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Recognising 'social' and 'non-social' emotions in self and others: A study of autism

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ABSTRACT Studies of emotion processing in autism have produced mixed results, with fewer studies observing autism-specific deficits than might be imagined. In the current study, 21 individuals with autism and 21 age- and ability-matched, learning disabled comparison participants were tested for their ability to (a) recognise, *in others*, expressions of 'social' emotions (e.g., embarrassment) and 'non-social' emotions (e.g., happiness) and; (b) report *their own* previous experiences of each of these emotions.

In line with predictions, amongst both groups of participants, social emotions were more difficult to recognise and report than non-social emotions. Also amongst both groups, the ability to report social emotion-experience was significantly associated with the ability to recognise social emotions in others, independent of age and verbal ability. However, contrary to predictions, no between-group differences in levels or patterns of performance on the experimental tasks were observed.

In light of previous research, these results suggest either that emotion-processing is not as specifically impaired in autism as is traditionally thought to be the case, or that individuals with autism are implementing compensatory strategies to succeed on experimental tasks in the absence of emotion-processing competence.

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Introduction

Deficits in emotion processing form part of the diagnostic criteria of autism, according to major classification systems (e.g., American Psychiatric Association, 2000), as well as according to 'gold standard' assessment tools (e.g., Lord et al., 2000). Certainly, reports of emotion processing deficits amongst

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people with autism are not hard to find, either from individuals with autism themselves (e.g., Grandin, 1996), or from their caregivers, or clinicians (e.g., Kanner, 1943; Hobson et al., 2006). Recently, there has been interest in the relation between autism and alexithymia, a personality trait defined by difficulty in identifying feelings in oneself and describing them to others. Hill, Berthoz and Frith (2004), for example, found that high-functioning adults with autism reported significantly higher levels of alexithymia than comparison adults who did not have autism. On the other hand, however, when considering the results of well-controlled cognitive-experimental studies, evidence of autism-specific deficits in recognizing emotions in others, or describing emotions in self, is mixed.

When considering the literature on emotion processing in autism, one important factor to bear in mind regards the *type* of emotion under consideration. For many emotion theorists, 'social' or 'self-conscious' emotions, such as embarrassment, pride, and guilt are a special class of emotion, separate from 'basic' emotions, such as fear, happiness, and sadness (e.g., Levenson, 1999). Although all emotions could be considered 'social' in the most basic sense, emotions like pride, shame, embarrassment, and guilt are assumed to be at least partly culturally constructed and dependent for their emergence on social-affective/social-cognitive capacities, including basic self-other differentiation and the ability to register the perspectives of others on oneself (e.g., Lewis, 2003; Tracy & Robins, 2004). In contrast, basic emotions are widely assumed to emerge early in development and have a biological (innate) basis (e.g., Izard, 1971). Given both the diagnostic difficulties with social interaction and communication experienced by individuals with autism, and the uniquely *inter*personal nature and origins of social emotions, it seems likely that this type of emotion will prove more difficult for people with autism to register in others or understand in themselves than other, non-social emotions.

In keeping with this suggestion, high-functioning individuals with autism, who do not have intellectual impairment (i.e., IQs > 70), appear relatively unimpaired in their ability to recognise expressions of non-social emotions in the faces of photographed actors (e.g., Heerey, Keltner, & Capps, 2003; Rutherford & Towns, 2008; van der Geest, Kemner, Verbaten, & Engeland, 2002; Wright et al., 2008; for alternative explanations and findings see e.g., Grossman, Klin, Carter, & Volkmar, 2000; Hobson, 1991; Wallace, Coleman, & Bailey, 2008). Amongst low-functioning individuals with autism (LFA), who do have accompanying learning disability (i.e., have IQs of 70 or below), there is greater evidence of deficits in the recognition of non-social emotions (e.g., Braverman et al., 1989; Hobson, 1982, 1986). However, even here differences between groups are observed usually when LFA participants are matched with non-autistic comparison partici-

pants only for *non-verbal* ability, and not when groups are matched for *verbal* skills (e.g., Ozonoff et al., 1990).

In keeping with the idea that difficulties in understanding social emotions should be particularly pronounced amongst people with autism, Heerey, Keltner and Capps (2003) found that even high-functioning children with autism were significantly less able than age- and verbal ability-matched comparison participants to identify expressions of embarrassment and shame in photographed actors. On the other hand, no group differences were observed in the recognition of non-social emotions, including 'complex', non-basic emotions such as surprise (contra Baron-Cohen, 1993).

In a similar vein, Losh and Capps (2006) found that high-functioning children with autism were as able as age- and verbal ability-matched comparison children to describe their previous experiences of non-social emotions (e.g., happiness, sadness, disappointment, surprise). However, when it came to describing their previous experiences of social emotions (pride, embarrassment, guilt, shame), participants with autism produced narratives that were significantly less contextually appropriate and coherent than those produced by comparison participants. These results replicate and extend those of Capps, Yirmiya, and Sigman (1992) who also found no qualitative differences between the self-reported experiences of happiness and sadness provided by children with and without autism, but found the descriptions of embarrassing situations provided by high-functioning children with autism significantly less appropriate than those provided by matched comparison participants.

Although this recent literature potentially provides a clearer picture of emotion-processing deficits in autism, other empirical evidence even casts doubt on the claim that individuals with autism show impaired comprehension of social emotions. Hillier and Allinson (2002), for example, presented relatively high-functioning individuals with autism (with mean verbal IQs of approximately 80), as well as age- and verbal ability-matched comparison participants, with a series of written scenarios involving potentially embarrassing situations. No significant differences between these two groups were observed in terms either of the overall degree of embarrassment attributed to the protagonist in each scenario, or the quality of explanation provided for these attributions.

More recently, Hobson et al. (2006) conducted a thorough investigation of social-emotion processing in low-functioning children with autism. Although in-depth parental interviews suggested that participants with autism manifested limited expression or understanding of social emotions in their everyday lives, participants' performance on experimental tasks provided little evidence that they did not grasp the nature of these emotions.

Contrary to the authors' expectations, children with autism were as able as age- and verbal ability-matched comparison participants to (a) recognise expressions of pride, guilt, and shame/embarrassment in the videotaped (and photographed) expressions of actors; and (b) describe their own previous experiences of pride and guilt.

Although the sample sizes in the studies by Hillier and Allinson (2002), and Hobson et al. (2006) were relatively small (n = 10 per group and 12 per group, respectively), it is striking that even low-functioning children (in the latter study) did not display clear deficits in their recognition/understanding of social emotions. In their Monograph, Hobson et al. provide a thought-provoking discussion of the structure of social emotions, arguing that whilst typical individuals arrive at their understanding of such emotions through their experience of early interpersonal relations, individuals with autism may acquire their knowledge through an alternative, compensatory route (see below for further discussion).

The aim of the current investigation was to explore not only the extent to which children with autism grasp the nature of social emotions, but also to provide some preliminary evidence with regard to the basis of this understanding. If, as we agree with Hobson et al. (2006) is the case, social emotions are typically grounded in reciprocal social exchanges, and later conceptualised as such, then the ability to describe one's own experiences of social emotions should be significantly associated with the ability to recognise instances of such emotion-experience in others. Certainly, there is evidence from investigations of typical theory of mind development that the ability to recognise others' mental states is closely associated with the ability to report mental states in self (e.g., Wellman, Cross, & Watson, 2001). However, if one's understanding of social emotions (or mental states) is only superficial, based on a kind of rule-bound cognitively-acquired heuristic (Hermelin & O'Connor, 1985), then there is no *a priori* reason to suppose that a close link between self- and other-understanding will exist (e.g., Williams, Lind, & Happé, 2009). This may be the case amongst people with autism, if they possess only a cursory grasp of social emotions.

The current study was conducted in order to explore this set of issues. Following Losh and Capps' (2006) method, participants were asked to define and then describe previous experiences of social (pride, guilt, and embarrassment) and non-social (happiness, sadness, fear, surprise, disgust, and disappointment) emotions. Following this aspect of the study, participants were shown a series of standard video clips, each depicting an actor expressing one of these emotions. Participants were asked to identify the emotion expressed in each clip. It was predicted that participants with autism would be impaired in their capacity to report (in self) and recognise (in others) social emotions, but not non-social emotions. Amongst comparison

participants, it was predicted that the ability to *describe* experiences of social emotions would be significantly associated with the ability to *recognise* social emotions. Amongst participants with autism, on the other hand, it was predicted that these abilities would not be significantly related, reflecting the use of task-specific strategies to complete the assessments, as opposed to typical conceptual competence.

Method

Participants

Ethical approval for this research was obtained from the appropriate Research Ethics Committee. Twenty-one children with autism spectrum disorder (ASD) and 21 comparison children completed the emotion recognition aspect of the experiment, after parents/guardians had given written, informed consent for their children to be included. The participants in the ASD group had received formal diagnoses, by a trained psychiatrist or paediatrician, of autistic disorder ($n = 18$), Asperger's disorder ($n = 2$) or atypical autism/pervasive developmental disorder not otherwise specified (PDD-NOS; $n = 1$) according to established criteria (American Psychiatric Association, 2000). All participants in this group attended specialist autism schools, which required a diagnosis of autism, Asperger's syndrome or PDD-NOS for entry into the school. The comparison group consisted of children with general learning disability of unknown origin who attended schools for children with developmental disabilities/special educational needs.

Background Assessments

Baseline verbal and non-verbal abilities were assessed using an appropriate measure for the developmental level of each participant. The verbal abilities of 15/21 children with ASD and 15/21 comparison children were assessed using the Vocabulary and Information subtests of the Wechsler Intelligence Scale for Children – Third Edition (WISC-III; Wechsler, 1991). The verbal IQ estimate gained from this short form has high reliability (Sattler, 1992). Because the lowest test age-equivalent offered by the WISC-III is 6 years 2 months, the verbal mental age (VMA) of any participant who fell below this level on either of the verbal subtests could not be calculated. Under these circumstances, participants were administered the British Picture Vocabulary Scale – Second Edition (BPVS; Dunn et al., 1997), which offers test age-equivalents down to 2 years 11 months. The verbal abilities of 6/21 children with ASD and 6/21 comparison children were assessed with the BPVS.

The non-verbal abilities of all participants were assessed using the Block Design and Picture Completion subtests of the WISC-III. Due to limited child availability, the non-verbal abilities of one participant with ASD and one comparison participant were not assessed[1]. Participant characteristics for the total sample of ASD and comparison participants are presented in Table 1.

Table 1 **Participant characteristics: Means and (standard deviations)**

	ASD	*Comparison*	*t*	*p*	*Effect size (r)*
n	*21*	*21*			
CA: years	12.35 (2.26)	12.59 (1.94)	–0.37	.72	.06
VMA: years	8.42 (2.24)	8.31 (1.97)	0.17	.87	.03
VIQ	73.24 (13.77)	69.33 (11.26)	1.01	.32	.16
PIQ[a]	67.10 (18.63)	66.60 (18.68)	0.85	.93	.14

[a] Based on data from $n = 20$ participants with ASD and $n = 20$ comparison participants.

Given that some ASD and comparison participants received the Wechsler Scales (Wechsler, 1991), whilst others received the BPVS (Dunn et al., 1997), independent *t*-tests were conducted comparing ASD and comparison participants from each sub-sample to ensure adequacy of matching in each case, as well as overall. ASD and comparison participants who received the WISC-III were well matched on all variables (all $ts < 0.40$, all $ps > .69$), as were ASD and comparison participants who received the BPVS (all $ts < 0.53$, all $ps > .61$).

Three children with ASD did not have data for the emotion reporting aspect of the experiment. The remaining groups (of 18 children with ASD and 21 comparison participants) were still well matched for this aspect of the study (all $ts < -0.71$, all $ps > .48$).

Design and Procedures

All participants were given the emotion reporting task first, followed by the emotion recognition task.

Reporting emotion experiences in self

Participants were asked two questions about each emotion, in a fixed order. Firstly, participants were asked to *define* the emotion in question (e.g., 'What does 'proud' mean?') and their response was noted by the experimenter. Regardless of the quality of the participant's definition, the experimenter always subsequently offered a standard definition, based on situations in which people would typically experience the emotion. For the emotion

'pride', for example, the experimenter would say, 'Well, I think people feel proud when they have done something really well, much better than they or other people thought they would do'. The definitions offered by participants for each emotion were rated as either correct or incorrect. For example, a correct definition of 'pride' had to contain reference to 'some positive act under the control of the individual which was either explicitly or implicitly relative to some standard'.

Having defined the emotion in question, the participant was then asked to *report* a time in their lives when they had experienced the emotion. Their report was noted, verbatim, by the experimenter. The types of emotion were presented in the following fixed order with social and non-social emotions interspersed: sadness, pride, disappointment, fear, embarrassment, surprise, happiness, guilt and disgust.

Following previous studies of emotion processing amongst typically and atypically developing children (e.g., Capps et al., 1992; Losh & Capps, 2006), self-reported experiences of each emotion were rated for the degree to which they involved contextually suitable situations. Each report was rated on a scale of 0 to 2. A score of 2 was assigned to reports that unambiguously described situations which were appropriate for eliciting the emotion in question (e.g., 'I felt proud when I won the 100 metres race at school'; 'I felt embarrassed when I fell over and everyone laughed at me'). A score of 1 was assigned to reports that described events which would not typically elicit the emotion in question, but which might usually elicit a feeling with a similar hedonic tone (e.g., 'I felt disappointed when my grandma died'). Finally, a score of zero was assigned to reports that described events which would not have elicited the emotion in question (e.g., 'I felt disgusted when I went to the park and played on the swings'; 'I felt guilty when I did my homework'), or when participants offered no response.

The first author of this paper rated each transcript in the first instance. A second rater, who was blind to participant diagnoses and the hypotheses of the study, independently rated all transcripts. Inter-rater reliability was substantial for judgments of both emotion definitions ($\kappa = .63$) and emotion reports ($\kappa = .69$) (see Landis & Koch, 1977).

Recognition of emotions in others

Stimuli for the recognition task were nine silent, five-second video clips each of an actor expressing a different emotion. Stimuli were taken from *Mind Reading: An Interactive Guide to Emotions* (Baron-Cohen, 2004), which provides standard expressions of each of the emotions. Participants watched the nine clips in turn and, after each, stated what emotion they believed was expressed by the actor.

Given concerns about forced-choice response methods (Haidt & Keltner, 1999), and following Heerey et al. (2003), a partly-free response method was adopted such that children could either spontaneously generate a word to describe the emotion expressed by each actor, or choose a word from a list of six emotion terms. A different list was provided for each of the nine emotions, and each list consisted of the target emotion plus five distractor emotion terms from the study.

Before beginning the task, it was established that the participant could read each of the emotion words. Four participants (two with ASD and two comparison participants, each with a VMA under 6 years) were unable to read the words on the list. For these participants, the experimenter read out each of the six words on each list after the video clip had been viewed.

Each clip was presented in the bottom left-hand corner of a standard laptop in a window approximately 10 × 10 cm in size. Each accompanying list of words was presented on-screen in Times New Roman font, 20 point, alongside the clip. Clips were presented in the following fixed order: happiness, guilt, surprise, sadness, pride, disgust, fear, embarrassment, and disappointment.

Results

Reporting Emotion Experiences in Self

Firstly, a series of chi-square analyses was conducted to compare the number of participants from each diagnostic group correctly *defining* each of the nine emotions. These analyses yielded no significant differences between the groups (all χ^2s < 1.82, all *p*s > .24). Both groups of participants appeared quite proficient at spontaneously defining each emotion. Figure 1 shows the percentage of participants from each diagnostic group correctly defining each emotion.

Next, points were tallied for participants' *reports* of each type of emotion experience, yielding scores of 0–12 for the six non-social emotions and 0–6 for the three social emotions. Because each type of emotion contained a different number of exemplars, overall percentage scores were calculated for each type of emotion for the purpose of comparison. Table 2 shows the mean percentage scores awarded for reports of social and non-social emotion experiences amongst ASD and comparison participants.

Data were analysed using a 2 × 2 repeated-measures ANOVA, with diagnostic group (ASD/comparison) as the between-participants factor and emotion-type (social/non-social) as the within-participants variable. This ANOVA yielded a significant main effect of condition, reflecting the fact that participants' reports of non-social emotions were significantly superior

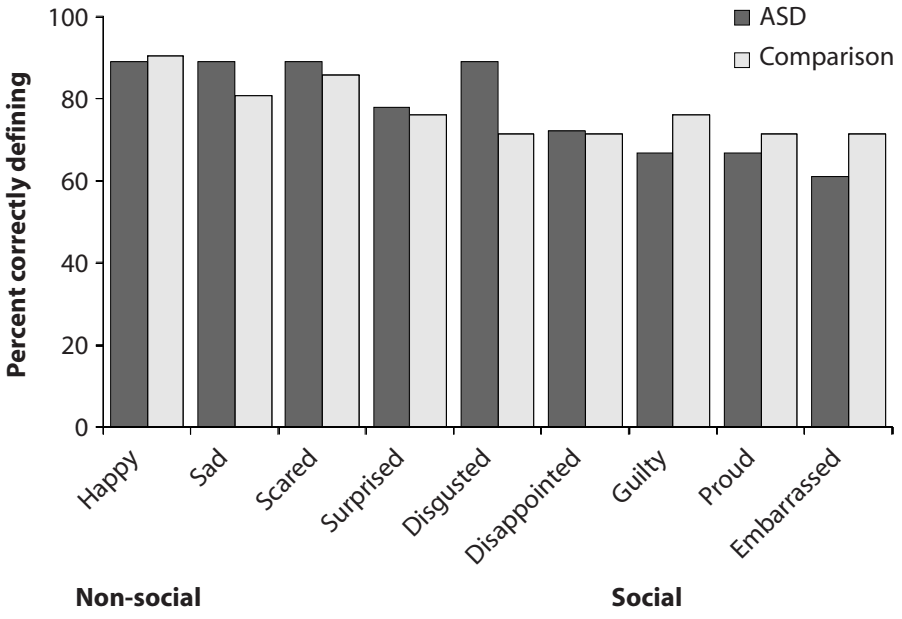

Figure 1 **Percentage of ASD and comparison participants correctly defining each emotion**

to their descriptions of social emotions, $F(1, 37) = 26.82$, $p < .001$, $r = .65$. The main effect of diagnostic group was not significant, indicating that, overall, the reports of emotion experiences offered by participants with ASD were not significantly different in quality from those offered by comparison participants, $F(1, 37) = 0.99$, $p = .76$, $r = .16$. There was no significant interaction between emotion-type and diagnostic group, indicating that participants with ASD showed the same pattern of performance across emotion-types as comparison participants, $F(1, 37) = 2.67$, $p = .11$, $r = .26$.

Table 2 **Mean (SD) percentage scores for reports of social and non-social emotion experiences by ASD and comparison participants**

Group	*Emotion type*	
	Non-social	*Social*
ASD (n = 18)	69.91 (25.10)	54.63 (35.15)
Comparison (n = 21)	79.37 (13.84)	50.00 (31.62)

Finally, a series of Mann-Whitney tests was conducted, comparing the quality of self-reports (on a scale of 0 to 2 points) of each emotion, independently, amongst ASD and comparison participants. These analyses revealed that participants with ASD described their own feelings of disappointment significantly less well than comparison participants, $U = 107.00$, $p = .007$, $r = .44$. However, this post hoc comparison did not remain significant after a Bonferroni correction for multiple comparisons had been applied. No other differences were significant (all Us > 155.00, all ps $> .34$). Figure 2 shows the mean score for each of the nine reports of emotion experiences, by ASD and comparison participants. In addition, a representative set of participants' self-reports of social emotions is included in Appendix 1. This serves to illustrate how similar the descriptions offered by ASD and comparison participants were, and how difficult it would be to distinguish the two groups on the basis of emotion reports.

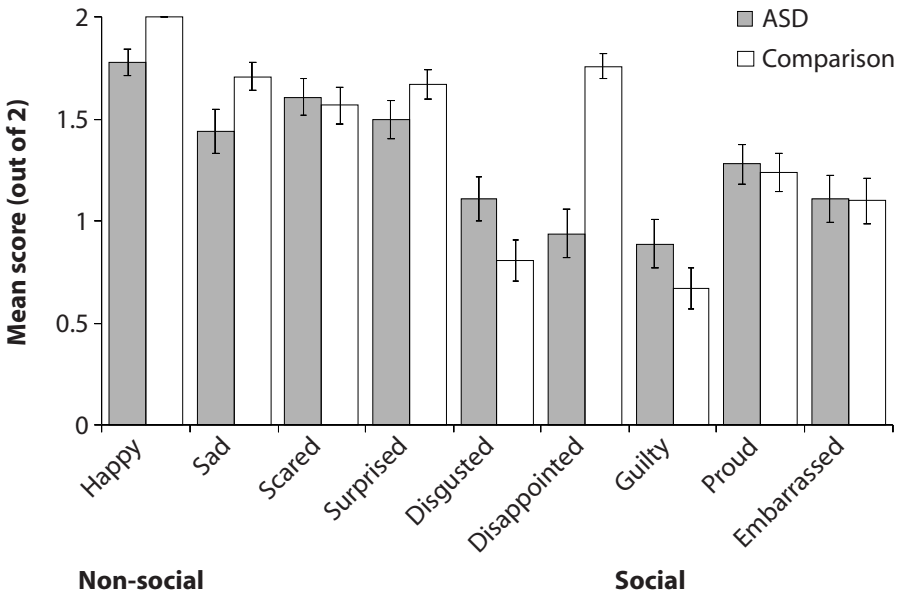

Figure 2 **Mean scores (out of 2) for each of the nine emotion descriptions by ASD and comparison participants. Error bars represent one *SE* of the mean.**

Relationship between VMA and quality of self-reports

Amongst comparison participants, VMA was not significantly associated with the quality of reports of social ($r = .19$, $p = .42$) or non-social ($r = .15$, $p = .51$) emotion experiences. In contrast, amongst participants with ASD, VMA was significantly correlated with reports of both social ($r = .66$, $p = .003$) and non-social ($r = .65$, $p = .004$) emotion experiences.

Recognition of Emotion in Others

One point was given for each emotion correctly identified and then points were tallied for each type of emotion, yielding scores of 0–6 for non-social emotions and 0–3 for social emotions. Again, for the purposes of comparison, percentage scores were calculated for each type of emotion. Table 3 shows the percentage of social and non-social emotions correctly recognised by ASD and comparison participants.

Data were analysed using a 2 × 2 repeated-measures ANOVA, with diagnostic group (ASD/comparison) as the between-participants factor and emotion type (social/non-social) as the within-participants variable. This ANOVA

Table 3 **Mean (SD) percentage of non-social and social emotions correctly recognised by ASD and comparison participants**

Group	*Emotion type*	
	Non-social	*Social*
ASD (n = 18)	76.98 (23.85)	41.27 (29.64)
Comparison (n = 21)	77.78 (18.51)	34.92 (22.30)

yielded a significant main effect of condition, reflecting the fact that participants recognised non-social emotions significantly more reliably than they recognised social emotions, $F(1, 40) = 86.66$, $p < .001$, $r = .83$. The main effect of diagnostic group was not significant, indicating that, overall, participants with ASD showed the same level of recognition as comparison participants, $F(1, 40) = 0.21$, $p = .65$, $r = .07$. The interaction between condition and diagnostic group was not significant indicating that participants with ASD showed the same pattern of recognition performance, across emotion-types, as comparison participants, $F(1, 40) = 0.72$, $p = .40$, $r = .13$.

Finally, a series of chi-square analyses did not reveal significant differences in the numbers of participants from each diagnostic group correctly recognising each of the nine emotions, individually, all χ^2s < 4.29, all ps $> .10$. Figure 3 shows the percentage of ASD and comparison participants correctly recognising each emotion.

Relationship between VMA and emotion recognition

Amongst participants with ASD, VMA was not significantly related to the recognition of social or non-social emotions, all rs $< .12$, all ps $> .62$. Amongst comparison participants, VMA was significantly correlated with

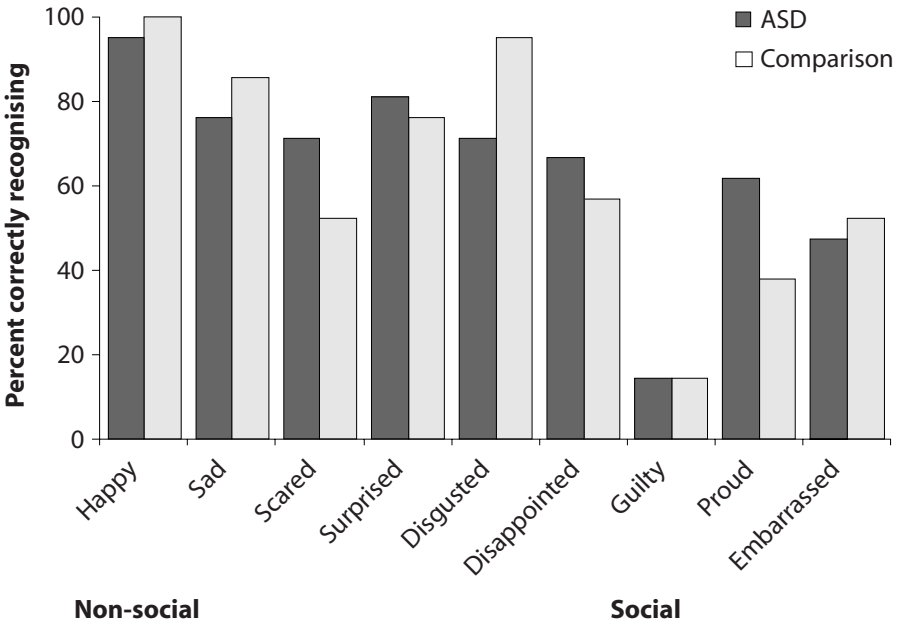

Figure 3 **Percentage of ASD and comparison participants correctly recognising each emotion**

the ability to recognise non-social emotions, $r = .56$, $p = .008$, but not social emotions, $r = .32$, $p = .16$.

Relation Between Describing Emotions in Self and Recognising Them in Others

A series of partial correlation analyses, controlling for chronological age and VMA, was performed in order to assess the relationship between reporting emotions in self and recognising them in others. Given that there were no between-group differences in the ability to report emotion experiences, or to recognise emotions in others, the groups were collapsed, in the first instance, to increase the power of the analysis.

When both diagnostic groups were collapsed, only the following partial correlations were significant (all other *p*s > .12): recognising social emotions × reporting social emotions ($r = .46$, $p = .004$), and recognising non-social emotions × reporting non-social emotions ($r = .37$, $p = .03$). However, only the correlation between recognising social emotions in others and reporting social emotions in self remained significant after Bonferroni adjustments for multiple comparisons had been applied.

When partial correlations were performed within each group separately, the correlation between recognising social emotions in others and

describing social emotions in self was significant amongst both participants with ASD ($r = .70$, $p = .003$) and comparison participants ($r = .47$, $p = .04$). The significant positive correlation between recognising social emotions in others and describing social emotions in self was not predicted amongst participants with ASD. However, this correlation remained significant even after adjusting for multiple comparisons.

Discussion

The results of this study were remarkably clear, although somewhat contrary to our hypotheses. Most importantly, children with autism (with average verbal IQs of just above 70 and average performance IQs of just under 70) were as able as age- and ability-matched comparison participants to recognise 'social' and 'non-social' emotions in others, and to describe their own previous experiences of these emotions. The effect sizes (r) for the main effects of diagnostic group in each ANOVA were .16 and .07 for the emotion reporting and emotion recognition aspects of the study, respectively. Such small effect sizes (Cohen, 1992) reassure us that it is unlikely to be merely a case of low power that has resulted in a failure to find significant differences between the groups on the experimental tasks.

Although equivalent levels of performance between the groups were expected with regard to the recognition/reporting of non-social emotions, such similar levels of understanding of social emotions between the groups were not predicted. Whilst this result runs counter to those of some previous studies (Capps et al., 1992; Heerey et al., 2003; Losh & Capps, 2006), it is important to note that this is not the first study to find children with autism unimpaired at recognising/reporting social emotions. For instance, our results closely match those of Hobson et al. (2006), who explored social emotion understanding amongst low-functioning children with autism, and Hillier and Allinson (2002) who explored understanding of embarrassment amongst high-functioning children.

Studies which end up failing to reject the null hypothesis (because they have produced what are sometimes termed '*negative* findings') are often viewed as uninformative and not adding to the literature on the topic of interest. There are, of course, many potential reasons for the failure of a study to find the statistically significant results necessary to support the rejection of the null hypothesis. For instance, well-designed studies in psychology, particularly of developmental disorders like autism, often have low power to detect genuine effects. In addition, in developmental research, the age or ability levels of the participants recruited may be outside the optimal window for detecting deficits/differences in one particular group. However, having noted these potential difficulties with interpreting null results, we believe

there are fundamental reasons to value well-designed studies in which these findings emerge.

There is not, arguably, a better test of the validity of a given result than independent replication. When any study has low power, caution should be taken when attempting to draw conclusions from results, given the high probability of type II error with small sample sizes[2]. However, when a number of studies (perhaps each of low power) converge on the same findings, then we can be more and more assured in the conclusions we draw. In this regard, it is notable how Hobson et al. (2006) expressed surprise at their failure to find significant group differences on measures that were not dissimilar to those employed in the current study. The current findings are remarkably in keeping with Hobson et al.'s, thus increasing confidence in their failure to reject the null hypothesis. Related to this, we wonder how many studies reporting negative findings go unpublished, either because the authors never write up the reports, or because the reports are rejected by journals for failing to provide results which are 'readily interpretable' (see Goldacre, 2008, chapter 10 for a discussion of the advantages of publishing negative findings). If well-designed studies that achieve null results go unpublished, then we are in danger of creating a false impression of exactly what abilities are and are not attenuated amongst individuals with autism.

Clearly, null findings are meaningless if they are simply the result of methodological flaws with the experimental design. Hence, before considering what conclusions might be properly drawn from the current findings, it is important to rule out as far as possible the possibility that design flaws caused the failure to find the predicted between-group differences in performance. On the one hand, it is possible that the lack of significant between-group differences observed in the current study was due to the use of a potentially insensitive methodology, which failed to detect (perhaps subtle) deficits amongst participants with autism. On the other hand, in neither the emotion recognition nor emotion description aspects of the study did participants display anything close to ceiling levels of performance. With regard to the recognition/reporting of social emotions, which is the area where group differences were most expected and explicitly predicted, participants with and without autism were achieving scores of around 50% or below, on average (see Tables 2 & 3). Therefore, although performance was obviously above chance, it is clearly not the case that the tasks were merely too simple for participants.

Another possible reason why group differences in emotion processing abilities were not observed in the current study might be due to the characteristics of the participant samples employed. Perhaps deficits in emotion-processing are clearer in younger and/or less intellectually able individuals with autism than employed in the current study. There are, however, reasons

not to accept this suggestion. Firstly, in the study which most closely matches our own in terms of experimental design, Hobson et al. (2006) employed samples of participants that were both younger and much less able than the sample of participants included in the current study. As noted above, they too failed to find significant differences between their (closely matched) groups. Conversely, it is interesting to note that in some other studies, deficits in emotion processing have been observed in older, more able individuals with autism than those who participated in the current study (e.g., Losh & Capps, 2006). Therefore, although we do not doubt that verbal intelligence, in particular, plays an important role in the ability of children with autism to perform a variety of psychological tasks (see, for example, Happé, 1995) we do not believe that age and ability were the critical factors in determining the performance of participants on the experimental tasks in the current investigation.

So, what can be made of the current set of results, assuming they are not merely the result of methodological flaws? As noted above, it is surprising how inconsistent the findings of experimental studies of emotion processing in autism have been. As Hobson et al. (2006, p.37) note, this surprise is mainly 'because there is a perplexing gap between what children [with autism] show in their daily lives, and what they seem able to formulate in words'. A possibility raised by several researchers (e.g., Hermelin & O'Connor, 1985) is that affected children's understanding of emotions, as it is tapped by experimental measures, is only superficial, and that successful performance on such measures is the result of compensatory (possibly task-specific) strategies. Indeed, we have previously made a similar argument with regard to the successful performance of children with autism on some measures of theory of mind (Williams & Happé, 2009; see also Bowler, 1992). Supporting this possibility with regard to emotion processing, some studies have found evidence which suggests that performance on emotion recognition tasks is uniquely supported by verbal intelligence amongst individuals with autism (e.g., Grossman et al., 2000). In the current study, however, verbal IQ was not significantly associated with the ability to recognise either social or non-social emotions amongst participants with autism (although verbal IQ was uniquely related to the ability to *describe* previous emotion experiences amongst these participants). In relation to emotion recognition, at least, it is not clear that participants with autism in the current sample were relying on their verbal skills (arguably) to compensate for inherent difficulties with this ability.

Another possibility was that children with autism in the present study were employing *task-specific* compensatory strategies to perform as well as comparison participants in the absence of true conceptual competence. To test this, we explored the association between the ability of participants to

recognise social emotions in others and the ability to describe social emotions in self. Our reasoning here was that it is arguably in the nature of psychological *concepts* (including concepts of emotions) that they be equally applicable to the case of self and others (Strawson, 1962; Hobson, 1990). Thus, if conceptual understanding of social emotions underpinned performance on the experimental tasks (amongst either group of participants), then a significant correlation should be observed between the abilities to describe these emotions in self and recognise them in others. Put in more cognitive terms, if the underlying psychological system responsible for emotion processing in individuals without autism was also utilised by individuals with autism, then a close link between performance on the recognition and description aspects of the study would be expected amongst all participants. If, on the other hand, task-specific compensatory strategies were being implemented by participants with autism in the absence of conceptual understanding/an 'intact' underlying psychological system, then such a close link between the self and other aspects of the task would not be expected in these individuals. Indeed, regardless of any (predicted) between-group differences, we predicted that this latter scenario would characterise the performance of participants with autism in the current study.

However, again contrary to our expectations, the performance of both participants with and without autism on these two aspects of the study was highly and significantly correlated, even after controlling for verbal ability and for multiple comparisons. Whatever underlying cognitive process was responsible for successful recognition of these emotions was apparently also responsible for the ability to understand these emotions in self. Supporting this idea, it is important to note just how superficially different the recognition and reporting aspects of the study appear to be. On the face of it, the task of labelling the emotional expression of another person, according to visually presented information, seems a quite different task from providing verbal descriptions of one's own previous emotion experiences, based on memorial reconstructions. Yet, some core knowledge of emotions appeared to bind these seemingly different abilities together not just amongst comparison participants, as expected, but also amongst children with autism, contrary to our predictions. This finding seems to represent a novel contribution to our understanding of emotion processing in autism.

To conclude, it is important to add that we do not believe that emotion processing is entirely typical or unimpaired in autism. As Hobson et al. (2006) found, emotional expression (and apparent understanding of emotions) amongst individuals with autism in daily life appears diminished and atypical. However, what emerges from this study, as from a small but

growing number of recent studies, is that children with autism probably *can* understand (even) social emotions in certain contexts. Furthermore, if the results of the current study are valid, this understanding appears to be based on principles similar to those on which understanding is based amongst individuals without autism. This leaves us with more work to do to explain exactly why the knowledge which individuals with autism appear to possess is not/cannot be applied flexibly in multiple contexts. However, the current findings arguably help to narrow down the search, indicating that we should look to other methods of investigation to discover the source of the emotion processing difficulties that are manifest in the daily lives of many individuals with autism.

Notes

1 To ensure that the groups would still be matched for performance IQ we arbitrarily assigned the outstanding ASD participant with the maximum possible performance IQ score (140 points) and the outstanding comparison participant with the minimum possible performance IQ score (45 points). A re-analysis of the data confirmed that the groups would still have been well matched under these conditions, $t(40) = 0.75$, $p = .46$, $r = .12$.

2 It is essential in such studies to focus on measures of effect size, rather than absolute *p* values (McCartney, Burchinal, & Bub, 2006). Such a strategy, adopted in the current paper, allows a) judgments to be made about the relative strength of between-group differences in performance on experimental tasks, independent statistical significance; and b) researchers to compare results across studies, some of which may reach conventional levels of statistical significance and some of which may not.

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Appendix

Pride

2 point descriptions:

'. . . I sang a song very well at a disco and everybody cheered and I felt proud' (ASD participant; CA = 12.42, VMA = 10.83).

'When I won a shield for the Governor's award for improved behaviour' (comparison participant; CA = 12.00, VMA = 10.33).

1 point descriptions:

'When I ride on big bikes' (ASD participant; CA = 7.42, VMA = 4.33)

'When I did my merits properly' (comparison participant; CA = 14.00, VMA = 6.58).

0 point descriptions:

'When I got a DVD' (ASD participant, CA = 12.42; VMA = 6.67).
'When my Dad let me watch this film without asking' (comparison participant; CA = 10.42, VMA = 6.42).

Embarrassment

2 point descriptions:

'When I was going home from school I accidentally spilled some water on my trousers and people saw it and they laughed at me and they asked if I'd wet myself' (ASD participant; CA = 15.75, VMA = 11.83).

'When I first came to this school and when I've been on stage acting in assemblies' (comparison participant; CA = 12.00, VMA = 10.33).

1 point descriptions:

'I did something silly. I forgot to do my homework' (ASD participant; CA = 9.08, VMA = 7.83).

'I was outside playing and then someone came up to me and they said 'hey what you doing?'' (comparison participant; CA = 10.42, VMA = 6.67).

0 point descriptions:

'I jump up and down' (ASD participant; CA = 12.08, VMA = 8.00).

'I've been embarrassed of my brother when I ask him to buy us something and he says 'no'' (comparison participant; CA = 8.42, VMA = 5.17).

Guilt

2 point descriptions:

'When I done something bad yesterday – I bit my Mum' (ASD participant; CA = 12.08, VMA = 8.00).

'When I told my friend she could stay, but I let somebody else stay' (comparison participant; CA = 14.32, VMA = 7.50).

1 point descriptions:

(all participants with ASD scored either 0 or 2 points)

'When I was little and I was grounded' (comparison participant; CA = 14.25, VMA = 9.33).

0 point descriptions:

'No, I'm not guilty' (ASD participant; CA = 13.08, VMA = 6.67).

'When I couldn't do the work in school' (comparison participant; CA = 12.42, VMA = 6.83).