questions (out of 16) answered correct, was derived.

Results

Preliminary Analyses

Prevalence of anti-social behavior within the cohort

Within the cohort there was a significant association between gender and anti-social behavior in that boys were significantly more likely to report involvement in anti-social behaviors than were girls. For example, 28.8% (949) of males and 15.8% (524) of females reported involvement in at least one anti-social behavior up until the age of 8.5 years ($\chi^2 = 161.36$, $p < .001$). In addition, at age 10.5 years 24.8% (845) of boys and 6.7% (234) of girls reported anti-social behavior in the last 6 months ($\chi^2 = 425.36$, $p<.001$). Overall involvement in anti-social behavior at age 8.5 was significantly associated with involvement in anti-social behavior at age 10.5 ($\chi^2 = 254.77$, $p<.001$). Due to the significant skew in the data a decision was taken to dichotomise involvement in anti-social behaviour into groups that either did, or did not, report involvement in any anti-social behaviour.

Associations between confounder and outcome variables.

Bivariate Pearson's correlations were conducted to determine the association between the potential

confounder variables and outcomes. These are presented in table 1 below.

[TABLE 1 ABOUT HERE]

Table 1 shows that in the majority of cases the pairwise correlations were significant. The only exception to this was that age was not significantly associated with the number of errors made when identifying emotions presented at high intensity for either boys or girls. In addition, whilst age was not associated with language comprehension for boys, it was for girls. Moreover table 1 shows that whilst the variables did co-vary the extent of this did not indicate substantial multicollinearity ($r < .80$, Tabachnik & Fidell, 2001).

Inferential Analyses

In order to test the hypothesis that children who reported involvement in any anti-social behavior by age 8.5 were less accurate in identifying facially expressed emotion and that there would be interactions with child gender, a series of 2 (Group: Anti-social/non-anti-social) x 2 (Gender: male/female) x 2 (Emotion intensity: High intensity/Low intensity) mixed analyses of co-variance (ANCOVA) were conducted in relation to the total errors across stimuli and separately for each emotion with the intensity (obviousness) of the stimuli presentation being the within subjects factor. In all analyses general cognitive abilities, language comprehension and age were added as covariates. Results were adjusted for multiple testing using a Bonferonni correction for Type 1 error (Field, 2005).

{TABLE 2 ABOUT HERE]

Decoding expressions of happiness

A significant interaction was found between the intensity of stimuli and gender ($F_{(1, 5895)} = 17.913$; $p = .000$; Partial $\eta^2 = .003$) which was attributed to the finding that the effect of gender was significantly

stronger for the low intensity stimuli (high intensity: ($F_{(1, 6178)}$ = 4.21; p = .04); low intensity: ($F_{(1, 6178)}$ = 56.34; p = .001). In addition a significant interaction between stimuli intensity and group was found ($F_{(1, 5895)}$ = 7.36; p = .007; Partial η^2 = .001), specifically for stimuli presented at low intensity ($F_{(1, 6171)}$ = 8.62; p = .003).

As expected a significant main effect of gender was found ($F_{(1, 5895)}$ = 23.445; p = .000; Partial η^2 = .004). Pairwise comparisons indicated that males were significantly less accurate than were females (Males: M = .16, Std. Error = .009, 95%CI = .15 - .17; Females: M = .11, Std. Error = .009; 95%CI = .10 - .13). In addition, a significant effect of stimuli intensity was found for the recognition accuracy of the anti-social group ($F_{(1, 1375)}$ = 8.31; p = .004) who were less accurate on low intensity rather than high intensity stimuli.

Decoding expressions of sadness

One significant interaction between the intensity and anti-social group was found ($F_{(1, 5895)}$ = 6.51; p = .011; Partial η^2 = .001). The anti-social group were significantly less accurate in their recognition of expressions of sadness than were the non anti-social children only for stimuli presented at low intensity ($F_{(1, 6171)}$ = 5.39; p = .020). It was also found that within the non anti-social group, significantly more errors were recorded for low intensity stimuli ($F_{(1, 4792)}$ = 18.16; p = .000).

A significant effect of intensity after controlling for general cognitive ability and age was found ($F_{(1, 5895)}$ = 8.66;p = .003; Partial η^2 = .001). Overall participants were more accurate in recognizing sad expressions when presented at high than low intensity (High intensity: M = .29, SD = .52; Low intensity: M = .35, SD = .63).

Decoding expressions of anger

A significant interaction between intensity and gender was found ($F_{(1, 5895)}$ = 10.42; p = .001; Partial η^2 = .002) as males were significantly less accurate than females in decoding expressions of anger when presented at low intensity ($F_{(1, 6178)}$ = 12.28; p = .000) and high intensity ($F_{(1, 6178)}$ = 77.45; p = .000), and when decoding expressions of anger when presented at low rather than high intensity ($F_{(1, 3086)}$ =

4.73; p = .030).

As expected a significant main effect of gender was found ($F_{(1, 5895)} = 28.64$; p = .000; Partial $\eta^2 = .005$). Pairwise comparisons indicated that on average males were significantly less accurate when recognizing angry expressions than were females (Males: *M* = 1.00; Std. Error = .014, 95% CI = .98 – 1.03; Females: *M* = .88; Std. Error = .018; 95%CI = .85 - .92).

Decoding expressions of fear

A significant main effect of intensity was found ($F_{(1, 5895)} = 10.64$; p = .000; Partial $\eta^2 = .002$). Contrary to expectations a non significant main effect of group was found ($F_{(1, 5895)} = .042$; p = .837) along with a non-significant effect of gender ($F_{(1, 5895)} = .69$; p = .793). Furthermore, the interaction between group and gender was also non-significant ($F_{(1, 5895)} = .51$; p = .475). In all instances partial $\eta^2 = .000$. No other interactions were found to be significant.

Is concurrent anti-social behavior associated with particular types of emotion misidentification?

In order to test the hypothesis that involvement in anti-social behavior at age 8.5 was associated with making particular types of errors a series of chi square analyses were conducted between involvement in anti-social behavior (yes/no) and a categorical variable derived to indicate whether across the presentation of each type of emotion the individual identified it as a specific alternative (e.g. happy as sad). The analyses were corrected for multiple testing using a Bonferroni correction which set the alpha level at .004. The results of the χ^2 analyses indicated that only one misattribution occurred more frequently in the anti-social than non-anti-social group. Anti-social behavior was associated with an increased likelihood of misattributing fear as sadness (Anti-social group: 16.6% vs 12.9% Non-anti-social group; $\chi^2 = 9.77$; p <.05). None of the other misattributions were associated with concurrent involvement in anti-social behavior.

Does facial affect recognition accuracy prospectively predict anti-social behavior?

Due to the large number of analyses undertaken, only the significant results will be discussed, (all data are available from the first author upon request). Contrary to expectations, in all instances the number of facial affect recognition errors recorded at age 8.5 years were not associated with the odds of children reporting involvement in anti-social behavior at age 10.5 years.

Do specific errors at age 8.5 predict involvement in anti-social behavior at age 10.5?

A series of logistic regression analyses were conducted in which involvement in anti-social behavior at age 10.5 was regressed onto each specific form of misattribution. In all analyses anti-social behavior at age 8.5, age and general cognitive abilities were controlled. Two of the results obtained appeared to be robust. First it was found that children who at age 8.5 misidentified the expression of anger as the expression of sadness were more likely to report involvement in anti-social behavior at age 10.5 (OR: 1.20; 95%CI: 1.00-1.45, p = .05). Second it was found that children who misidentified expressions of fear as expressions of anger were less likely to report involvement in anti-social behavior at age 10.5 (OR: .73; 95%CI: .57-.95, p = .008). All other results were less informative as in each instance the confidence intervals crossed 1.0.

Discussion

The aim of this study was to elucidate the hypothesized associations between children's facial affect recognition ability and involvement in concurrent and prospective anti-social behavior in a large birth cohort. Overall the results provided equivocal evidence of such associations. Although the sample size was large, in all cases observed effect sizes were small indicating that the observed effects provide tentative evidence of these associations and the identification of 'significant' results ($p<.05$) should not be taken to be conclusive of substantial effects (Sterne & Davy-Smith, 2001). However a number of the findings require further explanation.

Cross sectional findings

Previous studies that have employed adult facial stimuli consistently report that delinquent or externalizing adolescents exhibit global deficits in facial affect recognition (e.g. Blair & Coles, 2000; Strand & Nowicki, 1999; Walker & Leister, 1994), whereas those that examine child facial stimuli either report no such association (Carr & Lujmeier, 2005; Stevens *et al,* 2001) or limited evidence for such an association (Strand & Nowicki, 1999). The findings of the present study therefore appear more consistent with the latter group of studies that employed child facial stimuli. It is also possible that methodological variations between studies account for the lack of association found in the present study between anti-social behavior and facial affect recognition accuracy. For example, some of the studies operationalised delinquent behavior in terms of official sanctions (Carr & lutjemeier, 2005; McCown *et al.*, 1986; 1988), whilst others identified problematic behaviors on the basis of high scores on an independently rated behavioral inventory (Blair & Coles, 2000; Stevens *et al.*, 2001) and others used psychiatric diagnoses of externalizing behavior problems (Strand & Nowicki, 1999; Walker & Leister, 1994).

It is also possible that there exists considerable measurement error in the estimate of anti-social behavior employed in this study, as it is likely that the measure of anti-social behavior is contaminated by socially desirable responding, a factor that was not measured. It has been contended that self reported delinquency is the most appropriate measure to use in analyses of childhood anti-social behavior, and there is evidence to support its validity as a measure of this behavior (Farrington, 1973). Whilst this might indeed be the case, the impact of socially desirable responding remains an unaccounted source of variance.

A limited number of emotion specific deficits have also been reported, particularly in relation to the identification of sad and fearful expressions (e.g. Blair & Coles, 2000; Walker & Leister, 1994). Consistent with this literature, it was found that in contrast to children who did not report involvement in anti-social behavior, anti-social children were less able to accurately identify expressions of sadness, but only when presented at low intensity. However, anti-social children did not appear to have any deficits in the recognition of fearful expressions, and unexpectedly, anti-social children were relatively less accurate at identifying expressions of happiness when presented at low intensity. These

results are partially consistent with information processing models (e.g. Blair *et al.*, 1999) which suggest that negative emotions, particularly sadness, act as a punishment for typically developing children.

The deficit in recognizing subtle expressions of happy is more difficult to explain and may be more readily accounted for by a socialization based explanation (e.g. Bowen & Nowicki, 2007; Halberstadt, 1983; Hodgins & Belch, 2000) through which it is expected that exposure to emotion within family interactions enable children to learn to effectively encode and decode facial affect. Based on the evidence from this study it might therefore be suspected that the parents of anti-social children were ineffective in modeling subtle expressions of happiness and therefore as a result their children developed difficulties in decoding these expressions. However further research is required in order to examine more fully this possible explanation.

The results of this study only provide partial support for the hypothesized sex differences in facial affect recognition. Specifically, males were significantly less accurate at decoding expressions of happy and angry when presented at low intensities. Although substantial empirical evidence suggests that females have an advantage when recognizing facial affect (McClure, 2000) the evidence is not conclusive and explanations for such findings are in their infancy. Neither socialization (Fivush, 1993), nor neurological (McClure, 2000) theories regarding sex differences in facial affect recognition completely account for these findings as these explanations lead to the expectation of a global advantage across all emotions for girls. Alternative explanations have suggested that the ability to identify emotions specifically related to threat or intimacy may place females at an evolutionary advantage in their role as caregivers and child bearer (Geary, 1998). This might account for the apparent superior abilities of females to identify subtle expressions of anger and happiness in the present study.

Based on the findings reported by McCown *et al.* (1988), the association between the misidentification of specific emotions and involvement in anti-social behavior was examined. The findings of the present study however failed to support the original hypothesis as it was found that in contrast to non-anti-social children, anti-social children were more likely to identify expressions of

fear as expressions of sadness. That is, one negative emotion was misidentified as another rather than misidentifying positive emotions as negative emotions which was expected. These data suggest that although anti-social children were able to recognize that the emotion presented was negative, they were unable to accurately discriminate between negative emotions and therefore opted for the easiest to identify. This might reflect underlying deficits in amygdala functioning (c.f. Blair *et al.*, 1999). However, more research into the nature of recognition errors and their relationship with amygdala functioning is required, as certainly with respect to children's emotion identification there is some uncertainty regarding amygdala function in response to fearful expressions (Thomas *et al.*, 2001).

Longitudinal findings

Contrary to expectations no support was found for the hypothesis that inaccurate facial affect recognition would predict later involvement in anti-social behavior. However, it was found that misidentifying the expression of anger as sadness did increase the likelihood of engaging in anti-social behavior two years later. In addition, and somewhat unexpectedly it was found that misidentifying expressions of fear as anger led to a decrease in the likelihood of reporting involvement in anti-social behavior two years later. These findings whilst not completely expected are in some ways intuitive and can be interpreted within a social information processing account (c.f. Blair, 1995). If for example a child is prone to misidentifying others' expressions of anger as sadness they are less likely to perceive the threat to self associated with anger which itself might be perceived as a greater punishment than sadness. As a result it is possible that this misidentification reduces the sense of punishment associated with the behavior that elicited the emotional response and therefore increases the likelihood of it occurring again in the future. Additionally, if a child is prone to misidentify fear as anger, this is likely to be perceived as more of a direct threat to self and therefore act as more of a deterrent for behaviors that elicit this response in the future. This is the first prospective study to examine these associations and therefore these results stand alone. Further empirical research is required in order to examine the validity of these results and their interpretation.

Limitations

This study is the first to include a prospective design and use a large cohort sample in order to examine the associations between facial affect recognition and anti-social behavior. However it is not without its limitations and the results obtained need to be interpreted within this context.

It has been suggested that the facial affect recognition performance of children may be affected by the stimuli, specifically whether and adult or child faces are presented, due to interaction rules governing these relationships (Youniss, 1980). Youniss (1980) suggest that child-adult relationships are typically characterised by authority and submission. In contrast child-child relationships are characterised by sympathy and complicity. As a result it is possible that these relationships might impact on the recognition of specific emotions. For example, a child might be more likely to recognise expressions of anger when presented on adult rather than child stimuli. It is possible that such factors influenced the data with the present study as the stimuli consisted of only child faces. However there is mixed evidence of such effects (e.g. Strand & Nowicki, 1999). Future research therefore should incorporate both child and adult facial stimuli within a longitudinal paradigm to determine whether such effects are evident.

Although this study incorporates both cross sectional and longitudinal designs and as a result provides unique insights into the associations between variables, the study in no way provides evidence of the underlying mechanisms responsible for those associations. It has been shown that there exist many theoretical accounts of facial affect recognition development, all of which require additional variables to be examined than have been in this study to be fully tested. Of particular relevance is the lack of information concerning other intervening variables which could have influenced the likelihood of specific misidentifications at age 8.5 increasing the odds of children engaging in anti-social behavior two years later. Indeed, the consistently small effect sizes found lends support to the notion that many other variables are also associated with these relationships. Future research therefore should examine a multivariable model in order to determine the interaction between facial affect recognition accuracy and other areas of functioning associated with anti-social behavior risk. Such an enterprise would undoubtedly yield theoretically and clinically important

results.

Despite these obvious limitations, these data suggest that deficits in facial affect recognition ability are neither necessary nor sufficient to increase an individual's risk for future anti-social behavior. It appears as McCown *et al.* (1988) suggest that it is the nature of the error which is important rather than inaccuracy per se. This finding may have clinical implications. There is evidence that facial affect recognition accuracy can be increased through the provision of feedback (Grinspan, Hemphill & Nowicki, 2002). Therefore such retraining of anti-social children may decrease their risk of engaging in anti-social behavior in the future. Contrary to McCown *et al.*'s reasoning that the most problematic errors are those in which positive emotions are misclassified as negative emotions or vice versa, these data indicate that the misidentification of one negative emotion as another negative emotion may be just as problematic.

References

Bowen, E., Heron, J., Waylen, A., & Wolke, D. (2005). Domestic violence risk during and after pregnancy: Evidence from a British longitudinal study. *British Journal of Obstetrics and Gynaecology,* 112, 1083-1089

Bowen, E., & Nowicki, S. Jnr., (2007). The ability of children exposed to family violence and maltreatment to recognize facial emotions: Evidence from a British cohort. *Journal of Nonverbal behavior* (Special Edition: Nonverbal behavior in global contexts), 31 (3), 169 - 184

Blair, R.J.R. (1995). A cognitive developmental approach to morality: Investigating the psychopath. *Cognition,* 57, 1 – 29

Blair, R.J.R., & Coles, M. (2000). Expression recognition and behavioral problems in early adolescence. *Cognitive Development*, 15, 421-434

Blair, R.J.R., Morris, J.S., Frith, C.D., & Perrett, D.I. (1999). Dissociable neural responses to facial expressions of sadness and anger. *Brain,* 122, 883-893

Borke, H (1971) Interpersonal perception of young children: Egocentrism or empathy? *Developmental Psychology*, 5, 263 - 269

Burack, J.A., Flanagan, T., Peled, T., Sutton, H.M., Zygmuntowicz, C., & Manly, J.T. (2006). Social perspective taking skills in maltreated children and adolescents. *Developmental Psychology,* 42 (2), 207-217

Carlo, G., Knight, G.P., Eisenberg, N., & Rotenberg, K.J. (1991). Cognitive processes and prosocial behaviors among children: the role of affective attributions and reconciliations. *Developmental Psychology*, 27 (3), 456-461

Carr, M.B., Lutjemeier, J.A. (2005). The relation of facial affect recognition and empathy to delinquency in youth offenders. *Adolescence,* 40(159), 601-619

Dickson, K., Emerson, E., & Hatton, C. (2005). Self reported anti-social behavior: prevalence and risk factors amongst adolescents with and without intellectual disability. *Journal of Intellectual Disability Research,* 49(11), 820-826

Dodge, K (1993). Social cognitive mechanisms in the development of conduct disorder and

depression. *Annual Review of Psychology*, 44, 559-584

Dodge, K.A., Pettit, G.S., McClaskey, C.L., & Brown, M (1986). Social competence in children. *Monographs of Social Research in Child Developmental Services*, 213(2), 51

Eckman, P., Friesen, W.V. (1974). *Pictures of facial affect.* Paolo Alto, CA: Consulting Psychologists Press

Elliott, D.S., Huizinga, D., & Morse, B. (1986). Self reported violent offending: A descriptive analysis of juvenile violent offenders and their offending careers. *Journal of Interpersonal Violence*, 1, 472-514

Fairchild, G., Van Goozen, S.H.M., Calder, A.J., Stollery, S.J., & Goodyer, I.M. (2009). Deficits in facial expression recognition in male adolescents with early-onset or adolescence-onset conduct disorder. *Journal of Child Psychology and Psychiatry, 50,* 627-636.

Farrington, D.P. (1973). Self reports of deviant behavior: Predictive and stable? *The Journal of Criminal Law and Criminology*, 64(1), 99-110

Feschbach, N.D. (1987). Parental empathy and child adjustment/maladjustment. In N Eisenberg & J Strayer (Eds). *Empathy and its development (pp271-291).* New York: Cambridge University Press.

Fivush, R (1993). Emotional content of parent-child conversations about the past. In C.A. Nelson (Ed) *Memory and affect in development: The Minnesota symposia on child psychology (*vol 26, pp 39-77). Hillsdale, NJ: Erlbaum.

Frick, P.J., & Hare, R. (2001). *The psychopathy screening device.* Toronto: Multi-Health Systems.

Geary, D.C (1998). *Male and female: the evolution of human sex differences.* Washington, DC: American Psychological Association.

Golding, J., Pembrey, M., Jones, R., *et al* (2001) ALSPAC - The Avon Longitudinal Study of Parents and Children. 1. Study methodology. *Paediatric and Perinatal Epidemiology*, **15**, 74-87

Grinspan, D., Hemphill, A., & Nowicki, S, Jnr. (2003). Improving the ability of school age children to identify emotion in facial expressions. *Journal of Genetic Psychology,* 88-100

Halberstadt, A.G. (1983). Family expressiveness styles and nonverbal communication skills. *Journal of Nonverbal Behavior*, 8, 14-26

Hodgins, H.S., & Belch, C. (2000). Interpersonal violence and nonverbal abilities. *Journal of Nonverbal Behavior*, 24, 3-24

Jolliffe, D., & Farrington, D.P. (2004). Empathy and offending: a systematic review and meta-analysis. *Aggression and Violent Behavior*, 9, 441-476

Kelley, B.T., Loeber, T., Keenam, K., & DeLamatre, M. (1997). Developmental pathways in boys' disruptive and delinquent behavior. *Juvenile Justice Bulletin*, December, 1-20

Loeber, R., Stouthamer-Loeber, M., van Kammen, W.B., & Farrington, D.P. (1989). Development of a new measure of self-reported anti-social behavior for young children: prevalence and reliability. In M.W. Klein (ed). *Cross-national research in self-reported crime and delinquency*. Kluwer Academic Publishers.

Loeber, R., & Farrington, D.P. (2000). Young children who commit crime: epidemiology, developmental origins, risk factors, early interventions, and policy implications. *Development and Psychopathology*, 12, 737-762

McClure, E.B. (2000). A meta-analytic review of sex differences in facial expression processing and their development in infants, children and adolescents. *Psychological Bulletin*, 126, 42-453

McCown, W.G., Johnson, J.L., & Austin, S.H. (1986). Inability of delinquents to recognize facial affects. *Journal of Social Behavior and Personality*, 1, 489-496

McCown, W.G., Johnson, J.L., & Austin, S.H. (1988). Patterns of facial affect recognition errors in delinquent adolescent males. *Journal of Social Behavior and Personality*, 3, 215-224

Moffitt, T.E. (1993) "Life-course persistent" and "Adolescent-limited" anti-social behavior: A developmental taxonomy. *Psychological Review*, 100, 674-701

Nowicki, S. Jnr., & Duke, M.P (1994). Individual differences in the nonverbal communication of affect: The Diagnostic Analysis of Nonverbal Accuracy scale. *Journal of Nonverbal Behavior*, 18, -35

Rust, J. (1999). *The Wechsler Objective Language Dimensions Manual*. London: The Psychological Corporation.

Rutter, M., Giller, H., & Hagell, A. (1998). *Anti-social behavior by young people*. Cambridge:

Cambridge University Press.

Sterne, J.A.C., & Davy-Smith, G. (2001). Sifting the evidence – what's wrong with significance tests? *British Medical Journal*, 322, 226-231

Stevens, D., Charman, T., & Blair, R.J.R. (2001). Recognition of emotion in facial expressions and vocal tones in children with psychopathic tendencies. *Journal of Genetic Psychology*, 16 (2), 201-211

Strand, K., & Nowicki, S. Jnr (1999). Receptive nonverbal processing ability and locus of control orientation in children and adolescents with conduct disorders. *Behavioral Disorders*, 24 (2), 102-108

Tabachnik, B.G., & Fidell, L.S. (2001). *Using multivariate statistics.* (4th Edition). Boston, MA:Allyn & Bacon.

Thomas, K.M., Drevets, W.C., Whalen, P.J., Eccard, C.H., Dahl, R.E., Ryan, N.D., & Casey, B.J. (2001). Amygdala response to facial expressions in children and adults. *Biological Psychiatry*, 49, 309-316

Tremblay, C., Kirouac, G., & Dore, F.Y. (2001). The recognition of adult's and children's facial expressions of emotions. *The Journal Psychology*, 12 (4), 341-350

Tremblay., R.E., Pihl, R.O., Viaro, F., & Dobkin, P.L. (1994). Predicting early onset of male anti-social behavior from preschool behavior. *Archives of General Psychiatry*, 51, 732-739

Walker, D.W., & Leister, C. (1994) Recognition of facial affect cues by adolescents with emotional and behavioral disorders. *Behavioral Disorders*, 19(4), 269-276

Weschler, D., Golombok, S., & Rust, J. (1992). *WISC-IIIUK Weschler Intelligence Scales for children – Third Edition, Manual*. London: The Psychological Corporation.

Youniss, J. (1980). *Parents and peers in social development: A Sullivan-Piaget perspective*. Chicago, IL: University of Chicago Press.

Table 1. Pearson's correlation coefficients between all confounding variables and outcomes

Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1 Total errors all stimuli	-	.85	.90	-.07	-.17	-.18	-.12
2 Total errors for high intensity stimuli	.85	-	.54	-.05[a]	-.17	-.17	-.10
3 Total errors for low intensity stimuli	.88	.51	-	-.08	-.13	-.15	-.10
4 Age	-.08	-.05[a]	-.08	-	-.16	-.14	.04[a]
5 WISC: Verbal IQ	-.18	-.19	-.14	-.16	-	.48	.44
6 WISC: Performance IQ	-.20	-.19	-.16	-.13	.51	-	.25
7 WOLD: Comprehension	-.11	-.10	-.09	.020	.46	.27	-

Note: Numbers above the diagonal represent the Pearsons correlations for boys, those below the diagonal are the correlation coefficients for girls. a denotes correlation not significant after adjustment for multiple testing (Bonferroni) which required $p<.001$ to be deemed significant.

Table 2. Descriptive statistics for accuracy of identification across emotion, intensity of presentation and gender

Emotion	**Intensity**	**Gender**	**Group**		**$F_{(1, 5895)}$,**		
			M (SD)				
			Anti-social	Non-anti-social	Intensity	Gender	Group
Happiness	High	Male	.08 (.30)	.09 (.29)	1.02, p =.314	23.45, p = .000	1.62, p = .203
		Female	.07 (.27)	.07 (.29)			
	Low	Male	.27 (.51)	.22 (.49)			
		Female	.18 (.43)	.15 (.41)			
Sadness	High	Male	.29 (.51)	.29 (.52)	8.66, p = .003	.872, p = .350	.488, p = .486
		Female	.28 (.53)	.30 (.53)			
	Low	Male	.39 (.66)	.35 (.63)			
		Female	.38 (.64)	.32 (.61)			
Anger	High	Male	.79 (.82)	.77 (.79)	2.21, p = .137	28.64, p = .000	.013, p = .908
		Female	.63 (.71)	.61 (.73)			
	Low	Male	1.23 (.93)	1.24 (.91)			
		Female	1.17 (.89)	1.16 (.88)			

Fear	High	Male	.33 (.74)	.30 (.72)	10.64, p = .000	.690, p = .793	.042, p = .837
		Female	.31 (.72)	.28 (.70)			
	Low	Male	1.12 (.94)	1.08 (.91)			
		Female	1.11 (.92)	1.12 (.91)			