Journal of Child Psychology and Psychiatry 46:3 (2005), pp 327–336 doi: 10.1111/j.1469-7610.2004.00356.x

Deafness to fear in boys with psychopathic tendencies

R.J.R. Blair,[1] S. Budhani,[1,2,3] E. Colledge,[4] and S. Scott[5]

[1]Mood and Anxiety Disorders Program, National Institute of Mental Health, National Institutes of Heath, Department of Health and Human Services, USA; [2]Department of Psychology, University College London, UK; [3]Institute of Cognitive Neuroscience, University College London, UK; [4]SGDP Research Center, Institute of Psychiatry, King's College London, UK; [5]Department of Linguistics, University College London, UK

The processing of the emotional signals of others is fundamental for normal socialization and interaction. Reduced responsiveness to the expressions of sadness and fear has been implicated in the development of psychopathy (Blair, 1995). The current study investigates the ability of boys with psychopathic tendencies to process auditory affect information. Boys with psychopathic tendencies and a comparison group, as defined by the Antisocial Process Screening Device (APSD: Frick & Hare, 2001), were presented with neutral words spoken with intonations conveying happiness, disgust, anger, sadness and fear and were asked to identify the emotion of the speaker based on prosody. The boys with psychopathic tendencies presented with a selective impairment for the recognition of fearful vocal affect. These results are interpreted with reference to amygdala dysfunction and components of the Integrated Emotion Systems model. **Keywords:** Amygdala, psychopathic tendencies, psychopathy, integrated emotion systems.

The disorder of psychopathy is characterized by callousness, a diminished capacity for remorse, superficial charm, proneness to boredom and poor behavioral controls (Cleckley, 1967; Hare, 1991). Psychopathic criminals commit a disproportionate amount of crime, habitually fail to fulfill societal obligations and are unperturbed when confronted with the destructive nature of their behavior. Psychopathy is indexed behaviorally in children using the Antisocial Process Screening Device (APSD: Frick & Hare, 2001), and in adults by using the Revised Psychopathy Checklist (PCL-R: Hare, 1991). Both scales index a similar syndrome involving overt behavioral characteristics such as impulsivity and antisocial behavior as well as emotional dysfunction indicated by a lack of guilt and empathy, and superficial charm (Frick & Hare, 2001; Hare, 1991). However, while there are strong similarities between the APSD and PCL-R, it is premature to suggest the two are isomorphic. There are content differences that, at least partially, reflect the intention of both measures to be age appropriate. Thus, some PCL-R items have no APSD counterparts (e.g., parasitic lifestyle). Likewise some APSD items have no PCL-R counterparts (e.g., concerned about schoolwork). Importantly, however, comparable neuro-cognitive impairments are observed in children with psychopathic tendencies and adult psychopathic individuals (e.g., Blair, 1995, 1997; Newman, Patterson, & Kosson, 1987; O'Brien & Frick, 1996).

Currently, there are two main positions on the nature of the affective characteristics of psychopathy. The fear position stresses the aspects of psychopathy related to stimulation seeking and insensitivity to punishment (Hare, 1970; Lykken, 1995; Patrick, 1994). The empathy position stresses the aspects of psychopathy related to reduced sensitivity to the emotional signals of others; particularly sadness and fear (Blair, 1995). These two positions were integrated into the expanded, neurocognitive Violence Inhibition Mechanism model (Blair, 2001) which, in turn, has been developed further into the Integrated Emotion Systems model (Blair, in press). At the neural level, the suggestion is that the amygdala is the primary locus of dysfunction in psychopathic individuals (Blair, 2001; see also Patrick, 1994), although other regions such as orbitofrontal cortex may also be affected (Blair, 2003; Damasio, 1994; LaPierre, Braun, & Hodgins, 1995; Mitchell, Colledge, Leonard, & Blair, 2002). In line with this, psychopathic individuals have been found to present with reduced amygdaloid volume relative to comparison individuals (Tiihonen et al., 2000) and have been found to show reduced amygdala activation, relative to comparison individuals, during an emotional memory task (Kiehl et al., 2001). In addition, functional imaging studies have reported amygdala responses to sad and fearful expressions but not to angry or disgusted facial expressions (Blair, Morris, Frith, Perrett, & Dolan, 1999; Morris et al., 1996; Phillips et al., 1998). Moreover, at a functional level, the amygdala is known to be involved in aversive conditioning and potentiation of the startle reflex by visual primes (Angrilli et al., 1996; LaBar, LeDoux, Spencer, & Phelps, 1995). Similar to patients with amygdala lesions, individuals with psychopathy show impairment in aversive conditioning and potentiation of the startle reflex by visual threat primes [e.g., a picture of a pointed gun] (Lykken, 1957; Patrick, 1994). In addition, psychopathic adults and children with psychopathic tendencies show reduced skin

Published by Blackwell Publishing, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA

conductance responses to sad but not angry expressions (Aniskiewicz, 1979; Blair, 1999) and children with psychopathic tendencies have been found to show selective recognition difficulties for sad and fearful expressions but not for happy, surprised, disgusted or angry expressions (Blair, Colledge, Murray, & Mitchell, 2001).

At the cognitive level, the suggestion is that moral socialization occurs through the pairing of the sadness/fear of others with representations of the acts that caused the distress cues; i.e., moral transgressions (Blair, 1995). In conditioning terms, the sadness and fear of others act as unconditioned stimuli for both aversive conditioning (resulting in the individual disliking actions that hurt others) and instrumental learning (resulting in the individual avoiding actions that harm others). It is thought that a failure in the conditioning process is the fundamental cause of the difficulty in the psychopathic individual to be socialized. There are thus some similarities between Blair's model of the development of morality and Kochanska's work on the development of conscience (Kochanska, 1993, 1997). The major difference is that whereas Kochanska stresses 'fearfulness' as the important temperamental factor determining the child's ability to be socialized, Blair, in contrast, argues that fearfulness is an index of the developmental integrity of the amygdala and that empathy induction (Hoffman, 1987) is the most effective form of parenting strategy. Interestingly, there is evidence that the dysfunction associated with psychopathy does interfere with the processes that allow socialization. Thus, while positive parenting (i.e., supportive parenting involving empathy induction and not physical punishment), as measured by the Alabama Parenting Questionnaire (Frick, 1991), was significantly inversely correlated with level of antisocial behavior in healthy children, type of parenting behavior had no predictive power for the level of antisocial behavior shown by children who present with the callous and unemotional, affective impairment associated with psychopathy (Wootton, Frick, Shelton, & Silverthorn, 1997).

Previous studies of 'empathic' responding in psychopathic individuals have almost exclusively used visual stimuli, in particular facial expressions (Blair, Colledge, Murray et al., 2001; Blair, 1999). There have been very few studies of the ability of psychopathic individuals to process emotional information from vocal intonation. One study recently investigated the ability of adult psychopathic individuals to recognize an individual's emotion from their vocal intonation and reported reduced ability to recognize sad and fearful vocal intonations (Blair et al., under revision). A second study investigated the ability of children with psychopathic tendencies to process vocal intonations and reported reduced ability to recognize sad vocal intonations (Stevens, Charman, & Blair, 2001). However, this study involved a very small sample ($N = 9$ in both groups). Moreover, participants' IQ scores were not reported and therefore we cannot be sure whether the observed results reflect intellectual ability. However, an understanding of the ability of children with psychopathic tendencies to process emotional information from vocal intonation is important. The neuro-imaging literature suggests that the amygdala shows significant activity to fearful, though not sad, vocal affect (Morris, Scott, & Dolan, 1999; Phillips et al., 1998). Positions stressing amygdala impairment in psychopathy (Blair, 2001; Patrick, 1994) should therefore predict impairment in the recognition of fearful vocal affect in children with psychopathic tendencies. Moreover, at the cognitive level, if, as has been claimed (Blair, 2001), the emotional impairment seen in psychopathy interferes with socialization, we might expect to see comparable impairment emotional recognition in both the auditory and visual modalities. Without this comparable impairment, and assuming that the fearful voice is as aversive as the fearful face, there should be the possibility of socialization through the unimpaired modality.

The current study investigates whether boys with psychopathic tendencies will show impairment in the processing of sad and fearful vocal intonations.

Method

Design

This experiment involved a 2 (Group; boys with psychopathic tendencies and comparison individuals) × 5 (Emotional vocal intonations; happy, disgust, anger, sadness and fear) mixed model factorial design. The groups were made up of boys separated into two groups based on their Antisocial Process Screening Device (APSD) scores. The dependent variable was the number of errors made for each emotional vocal intonation. The participants' ages and their scores on the British Picture Vocabulary Scale were also recorded (BPVS; Dunn, Wheklan, & Pintillie, 1982).

Participants

The participants were recruited from three schools for boys with emotional and behavioral difficulties (EBD). All of these children had received statements under the Education Act of 1993 as being too problematic for mainstream education. However, this is an educational and not a clinical setting and thus none had received psychiatric diagnoses. The authors employed an EBD comparison group to insure that both groups of children were subjected to the same environmental influences in their school life, in order to minimize extraneous factors that may have had an effect on the task. All children invited to participate in the study and for whom parental consent was obtained did participate. The boys were free to withdraw from the study at any time.

The participants were selected on the basis of the combined scores of two teachers, or a teacher and a classroom assistant. Initially 150 boys were screened

Table 1 Participant characteristics and mean vocal emotion recognition errors for boys with psychopathic tendencies and comparison individuals

	Psychopathic tendencies group ($N = 22$)			Comparison group ($N = 21$)		
	M	*SD*	Range	*M*	*SD*	Range
Participant characteristics						
APSD	30.52**	3.07	25 to 37	6.48	4.68	0 to 15
C/U	7.28**	1.41	5.5 to 10	2.43	2.10	0 to 6
Impulsivity	8.83**	1.87	6 to 15	2.57	2.49	0 to 8
Narcissistic	11.15**	2.33	4.5 to 14	1.52	1.63	0 to 6.5
Age	13.15	.91	12.3 to 15.5	12.87	.82	11.8 to15.2
IQ	87.82*	8.51	73 to 108	94.52	12.46	79 to 126
Vocal affect recognition errors (maximum = 12)						
Happiness	3.73	3.17	0 to 11	1.75	1.92	0 to 7
Disgust	4.00	3.88	0 to 11	3.50	2.91	0 to 10
Anger	2.18	1.82	0 to 8	2.25	1.56	0 to 5
Sadness	2.05	1.53	0 to 6	2.50	2.82	0 to 9
Fear	4.73*	3.84	0 to 12	2.20	1.96	0 to 7

Key to Table 1: APSD = Antisocial Process Screening Device; C/U = the Callous and Unemotional component of psychopathy (e.g., a lack of guilt); I/CP = the impulsive and conduct problems component of psychopathy (e.g., engaging in crime); IQ = intelligence quotient (from BPVS); N = number of participants.
*$p < .05$. **$p < .001$.

using the Antisocial Process Screening Device (Frick & Hare, 2001). In line with previous work (Blair, Colledge, Murray et al., 2001; Fisher & Blair, 1998), participants with an APSD score of 25 or above were eligible for the psychopathic tendencies group (14% of total population) and participants with an APSD score of 15 or below were eligible for the comparison group (25% of total population). Twenty-two boys were included in the psychopathic tendencies group and 21 boys were included in the comparison group.[1] As there were more potential comparison boys than boys with psychopathic tendencies, the boys chosen were selected if they attended the same class as the boys with psychopathic tendencies.

Participant details are reported in Table 1. A one-way ANOVA showed no significant differences between the ages of the groups ($F(1,42) = 1.47$, n.s.). There were, however, significant differences between the mean IQ score of the two groups, with the comparison children scoring higher than the children with psychopathic tendencies ($F(1,42) = 4.28$, $p < .05$). As a result of these significant differences IQ was included as a covariate in all future analyses. All children in the psychopathic tendencies group were Caucasian. Twenty out of 21 children in the comparison group were Caucasian (the remaining child was Asian).

Measures

British Picture Vocabulary Scale (BPVS; Dunn et al., *1982).* The BPVS measures receptive vocabulary for standard English. Vocabulary has been considered to be the best single measure of academic achievement (Dale & Reichart, 1957). The BPVS is not dependent on the child's ability to read.

Antisocial Process Screening Device (APSD; Frick & Hare, 2001). The APSD consists of 20 behavioral items presented in a questionnaire format. It is designed to measure the characteristics of psychopathy in a way that is analogous to the Revised Psychopathy Checklist (PCL-R; Hare, 1991) which was designed exclusively for adults. Recently, a three-factor structure into which the cognitive and behavioral characteristics may be separated has been identified in a large community sample of children (Frick, Bodin, & Barry, 2000). These are: (1) Narcissism (including items such as 'seems to think that he/she is better than other people', 'uses or "cons" other people to get what he/she wants'), (2) Impulsivity (including items such as 'acts without thinking of the consequences', 'engages in risky activities'), and (3) Callous-Unemotional (including items such as 'is not concerned about the feelings of others', 'does not show feelings or emotions'). Frick et al. (2000) left one item (6; 'lies easily and skillfully') unclassified and chose to exclude item 2, 'engages in illegal activities'.

Scores of '0' for items referred to the fact that the statement was 'not true at all', 1 being 'sometimes true' and 2 being 'definitely true'. Five items were inversely scored prior to the totaling of each statement to obtain the final APSD score, which was out of 40. Participants' scores for each item were the averages assigned by the two raters. Pearson's correlations of the two ratings for each child were $r = .69$ ($p < .001$) for total APSD score, for Factor 1 (Narcissism) .73 ($p < .001$); for Factor 2 (Impulsivity) .84 ($p < .001$); and for Factor 3 (Callous-Unemotional; C/U) the inter-rater correlation co-efficient was .48 ($p < .05$).

As seen in Table 1, the mean APSD scores of the boys with psychopathic tendencies and the comparison boys were 30.52 and 6.48 respectively. Current US community sample data indicates that less than 5% of boys score more than 24 on the APSD. The community

[1] The schools involved in the current study have been kind enough to allow us to work with them on previous studies. Of these 43 participants, 7 children with psychopathic tendencies, and 11 comparison children had taken part in previously published studies (Blair, Colledge, & Mitchell, 2001; Blair, Colledge, Murray et al., 2001).

sample mean was considerably lower (10.90); (Frick, personal communication). Thus, the mean APSD score of the boys with psychopathic tendencies in the current study represents a greater level of behavioral problems than 95% of the community population. The mean APSD score of the comparison boys was lower than the community average.

Vocal Affect Recognition Test. This task was originally developed by Scott and colleagues (1997) in an investigation of a patient with a bilateral amygdala lesion. This test involved 6 bisyllabic concrete nouns with neutral meaning (carpet, finger, hammock, motor, sailor, daughter). These nouns were selected by Scott et al. (1997) because of their varied phonetic properties. The initial phoneme was varied across two fricative onsets, two plosive, one aspirant and one nasal obstruent. Stress was held constant (on the first syllable) and each stressed syllable featured a different vowel.

These nouns were spoken by six native English speakers (3 male, 3 female, with a variety of accents), in five different manners intended to convey emotions of happiness, disgust, anger, sadness and fear. Scott et al. (1997) chose these emotions because they are each known to have varied phonetic qualities (Murray & Arnott, 1993). Scott et al. (1997) provided training and feedback to ensure that appropriate prosodic features were used to communicate each emotion. They recorded the speech in a sound-protected environment onto digital audio tape (DAT).

Scott et al. (1997) digitized tokens of each speech item at 22 kHz, and presented these to 5 judges for categorization as each emotion. They used these categorizations to make up a set of two different stimuli per emotion (1 male voice, 1 female voice) which resulted in similar average correct categorization of each emotion across the 5 judges (happiness, 82%, sadness, 93%, anger, 94%, fear, 89%, disgust, 84%).

Each of the ten stimuli was presented 12 times. Because many of the children initially found the task quite difficult, the first 6 times were treated as a practice block and data from this block was not recorded. Stimuli were presented in random order on a Macintosh G3 laptop computer. Stimulus presentation was under participant control – a new stimulus would only be presented after the participant had responded to the previous stimulus.

Procedure

Each participant was tested individually in a quiet interview room allocated by the school. The task was described without informing the participant of the investigation's specific objectives and expectations. The objective of participants was to determine what emotion the speaker was thinking or feeling at the time that the word was spoken. Each participant was reminded that the meaning of the words would not convey any emotion. Instead they were instructed to rely purely on the way in which the word was spoken to determine what emotion the speaker was thinking or feeling. Participants could take as much time as they required before proceeding to the next stimulus. They were told to choose one of five response options (happiness, disgust, anger, sadness and fear) for each stimulus presented. These options were placed in front of the participant and were available at all times. The duration of the experiment was approximately 24 minutes for each participant.

Results

A correlational analysis was carried out to explore the effect of age and IQ on task performance for the total sample and the groups separately. This revealed several significant correlations; for the total sample and the two groups separately there was a significant correlation between IQ and the ability to recognize disgusted vocal affect (for total group, $r = .54$, for children with psychopathic tendencies, $r = .64$, for comparison individuals, $r = .50$; $p < .05$). Thus, for the children in this sample. as IQ increased, ability to recognize disgusted vocal affect also increased. For the children with psychopathic tendencies, there was a significant association between age and the ability to recognize fearful vocal affect ($r = .54$; $p < .01$). For the total group, there was a significant association between IQ and the ability to recognize fearful vocal affect ($r = .35$; $p < .05$). In addition, for the comparison individuals, there was a significant association between IQ and the ability to recognize sad vocal affect ($r = .45$). Because of these effects, all subsequent analyses included age and IQ as covariates.

An initial 2 (Group: children with psychopathic tendencies and comparison individuals) × 5 (emotion [mean errors for happy, disgusted, angry, sad and fearful vocal affect]) MANCOVA was conducted with age and IQ acting as covariates. This revealed a significant main effect for group ($F(5, 35) = 3.17$; $p < .05$). The boys with psychopathic tendencies made more errors than the comparison boys (M(errors made by the boys with psychopathic tendencies) = 3.34, s.d. = .39; M(errors made by the comparison boys) = 2.44, s.d. = .41). In addition, the effects of both covariates were also significant ($F(5, 35) = 3.49$, $p < .01$ and $F(5, 35) = 5.73$, $p < .001$ for age and IQ respectively). The older and higher IQ boys made fewer errors than the younger and lower IQ boys. Follow-up univariate ANCOVAs revealed a significant group effect for fearful vocal affect ($F(1, 38) = 7.94$; $p < .05$, Bonferroni corrected). As can be seen in Table 1, the children with psychopathic tendencies were markedly impaired in their recognition of fearful vocal affect. There were no other significant group effects following Bonferroni corrections. However, and in line with the correlational analysis, the covariate age had a significant effect on recognition of fearful affect ($F(1, 38) = 14.45$, $p < .05$) and the covariate IQ had a significant effect on both the recognition of fearful and disgusted vocal affects ($F(1, 38) = 9.14, 19.70$, $p < .05$, for fearful and disgusted vocal affect respectively).

Table 2 Type of misidentification made for each emotion by group

Correct answer	Answer given				
	Happy	Disgust	Anger	Sad	Fear
Happy					
Psychopathic tendencies	–	19.4%	–	56.5%	24.2%
Comparison	–	19.2%	7.7%	50.0%	23.1%
Disgust					
Psychopathic tendencies	41.8%	–	10.1%	24.1%	24.1%
Comparison	46.5%	–	26.8%	19.7%	7.0%
Anger					
Psychopathic tendencies	40.4%	34.0%	–	4.3%	21.3%
Comparison	39.6%	52.1%	–	4.2%	4.2%
Sad					
Psychopathic tendencies	15.6%	37.8%	8.9%	–	37.8%
Comparison	10.4	29.2%	4.2%	–	56.3%
Fear					
Psychopathic tendencies	7.7%	13.5%	2.9%	76.0%	–
Comparison	6.0%	16.0%	6.0%	72.0%	–

To examine whether the 3 sub-scales of the APSD provided differential contributions to the results, we correlated recognition errors for the five vocal affects against the 3 sub-scales whilst partialling out the influences of IQ and age. This revealed three significant correlations: Callous and unemotional correlated significantly with the number of fearful and happy vocal affect recognition errors ($r = .447$ [$p < .005$] and $r = .349$ [$p < .05$] respectively). Narcissism also correlated significantly with the number of fearful vocal affect recognition errors ($r = .438$; $p < .005$). There were no significant correlations with scores on the Impulsivity factor.

Finally, the error pattern of the psychopathic and comparison individuals was examined. Table 2 presents the percentage of total errors of each erroneous response by correct response and group. As can be seen, both groups made similar types of errors to the audio emotion stimuli (i.e., when incorrect both groups tended to answer happiness for disgust, sadness for happiness, disgust/happy for anger and sadness for fear). However, chi-square tests conducted on the data, where each error response was treated as an individual data point, revealed significant effects for the judgment of disgusted and angry expressions ($\chi^2 = 14.04$ and 12.39 respectively, $df = 3$, $p < .01$) but not happy, sad or fearful expressions. This was due to the children with psychopathic tendencies being more likely to mistake disgusted and angry expressions for fearful expressions.

Discussion

The goal of the current study was to investigate the ability of boys with psychopathic tendencies to identify vocal affect. In line with predictions, boys with psychopathic tendencies showed impaired recognition of fearful vocal intonation. In contrast to predictions, no significant impairment was identified for the recognition of sad vocal affect. In addition, and in line with predictions, no significant impairment was identified for the recognition of happy, angry or disgusted vocal affect. However, children with psychopathic tendencies were more likely, when making errors on angry or disgusted expressions, to mistake these expressions for fearful expressions.

A series of studies have examined the ability of boys with psychopathic tendencies and adult psychopathic individuals to identify facial emotional expressions (Blair, Colledge, Murray et al., 2001; Stevens et al., 2001). In all of these studies, group differences have been found for sad and fearful, but not happy, disgusted, angry or surprised expressions. In addition, a second series of studies have examined autonomic responses to the distress of others in children with psychopathic tendencies and adult psychopathic individuals (Aniskiewicz, 1979; Blair, 1999). These have consistently found that psychopathic individuals show reduced autonomic activity to sad facial expressions. The current study extends this work by showing that the impairment of boys with psychopathic tendencies in processing the emotional signals of other humans extends to the auditory domain. Not only do these boys with psychopathic tendencies present with difficulties recognizing facial expressions of fear but they also show selective impairment for the recognition of fearful vocal affect.

Before we consider the theoretical implications of the present study, it is necessary to consider whether the results could be explained in terms of an experimental artifact. For example, could the specificity of the present results be a product of task difficulty? This is an unlikely explanation of the current findings for the following reason. While individuals frequently find fearful facial expressions very difficult to recognize in naming tasks, the same is not true for fearful vocal affect (Scott et al., 1997). Indeed, in the current study, fearful vocal affect was the second easiest stimulus for the comparison boys to recognize, substantially easier to recognize for these boys than disgusted vocal affect. Thus, a task difficulty explanation would seem to be unlikely.

The low-fear explanation suggests that psychopathic individuals are poorly socialized as a result of a failure to adequately process impending threat or punishment (Lykken, 1957; Patrick, 1994). Such positions might generate the prediction that psychopathic individuals should show impaired processing of expressions such as anger and fear as both these expressions have been considered to act as threat cues (Whalen, 1998). While the current finding of impaired fearful vocal affect would be in line with the low-fear account, the absence of impaired recognition of angry vocal affect would not be.

The low-empathy position stresses the aspects of psychopathy related to reduced sensitivity to the emotional signals of others, particularly sadness and fear (Blair, 1995). While the current finding of impaired fearful vocal affect would be in line with the low-empathy account, the absence of impaired recognition of sad vocal affect would not be. There are two possible explanations for this result. First, the processing of sad vocal affect is less reliant on the amygdala. This would be in accordance with the neuro-imaging literature which suggests only significant amygdala activity to fearful vocal affect (Morris et al., 1999; Phillips et al., 1998). However, the sound of another's sadness is aversive. It seems surprising that the experienced aversion to the sound of another's sadness does not involve an amygdala response, especially since the aversion to sad facial expressions does (Blair et al., 1999; Schneider et al., 1995). A second possibility is that the processing of sad vocal affect is impaired in children with psychopathic tendencies and our failure to observe such an impairment in the current study represents a type II error. Interestingly, in the earlier study conducted by Stevens et al. (2001), the children with psychopathic tendencies showed a selective impairment for sad, and not fearful, vocal affect, while in a study conducted with adults, the individuals with psychopathy presented with impairment for fearful and sad vocal affect (Blair et al., 2002). Further studies with larger sample sizes will be necessary to determine whether the impairment in children with psychopathic tendencies is selective for only fearful vocal affect or whether it also includes sad vocal affect.

Of course, it is important to note that much of the low-fear and low-empathy positions have been incorporated within the recent neuro-cognitive Integrated Emotion Systems (IES) model (Blair, in press). This position can be considered an expansion of the older Violence Inhibition Mechanism model (Blair, 1995, 2001). However, it diverges in certain important respects from classic low-fear positions (Hare, 1970; Lykken, 1995; Patrick, 1994) by assuming that there is no single fear system but rather a series of at least partially separable neural systems that are engaged in specific forms of processing that can be subsumed under the umbrella term fear. For example, aversive conditioning and instrumental learning are two forms of processing that the fear system is thought to be involved in (Lykken, 1995; Patrick, 1994). Yet the neural circuitry to achieve aversive conditioning and instrumental learning are doubly dissociable (Killcross, Robbins, & Everitt, 1997). Moreover, early amygdala lesions result in a massive reduction of neo-phobia; the infant monkey is no longer fearful of novel objects. However, the same infant monkeys with amygdala lesions show heightened social phobia; i.e., their fear response to another infant monkey is actually heightened (Amaral, 2001; Prather et al., 2001). These findings strongly suggest partially separable "fear" systems: for aversive conditioning/instrumental learning and for social threats (with this latter system involved in responding particularly to angry expressions) (Blair & Cipolotti, 2000; Blair et al., 1999).

In Figure 1, we depict those components of the IES model which we believe to be particularly important in performing the vocal affect recognition test. Specifically, we assume that the vocal affects are represented as clusters of sensory representation units which are mutually excitatory but inhibitory towards competing unit clusters (at the anatomical level, this is assumed to involve sensory cortex). We assume representational overlap; thus, in Figure 1, one of the units representing fearful vocal affect also represents disgusted vocal affect. The suggestion is that each representational cluster can directly activate linguistic units associated with the appropriate output response, allowing naming (at the anatomical level, these language units are thought to involve a region of temporal cortex). In short, naming need not require input from affect-relevant units (as occurs when naming emotionally neutral sounds). These affect-relevant units involve the amygdala. However, the suggestion is that affect-relevant units do play a role when naming vocal affect. We suggest that this role is two fold: First, the connections between the sensory representational units and the affect-specific units are assumed to be reciprocal (reflecting the interconnections of the amygdala with cortical regions; Amaral, Price, Pitkanen, & Carmichael, 1992). Thus, activation of the affect-specific units by the sensory representational units will, in turn, lead to increased activation of the relevant sensory representational units. The stronger activity of the appropriate sensory representational units will increase the probability of a correct response. Secondly, the affect-specific units themselves may bias the appropriate linguistic units, again increasing the probability of a correct response.

The vocal affect recognition task can be considered an appraisal task; a verbal response is required to an emotional stimulus (in this case an auditory one). As is indicated in Figure 1, appraisal

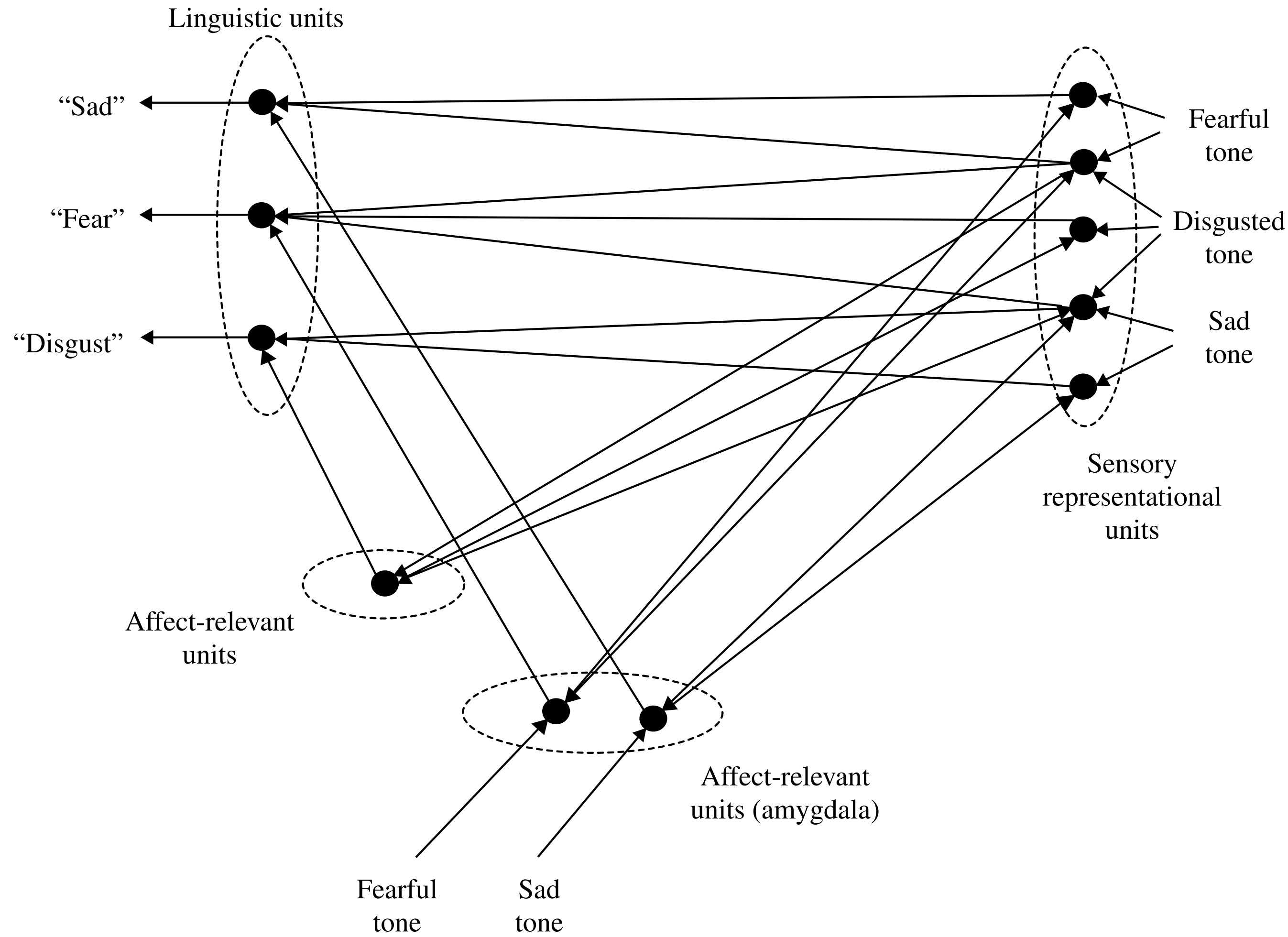

Figure 1 Components of the IES model involved in performance on the vocal affect recognition test. Each dashed oval should be considered a system containing competing clusters of units that are self-excitatory but mutually inhibitory. Thus, the sensory representational units (assumed to involve sensory temporal cortex), though they involve representational overlap, compete for dominance (cf. Desimone & Duncan, 1995). These representational clusters directly activate linguistic units associated with the appropriate output response, allowing naming (at the anatomical level, these language units are thought to involve temporal cortex). While naming need not require affect-relevant units, these are likely to play a role. First, through their reciprocal connections with the sensory representational units, they help in 'cleaning up' the sensory representation. Secondly, they may also bias the activation of the appropriate linguistic units. Affect-relevant units for fearfulness, and we believe possibly sadness, are thought to involve the amygdala (Morris et al., 1999; Phillips et al., 1998). Affect-relevant units for disgust (and anger and happiness – not represented) are not thought to involve the amygdala and the neural systems involved are currently unknown

tasks can occur without the involvement of affect-relevant units [as opposed to tasks involving the formation of stimulus-reward or stimulus-punishment associations, such as passive avoidance learning, which cannot (Baxter & Murray, 2002)]. The task is a naming task and learning the names of stimuli does not usually involve the input of affect, just the appropriate formation of connections between sensory units and linguistic units. Instead, with respect to the vocal affect recognition test, the suggestion is that the affect-relevant units only improve the probability of a correct response. This means that the degree to which their input is important is a function of the degree to which successful performance can be achieved without their involvement. We contend that most participants, when performing affect recognition tasks, do recruit the involvement of affect-relevant units. This is supported by neuro-imaging and neuropsychological data. Thus, the two neuro-imaging studies that have investigated the neural response to vocal affect have both identified an amygdala response to fearful vocal affect (Morris et al., 1999; Phillips et al., 1998). Moreover, these studies have shown that the amygdala response is selective. Morris et al. (1999) found no significant neural response in the amygdala to either happy or sad vocal affect and Phillips et al. (1998) observed that the neural response to disgusted vocal affect did not include the amygdala. In addition, a case study of a patient with an amygdala lesion has been reported who presented with impaired recognition of fearful vocal affect (Scott et al., 1997, although other patients with amygdala lesions have not necessarily shown this impairment; e.g., Adolphs, Tranel, & Damasio, 2001; Anderson & Phelps, 1998). Thus, the finding of a selective impairment for fearful vocal affect in boys with psychopathic tendencies is directly in line with the suggestion that the primary locus of dysfunction in psychopathy involves the amygdala (Blair, 2001; Blair et al., 1999). Of course, other forms of appraisal tasks need not recruit affect-relevant units. Assigning scores to visual images, for example, does not appear to require the involvement of affect-relevant units; certainly individuals with psychopathic tendencies are not impaired in this form of appraisal task (Patrick, Bradley, & Lang, 1993). This suggests the prediction that individuals with amygdala lesions should not show impairment on such tasks either. This prediction remains to be tested.

One caveat should be noted with respect to the findings of the current study. The participants in this study did not receive a full psychiatric work-up. Thus, it is possible that the individuals in this study may have been co-morbid for other disorders. It is possible that pathology associated with these co-morbid disorders could have contributed to the results. Of course, at present, to our knowledge, no difficulties/superiorities in vocal affect recognition have been reported in any psychiatric group. Moreover, it is important to note that the performance of the children with psychopathic tendencies and comparison children, for all emotions other than fear, was similar to that of the comparison adults in the earlier study (Blair et al., 2002). The comparison children also performed similarly to the comparison adults for fearful vocal affect. In contrast, the children with psychopathic tendencies performed similarly to the adults with psychopathy. In short, the comparison children showed no indications of selective superiority for fearful vocal affect, while the children with psychopathic tendencies did show indication of a selective impairment for fearful vocal affect.

In summary, the current study observed that boys with psychopathic tendencies present with impaired recognition of fearful vocal affect. This is compatible with the suggestion that the emotional component of psychopathy reflects early amygdala dysfunction (Blair, 2001; Blair et al., 1999; Patrick, 1994). Moreover, the results strengthen claims that psychopathy is a neuro-cognitive disorder that is apparent across the lifespan. Adult psychopathic individuals also present with impairment in the processing of fearful vocal affect (Blair et al., in press). Thus, not only does the behavioral profile of psychopathic adults show similarities to that of children with psychopathic tendencies (Frick et al., 1994; Hare, 1991) but also the neuro-cognitive impairments may present in a comparable way across the lifespan.

Acknowledgements

This work was supported by a Medical Research Council grant [ref. G9716841] and the Department of Health (VISPED initiative). The authors would like to thank the staff and students at the Batchwood, Boxmoor, Larwood, and Rushden Schools.

Correspondence to

James Blair, Chief, Unit on Affective Cognitive Neuroscience, Mood and Anxiety Disorders Program, National Institute of Mental Health, 15K North Drive, Room 206, MSC 2670, Bethesda, Maryland 20892-2670, USA; Email: blairj@intra.nimh.nih.gov

References

Adolphs, R., Tranel, D., & Damasio, H. (2001). Emotion recognition from faces and prosody following temporal lobectomy. *Neuropsychology*, *15*, 396–404.

Amaral, D.G. (2001). *The amygdaloid complex and the neurobiology of social behaviour*. Paper presented at the Society for Research in Child Development, Minneapolis.

Amaral, D.G., Price, J.L., Pitkanen, A., & Carmichael, S.T. (1992). Anatomical organization of the primate amygdaloid complex. In J.P. Aggleton (Ed.), *The amygdala: Neurobiological aspects of emotion, memory, and mental dysfunction* (pp. 1–66). New York: Wiley.

Anderson, A.K., & Phelps, E.A. (1998). Bilateral amygdala damage impairs evaluation of facial but not vocal expressions of fear. *Cognitive Neuroscience Meeting Abstract Program*, 109.

Angrilli, A., Mauri, A., Palomba, D., Flor, H., Birhaumer, N., Sartori, G., & di Paola, F. (1996). Startle reflex and emotion modulation impairment after a right amygdala lesion. *Brain*, *119*, 1991–2000.

Aniskiewicz, A.S. (1979). Autonomic components of vicarious conditioning and psychopathy. *Journal of Clinical Psychology*, *35*, 60–67.

Baxter, M.G., & Murray, E.A. (2002). The amygdala and reward. Nature Reviews. *Neuroscience*, *3*, 563–573.

Blair, R.J., Colledge, E., & Mitchell, D.G. (2001). Somatic markers and response reversal: Is there orbitofrontal cortex dysfunction in boys with psychopathic tendencies? *Journal of Abnormal Child Psychology*, *29*, 499–511.

Blair, R.J., Colledge, E., Murray, L., & Mitchell, D.G. (2001). A selective impairment in the processing of sad and fearful expressions in children with psychopathic tendencies. *Journal of Abnormal Child Psychology*, *29*, 491–498.

Blair, R.J., Mitchell, D.G., Richell, R.A., Kelly, S., Leonard, A., Newman, C., & Scott, S.K. (2002). Turning a deaf ear to fear: Impaired recognition of vocal affect in psychopathic individuals. *Journal of Abnormal Psychology*, *111*, 682–686.

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

Blair, R.J.R. (1997). Moral reasoning in the child with psychopathic tendencies. *Personality and Individual Differences*, *22*, 731–739.

Blair, R.J.R. (1999). Responsiveness to distress cues in the child with psychopathic tendencies. *Personality and Individual Differences*, *27*, 135–145.

Blair, R.J.R. (2001). Neuro-cognitive models of aggression, the antisocial personality disorders and psychopathy. *Journal of Neurology, Neurosurgery and Psychiatry*, *71*, 727–731.

Blair, R.J.R. (2003). A neurocognitive model of the psychopathic individual. In T.W. Robbins (Ed.), *Disorders of brain and mind 2* (pp. 400–420). Cambridge: Cambridge Press.

Blair, R.J.R. (in press). The roles of orbital frontal cortex in the modulation of antisocial behavior. *Brain and Cognition*.

Blair, R.J.R., & Cipolotti, L. (2000). Impaired social response reversal: A case of 'acquired sociopathy'. *Brain*, *123*, 1122–1141.

Blair, R.J.R., Mitchell, D.G.V., Richell, R.A., Kelly, S., Leonard, A., Newman, C., & Scott, S.K. (under revision). Turning a deaf ear to fear: Impaired recognition of vocal affect in psychopathic individuals. *Journal of Abnormal Psychology*.

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

Cleckley, H. (1967). *The mask of sanity* (4th edn). St Louis, MO: Mosby.

Dale, E., & Reichart, D. (1957). *Bibliography of vocabulary studies*. Columbus, OH: Ohio State University, Bureau of Educational Research.

Damasio, A.R. (1994). *Descartes' error: Emotion, rationality and the human brain*. New York: Putnam (Grosset Books).

Desimone, R., & Duncan, J. (1995). Neural mechanisms of selective visual attention. *Annual Review of Neuroscience*, *18*, 193–222.

Dunn, L.M., Wheklan, C., & Pintillie, D. (1982). *British Picture Vocabulary Scale*. Windsor, UK: NFER-Nelson.

Fisher, L., & Blair, R.J.R. (1998). Cognitive impairment and its relationship to psychopathic tendencies in children with emotional and behavioural difficulties. *Journal of Abnormal Child Psychology*, *26*, 511–519.

Frick, P.J. (1991). *The Alabama Parenting Questionnaire*. The University of Alabama.

Frick, P.J., Bodin, S.D., & Barry, C.T. (2000). Psychopathic traits and conduct problems in community and clinic-referred samples of children: Further development of the psychopathy screening device. *Psychological Assessment*, *12*, 382–393.

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

Frick, P.J., O'Brien, B.S., Wootton, J.M., & McBurnett, K. (1994). Psychopathy and conduct problems in children. *Journal of Abnormal Psychology*, *103*, 700–707.

Hare, R.D. (1970). *Psychopathy: Theory and research*. New York: Wiley.

Hare, R.D. (1991). *The Hare Psychopathy Checklist–Revised*. Toronto, Ontario: Multi-Health Systems.

Hoffman, M.L. (1987). The contribution of empathy to justice and moral judgment. In N. Eisenberg & J. Strayer (Eds.), *Empathy and its development* (pp. 47–80). Cambridge: Cambridge University Press.

Kiehl, K.A., Smith, A.M., Hare, R.D., Mendrek, A., Forster, B.B., Brink, J., & Liddle, P.F. (2001). Limbic abnormalities in affective processing by criminal psychopaths as revealed by functional magnetic resonance imaging. *Biological Psychiatry*, *50*, 677–684.

Killcross, S., Robbins, T.W., & Everitt, B.J. (1997). Different types of fear-conditioned behaviour mediated by separate nuclei within amygdala. *Nature*, *388*, 377–380.

Kochanska, G. (1993). Toward a synthesis of parental socialization and child temperament in early development of conscience. *Child Development*, *64*, 325–347.

Kochanska, G. (1997). Multiple pathways to conscience for children with different temperaments: From toddlerhood to age 5. *Developmental Psychology*, *33*, 228–240.

LaBar, K.S., LeDoux, J.E., Spencer, D.D., & Phelps, E.A. (1995). Impaired fear conditioning following unilateral temporal lobectomy in humans. *Journal of Neuroscience*, *15*, 6846–6855.

LaPierre, D., Braun, C.M.J., & Hodgins, S. (1995). Ventral frontal deficits in psychopathy: Neuropsychological test findings. *Neuropsychologia*, *33*, 139–151.

Lykken, D.T. (1957). A study of anxiety in the sociopathic personality. *Journal of Abnormal and Social Psychology*, *55*, 6–10.

Lykken, D.T. (1995). *The antisocial personalities*. Hillsdale, New Jersey: Erlbaum.

Mitchell, D.G.V., Colledge, E., Leonard, A., & Blair, R.J.R. (2002). Risky decisions and response reversal: Is there evidence of orbitofrontal cortex dysfunction in psychopathic individuals? *Neuropsychologia*, *40*, 2013–2022.

Morris, J.S., Frith, C.D., Perrett, D.I., Rowland, D., Young, A.W., Calder, A.J., & Dolan, R.J. (1996). A differential response in the human amygdala to fearful and happy facial expressions. *Nature*, *383*, 812–815.

Morris, J.S., Scott, S.K., & Dolan, R.J. (1999). Saying it with feeling: Neural responses to emotional vocalizations. *Neuropsychologia*, *37*, 1155–1163.

Murray, I.R., & Arnott, J.L. (1993). Toward the simulation of emotion in synthetic speech: A review of the literature on human vocal emotion. *Journal of the Acoustical Society of America*, *93*, 1097–1108.

Newman, J.P., Patterson, C.M., & Kosson, D.S. (1987). Response perseveration in psychopaths. *Journal of Abnormal Psychology*, *96*, 145–148.

O'Brien, B.S., & Frick, P.J. (1996). Reward dominance: Associations with anxiety, conduct problems, and psychopathy in children. *Journal of Abnormal Child Psychology*, *24*, 223–240.

Patrick, C.J. (1994). Emotion and psychopathy: Startling new insights. *Psychophysiology*, *31*, 319–330.

Patrick, C.J., Bradley, M.M., & Lang, P.J. (1993). Emotion in the criminal psychopath: Startle reflex modulation. *Journal of Abnormal Psychology*, *102*, 82–92.

Phillips, M.L., Young, A.W., Scott, S.K., Calder, A.J., Andrew, C., Giampietro, V., Williams, S.C., Bullmore, E.T., Brammer, M., & Gray, J.A. (1998). Neural responses to facial and vocal expressions of fear and disgust. *Proceedings of the Royal Society of London. Series B: Biological Sciences*, *265*, 1809–1817.

Prather, M.D., Lavenex, P., Mauldin-Jourdain, M.L., Mason, W.A., Capitanio, J.P., Mendoza, S.P., & Amaral, D.G. (2001). Increased social fear and decreased fear of objects in monkeys with neonatal amygdala lesions. *Neuroscience*, *106*, 653–658.

Schneider, F., Gur, R.E., Mozley, L.H., Smith, R.J., Mozley, P.D., Censits, D.M., Alavi, A., & Gur, R.C. (1995). Mood effects on limbic blood flow correlate with emotional self-rating: A PET study of oxygen-15 labeled water. *Psychiatry Research: Neuroimaging*, *61*, 265–283.

Scott, S.K., Young, A.W., Calder, A.J., Hellawell, D.H., Aggleton, J.P., & Johnson, M. (1997). Impaired auditory recognition of fear and anger following bilateral amygdala lesions. *Nature*, *385*, 254–257.

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*, *162*, 201–211.

Tiihonen, J., Hodgins, S., Vaurio, O., Laakso, M., Repo, E., Soininen, H., Aronen, H.J., Nieminen, P., & Savolainen, L. (2000). Amygdaloid volume loss in psychopathy. *Society for Neuroscience Abstracts*, 2017.

Whalen, P.J. (1998). Fear, vigilance, and ambiguity: Initial neuroimaging studies of the human amygdala. *Current Directions in Psychological Science*, *7*, 177–188.

Wootton, J.M., Frick, P.J., Shelton, K.K., & Silverthorn, P. (1997). Ineffective parenting and childhood conduct problems: The moderating role of Callous-Unemotional traits. *Journal of Consulting and Clinical Psychology*, *65*, 292–300.

Manuscript accepted 18 December 2003