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A Second Look at Second-Order Belief Attribution in Autism[1]

Helen Tager-Flusberg[2] and Kate Sullivan
University of Massachusetts at Boston

Compared the performance of autistic and mentally retarded subjects, all of whom had passed a standard first-order test of false belief, on a new second-order belief task. 12 autistic and 12 mentally retarded subjects, matched on verbal mental age (assessed by PPVT and a sentence comprehension subtest of the CELF) and full-scale IQ were given two trials of a second-order reasoning task which was significantly shorter and less complex than the standard task used in all previous research. The majority of subjects in both groups passed the new task, and were able to give appropriate justifications to their responses. No group differences were found in performance on the control or test questions. Findings are interpreted as evidence for the role of information processing factors rather than conceptual factors in performance on higher order theory of mind tasks.

Current studies of theory of mind abilities in autism have focused primarily on attributions of first-order mental states, especially false beliefs (e.g., Baron-Cohen, Leslie, & Frith, 1985; Dawson & Fernald, 1987; Leslie & Frith, 1988; Oswald & Ollendick, 1989; Perner, Frith, Leslie, & Leekam, 1989; Prior, Dahlstrom, & Squires, 1990; Reed & Paterson, 1990). The ability

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[2]Address all correspondence to Helen Tager-Flusberg, Department of Psychology, University of Massachusetts, 100 Morrissey Boulevard, Boston, Massachusetts 02125.

to attribute first-order beliefs requires understanding the relation between a person's belief and reality and is generally achieved by the age of 4 in normally developing children. Studies of autistic subjects have shown that they have difficulty compared to mentally retarded or normal controls in attributing first-order beliefs, however, in all studies a sizable proportion of autistic subjects (ranging from 20–60%) pass the first-order false belief task.

Second-order beliefs, which involve the understanding of one person's beliefs about another person's beliefs about reality (e.g., "John thinks that Mary thinks X"), underlie much of our social reasoning and are necessary for sophisticated understanding of human behavior. The most widely used method for assessing second-order belief attribution was introduced by Perner and Wimmer (1985). In their task subjects are told a story about John and Mary who see an ice-cream van in the park. Later, both John and Mary are told that the ice-cream van has gone to the church but neither knows that the other has been informed. The test question asks the subject to predict where John thinks that Mary thinks the ice-cream van is (or where she will go to buy ice cream). In general, children do not pass second-order belief tasks until they are about 6 or 7 years old (Perner & Wimmer, 1985). The time lag between the ability to attribute first- and second-order beliefs has been interpreted as the result of conceptual change, specifically the understanding that mental states can be recursively embedded (Perner, 1988). However, a recent study, introduced a new task to tap second-order reasoning (Sullivan, Zaitchik, & Tager-Flusberg, 1994), which greatly simplified the information processing demands (i.e., the length, format, and complexity of the story) of the task and included a control question to ensure that children had the requisite syntactic ability to handle the double-embedded sentences used in the test question. Sullivan et al. (1994) found that on the new task almost half the preschoolers in their sample were able to correctly answer *and* justify a second-order belief question. These findings suggest that second-order belief attribution does not entail any conceptual change, but may require more advanced information-processing abilities, including linguistic capacity, the ability to track sequences of story information, reasoning through long inferential chains and memory load.

Baron-Cohen (1989) was the first to report on the ability of autistic subjects to understand second-order beliefs. In his study, which used the standard Perner and Wimmer (1985) task, not 1 out of 10 autistic subjects who had passed a first-order task could correctly answer the second-order belief test question. Two additional studies have been conducted with autistic and Asperger syndrome subjects, also using the standard task (Bowler, 1992; Ozonoff, Pennington, & Rogers, 1991; Ozonoff, Rogers, & Pennington, 1991). Ozonoff, Pennington, and Rogers (1991) reported that high-functioning autistic subjects were significantly worse than controls on the second-order task; however, both Ozonoff, Rogers, and Pennington (1991) and Bowler (1992) reported no difference between subjects with Asperger syndrome and normal or learning-disabled controls in the ability to attribute second-order beliefs. Bowler (1992) did find that the subjects with Asperger syndrome were significantly less likely to justify their responses using mental state terms, although he suggests this may be due to performance factors. Thus, taken together, these studies suggest that autistic subjects are significantly impaired in their ability to pass the standard second-order task; subjects with Asperger syndrome may be able to pass such tasks although they are not able to justify their correct responses using mental state constructs.

It is not clear from these studies what the source of the difficulty on second-order tasks might be for individuals with autistic spectrum disorders (including both autistic and Asperger syndrome). Baron-Cohen (1989) argues that his results support the view that autism involves a specific developmental delay in theory of mind, but the source of the delay between the ability to attribute first- and second-order beliefs is not clearly specified. Both Ozonoff, Rogers, and Pennington (1991) and Bowler (1992) argue that Asperger syndrome may be distinct from autism in that it does not entail deficits in theory of mind; however, this does not explain why even their Asperger syndrome subjects could not appropriately justify their correct second-order belief responses.

We hypothesize that the difficulty posed by second-order tasks for autistic, as well as for mentally retarded and young normal children, lies in their added information-processing load. It is interesting to note that Ozonoff, Rogers, and Pennington (1991) found that their subjects with Asperger syndrome had significantly better verbal memory ability (i.e., information processing capacity) compared to their autistic subjects, suggesting that this might account for their better performance on the theory of mind tasks. We tested this hypothesis by investigating second-order mental state attribution in matched groups of autistic and mentally retarded subjects using the new task designed by Sullivan et al. (1994), which has been shown to drastically reduce the information processing demands of the second-order task.

METHOD

Subjects

Two groups of subjects participated in this study: a group of 12 autistic (11 male and 1 female) and a group of 12 matched mentally retarded (4 male, 8 female) subjects. The autistic subjects, drawn from a private

Table I. Means for Subject Characteristics

	Autistic		Mentally retarded	
	M	*SD*	*M*	*SD*
Chronological age (years, months)	17, 1	4, 3	14, 3	1, 10
PPVT Mental age (years, months)	9, 8	2, 7	8, 6	0, 8
Full-scale IQ	76.1	14.3	73.0	12.3
CELF Sentence structure	20.9	5.0	21.1	4.2

school serving this population, were diagnosed with autism (9 subjects) or pervasive developmental disorder (PDD) not otherwise specified (3 subjects) consistent with current DSM-III-R criteria (American Psychiatric Association, 1987), based on medical histories and information in the subjects' files. Each subject had received a diagnosis of autism or PDD by a psychiatrist or neurologist, according to information in the medical records. Furthermore, we confirmed the diagnosis, using a behavior checklist, that the subjects currently exhibited or had a history of the major DSM-III-R characteristics of these disorders. The autistic and PDD subjects ranged in age from 8 years 0 months to 22 years 2 months and all had previously passed a first-order task, using a standard task based on Wimmer and Perner (1983).

The subjects were administered Form L of the PPVT-Revised version, and the Sentence Structure subtest of the Clinical Evaluation of Language Fundamentals–Revised (CELF; Semel, Wiig, & Secord, 1987) to provide information about the subjects' sentence comprehension ability. Previous research has shown that syntactic comprehension is highly correlated with performance on theory of mind tasks, especially in autistic subjects (Tager-Flusberg & Sullivan, 1994). The subjects' scores on these standardized tests, as well as IQ information, taken from school records, are shown in Table I. *T* tests confirmed that the children diagnosed with autism and PDD did not differ on chronological age, full-scale IQ, performance IQ, verbal IQ, PPVT, or CELF scores. Hereafter, this group is referred to as the autistic group.

The mentally retarded subjects were selected to match the autistic subjects on the PPVT, the sentence structure subtest of the CELF, and full-scale IQ, and they too had all passed a first-order belief test. These subjects were drawn from special education classrooms of local public schools and had educational and socioeconomic backgrounds similar to the autistic subjects. Their retardation was linked to a variety of etiologies (for many unknown) but none of the subjects in this group met the DSM-III-R criteria for autism or PDD, nor had any received such a diagnosis. The subjects in the mentally retarded group ranged in age from 11 years 2 months to 17 years 2 months. The IQ scores of the mentally retarded subjects were also taken from school records. *T* tests confirmed that the autistic and mentally retarded groups were well matched on the PPVT, the CELF subtest, and verbal, performance, and full-scale IQs. The autistic subjects, however, were marginally older than the mentally retarded subjects, $t(15.13) = 2.119, p < .051$, assuming unequal variances.

Procedure

Each subject was presented with two second-order stories based on the task used by Sullivan et al. (1994) accompanied by three-dimensional displays, toys, and props. The context of the two stories included deception. Other changes in this task, compared to the standard task introduced by Perner and Wimmer (1985) include, reduced length, fewer characters, locations, and episodes, and a different test question format which did not included embedded propositions. In one story a mother deliberately lies to her son about his birthday present because she wants to surprise him. Later, unbeknownst to his mother, the boy discovers his present. When speaking to the boy's grandmother the mother is asked whether the boy knows what he is getting (second-order ignorance) and what he thinks he is getting (second-order belief) for his birthday. The second story was about a brother who deliberately misinforms his sister about where he put a chocolate bar. Both stories were presented in the same test session in counterbalanced order. For each story subjects were presented with three control questions (reality, first-order ignorance, linguistic control), and two test questions (ignorance, false belief). Subjects were then asked to justify their responses to the second-order false belief question. The Appendix provides an example of one of the stories used in this study.

RESULTS

Preliminary analyses showed that there were no significant differences between the autistic and PDD subjects. Subjects' performance on the two stories for both the control and test questions is shown in Table II. All the subjects in both groups passed at least one of the two trials of the reality and linguistic control questions. Two autistic and three mentally retarded (MR) subjects failed both trials of the first-order ignorance control question.

Table II. Means on Control and Test Questions[a]

	Autistic		Mentally retarded	
	M	*SD*	*M*	*SD*
Control questions				
Reality	1.75	0.45	1.75	0.45
First-order ignorance	1.42	0.79	1.33	0.89
Linguistic	1.92	0.29	1.75	0.45
Test Questions				
Second-order ignorance	1.58	0.67	1.50	0.80
Second-order false belief	1.17	0.94	1.25	0.97

[a] Maximum score = 2.

There were no significant differences between the groups on the control questions. A two-way ANOVA (Group × Question) with repeated measures on the second factor yielded no significant effect of group for the test questions. The question factor was marginally significant, $F(1, 22) = 3.42$, $p < .08$; indicating that performance on the ignorance question was marginally better than on the false belief question. The interaction between group and question was not significant.

In both groups 8 out of 12 subjects passed both trials of the second-order ignorance question; on the second-order false belief question, 7 out of 12 autistic and 8 out of 12 MR subjects passed both trials. This difference was not significant on a chi-square analysis.

Subjects' justifications were coded into the following categories based on those used by Sullivan et al. (1994). Appropriate justifications included: *explicit second-order* reasoning (e.g., "Mom does not know that Peter knows what he is getting for his birthday"), *implicit second-order* reasoning (e.g., "Mom does not know Peter saw the birthday puppy"), *communicated information* (e.g., "Mom told Peter he was getting a toy"), and *deception* (e.g., "Because Mom wanted to surprise Peter"). Inappropriate justifications included *first-order reasoning* (e.g., "Peter knows he got a puppy"), *story facts* (e.g., "Peter wants a puppy"), *nonsense,* or *no response.* The frequency with which each of these justifications was given for correct responses only are shown in Table III.

There were no significant differences between the groups on the use of any of the justification responses, using ANOVA. The majority of correct responses were appropriately justified for both groups of subjects. The highest proportion of appropriate justifications involved explicit mention of the deception; none of the subjects in either group made use of explicit second-order reasoning.

Table III. Frequency of Appropriate and Inappropriate Justifications to Correct False Belief Responses

	Autistic		Mentally retarded	
	n	%	*n*	%
Appropriate				
Explicit second-order	0	0	0	0
Implicit second-order	2	14	3	20
Communicated information	2	14	1	7
Deception	6	43	10	67
Inappropriate				
First-order reasoning	0	0	0	0
Story facts	1	7	1	7
Nonsense	1	0	0	0
No response	2	14	0	0

Correlations were computed for each group between performance on the second-order belief task (summing correct responses to the ignorance and belief questions) and age, verbal IQ, performance IQ, full-scale IQ, PPVT, and CELF subtest. None of these correlations were significant; however, it is important to note the relatively small sample of subjects in the study.

DISCUSSION

Contrary to prior research (Baron-Cohen, 1989; Ozonoff, Pennington, & Rogers, 1991), this study suggests that autistic subjects who can pass a first-order belief task are not significantly different from matched mentally retarded controls on a second-order belief task. These findings confirm our hypothesis that the difficulty for both groups with the standard second-order task lies in its information processing demands, rather than subjects' conceptual difficulties in handling recursively embedded mental states. The introduction of a new task in which the length and complexity of the story were significantly reduced (Sullivan et al., 1994) allowed us to demonstrate that the majority of both autistic and mentally retarded subjects who pass first-order tasks, also pass second-order theory of mind tests. Because none of the subjects in the autistic group was diagnosed with Asperger syndrome, these findings also suggest that there may not be a significant distinction between autism and Asperger syndrome on second-order theory of mind abilities. The difference found by Ozonoff, Rogers, and Pennington (1991) between these two autism spectrum disorders may have been the result of these group's differences in verbal memory ability, and hence their ability to retain more of the information in the lengthy and complex standard second-order task.

It is important to note that we not only gave our subjects a new task in which the information processing demands were reduced but also matched our subjects closely on verbal abilities, including verbal IQ, vocabulary level (PPVT), and syntactic comprehension. It may well be that this careful matching, especially on syntactic comprehension, eliminated potential group differences because we know that theory of mind performance is related to language ability. Nevertheless, we did not obtain significant correlations between any of our language measures and performance on the second-order task. Because of the relatively small number of subjects, it may be inappropriate to overinterpret these null results.

Nevertheless, at least one third of both the autistic and mentally retarded subjects failed the second-order task; their performance was comparable to the preschool group (ages between 4 years 1 month and 5 years 3 months) reported in Sullivan et al. (1994). This suggests that there is some significant delay for both groups in second-order reasoning. Because even the new second-order task was significantly longer than a standard first-order task, it is likely that information processing factors may explain this delay rather than deficits in conceptual developments related to higher order theory of mind abilities. Studies on first-order belief *always* find that autistic subjects are significantly worse than mentally retarded controls (see Baron-Cohen, 1993, for a recent review), which is the primary evidence that indeed, autism involves deficits in theory of mind. Nevertheless, in this study of second-order theory of mind ability, in which all the autistic subjects had the requisite metarepresentational capacity to pass a first-order theory of mind task (which may well have been seriously delayed) and the information processing demands were minimized, no difference between the autistic and mentally retarded subjects (matched on IQ and verbal ability) was found. Thus, we argue that for all children, normal, mentally retarded, or autistic, once first-order abilities have been acquired, performance on higher order theory of mind tests is related more to information processing abilities than to any additional conceptual advances in the domain of theory of mind.

APPENDIX

Birthday Puppy Story

Tonight it's Peter's birthday and Mom is surprising him with a puppy. She has hidden the puppy in the basement. Peter says, "Mom, I really hope you get me a puppy for my birthday." Remember, Mom wants to surprise Peter with a puppy. So, instead of telling Peter she got him a puppy, Mom says, "Sorry Peter, I did not get you a puppy for your birthday. I got you a really great toy instead."

Reality Control Question: What did Mom really get Peter for his birthday?

Now, Peter says to Mom, "I'm going outside to play." On his way outside, Peter goes down to the basement to fetch his roller skates. In the basement, Peter finds the birthday puppy! Peter says to himself, "Wow, Mom didn't get me a toy, she really got me a puppy for my birthday." Mom does NOT see Peter go down to the basement and find the birthday puppy.

First-Order Ignorance Control Question: Does Peter know that his Mom got him a puppy for his birthday?

Linguistic Control question: Does Mom know that Peter saw the birthday puppy in the basement?

Now, the telephone rings, ding-a-ling! Peter's grandmother calls to find out what time the birthday party is. Grandma asks Mom on the phone, "Does Peter know what you really got him for his birthday?"

Second-Order Ignorance Question: What does Mom say to Grandma?

Now remember, Mom does not know that Peter saw what she got him for his birthday. Then, Grandma says to Mom, "What does Peter think you got him for his birthday?"

Second-Order False Belief Question: What does Mom say to Grandma?

Justification Question: Why does Mom say that?

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