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ORIGINAL CONTRIBUTION

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Social-cognitive abilities in children with lesser variants of autism: skill deficits or failure to apply skills?

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Abstract The present study re-examined the ability of children with lesser variants of autism (classified as PDD-NOS) to infer emotions of other people and to describe others in terms of inner, psychological characteristics. It also explores the hypothesis that these children may have the skill to infer mental states of other people, but fail to use these skills spontaneously. Children with lesser variants of autism and normal control children matched for age, sex and intelligence were given three structured emotional role-taking tasks and asked to give two spontaneous descriptions of peers. The results showed that both groups did not differ with respect to their ability to infer other people's emotions in the structured role-taking tasks. In contrast, significant differences were found on the free person descriptions: the children with PDD-NOS used fewer inner, psychological characteristics to describe peers.

Key words Social cognition – lesser variants of autism – PDD-NOS

Introduction

Various authors have described groups of children with severe social interactive and communicative problems who do not meet strict criteria for autistic disorder (2). Here the term "lesser variants" of autism is used, which does not, however, imply that these individuals are less handicapped in their daily functioning. The consequences of the social and communicative deficits as shown by this group can be as severe as for those children who have the same level of ability and typical autism. In this context "lesser" only refers to the severity or the amount of symptoms and not to the consequences of these symptoms for daily functioning. Examples of such lesser variants of autism include Wing's 'active-but-odd' and 'over-formal, stilted' groups (43, 44), children with Multiple Complex Developmental Disorder (16, 40), or children with Asperger's syndrome (3, 42). Other groups may not have been described as being part of the autistic spectrum (44), but may have many characteristics in common with these disorders. Examples include children with disorders in attentional, motor and perceptual control – DAMP – (18) or children with non-verbal learning disorders (36).

The groups described above (except for the Asperger's syndrome which is included as a separate diagnostic category in the DSM-IV) may all meet DSM-III-R (1) or DSM-IV (2) criteria for Pervasive Developmental Disorders Not Otherwise Specified (PDD-NOS). This category provides a diagnostic holding place for a large group of children whose problems are not well captured by the available disorders (41). The criteria for this subthreshold category are very broad and mainly negatively formulated. As a result, children with problems classified as PDD-NOS often differ with respect to the quantity or seriousness of social, communicative and associated problems.

Theory of Mind

Despite the heterogeneity and the current lack of diagnostic validity for this clinically relevant group of children a rather specific hypothesis has been formulated

concerning the underlying common cause of their social and communicative problems. Gillberg (19, 20) argues that problems in understanding other people's psychological or mental states may be the underlying cause of the social problems of children with lesser variants of autism.

Several authors have presumed that autistic children lack an innate, cognitive ability to attribute mental states (e.g. thoughts, intentions, emotions) to others. These so-called Theory-of-Mind deficits (7) are supposed to account for social and communicative problems of autism. Most experiments carried out within the Theory-of-Mind approach focus on the attribution of beliefs to others. Support has been found for the presence of belief-attribution deficits in mentally handicapped children with autism. These children seem to be less able than control subjects to understand that other people can have beliefs which are not in accordance with reality (i.e. 'false beliefs') (4–8).

There is also evidence that many autistic children have an impaired understanding of other people's knowledge (30, 34), perception (25, 34) and belief-based emotions (9). However, Baron-Cohen (6) and Tan and Harris (39) demonstrate that autistic subjects are able to understand certain aspects of desires. Thus, studies with mentally retarded autistic subjects generally support the hypothesis that these subjects have problems in understanding representational mental states, such as beliefs. The results of studies on Theory-of-Mind abilities of higher functioning autistic children or adolescents are more variable and more difficult to interpret. Among other things, this may be due to the lack of diagnostic consensus considering the distinction between high-functioning autism and Asperger's syndrome. The results seem to vary depending on whether of not subjects with Asperger's syndrome are included. Ozonoff and colleagues demonstrated that high-functioning autistic children or adolescents perform worse than normal and clinical controls on both simple and complex belief-attribution tasks (33). Also, subjects with high-functioning autism seemed to have less optimal abilities to infer and understand emotional mental states in others (15, 31, 45). Several authors have not found any significant differences between people with Asperger's syndrome and normal and psychiatric controls. Children with Asperger's syndrome were able to solve even complex belief-attribution tasks (13, 33, 35). Fine et al. (17) demonstrated Theory-of-Mind problems in children with Asperger syndrome, but they used a more naturalistic task-situation.

Gillberg (19, 20) extends the Theory-of-Mind hypothesis and suggests that problems in the development of adequate Theory-of-Mind skills or an inability to 'empathise' could not only be the underlying causal factor in autism, but also of lesser variants of autism. Empirical studies that include children with 'milder' social and communicative problems are rare. Buitelaar et al. (14) found impaired performance on standard Theory-of-Mind tasks in normally intelligent children with PDD-NOS. Using tasks measuring the ability to predict and recognise emotional mental states, Serra et al. found less optimal performance on some of these tasks in normally intelligent children with PDD-NOS (37).

In sum, there is at least some evidence for Theory-of-Mind deficits in children with lesser variants of autism, but given the lack of research data, no firm conclusions can be made. In addition, most studies focus on the attribution of beliefs. Inference and understanding of emotions has generally been neglected, although the importance of these skills has been stressed by many authors (24, 28, 29).

Theory of Mind: absence of skills or failure to apply them?

Apparently, not all children with disorders in the autistic spectrum have severe and demonstrable Theory-of-Mind deficits. As a result, additional hypotheses need to be formulated in order to explain the social deviant behaviour of such children. An example concerns the hypotheses that the social-interactive and communicative problems of children who do possess adequate Theory-of-Mind skills might be caused by an inability to apply these skills in a spontaneous and effective manner (12, 13). Thus, their deviant social behaviour is explained by a 'failure in performance' rather than by an 'absence of skills'.

Studies using unstructured and naturalistic tasks have provided some preliminary support for this suggestion. Happé (27) used an advanced test of Theory of Mind in which understanding of other people's intentions was needed to grasp, for example, white lies, jokes, pretence or irony. Happé found that even those children who were able to solve complex, standard Theory-of-Mind tasks, failed to understand irony, jokes etc. Fine et al. (17) studied conversational abilities of high-functioning autistic individuals and individuals with Asperger's syndrome. They found that both groups were less able to adjust their conversation to the needs (e.g. knowledge, interests) of the listener.

Both studies suggest that the children who participated might have had problems in using their Theory-of-Mind knowledge in daily-life situations. However, in none of the studies described above it is clear whether the children did not possess the skills to infer intentions, interests or knowledge of other persons, or whether they were only unable to apply them. To really study this issue it is necessary to investigate both skills and application of these skills in the same situation. No such studies appear to have been carried out.

Aim of the present study

The present study is based on a previous one described in two separate papers [Serra et al. (37, 38)]. It aims to re-investigate the ability to infer other people's emotions and to provide differentiating descriptions of peers in normally intelligent children with problems in social interaction and communication which are sufficiently severe to be described as lesser variants of autism. In terms of the DSM-III-R (the study was carried out when this version of the manual was in use), these problems may be categorised as PDD-NOS. In addition, the study explores the possibility that these children have problems in spontaneously using their ability to infer the psychological or mental characteristics of other people.

A combination of structured and unstructured methods was used. Children's ability to infer emotions was tested by means of three structured tasks, which were also used in Serra et al. (37). These tasks were chosen since they required subjects to understand individual differences in emotional perspectives rather than stereotyped reactions to situations (22–24). Two person descriptions (38) were employed to test the spontaneous use of psychological characteristics to describe peers. This free description method was combined with structured interview questions in which children were explicitly prompted to give certain types of information. The study included healthy, normally intelligent control subjects who were individually matched for age, sex and intelligence with the clinical group.

If differences between the clinical and the control group are found (i.e. on the basis of the data described in Serra et al. (37) differences are expected on two of the three tasks), this provides support for the hypothesis that deficits in Theory-of-Mind skills are present in children with lesser variants of autism. If there are significant differences in the spontaneous use of psychological characteristics, but not in the ability to infer emotions after explicit prompting, this gives some preliminary support to the idea that these children's social and communicative problems may be related to the failure to apply social-cognitive skills.

Method

Subjects

The clinical group consisted of 31 (6 girls and 25 boys), normally intelligent, 6- to 12-year-old children with problems in social interaction and communication who were categorised as Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS) according to DSM-III-R criteria (1). Although their problems were described as autistic-like (i.e. children had problems in interacting with others in a reciprocal way), none of the children met DSM-III-R criteria for Autistic Disorder. All were out-patients at the Dept. of Child and Adolescent Psychiatry in Groningen and lived with their parents. The majority of the children (n = 22) attended a mainstream school, the remaining nine followed special education.

The clinical diagnosis was made by two child psychiatrists who used several sources of information. They carried out extensive clinical interviews with the parents. In these interviews the clinicians asked the parents about the present functioning of the child on various developmental domains. Examples include social functioning (e.g. the quality of social relationships, the child's readiness to initiate social approaches), attention and motor control problems and communicative abilities (e.g. understanding and use of verbal and non-verbal communication). Parents were also asked about the developmental history of the child (e.g. pregnancy and birth, developmental milestones, school history and family history). Several play contacts with the child provided additional information about his or her functioning.

The DSM-III-R offers only broad diagnostic criteria for PDD-NOS. Moreover, no standardised measures are available to measure 'milder' social and communication deficits (21). We tried, therefore, further to specify the problems of these children by means of a 64-item questionnaire completed by their parents. The items were based on the DSM-III-R criteria for PDD and were formulated so as to ensure that subthreshold manifestations could be also rated. To ensure that a somewhat more homogeneous subject sample could be obtained, the following procedure was adopted. Summary scores for each subject were computed for each domain (i.e. impairment in social interaction, impairment in (non-)verbal communication and restricted repertoire of activities and interests) in order to see how many problems children experience on each domain. For an initial sample of 35 children diagnosed as having PDD-NOS parents completed this checklist. To select a more homogeneous subject sample, the subjects with the lowest scores (i.e. lowest 10%, n = 4) on both the first and the second domain were excluded because impairments in social interaction and in (non-)verbal communication were considered to be most characteristic for the PDD-NOS diagnosis (DSM-III-R and DSM-IV). The cut-off point of 10% was chosen so as to ensure that the subject sample remained large enough but that subjects with very mild social interactive and communication problems were excluded. Table 1 summarises the behaviours which were present in more than 75% (n = 23) of the sample.

Problems in the social interaction domain which were shown by only a few of the subjects in this sample included an inability to show compassion, telling private things to strangers and a lack of response to other

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Table 1 Symptom characteristics of the PDD-NOS group 1

	sometimes/ a little[1]	often/ very strong
Impairment in social interaction		
Does not react when spoken to	23	2
Makes remarks which are painful to others	9	15
Does not understand why someone is angry (e.g. does not stop when someone gets angry)	13	17
Does not understand jokes	11	17
Takes things literally (e.g. does not understand certain expressions)	14	14
Does not take the needs of others into account	17	13
Cannot play with peers without problems	18	11
Has difficulty staying friends	12	12
Impairment in (non-)verbal Communication		
Makes no eye-contact while talking with someone	11	13
Says things which are not relevant to the conversation	16	11
Only talks about things that are of concern to him/her	7	19
Does not bother whether others understand him/her (e.g. does not finish sentences, does not give background information)	12	12
Tends to miss the point in a conversation	13	13
Restricted, repetitive patterns of Behaviour, interests and activities		
Panics or gets nervous if change occurs	10	14
Shows chaotic behaviour in unfamiliar situations	11	13

Note: n = 31. Data are based on a checklist completed by parent
[1] Number of children

children's social approaches. Problems in the domain of verbal and non-verbal communication which were shown by a small number of children concerned abnormalities in speech or language (e.g. strange intonation, echolalia, pronoun reversal and idiosyncratic language). The majority of the subjects did not show any motor stereotypies (walking on tiptoes, flapping arms, finger-flicking etc.) or abnormalities in sensory information processing (fascination for sounds, feeling objects or being preoccupied with parts of objects). Only four children in the sample had strong circumscribed interests.

With respect to co-morbidity, a fair number of children in the sample suffered from attentional problems and/or hyperactivity (n = 13). All children with attentional and/or hyperactivity problems were in the 6- to 7-year-old or in the 9- to 10-year-old group. Other problems in addition to the social interactive and communication problems included Tourette's syndrome (n = 1), specific learning disability (n = 1), depression (n = 1) and obsessive-compulsive symptoms (n = 2).

The global intelligence level of the PDD-NOS children was assessed by means of a shortened version of the Dutch WISC-R (37). All children included in the sample had an IQ of 80 or above. Since only four subtests were included in the shortened version of the WISC-R, no separate verbal and non-verbal IQ measures could be provided.

Table 2 Numbers, mean age (range) and IQ (range, standard deviation) of subject samples

	control group (n = 31)	PDD-NOS group (n = 31)
Mean age	9.4 (6.5–12.9)	9.4 (6.2–13.1)
IQ	101 (84–123, sd = 11.1)	100 (82–125, sd = 12.0)

For comparison purposes a group of 31, 6- to 12-year-old normal, healthy elementary school children were obtained. This sample was drawn from 4 different schools. The control children were matched with the PDD-NOS group for age, sex and intelligence. The intelligence level of the control group was also assessed by means of the shortened version of the WISC-R. Table 2 summarises subjects, ages and intelligence levels.

Materials

Experiment 1. Inferring other people's emotions

Task 1: prior experience

A modified version (37) of a task originally developed by Gnepp and Gould (23), was used to assess the child's ability to use information about an emotionally charged event in order to make an affective inference about a following event. For example, in one story a girl at school picks up a rabbit. The rabbit bites her and it hurts (first event). The next day in class, the teacher asks the girl to feed the rabbit (second event). The first event is expected to change the character's emotional reaction to the second event. Six different stories, tape-recorded in order to standardise the procedure and illustrated by drawings, were told to the subjects. First, four memory

questions were asked to assure that the subjects correctly remembered the story details. Second, subjects had to infer the emotional state of the child in the story (e.g. How does she feel when...) by choosing one out of five faces (happy, sad, angry or afraid and one face was blanked out. This last possibility could be used if the child thought of some other emotion). Third, the subjects were asked to explain their answer (e.g. Why do you think she feels that way?).

The memory questions were coded as accurate (1) or inaccurate (0). The answer to the emotion question was also scored as accurate or inaccurate (0 = the emotion was entirely based on the second event without regard to the influence of the first event, 1 = the emotion reflected the use of the first event for the interpretation of the second event. Answers to the explanation question could be scored as 0, 1 or 2 (0 = the subject explained the answer by referring to the second situation or by referring to circumstances not mentioned in the story, 1 = the subject referred to the first event without explicitly mentioning the consequences of the first event for the emotional state in the second event, 2 = the subject explicitly mentioned the emotional consequences of the first event for the second). Two independent raters scored the answers of a sample of 10 children to assess the reliability of the scoring system (Cohen's Kappa: 0.92).

For each child, a total memory score, an emotion score and an explanation score were computed based on all six stories (range of possible scores: memory 0–24, emotions 0–6; explanation 0–12).

Task 2: Personality information

A modified version (37) of a task originally described by Gnepp and Chilamkurti (24) was used to assess whether children are able to use information about someone's personality to make an affective inference. For instance, in one story a boy always helps old people carry their shopping, he shows new kids around the school and he sets the table for his mother whenever he can. In these three events, the boy demonstrates his helpfulness. A fourth event is then introduced: one day his mother asks him to help his sister clean her room. The characteristics of the boy (described in terms of concrete behaviour in the first three events) are likely to influence his reaction in this situation. Six different stories, tape-recorded and illustrated by drawings, were shown to the subjects. First, four memory questions were asked in order to assess whether children remembered the story details. Second, the subjects were asked to indicate how the boy would feel (How does he feel when...?) by choosing one out of five faces (see task 1). Third, the subjects were asked to explain their answer (e.g. Why do you think he feels that way?). Finally, a question was asked to check whether they understood which trait was suggested in the story.

The memory questions and the trait question were coded as accurate (1) or inaccurate (0). The answer to the emotion question was also scored as accurate or inaccurate (0 = the emotion was entirely based on the fourth event without regard for the influence of the personality information shown in the first three events, 1 = the emotion reflected the use of the personality information for the interpretation of the fourth event). Answers to the explanation question could be scored as 0, 1 or 2 (0 = the subject did not refer to either the concrete behaviour in the first three situations or to the trait, 1 = the subject referred to the concrete behaviour in one of the preceding events, 2 = the subject referred to the trait featured in the story). The answers to the explanation questions provided by a sample of 10 subjects were scored by two independent raters to assess reliability of the scoring system. A very satisfactory level of reliability was obtained (Cohen's Kappa: 0.96).

For each child, a total memory score (range 0–24) an emotion score (range 0–6), an explanation score (range 0–12) and a trait score (range 0–6) were computed.

Task 3: Conflicting cues

The third role-taking task (37) was originally used by Gnepp (22). Children were shown pictures containing both situational and facial cues. However, the facial expressions differed from those usually encountered in such situations. For example, a happy-faced child was shown visiting the doctor to receive an inoculation. Normally a sad or frightened expression is expected in this situation. Six different pictures with conflicting cues were shown to the subjects.

In order to detect the conflict between facial and situational information, the child needs to interpret correctly the facial (facial control question: What kind of face does she have?) and situational information (situational control question: Where is... or what is she doing?) in the picture. Furthermore, the child needs to know the typical, most common emotional reaction in that situation (implication control question: How do most children feel when they...?). To examine whether the children had noticed the conflict and if they were able to reconcile the conflicting cues, they were asked to tell a story about the child in the picture (Could you tell me a story about the girl or boy?). If the subject did not spontaneously give an explanation for the inconsistency, the experimenter prompted the child with another question (Why do you think she has a happy face?).

The responses to the three control questions were coded as accurate (1) or inaccurate (0). Answers to the story question were coded as 0, 1, 2 or missing (0 = subjects were not able to come up with an

explanation, not even after prompting, 1 = subjects gave an explanation after prompting, 2 = subjects were able to give an explanation in response to the story-telling question, missing = one of the control questions was answered incorrectly). Two independent raters scored the answers of a sample of 10 subjects to assess reliability (Cohen's Kappa: 0.86 for the answers to the story telling question).

For each child a summary score for noticing the conflict (i.e. only for those stories in which all three control questions were answered correctly) was computed (range of possible scores: 0–12). For each control question, a summary score was computed (range 0–6).

Experiment 2: Person perception

The free person description method was used to test person perception. The subject was encouraged to think of a boy or a girl whom he or she knew well and wanted to describe. If the subject had problems deciding which child to describe, some help was offered (Think about someone at school, at your club, etc.). The child was then asked the following question: What can you tell me to make clear what kind of boy (or girl) he (she) is?. If the child did not spontaneously produce 10 statements, the experimenter encouraged the child with neutral questions (e.g. Can you tell me more about him?, What do you remember of him?). Prompting was limited to a maximum of two questions for each description in order to ensure that children who had difficulty with this spontaneous description, received no more stimulation than the others (38).

To increase the number of scorable statements (38), two descriptions were obtained (i.e. generally the first description concerned a boy and the second one a girl). All descriptions were obtained orally in order to reduce the possibility that they would be influenced by problems in writing and spelling.

The spontaneous descriptions were scored using a revised version (38) of the coding system described by Matthys (32). The descriptions of the subjects were tape-recorded and written out after the experiment. Each description was divided into statements. A statement was defined as: a word or one or more sentences containing relevant information about the person described. Twelve different categories were used to code each of the statements. Matthys (32) grouped the content categories into the larger categories peripheral and central. For the peripheral category, we followed his approach. In this study however, the central category includes statements about inner, psychological characteristics of others (e.g. statements about 'family' were excluded). Table 3 summarises the coding system.

An Intraclass Correlation Coefficient (ICC) was computed as a measure for inter-rater reliability and accounts for both the variance between raters and the variance between subjects (11). Most categories could be scored reliably. The ICCs ranged from 0.65 (Feelings-Ambitions) to 1.00 (Abilities-Inabilities).

Interview questions

To assess whether children were able to give information about the other person when specifically prompted, a number of interview questions was added to the free descriptions. For each category included in the central (i.e. Personality, Feelings/Ambitions, Preferences/Aversions) or peripheral category (i.e. Appearance, General information, (In)abilities and Interaction with others), three questions were formulated (e.g. for category Appearance: Do you know the colour of her eyes?, What kind of clothes does he wear? and What's the colour of his hair?).

After each spontaneous description, the interview was introduced to the child with: You already told me a lot about this boy. I would like to ask you some more questions about him. The experimenter then asked the child one, two or three questions from each content category. In practice, if the child already used a category (e.g. the child extensively told about someone's appearance), no further questions were asked.

An interview question was scored as 0, 1 or 2 (0 = the child did not know any answer or if the answer did not fit into that category or the answer was irrelevant and concerned the subject instead of the person described, 1 = the answer fitted into the category, but did not give any new information, 2 = new, relevant information was given about the other person). If a question was answered correctly (i.e. a score of 2 could be assigned), the experimenter continued with the following category. If an answer fitted the category but was a repetition of information previously given, another question was asked for that category (up to a maximum of three questions).

Procedure

The children in the clinical group were individually tested at the out-patient clinic after parents had given their permission. Administering the three role-taking experiments and the free person descriptions took about one hour. Intelligence was assessed in the same session or testing was carried out as part of a more extensive psychological examination (separate session).

The children in the control group were individually tested at school. Parents of all children in three grades (3, 5 and 8) were asked to permit their children to participate in the experiments by means of a letter explaining the purpose of the study.

Table 3 Coding system (revised) for the free person description (content categories)

1. Appearance	Statements about physical build, clothing, facial appearance etc., including approvals or disapprovals	He has blue eyes She is pretty He always wears jeans
2. General information	Information about name, sex, residence or school Information about possessions Information about life history Information about physical condition	He lives in... She goes to my school He has a lot of cars He comes from Groningen She is often ill
3. Actual incidents	Description of actual incidents that happened or will happen to the person described	Next week he will move to…
4. Personality	Personality traits, characteristic reactions to success and failure, habits	She's a shy girl He cries when he loses a game
5. Feelings and ambitions	Statements about feelings, ambitions, standards and values of the person described	He's afraid of dogs She would like to be a doctor She's a vegetarian
6. (In)abilities	Intellectual aptitudes and abilities and physical skills	She's good at maths He's a good footballer
7. Preferences/aversions	Likes and dislikes (persons and things), preferences (hobbies) or aversions to activities	He likes sweets Cats are his favourite pets
8. Interactions with others	Interactions between the subjects and the person described, other people's behaviour and opinion towards the person described	He likes preparing meals I often play with him He is very popular Others often tease her
9. Family	Statements that describe a persons's family, description of family members and statements that describe relations within the family	She has two brothers His father is a teacher She does not get along with her mother
10. Reflections	Subject's opinion about behaviour of the person described or attitudes and opinions of the stimulus person towards himself	It is a pity that she doesn't like animals She thinks she's very beautiful
11. Repetitions	Exact repetitions of words and phrases	
12. Residual	Unclassifiable statements	

Results

Experiment 1

Since data were not normally distributed, a non-parametric measure was used to test differences between the groups (Mann-Whitney U-test). Analyses comparing the memory questions (task 1 and 2) showed that the clinical and the control group did not differ with respect to their ability to memorise relevant details of the story. Nor were there any significant differences in answering the control questions in task 3 (i.e. recognising the facial expression, the situational cues and the usual emotional reaction). Further analyses showed that the clinical and the control group did not differ significantly in performance on any of the emotional role-taking tasks. Mean scores and standard deviations are shown in Table 4.

Experiment 2

Descriptions were available for 27 children with PDD-NOS and 30 control children (for practical reasons, descriptions were missing for four children in the clinical group and one child in the control group). To correct for the total number of statements, the total number of statements in three central categories and the four peripheral categories were divided by the total number of statements given in a description (feelings-ambitions + preferences-aversions + personality/total number of statements = central score, (appearance + general information + (in)abilities + action-relation/total number of statements = peripheral score). Data were analysed using an ANOVA with age as co-variant. Comparison of the two descriptions was carried out by means of a paired T-test. Table 5 summarises the main results of experiment 2.

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Table 4 Mean summary scores (standard deviation, range) of the clinical and the control group on the emotional role-taking tasks

	Control group (n = 31)	PDD-NOS group (n = 31)
Task 1		
Emotion (6)[1]	2.80 (1.13, 0–4)	2.81 (1.25, 1–5)
Explanation (12)	3.74 (2.32, 0–8)	3.00 (1.93, 0–8)
Memory (24)	23.61 (0.84, 20–24)	23.77 (0.43, 23–24)
Task 2		
Emotion (6)	3.58 (1.34, 1–6)	3.77 (1.22, 1–6)
Explanation (12)	2.55 (2.39, 0–7)	2.55 (2.45, 0–9)
Memory (24)	23.70 (0.75, 21–24)	23.42 (1.06, 19–24)
Trait (6)	5.71 (0.53, 4–6)	5.71 (0.53, 4–6)
Task 3		
Storytelling (12)	6.76 (2.11, 2–10)	5.32 (2.53, 0–10)
Facial control (6)	4.52 (1.41, 1–6)	5.00 (1.10, 1–6)
Situational control (6)	5.94 (0.25, 5–6)	5.77 (0.50, 4–6)
Implication control (6)	5.29 (0.64, 4–6)	5.30 (0.70, 4–6)

[1] Maximum possible score

Table 5 Mean scores (standard deviation, range) of the clinical and the control group on the free person descriptions

	Control group (n = 30)	PDD-NOS group (n = 27)
Total number of statements	22.37 (6.20, 11–35)	20.19 (8.03, 10–47)
	Control group (n = 27)	PDD-NOS group (n = 26)
% Peripheral statements		
Description 1	27.69 (17.52, 2–62)	27.07 (14.16, 1–66)
Description 2	20.93 (17.06, 2–71)	20.89 (12.25, 2–45)
% Central statements	9.97 (8.07, 1–29)	5.58 (3.91, 0–14)

Total number of statements

Comparison of the two different descriptions showed that there was no statistically significant difference between the total number of statements in the first and the second description ($t = 1.80$, $p = 0.077$, two-tail significance levels are shown since there was no specific hypothesis on differences between the first and the second description). The clinical and the control group did not differ significantly with respect to the total number of statements on the first and the second description. Only in the first description, there was a significant correlation between total number of statements and age ($F = 5.01$, $p < 0.05$).

It was decided to omit children who produced fewer than 10 statements from further analyses. This cut-off point was chosen because the use of 10 statements was seen as representing a satisfactory proportion of the number of content categories. This led to 3 control children and 1 child with PDD-NOS being omitted from further analyses.

Peripheral statements

The subjects in the clinical group used fewer peripheral statements in the second description ($t = 2.47$, $p = 0.020$) than in the first one, but in the control group, there were no significant differences ($t = 1.29$, $p = 0.209$). Considering this, the following analyses were carried out for the two descriptions separately.

For the use of peripheral statements, no significant differences were found between the clinical and the control group in the first and the second description. No significant correlation between the use of peripheral statements and age was found.

Central statements

In general, there were no significant differences between the two descriptions in the use of central statements ($t = 0.28$, $p = 0.781$). Therefore, a summary score was computed which accounts for both the first and the second description. The children in the clinical group used fewer central statements in their descriptions of others than the control children. This difference was statistically significant ($F = 6.29$, $p < 0.01$).

Interview questions

Analyses of the interview questions were carried out separately for the central and peripheral categories and for the first and the second description. We counted the number of children in each group (clinical vs. control)

giving 0, 1, 2, 3 or 4 correct responses to the questions concerning the peripheral categories (i.e. appearance, general information, abilities and action/relation) and 0, 1, 2 or 3 correct responses to the questions concerning the central categories (i.e. personality, feelings/ambitions and preferences/aversions). No significant differences were found between the clinical and the control group (Chi-square) with respect to the number of correct answers to the interview questions on peripheral and central categories.

Discussion

The present study re-examines possible differences in social-cognitive abilities between a group of children with lesser variants of autism (problems classified as PDD-NOS) and a group of normal, healthy children individually matched for age, sex and intelligence with the clinical group. In addition, the study explores the hypothesis that children with PDD-NOS may have the skill to infer other people's mental states, but fail to do so spontaneously. Three highly structured tasks were used in which children were prompted to infer emotional states. In addition, an unstructured task was employed in which children had to describe two peers. The latter method was combined with a number of structured interview questions.

Comparing the clinical and the control group, no statistically significant differences were found in using information about a prior, emotionally charged event (task 1) and information about a personality trait to infer and explain emotional reactions of others (task 2) or in explaining emotional reactions in cases of conflicting information (task 3).

The experiment using the free person description showed that the children in the clinical group did not differ significantly from the children in the matched control group with respect to the use of peripheral statements, but they used significantly fewer central statements to describe peers than the controls. This means that the children with lesser variants of autism focussed more on directly visible, outward characteristics than on psychological characteristics of others. However, there were no significant differences with respect to the number of correct answers to the interview questions concerning peripheral and central statements.

The results of both experiments differ from those of the two previous studies (37, 38). Several factors might have caused these differences. The first factor concerns selection and matching of the subject samples. An attempt was made to select a clinical sample which was more homogeneous with respect to the social interactive and communicative problems. Since no valid instruments are available to measure 'milder' expressions of autistic symptoms, the authors developed such a questionnaire, based on the DSM-III-R criteria for Pervasive Developmental Disorders. Although this instrument has not been standardised or validated, it gives an indication of the number and the severity of the problems experienced by children with the clinical diagnosis of PDD-NOS. To select a more homogeneous sample, the children with the lowest amount of problems on both the social interaction and the communication items were excluded from the initial sample. This might have led to the selection of a clinical group with more severe social interaction and communication problems than those participating in the explorative study. Contrary to the previous study, the clinical and the control group in this study were individually matched for intelligence.

The second group of factors which might explain the different results concerns the adaptations in the materials. First, in the present study the questions asking for an emotional inference (task 1 to 3) were multiple choice instead of open-ended. This way of structuring the task might have been a relatively large advantage for the children in the clinical group. Second, the different scoring procedure in these tasks (i.e. using separate scores for emotional inference and explanation of the inference) might have led to a different pattern of results. Third, the prompting procedure in the free person descriptions was standardised to assure that equal numbers of prompting questions were given to the clinical and the control group. In the previous study, the children in the clinical group received significantly more stimulation, which might have made them perform at a level comparable to that of the control children.

Both the sampling/matching changes and the adaptations of the test materials can be regarded as improving the experimental procedures. In view of this, the current findings might be regarded as somewhat more robust than those of the previous two studies.

Theory of Mind: skill deficits or failure to apply skills?

To examine the possibility that children with lesser variants of autism might have problems in applying their social cognitive skills effectively, a combination of structured (i.e. structured emotional role-taking tasks and structured interview questions added to the free person description) and unstructured tasks (free person descriptions) was employed. The children in the clinical group proved to be as able as the control children to infer other people's emotions in the aforementioned tasks. Also, they were able to provide information about inner, psychological characteristics in response to structured questions. However, in their free descriptions, they used fewer – in comparison with the control children – statements about inner, psychological characteristics of others. These results support the idea that, although

children with milder forms of autism seemed to have as much knowledge as the control children about 'central characteristics' of others, they seemed less inclined to use this knowledge spontaneously when describing another person.

Several authors have suggested that the inability to spontaneously conceive of other people as having minds would be the distinctive feature of children with autism (12) and Asperger's syndrome (20). Such a failure to apply social cognitive skills could have different causes. It might result, for example, from a failure to understand relevant aspects of other people's minds (i.e. deficits in Theory-of-Mind skills). This seems to be true for the majority of mentally handicapped autistic children. Most studies have found rather severe Theory-of-Mind deficits in this group (e.g. 4–8, 10, 30). However, a small minority of children with PDD – those who have better developed intellectual abilities or those with milder social problems (of the type included in the present study) – proved to be able to understand other people's mental states in experimental task situations (13, 27, 33, 35). In this group, a failure to spontaneously conceive of other people's thoughts and feelings might have different origins. One possibility could be that such children have a restricted capacity to empathise in an intuitive fashion, but learn to use more cognitive ways to circumvent their handicap (e.g. 26, 45). Such cognitive ways to infer other people's beliefs, feelings or intentions may be more time-consuming and, therefore, not adaptive in social situations. It is also possible that the inability to apply social-cognitive skills in daily-life situations may result from a more general difficulty to solve problems – including social problems – in a planful, strategic and flexible way, the so-called executive function deficit (10, 33).

In short, the literature suggests that different aspects of social cognitive functioning may contribute to the problems in social interaction and communication, namely problems in the ability to infer mental states (i.e. deficits in Theory-of-Mind skills) or difficulties in the spontaneous use of these skills (i.e. application deficits). The experiments described in this paper suggest that for children with lesser variants of autism a failure to apply Theory-of-Mind skills spontaneously could be the more important contributing factor. Further investigation is required in order to discover the reason for this failure. This means that future studies need to develop validated and standardised tasks which explore different possible contributing factors. Including high-functioning subjects with typical autism in future studies is useful in order to test if these individuals who probably are able to understand mental states in experimental task situations, also have problems using Theory-of-Mind skills in daily life. Such studies might help to discriminate different subgroups within the spectrum of autistic disorders based on the patterns of underlying social-cognitive problems. If the different factors contributing to the social problems of different groups of children with PDD problems could be identified, this could lead to the development of more effective treatment facilities.

Abbreviations – PDD-NOS Pervasive Developmental Disorder Not Otherwise Specified

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