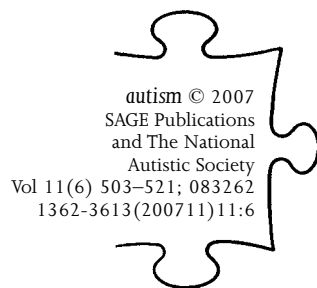# Do children with autism acknowledge the influence of mood on behaviour?

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ABSTRACT   We tested whether children with and without high-functioning autism spectrum disorders (HFASD) differ in their understanding of the influence of mood states on behaviour. A total of 122 children with HFASD or typical development were asked to predict and explain the behaviour of story characters during hypothetical social interactions. HFASD and typically developing children predicted at equal rates that mood states likely result in similar valenced behaviour. 'Explicit' descriptions were used to explain predictions more often by children with HFASD than by typically developing children. However, 'implicit' and 'irrelevant' descriptions elicited fewer mood references among HFASD children. Furthermore, they less often referred to the uncertainty of the influence of mood on behaviour, and less often used mood-related explanations, in particular when they had to rely on implicit information. This may indicate a rote- rather than self-generated understanding of emotions in children with HFASD.

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Autism has often been related to poor emotional skills (Hobson, 2002). In particular low-functioning, mentally retarded children with autism spectrum disorders (ASD) have been found to be less attentive to emotional expressions in other people, to communicate emotions in a less appropriate fashion and to be less aware of the subjective nature of emotions than children without ASD (Kasari et al., 1990). Children with autism spectrum disorders and normal IQ (i.e. high-functioning children with autism

spectrum disorders, HFASD) appear to have an adequate elementary *under-standing* of basic emotions, such as happiness, fear, anger and sadness. At 8 to 10 years of age they recognize emotional expressions, name emotions and understand emotion-related contexts and causes at equal rates as their typically developing peers (Capps et al., 1995; Davies et al., 1994; Downs and Smith, 2004; Peterson et al., 2005). However, despite these abilities, various researchers found pragmatic problems related to the emotional understanding of individuals with HFASD, including the use of superficial and scripted responses (Adams et al., 2002; Hale and Tager-Flusberg, 2005), failure to generalize their understanding and provide informative explanations (Beversdorf et al., 1998; Hadwin et al., 1997), and a need for explicit cues to trigger their explanations of emotions (Loveland et al., 1997; Begeer et al., 2006; Rieffe et al., 2000). These problems are closely related to the social, communicative and restricted repetitive impairments that characterize autism spectrum disorders (American Psychiatric Association, 2000). This study aimed to further delineate the suggested cognitive strength and pragmatic weakness with regard to the understanding of emotions of children with HFASD. We addressed four topics: the elementary understanding of basic emotions, the pragmatics in the explanations of these emotions, the need for explicit cues in triggering adequate responses and explanations of emotions, and the acknowledgement of the uncertain nature of emotions.

First, a generally agreed upon purpose of understanding emotions is that it can be informative about other people's subjective states and can allow the anticipation and comprehension of other people's behaviour (Cole et al., 2004). Typically developing 6-year-olds can connect mood states and behavioural tendencies on an elementary level, following the simple rule that positive or negative mood states are connected to positive or negative behaviour, respectively (Harris et al., 1981). Given their normal IQ, the reasoning skills of school aged children with HFASD should allow them to use such basic rules.

Second, typically developing 10-year-olds can be found to spontaneously use mood-related *explanations* for other's behaviour (Meerum Terwogt, 2002). In contrast, children with HFASD tend to explain mood states by referring to concrete, non-social aspects rather than social or emotional aspects of a situation (Baron-Cohen, 1991; Jaedicke et al., 1994; Rieffe et al., in press; Serra et al., 1995). Their reluctance to use mood-related explanations may be due to a failure to acknowledge the causal influence of moods on behaviour. Thus, children with HFASD may understand that certain moods are connected to certain behaviour, but likely fail to apply this understanding by providing relevant causal explanations of this connection.

Third, previous studies suggested that the performance of children with HFASD on explicit tasks of social or emotional understanding, where all

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elements of a problem are given, can be highly adequate, while they generally fail in more implicit, naturalistic settings (Happé, 1994; Klin, 2000). Therefore, adequate responses and explanations of the influence of mood on behaviour may be triggered more when children with HFASD are presented with explicit and straightforward information. With implicit and distracting information, these children likely fail to detect and interpret relevant cues, and their otherwise adequate emotional understanding will not be retrieved.

Fourth, mood states are directive, but not imperative for behavioural tendencies. This uncertain relationship between mood and behaviour is hard to capture in strict rules. The multitude of possible social consequences of someone's mood state requires an understanding of the changeable influence of moods on behaviour, e.g. understanding that when your dad is angry he *usually* but not *necessarily* wants to be left alone. Typically developing 6-year-olds acknowledge that it is uncertain whether specific situational contexts will result in specific mood states (Gnepp and Klayman, 1992), and can be assumed to show a similar ability to deal with uncertain consequences of mood states. The inclination of children with HFASD to rely on strict, certain rules in their understanding of emotions (Klin et al., 2003; Peterson et al., 2005) may result in a neglect of references to the uncertain effect of mood on behaviour.

In summary, it is hypothesized that children with HFASD are (1) able to connect explicit information on mood and behaviour by using general rules, such as the congruence of valence. However, their pragmatic impairments and their tendency to rely on strict rules should result in (2) a diminished ability to explain the connection between mood and behaviour, (3) a strong dependence on explicit and straightforward information on emotions, and (4) a limited understanding of the uncertain nature of the connection between mood and behaviour. These hypotheses were tested by asking children to predict and explain the behaviour of story characters in hypothetical social situations. In Study 1, the mood states of the story characters were explicitly described; in Study 2, they were described implicitly and irrelevant information was added to the stories.

Study 1: inferring behaviour based on explicitly described mood states

In this study we addressed whether children with HFASD are equally able as typically developing children to connect explicitly described positive or negative mood states of story characters to positive (helping) or negative (teasing) behavioural tendencies, respectively, to explain this connection and to refer to the uncertainty with which mood states result in behavioural outcomes.

We expected that children with HFASD would, in comparison to their typically developing peers, (1) be equally able to make congruent connections between mood states and behavioural tendencies, i.e. positive mood with positive behaviour and negative mood with negative behaviour, but (2) provide less mood-related explanations for the behaviour, i.e. references to mood or situation factors as causing the behaviour, and (3) refer less often to the uncertain influence of mood on behaviour.

Method

Participants

Two groups of 32 children each were included in Study 1. Thirty-two children with HFASD, 31 boys and one girl (mean age 9.7, SD 1.7), were recruited from child psychiatric centres and schools in The Netherlands which specialized in autism spectrum disorders. The diagnostic classification of the children was based on assessments by a child psychiatrist, and on reports of multiple informants who observed the children in the residential living group and in school. The children fulfilled established diagnostic criteria for ASD (American Psychiatric Association, 2000). The mean IQ scores of the HFASD group were: total, 101.3, SD 15.7; verbal, 104.3, SD 18.0; non-verbal, 99.4, SD 17.3. The IQ scores of this group were based on the Wechsler Intelligence Scale for Children–III (Wechsler et al., 1986) or the RAKIT intelligence test (Bleichrodt, 1988).

The comparison group consisted of 32 typically developing children (31 boys and one girl, mean age 9.8, SD 1.4) recruited from primary schools in the Amsterdam region. Children in the comparison and HFASD group were matched as closely as possible on age, gender and IQ. Comparison children were not explicitly tested for their intelligence, but teachers were asked to choose children with average verbal skills in order to correspond with the HFASD group. Other inclusion criteria specified that the children's native language was Dutch, and that they had no learning disabilities or other disorders. At the time of testing, the elementary school system in The Netherlands was based on an outplacement policy of cognitively delayed children (i.e. IQ scores <70) to special education institutes (Driessen, 2002).

Material

The material consisted of four stories. In each story, two different characters were introduced: one in a positive (happy) mood, and one in a negative (angry) mood. The story characters' mood states and the events that caused these mood states were explicitly described, e.g. 'Joost is happy, he made a nice drawing; Kees is angry, his Game Boy broke.' Out of these four stories,

two stories then continued to describe positive behaviour, e.g. helping to fix someone's bicycle, and two other stories continued with negative behaviour, e.g. deliberately flattening someone's bicycle tyre. Children were then asked (1) to estimate which one of the two story characters performed the described behaviour, and (2) to explain the reasons for this character's behaviour. See Table 1 for a fully transcribed story version.

Procedure

After the consent of both parent and child had been established, children were tested individually by one experimenter (SB) in a quiet room at their school or institute in one session of approximately 25 minutes. Four stories sequences, alternating between positive and negative stories, were randomized across the subjects. These sequences were equally distributed over the HFASD and comparison groups. Sessions were audio-recorded and transcribed later.

Scoring

Mood–behaviour congruence Responses to the question regarding the behaviour of the story character were scored as 'mood-congruent' when the story character with a positive mood was assigned positive behaviour or the character with a negative mood was assigned negative behaviour. Mood-congruent responses were awarded one point; non-mood-congruent responses were awarded no points. All children received two scores ranging from 0 to 2, reflecting their summed scores of congruent mood–behaviour responses per condition (positive or negative).

Mood-related explanations Explanations were coded in two categories: inclusion of a reference to mood (e.g. 'Kees did it because he was angry') or inclusion of a reference to the event that caused the mood (e.g. 'Kees did it because his Game Boy broke'). Explanations that included at least

Table 1 **Example of a story in the negative behaviour condition used in Study 1**

Ricardo's Game Boy broke and can't be fixed anymore. Ricardo is angry and moody.

Iwan made a nice clay statue. He is going to give it to his mother. Iwan is happy and cheerful.

This is Steven. At school, Steven saw that someone flattened his bicycle tyre. Now he has to walk all the way home. Neither Ricardo nor Iwan are friends of Steven. Both Ricardo and Iwan often tease other children. What do you think, which of these two boys flattened Steven's tyre? Why do you think so?

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one reference to mood or event were awarded one point in one or both of these categories. Categories were not exclusive. All children received two scores per condition (positive or negative story), ranging from 0 to 2. One score reflected the number of references to mood, the other score the number of references to events as possible causal factors of behaviours.

Uncertain relation between mood and behaviour   In order to quantify the child's acknowledgement of the uncertainty of the relation between mood and behaviour, we counted the number of responses in which children included terms that referred to uncertainty, e.g. '*Maybe* Kees did it because he was angry', 'Kees was angry so he *probably* did it', or explicit indications of the uncertainty of the effect of mood on behaviour, e.g. 'He *could/might* have done it.' Explanations that included at least one of the above elements were awarded one point. The analyses were conducted for all four stories together and children received one score that ranged from 0 to 4.

Syntactic quality   The syntactic quality of children's responses was explored through analyses of discourse structure, including length, and the extent of experimenter prompting necessary for the eliciting of responses. We assessed length by tallying the number of words and the number of clauses, defined as a verb and its arguments, in each response. The frequency of experimenter prompting to elicit a response provided a measure of the ease with which children provided their explanations.

Two raters, graduate students who were blind to the diagnosis of the children, independently coded a selection of the transcripts. Interrater reliability between the coders was monitored using Cohen's kappa for 10 randomly selected transcripts. Kappas were 0.78 for references to mood states, 0.80 for references to events, and 1.00 for references to uncertainty.

Results

We first established that total IQ, verbal IQ and non-verbal IQ were not significantly correlated with any of the scores within the HFASD group (all $p > 0.15$).

Mood–behaviour congruence

Within the negative and the positive condition, the chance level score for corresponding mood–behaviour responses was 1, based on two stories with a chance level of 0.5. Inspection of Table 2 indicates that the mean number of congruent mood–behaviour responses of all children was far above chance level ($p < 0.001$), in particular in the positive behaviour condition. Children from HFASD and comparison groups responded similarly to the

Table 2 **Mean (SD) number of responses that included mood-congruent behaviour in the positive and the negative behaviour conditions (range 0–2) and references to mood or event as causal factors of behaviour (range 0–4) for children with HFASD and comparison children**

Group[a]	Mood–behaviour congruence		References to mood or event as causal factors of behaviour	
	Negative behaviour version	Positive behaviour version	Causal mood*	Causal event**
HFASD	1.47 (0.84)	1.91 (0.30)	3.44 (1.01)	0.25 (0.67)
Comparison	1.56 (0.72)	1.84 (0.45)	2.88 (1.34)	0.97 (1.26)

[a] $n = 32$ for each group.
* $p < 0.06$, ** $p < 0.01$.

positive and negative story versions, and therefore the scores were collapsed over both story conditions. As expected, children with and without HFASD equally often connected mood states of story characters with congruent behaviour ($F_{(1, 62)} = 0.21$, $p = 0.88$).

Mood-related explanations

In the analysis of the explanations, stories were collapsed over the two story version conditions, because they did not interfere with the results. A 2 (group: HFASD and comparison) $\times$ 2 (reference: mood and event) mixed-design ANOVA showed no main effect for group ($F < 1$), but there was a main effect for reference ($F_{(1, 62)} = 144.93$, $p < 0.01$) and an interaction effect for group $\times$ reference ($F_{(1, 62)} = 9.17$, $p < 0.01$). As shown in Table 2, children from both groups referred more often to moods than events in their responses. However, children with HFASD showed a trend towards a higher number of mood references than comparison children (simple effect, $F_{(1, 62)} = 3.59$, $p < 0.06$), whereas comparison children referred more often to events as causal factors of behaviour than children with HFASD (simple effect, $F_{(1, 62)} = 8.14$, $p < 0.01$).

Uncertain relation between mood and behaviour

In their responses to the stories, children with HFASD (mean = 0.38, SD = 0.75, range 0–4) referred significantly less often to uncertainty terms in their explanations of the causal relation between mood and behaviour than children from the comparison group (mean = 0.88, SD = 1.01) ($F_{(1, 62)} = 5.06$, $p < 0.03$).

Syntactic quality

The syntactic quality of the responses did not differ between children with HFASD or comparisons in terms of number of words used (mean = 10.51, SD = 5.08 versus mean = 13.52, SD = 9.92, respectively) or number of clauses (mean = 1.71, SD = 0.80 versus mean = 2.21, SD = 1.87, respectively) or number of experimenter prompts that were needed to elicit a response (twice in the HFASD and once in the comparison group).

Discussion of Study 1

The majority of children from the HFASD and the comparison group adequately connected explicit descriptions of story characters' moods with congruent behaviour. However, children with HFASD, unexpectedly, showed a tendency to explain this connection by referring to mood states even more than children from the comparison group. The latter, in turn, more often referred to the event that caused the mood state. Thus, like comparison children, children with HFASD clearly seemed to explicitly acknowledge mood as a possible moderator of behaviour. A limitation of the current study is that there appears to have been a ceiling effect in the measure of mood–behaviour congruence in the positive stories.

The lower frequency of mood references in the typically developing group seems counterintuitive and did not coincide with their more frequent reference to events as causal factors. An explanation for this finding may be that the influence of the explicitly mentioned mood state was considered so obvious for them that the typically developing children did not think it necessary to repeat the mood references to the experimenter as an elicitor of the story character's behaviour. A similar effect was found in an earlier study with HFASD children (Rieffe et al., 2000). This assumption does imply that the effect would disappear when the mood component is described less explicitly. This implication will be addressed in Study 2.

Study 2: inferring behaviour based on implicitly described mood states

Based on the findings of the first study, it could be argued that explicit mood state information enabled children with HFASD to reason about the social consequences of mood in a manner similar to comparison children. Moreover, children with HFASD seemed to acknowledge the importance of mood information, since they actively presented mood states as reasons for the story character's behaviour. However, in daily life, someone's mood state often needs to be derived from implicit sources of information, which

is troublesome for children with HFASD (Klin et al., 2003). Given their dependence on explicit information to be able to understand emotional situations (Loveland et al., 1997), it might well be that children with HFASD fail at tasks on emotion understanding if needed cues are less obvious. Therefore, in a second study, we assessed whether children with HFASD are able to correspond implicit mood descriptions with behavioural responses equally as well as comparison children. To further manipulate the clarity of the mood descriptions, we used two types of stories: short implicit stories that resembled the stories from Study 1 but did not explicitly mention mood states; and long implicit stories that included added irrelevant context information. Compared to typically developing children, we expected children with HFASD to make less congruent connections between moods and behaviour and refer less often to moods or events as possible causal factors of behaviour. These group differences were expected to increase in the longer story versions compared to the short versions. A lower number of references to the uncertain influence of mood on behaviour was expected in the HFASD children following all story versions.

Method

Participants
Two groups of children (n = 29 each) were recruited for the second study. The first group included children with HFASD (one girl, 28 boys, mean age 11.1, SD 2.2). These were all different children than those participating in Study 1, but they were recruited from the same institutions, and diagnosed according to the same classification procedures. The comparison group included typically developing children (one girl, 28 boys, mean age 11.0, SD 1.1), recruited from primary schools in the Amsterdam region, which were different children than the comparison children participating in Study 1. The mean IQ scores of the HFASD group were: total, 94.1, SD 18.0; verbal, 94.54, SD 17.0; non-verbal, 91.5, SD 16.7. The children in the comparison group were not explicitly tested for their intelligence, but according to their teachers they showed intelligence within the 'normal' range.

Material
Children were presented with eight stories in which mood-eliciting events were described that occurred to two story characters. In every story, one character experienced a positive event (e.g. 'Tom won with gymnastics'); the other character experienced a negative event (e.g. 'Bob lost his judo match'). Both events were expected to affect the story character's mood states accordingly, but in contrast with Study 1, mood states were not

explicitly mentioned. The stories then continued with the description of positive behaviour (four stories) or negative behaviour (four stories), comparable to the behaviour descriptions used in Study 1 (e.g. fixing or destroying other children's property). Children were asked which one of the characters committed the described (positive or negative) behaviour, and were asked to explain why. The stories were presented in four short (see Table 3) and four long (see Table 4) versions, equally distributed across the positive and negative behaviour stories. The longer versions contained irrelevant, distracting context information about the two story characters, such as where they lived and what their hobbies were. Full story versions can be obtained from the first author.

Procedure

The procedure was similar to Study 1, with the following changes: four different sequences of the eight stories, alternating between positive and

Table 3 **Example of a short story in the positive behaviour condition used in Study 2**

> Bob lost his judo match today. He trained really hard for it.
>
> Tom did really well in the gymnastics class today. He was the best man of the team.
>
> Your bicycle is broken. However, when you come home after school, you find that someone has fixed your bike. Bob and Tom are both friends of yours. Bob and Tom are both very able to fix a bike, and one of them has fixed the bike.
>
> What do you think, which one of these boys has fixed your bike? Why do you think so?

Table 4 **Example of a long story in the positive behaviour condition used in Study 2; distracting context information is italicized**

> *Steven and Jan are both living in your street.* Jan got new colour markers last week. *He took them with him to school. When he wanted to draw a painting today*, he found that someone did not put the lids back on the markers. Now they are all dried out.
>
> Steven always wanted to have a dog. *His parents used to say that he wasn't allowed to have a dog, but Steven's aunt's dog had puppies. Steven's aunt cannot keep all the pups*, so this week, Steven is allowed to pick a dog.
>
> Jan and Steven both have the same bike. Yesterday you asked both of them if you could borrow their bike. When you come home, you see that a bike is standing in your garden. You do not know whose bike it is. Jan and Steven are both friends of yours.
>
> What do you think; did Jan or Steven lend you his bike? Why do you think so?

negative, as well as between short and long stories, were randomized over the subjects.

Scoring

Mood–behaviour congruence   Mood-congruent responses were scored similarly to Study 1, congruent responses were given a score of 1, non-congruent responses were scored 0. Within the long and short story version conditions a total score ranging from 0 to 4 was computed to reflect the summed congruent responses.

Mood-related explanations   All explanations that included references to mood or the event that caused the mood were awarded one point. For each condition (long or short) total scores were computed, ranging from 0 to 4, the first one to reflect the summed number of references to mood, the second to reflect the summed number of references to the event that caused the mood.

Uncertain relation between mood and behaviour   All explanations that included at least one of the uncertainty terms (see scoring Study 1) were awarded one point. Analyses were performed over all eight stories together (score range 0–8).

Syntactic quality   The syntactic quality of children's responses was scored similar to Study 1, differentiating between number of words, clauses and experimenter prompts.

Two graduate students, blind to the age and diagnosis of the children, independently coded a selection of the transcripts. Interrater reliability was monitored using Cohen's κ for 10 randomly selected transcripts, and found to be satisfactory ($\kappa = 0.70$ for mood references, 0.76 for references to events that caused the mood and 1.00 for uncertainty understanding). Kappas proved to be highly similar to those found in Study 1.

Control measures

In order to control for possible differences between children with HFASD and normally developing children in the general ability to infer information from implicit sources, we designed two additional stories with implicit non-mood information that could be used to predict behavioural outcomes (e.g. 'Lisa lives on a farm, Wendy lives in a flat, who has fed the rabbits in the schoolyard?'). These stories were comparable to the long story versions, and included positive or negative behaviour. Responses were scored for the congruence of implicit source and behaviour and the references to the implicit source in chidren's explanations.

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Results

Again, total IQ, verbal IQ and non-verbal IQ were not significantly correlated with any of the scores within the HFASD group (all $ps > 0.15$).

Mood–behaviour congruence

The HFASD group connected positive and negative mood to behaviour remarkably well. Table 5 indicates that children in both HFASD and comparison groups scored well above chance ($p < 0.001$) in identifying characters whose behaviour and moods were of equal valence. The scores were collapsed over the positive and negative behaviour conditions, because no effect of story valence was found. Contrary to our expectation, children with HFASD performed at a similar level to the comparison group in both the short and long story versions. A 2 (group: HFASD and comparison) × 2 (story length: short and long) mixed-design ANOVA showed no main or interaction effects.

Mood-related explanations

Explanations were analysed for references to mood or event in the two story length conditions. A 2 (group: HFASD and comparison) × 2 (story length: short and long) × 2 (reference: mood and event) mixed-design ANOVA indicated an interaction effect of group × story length ($F_{(1, 56)} = 4.83$, $p < 0.05$) but no interaction effect of group × reference ($F_{(1, 56)} = 1.45$, $p = 0.23$) or other effects. The group × story length interaction principally emanated from the higher rate of reported mood and event references in the long story condition of comparison children compared to children with

Table 5 **Mean (SD) number of responses that included mood–behaviour congruence and number of responses that included references to mood or event as causal factors of behaviour of children with HFASD and comparison children following short and long story versions (range 0–4)**

Group[a]		Short story version	Long story version[b]*
HFASD	Mood–behaviour congruence	2.86 (1.16)	3.09 (0.91)
	Causal mood	1.48 (1.53)	1.21 (1.32)
	Causal event	1.72 (1.22)	1.55 (1.15)
Comparison	Mood–behaviour congruence	3.21 (1.08)	3.14 (0.95)
	Causal mood	1.93 (2.70)	1.97 (1.42)
	Causal event	1.55 (1.21)	1.86 (0.95)

[a] $n = 29$ for each group.
[b] Children with HFASD reported fewer mood and event references than comparison children in the long story versions only.
*$p < 0.05$.

HFASD (simple effect, $F_{(1, 56)} = 5.87$, $p < 0.05$). Children with HFASD explained their responses to the longer story versions relatively more often by referring to non-emotional features of the story characters (size, appearance and abilities; e.g. 'he is bigger') or the situation (time and space; e.g. 'she was in her room'), even though these features were kept identical for both story characters. In only five out of 232 responses children said they didn't know why the character they chose would be the likely actor of the described behaviour. This happened four times in the HFASD and once in the comparison group.

The short story condition elicited similar levels of mood and event references in the HFASD and comparison groups (simple effect, $F_{(1, 56)} = 2.13$, n.s.) (Table 5).

Uncertain relation between mood and behaviour

Again, children with HFASD made fewer references to uncertainty terms in the explanations of the causal relation between mood and behaviour (mean = 0.45, SD = 0.91, range 0–8) than children from the comparison group (mean = 1.66, SD = 2.47) ($F_{(1, 56)} = 6.11$, $p < 0.02$).

Syntactic quality

Children with HFASD used fewer words than children from the comparison group (mean = 9.38, SD = 3.00 versus mean = 14.86, SD = 11.19, respectively) ($F_{(1, 56)} = 6.50$, $p < 0.02$), and also included fewer clauses (mean = 1.53, SD = 0.43 versus mean = 2.30, SD = 1.68, respectively). However, including the number of words or clauses as covariates did not alter the results of the analyses of the mood-related explanations. Furthermore, no difference was found in the number of experimenter prompts that were needed to elicit a response (twice in the HFASD group and four times in the comparison group).

Control measures

The implicit source–behaviour congruence responses given in response to the non-mood stories were compared to the mood–behaviour congruence responses given in the mood stories. A 2 (group: HFASD and comparison) × 2 (information: mood and non-mood) mixed-design ANOVA showed a main effect for information ($F_{(1, 56)} = 16.78$, $p < 0.01$), but no other effects. All children made more corresponding behavioural inferences following non-mood (mean = 0.93, SD = 0.13, score range 0–1) than mood (mean = 0.78, SD = 0.23) stories. While the non-mood stories seem to have elicited ceiling effects in both groups, they do indicate that the ability to make behavioural inferences based on implicit information is clearly available to children from both comparison and HFASD groups.

Interestingly, children with HFASD referred to the implicit cause of the non-emotion stories in all their responses, while comparison children partially failed to do so (chi^2 = 88.17, p < 0.01). References to the uncertain relation between the implicit source and the behaviour in the non-emotion stories did not differ between comparisons and children with HFASD.

Discussion of Study 2

The second study indicated that the majority of HFASD and typically developing children adequately connected mood states with congruent behaviour, even if these mood states were not explicitly described or had to be inferred from irrelevant context information. Children's explanations of story characters' behaviours were not equivalent between the groups. The short story versions indicated equal numbers of mood and event references in both groups. Following the long story versions, where distracting context information was added to the story content, children with HFASD referred less often to mood and event as causal factors than typically developing children. Furthermore, children with HFASD referred less often to the uncertainty of the connection between mood and behaviour than typically developing children. Again, all findings were independent of the IQ in the HFASD group.

General discussion

High-functioning children with ASD and their typically developing peers connected at equal rates the descriptions of story characters' positive or negative moods with descriptions of positive or negative behaviour, respectively. It made no difference whether mood descriptions were presented explicitly, implicitly or combined with distracting context information: all children seemed to make equal use of the basic rule that positive or negative mood states affect behavioural tendencies accordingly. The finding that the application of this rule was not influenced by the absence of explicit mood descriptions or the addition of irrelevant information was unexpected. Apparently, children with HFASD are able to extrapolate relevant mood information from these implicit sources, and do not rely as strongly on explicit sources as anticipated. Alternatively, they may have relied on a more general rule regarding the congruence of same-valenced story elements which, besides mood and behaviour, can also consist of context information.

As expected, the main group differences were identified in the explanations of the mood–behaviour congruence. Children from the HFASD and

comparison groups differed on two accounts: the number of mood-related explanations, i.e. references to mood or events, and the number of references to the uncertain relation between mood and behaviour.

The direction of the group differences in the mood-related explanations depended on the explicitness and complexity of the mood descriptions. Following the explicit mood descriptions of the first study, the group effect was counter-intuitive: children with HFASD relatively more often mentioned moods of story characters, while children from the comparison group – besides their references to moods – more often mentioned events that caused the story character's mood states. As discussed above, the possibility exists that children from the comparison group found the – explicitly described – mood states of the story characters so obvious that they would consider it unnecessary to mention these again in their explanations, instead referring more often to the event causing the mood state. Indeed, the group difference disappeared when mood information was no longer explicit in the second study.

Following the long story versions, which also included irrelevant information, the group effect partly reversed: children with HFASD now gave fewer mood-related explanations than comparison children. This may indicate that they extended the 'valence congruency' rule to implicit information on mood, which allowed them to connect a negative situation (e.g. losing a judo match) to negative behaviour (e.g. destroying property) without having to consider the mood state (anger) as the underlying cause of the behaviour. This result supports previously suggested ideas that children with HFASD are inclined to reason about emotions by relying on 'rote solutions', such as the currently suggested 'valence congruence' rule, but are limited in their ability to generalize such rules to other domains, as currently evidenced by their lack of references to mood states as causing behaviour (Kaland et al., 2002; Klin et al., 2003; Peterson et al., 2005; Pons & Harris, 2005).

Some mood–behaviour incongruence responses could have reflected emotional understanding, for example when children report 'mood improvement' strategies (Stegge et al., 1994). In such responses, a negative mood is connected with positive behaviour, followed by mood improvement explanations (e.g. 'X will help because he is sad and helping will cheer him up'). We avoided sadness as an initial mood state in our scripts, since in contrast to anger, sadness is known to stimulate positive behaviour for various reasons (Meerum Terwogt, 2002). However, even in an angry person, mood improvement can be a reason to do something positive: 'He helps, because it takes his mind off [the angering incident]' or 'He helps, because it makes him feel better.' Although not a part of the original coding scheme, this feature was noted because it was exclusively found within the

comparison group (five times in total over both studies). These responses had no impact on the congruence scores, and due to their low frequency, the interpretation of these responses is preliminary. Still, they indicate advanced ways of reasoning about emotions in social interactions that are relevant to future studies with both children and adults with HFASD.

Both studies confirmed that children with HFASD referred to the uncertain connection between mood and behaviour less than comparison children, who more often explicitly acknowledged that someone's mood is a heuristic for someone's behaviour, i.e. when you are angry you *usually* but *not necessarily* act it out. Children with HFASD generally neglected this uncertain element and seemed to interpret the influence of mood on behaviour in a more deterministic fashion, i.e. when angry, you act it out. Possibly, children with HFASD do not possess sufficient linguistic abilities to report on uncertainty with respect to mood and behaviour (Losh and Capps, 2003). However, their equally coherent explanations are not in congruence with this hypothesis, and no group differences were found in the number of references to uncertainty in the non-mood control stories. The explanation that the low number of references to uncertainty terms may indicate a deterministic appreciation of the influence of mood on behaviour would be more in line with the tendency of children with HFASD to seek rote solutions in their reasoning about emotions (Capps et al., 1992; Peterson et al., 2005).

The present study is limited in the information about participants' characteristics. This information was not collected because the Dutch elementary school system is based on an outplacement policy for cognitively delayed children. Furthermore, findings of both studies were independent of IQ in the HFASD group. However, including more explicit IQ measures of comparison children would have allowed us to provide more convincing evidence for the suggested equal verbal skills in both groups, and contrast these to the observed group differences in explaining emotions. Also, standardized diagnostic measures would have decreased the likelihood of misdiagnoses, and the inclusion of measures on adaptive behaviour would have allowed the direct comparison of theoretical abilities to natural behaviour.

Still, the adequate responses and explanations of the non-emotional control stories of the second study indicated that HFASD children were able to reason about implicit causes of behaviour. Furthermore, the length of responses in Study 1 was identical for HFASD and comparison children. In Study 2, responses of children with HFASD were shorter than those of comparison children, but controlling for length did not alter the main effects. Lastly, the fact that even the most complex stories elicited only five 'don't know' responses in total, and both studies required hardly any prompting to elicit responses, suggest adequate story comprehension in all children.

To summarize, we posit that the influence of mood on behaviour is acknowledged by children with HFASD, but that their explanations for this influence suggest a rote- rather than self-generated understanding of the causal role of mood on behaviour. When the necessary elements for an adequate explanation were explicitly described, children with HFASD could connect information about mood states and behaviour based on their valence. Using this general rule, it would make sense to include, for example, references to positive mood states when arguing for positive behavioural tendencies. However, following implicit and obscured descriptions, the possibility to revert back to explicit information in the stories was closed off and children had to generate responses on their own account. In these cases they emphasized mood-related information less often than typically developing children, which suggests that they know the general rules, but seem less attentive to mood-related information in their explanations. These results map neatly to the difficulties of ASD children in understanding the hedonic value of their sensory environment, as suggested by the social-affective dysfunction theory of autism (Hobson, 1989; 1993).

To further our knowledge of the pragmatics in the emotional understanding of children with HFASD, it is necessary to closely delineate the extent and the development of the emotional understanding of children with HFASD, encompassing issues on how and when these children apply their understanding of emotions in natural settings. When further studies confirm the currently suggested rote-based understanding of emotions in children with HFASD, this information should be integrated in clinical practice. Standard diagnostic instruments such as the ADOS–G (Lord et al., 2000), or measures used in research on intervention effects (Howlin, 2005; Lord et al., 2005), could be improved by specifying questions to tap into children's rote- or self-generated aspects of emotional understanding. This may prevent clinicians and researchers from being misled by the adequate responses of children with HFASD, which may not indicate the same type of emotional understanding, i.e. based on the integration of personal social and affective experiences, that can be found in typically developing children.

References

ADAMS, C., GREEN, J., GILCHRIST, A. & COX, A. (2002) 'Conversational Behaviour of Children with Asperger Syndrome and Conduct Disorder', *Journal of Child Psychology and Psychiatry* 43: 679–90.

AMERICAN PSYCHIATRIC ASSOCIATION (2000) *Diagnostic and Statistical Manual of Mental Disorders*, 4th edn (DSM-IV). Washington, DC: APA.

BARON-COHEN, S. (1991) 'Do People with Autism Understand What Causes Emotion?', *Child Development* 62: 385–95.

BEGEER, S., RIEFFE, C., MEERUM TERWOGT, M. & STOCKMANN, L. (2006) 'Attention to Facial Emotion Expressions in Children with Autism', *Autism* 10 (1): 37–51.

BEVERSDORF, D.Q., ANDERSON, J.M., MANNING, S.E., ANDERSON, S.L., NORDGREN, R.E., FELOPULOS, G.J. ET AL. (1998) 'The Effect of Semantic and Emotional Context on Written Recall for Verbal Language in High Functioning Adults with Autism Spectrum Disorder', *Journal of Neurology Neurosurgery and Psychiatry* 65: 685–92.

BLEICHRODT, N. (1988) *RAKIT: Handleiding bij de Revisie Amsterdamse Kinder Intelligentie Test.* Lisse: Swets & Zeitlinger.

CAPPS, L., SIGMAN, M. & YIRMIYA, N. (1995) 'Self-Competence and Emotional Understanding in High-Functioning Children with Autism', *Development and Psychopathology* 7: 137–49.

CAPPS, L., YIRMIYA, N. & SIGMAN, M. (1992) 'Understanding of Simple and Complex Emotions in Non-Retarded Children with Autism', *Journal of Child Psychology and Psychiatry* 33: 1169–82.

COLE, P.M., MARTIN, S.E. & DENNIS, T.A. (2004) 'Emotion Regulation as a Scientific Construct: Methodological Challenges and Directions for Child Development Research', *Child Development* 75: 317–33.

DAVIES, S., BISHOP, D., MANSTEAD, A.S. & TANTAM, D. (1994) 'Face Perception in Children with Autism and Asperger's Syndrome', *Journal of Child Psychology and Psychiatry* 35: 1033–57.

DOWNS, A. & SMITH, T. (2004) 'Emotional Understanding, Cooperation, and Social Behavior in High-Functioning Children with Autism', *Journal of Autism and Developmental Disorders* 34: 625–35.

DRIESSEN, G. (2002) 'School Composition and Achievement in Primary Education: A Large-Scale Multilevel Approach', *Studies in Educational Evaluation* 28: 347–68.

GNEPP, J. & KLAYMAN, J. (1992) 'Recognition of Uncertainty in Emotional Inferences: Reasoning about Emotionally Equivocal Situations', *Developmental Psychology* 28: 145–58.

HADWIN, J., BARON-COHEN, S., HOWLIN, P. & HILL, K. (1997) 'Does Teaching Theory of Mind Have an Effect on the Ability to Develop Conversation in Children with Autism?', *Journal of Autism and Developmental Disorders* 27: 519–37.

HALE, C.M. & TAGER-FLUSBERG, H. (2005) 'Brief Report: The Relationship between Discourse Deficits and Autism Symptomatology', *Journal of Autism and Developmental Disorders* 35: 519–24.

HAPPÉ, F. (1994) 'An Advanced Test of Theory of Mind: Understanding of Story Characters' Thoughts and Feelings by Able Autistic, Mentally Handicapped, and Normal Children and Adults', *Journal of Autism and Developmental Disorders* 24: 129–54.

HARRIS, P.L., OLTHOF, T. & MEERUM TERWOGT, M. (1981) 'Children's Knowledge of Emotion', *Journal of Child Psychology and Psychiatry* 22: 247–61.

HOBSON, P. (2002) *The Cradle of Thought.* London: Macmillan.

HOBSON, R.P. (1989) 'Beyond Cognition: A Theory of Autism', in G. DAWSON (ed.) *Autism: Nature, Diagnosis and Treatment*, pp. 22–48. New York: Guilford.

HOBSON, R.P. (1993) *Autism and the Development of Mind.* Hove: Erlbaum.

HOWLIN, P. (2005) 'The Effectiveness of Interventions for Children with Autism', *Journal of Neural Transmission, Supplement* 69: 101–19.

JAEDICKE, S., STOROSCHUK, S. & LORD, C. (1994) 'Subjective Experience and Causes of Affect in High-Functioning Children and Adolescents with Autism', *Development and Psychopathology* 6: 273–84.

KALAND, N., MOLLER-NIELSEN, A., CALLESEN, K., MORTENSEN, E.L., GOTTLIEB, D. & SMITH, L. (2002) 'A New "Advanced" Test of Theory of Mind:

Evidence from Children and Adolescents with Asperger Syndrome', *Journal of Child Psychology and Psychiatry* 43: 517–28.

KASARI, C., SIGMAN, M., MUNDY, P. & YIRMIYA, N. (1990) 'Affective Sharing in the Context of Joint Attention Interactions of Normal, Autistic, and Mentally Retarded Children', *Journal of Autism and Developmental Disorders* 20: 87–100.

KLIN, A. (2000) 'Attributing Social Meaning to Ambiguous Visual Stimuli in Higher-Functioning Autism and Asperger Syndrome: The Social Attribution Task', *Journal of Child Psychology and Psychiatry* 41: 831–46.

KLIN, A., JONES, W., SCHULTZ, R. & VOLKMAR, F. (2003) 'The Enactive Mind, or from Actions to Cognition: Lessons from Autism', *Philosophical Transactions of the Royal Society of London: Biological Sciences* 358: 345–60.

LORD, C., RISI, S., LAMBRECHT, L., COOK, E.H., LEVENTHAL, B.L., DILAVORE, P.C. ET AL. (2000) 'The Autism Diagnostic Observation Schedule–Generic: A Standard Measure of Social and Communication Deficits Associated with the Spectrum of Autism', *Journal of Autism and Developmental Disorders* 30: 205–23.

LORD, C., WAGNER, A., ROGERS, S., SZATMARI, P., AMAN, M., CHARMAN, T. ET AL. (2005) 'Challenges in Evaluating Psychosocial Interventions for Autistic Spectrum Disorders', *Journal of Autism and Developmental Disorders* 35: 695–708.

LOSH, M. & CAPPS, L. (2003) 'Narrative Ability in High-Functioning Children with Autism or Asperger's Syndrome', *Journal of Autism and Developmental Disorders* 33: 239–51.

LOVELAND, K.A., TUNALI-KOTOSKI, B., CHEN, Y.R., ORTEGON, J., PEARSON, D.A., BRELSFORD, K.A. ET AL. (1997) 'Emotion Recognition in Autism: Verbal and Nonverbal Information', *Development and Psychopathology* 9: 579–93.

MEERUM TERWOGT, M. (2002) 'Emotional States in Self and Others as Motives for Helping in 10-Year-Old Children', *British Journal of Developmental Psychology* 20: 131–47.

PETERSON, C.C., WELLMAN, H.M. & LIU, D. (2005) 'Steps in Theory-of-Mind Development for Children with Deafness or Autism', *Child Development* 76: 502–17.

PONS, F. & HARRIS, P.L. (2005) 'Longitudinal Change and Longitudinal Stability of Individual Differences in Children's Emotion Understanding', *Cognition & Emotion* 19: 1158–74.

RIEFFE, C., MEERUM TERWOGT, M. & STOCKMANN, L. (2000) 'Understanding Atypical Emotions among Children with Autism', *Journal of Autism and Developmental Disorders* 30: 195–203.

RIEFFE, C., MEERUM TERWOGT, M. & KOTRONOPOULOU, C. (2007) 'Awareness of Single and Multiple Emotions in High-Functioning Children with Autism', *Journal of Autism and Developmental Disorders* 37: 455–465.

SERRA, M., MINDERAA, R.B., VAN GEERT, P.L., JACKSON, A.E., ALTHAUS, M. & TIL, R. (1995) 'Emotional Role-Taking Abilities of Children with a Pervasive Developmental Disorder Not Otherwise Specified', *Journal of Child Psychology and Psychiatry* 36: 475–90.

STEGGE, H., MEERUM TERWOGT, M. & KOOPS, W. (1994) 'Positive and Negative Mood Effects in Children: The Mediating Influence of Task Characteristics', *Journal of General Psychology* 121: 333–44.

WECHSLER, D., HAASEN, P.P., BRUYN, E.E.J., PIJL, Y.L., POORTINGA, Y.H., LUTJE SPELBERG, H.C. ET AL. (1986) *Wechsler Intelligence Scale for Children – Revised: Nederlandstalige uitgave.* Lisse: Swets & Zeitlinger.