PROJECT TITLE: Social Perspective-Taking Abilities in Children with Autism Spectrum Disorder (ASD)

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SUMMARY:

Approximately 80% of children with autism spectrum disorders (ASDs) fail to perform perspective taking as measured by false belief (FB) tests that require speech. Since children with ASDs exhibit a range of verbal abilities, it is possible that children with limited speech may be successful on false belief tests that do not require vocal responses. The present study examined the performance of children on three false belief tests that require different verbal skills. Eighteen children with ASDs (ages 5 years to 11 years 11 months) and eighteen typically developing children (ages 3-5 years 11 months)were tested on: (a) two standard FB tests that require children to answer questions vocally and a nonvocal Guesser-Knower (GK) test designed to evaluate whether children are able to discriminate the relationship between seeing and knowing. Results indicate that: (a) performance did not differ significantly among the three different tests; (b) in the ASD population, children with higher expressive language scores outperformed those with lower expressive language scores on all tests.

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Introduction

Children with autism spectrum disorders (ASDs) have been consistently shown to present difficulty in perspective taking. The inability to take another person's perspective is a key deficit in reciprocal social interactions for this population. Perspective taking is measured by false belief (FB) tests, which require a child to answer a series of questions about how another person understands a particular event based on that person's perspective. Given that 80% of children with ASDs fail FB tests, research on component skills of perspective taking is much needed. Therefore, the present study examined the performance of children with ASDs, compared to that of typically developing children, on standard FB tests.

Autism Spectrum Disorders

Autism spectrum disorders or ASDs refer to a subgroup of pervasive developmental disorders (American Psychiatric Association, 2000) including autistic disorder, Asperger syndrome, and pervasive developmental disorder-not otherwise specified (PDD-NOS). They are characterized by severe impairment in social interactions and by restricted behaviour and interests (e.g., ritualistic and repetitive movements). Autistic disorder and PDD-NOS are further characterized by a deficit in communication skills including expressive and receptive language. Children who exhibit characteristics associated with autistic disorder, but who do not meet the diagnostic criteria would be given a diagnosis of PDD-NOS.

ASD is characterized by three core areas of impairment as described in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2000). These core areas include deficits in social interaction and communication, and repetitive type interests and behaviours. Other developmental deficits include deficits in executive functioning, abstract reasoning, and adaptive behaviour. The hallmark feature in children with ASDs is the deficit in reciprocal social interactions, which includes a deficit in ‘theory of mind’ or the ability to identify the perspective of another person about an objective event (Baron-Cohen et al.,1985). Social skills impairment is a primary characteristic of ASDs and impairment in reciprocal social interaction is gross and sustained (Baron-Cohen, 1988; Rutter, 1983). Children with ASDs display a wide range of verbal skills from being mute to emitting speech that is comparable to their typical peers.

As one of the most common neurodevelopmental disorders, autistic disorder affects approximately 11 per 10,000 children and its prevalence has been increasing over the past 15 years.

Research on Perspective Taking

The ability to take another person’s perspective is impaired in individuals with ASDs (Baron-Cohen, Leslie, & Frith, 1985, 1986). Perspective taking is typically studied using structured tasks that require the child to: (a) distinguish his or her own perspective from that of others, and (b) predict the behaviour of the other person based on that person’s perspective (e.g., an experimentally arranged false belief) as opposed to one's own. Behaviourally, the child is required to: (a) discriminate between two sets of environmental stimuli (e.g., what the child sees and what another person can see, which may be different); and then (b) predict or describe how the other person would respond in a given situation.

The two commonly used FB tests designed to evaluate Level 1 perspective taking require the child to predict the behaviour of another person, given information about that person's false belief and the child's knowledge about the true state of affairs. To pass the FB tests, the child is required to convey that a person's behaviour is determined by his/her beliefs about reality, rather than by reality itself, even when those beliefs are wrong (i.e., false). One type of assessment involves *false location* whereby the child must identify another person's false belief about the location of an item- see methods 'Sally Anne False Location Test' (Baron-Cohen et al., 1985). Another type of assessment involves *false content*, during which the child must identify the false belief another person has about the contents of a container- see methods 'Smarties False Content Test' (Perner et al., 1989).

Both tests contain: (a) a prediction question requiring the child to indicate what another person would say about an event, (b) a reality question requiring the child to indicate the true state of events, and (c) a memory question requiring the child to recall the state of events before the false belief was introduced. Correct responding to these questions determines whether an individual is able to take the perspective of another person.

By the age of 3, a child understands that beliefs influence behaviours. After age 3, they understand that even when such beliefs are false, people will behave according to their beliefs (Siegler, 1986). Most typically developing children pass the above FB tests by age 4 (Baron-Cohen et al., 1985). On the other hand, approximately 80% of children with ASDs with a verbal age between 4 and 5 years could not pass the FB tests (Baron-Cohen et al., 1985, 1986; Perner et al., 1989; Swettenham, 1996). Children with ASDs either do not develop perspective taking or have a significant delay in acquiring this ability (Baron-Cohen et al., 1985). Non-intervention studies have demonstrated that it remains a persistent deficit that does not improve as mental age advances (Holroyd & Baron-Cohen, 1993; Ozonoff & McEvoy, 1994). While support for a perspective-taking deficit is clear in children with ASDs, few studies have examined the component skills that make up perspective taking.

Research on Language and Perspective Taking

Research examining children with specific language impairments has focused primarily on children whose impairment involves language comprehension (e.g., Leslie & Frith, 1988; Perner, et al., 1989). The results showed that typically developing children with receptive language deficits consistently outperformed children with ASDs, suggesting that receptive language deficits are not responsible for failure to perform standard FB tests. However, research shows that children who lack expressive language are at a clear disadvantage when tested for perspective taking. When the children were taught language skills specific to the FB tests, their performance improved (Lohmann & Tomasello, 2003; Olson, 1988). This is an important finding given that success on the standard FB tests is dependent on expressive language (e.g., when asked "What do you think Jon will say is inside the box?" the child must respond by saying "candy" or "M&Ms"). The results of previous research support the argument that language acquisition plays a role in standard FB test performance. Furthermore, research examining verbal mental age (VMA; which includes both expressive and receptive language) and performance on standard FB tests has demonstrated that VMA is highly correlated with performance on perspective taking tests among children with ASDs as well as children who were considered to

be typically developing (Happé, 1995).

Statement of the Problem

The purpose of this research was to examine performance of children diagnosed with ASDs compared to typically developing children on standard FB tests and the Guesser-Knower (GK) test.

The hypothesis is that significantly more children would pass the GK test than either of the two standard FB test. Furthermore, we expect that there will be qualitative differences in the theory of mind deficits between children with Autism spectrum disorders (ASD) and typically developing children.

Methods

Participants and Setting

Eighteen children, 16 boys and 2 girls (mean age= 7 years 3 months), with prior confirmed diagnoses of ASDs were recruited from Winnipeg through St. Amant, Children Special Services, and the Manitoba Autism Research Team. Diagnostic information was obtained either from the parents' diagnostic records or direct record review. 18 typically developing control children between the ages of 3-5 years were recruited via posters placed at Health Sciences Centre, St. Amant Centre, and the University of Manitoba. Ethical approval was obtained from the Psychology/Sociology Research Ethics Board of the University of Manitoba and written informed consent to participate in the study was obtained from the legal guardians.

To be included in the study, children with ASDs were required to demonstrate a minimum verbal age of 36 months on expressive and receptive language based on their language assessment scores. Although previous research has suggested that typically developing children pass standard FB by age 4 (e.g., Baron-Cohen, 1985), Siegler (1986) reported that after age 3 children understand that even when another person's beliefs are false, people will behave according to their beliefs.

Children under 7 years of age were assessed using the Preschool Language Scale 4 (PLS-4; Zimmerman, Steiner, & Pond, 2002). The PLS-4 is designed to identify children who have a language disorder or delay and has been normed for children ages 0 months through six years 11 months. Children older than 7 years of age were assessed using the Clinical Evaluation of Language Fundamentals-Fourth Edition (CELF-4; Wiig & Secord, 2004).

All assessments of the children took place in a quiet assessment room at the St. Amant Research Centre or at a quiet location in the children's homes.

Experimental Design

All children were tested on the two standard FB tests (False Location and False Content) and the GK test. The order of testing was counterbalanced to control for order effects.

False Belief Assessment Procedures

All children were tested on both the Bobby Anne False Location test and the Smarties

False Content test using the procedures described by Baron-Cohen et al. (1985) and Perner et al. (1989), respectively. On the Bobby Anne False Location test a pass was scored if the child responded correctly on the *belief* question, the *reality* question, and the *memory* question according to Baron-Cohen et al. (See Table 1). If the child responded incorrectly to any of these questions a fail was scored. Nonvocal responses (such as pointing to the container and head nodding in response to questions that required yes/no answers) were recorded and accepted.

On the Smarties test a pass was scored if the child responded correctly on the *prediction* question, the *reality* question, and the *memory* question (See Table 2). Nonvocal responses (such as head nodding or shaking) to questions that required yes/no answers (e.g., “Is Jon here with us?”) were accepted.

Guesser-Knower Assessment Procedures

Each child was exposed to two phases: goggle preexposure and assessment. Prior to each session the child was presented with an edible prize, with was used to reinforce attending on each trial independent of the child's responding (See Table 3 for the procedural checklist).

Goggles preexposure. Children were presented with a number of items and asked to label those items. Once the child correctly labelled the items to be used, the goggle preexposure phase began. During this phase a child was exposed to the two pairs of goggles. The child was given a pair of goggles and, while wearing the goggles, the child was asked to point to or interact with an object that had beed placed on the table. All but three children with ASDs completed a minimum of six preexposure trials (mean number of trials was 10).

Guesser-Knower assessment. During the assessment two assistants sat across the table facing the child, and the administrator sat to the side of the child at the end of the table. On the table were two identical boxes in front of the child with a plexiglass barrier placed over the boxes. A partition was placed between the child and the boxes, such that the child was unable to see the boxes. One assistant put on the translucent goggles (the Knower) and the other put on the opaque goggles (the Guesser) and both assistants oriented their heads towards the boxes. The adminitrator held up the wooden star and said, "I'm going to hide the star." She then opened and closed each box in sequence behind the partition and went through the motion of placing the wooden star in each box, although the star was actually placed in only one of the boxes. The box with the star varied across trials according to a predetermined randomized order. The partition was lowered and each assistant pointed to a different box. The Knower always pointed to the box with the star and the Guesser to the box without the star. The child was asked, “Who knows where the star is?” A correct response was defined as touching or pointing to the Knower or the corresponding box. An incorrect response was defined as touching or pointing to the Guesser or the corresponding box. Once the child responded, the administrator opened the corresponding box and showed the contents to the child. The child had two tries to answer the question before an incorrect answer was marked. Each test session consisted of 10 trials, and a pass was awarded if the child responded correctly on a minimum of 8 out of 10 trials.

Results

Performance on the standard FB tests and GK tests is presented in Table 4. In the ASD

population, 6/18 children passed the False Location test, 4/18 passed the False Content test, and 5/18 passed the Guesser-Knower test. 4/18 children (22%) passed both standard FB tests. 3/4 children who passed both standard FB tests passed the GK test, obtaining scores between 90% and 100%. Of the 12 children who failed both standard FB tests, 2 passed the GK, obtaining scores of 80% and 100%, respectively.

In the control population, 4/18 children passed the False Location test, and 4/18 passed the false content test. 3/18 passed the Guesser-Knower (GK) test. Only one child passed both the FB tests. Of the three children who passes the GK test, one failed both the FB tests, one passed the False Location, and one passed the False content. No child in the control population passed all three tests.

The relationship between chronological age, standard language scores, and performance on the three perspective-taking tests was investigated using Pearson Correlations (see table 2). There was a moderate correlation between performance on the false belief false content test and the age in the ASD population ($r= 0.490$; $n=18$; $p<0.05$). There was a strong correlation between performance on the same test and age in the control population ($r= 0.0.663$; $n=18$; $p<0.05$).

There was a strong correlation between standard language scores and performance on all three perspective-taking tests in the ASD population. (n=18; p,0.05). However, there was no significant correlations between standard language scores and performance on the three tests in the control group.

We performed a 2 (group: ASD or control) x 2 (test) multivariate analysis of variance on each of the tests given to the participants (false belief false location, false belief false content, guesser-knower). None of the results were statistically significant (all *P*s > 0.05).

Discussion

We hypothesized that significantly more children would pass the GK test than the FB tests. This hypothesis was not supported in both the ASD and control populations. Performance on the GK test did not differ significantly from performance on the standard FB tests. Therefore, it remains unclear how “seeing and knowing”, as measured by the GK test, is related to false belief test performance.

Several observations from the results of this study are consistent with previous research. Firstly, 22% of the current ASD sample passed both standard FB tests (Baron-Cohen et al., 1985, 1986; Perner et al., 1989; Swettenham, 1996). Approximately 90% of all children who participated in this study were able to respond correctly to the reality question on both FB tests, while approximately 40%-50% responded correctly to the belief question (Table 1). This finding is consistent with previous research (e.g., Baron-Cohen et al. and Perner et al.) which found that all children passed the reality question while only 17%-20% of the children correctly responded to the belief question. Approximately 40%-60% of the children passed the memory question on both tests in this study, a similar finding to that of Perner et al. who reported 61% of children passing the memory question among their sample. This contradicts results presented by Baron-Cohen et al., who reported that 100% of children responded correctly to the memory question on

the Sally-Anne test regardless of performance on the belief question.

Among the children who failed the standard FB tests, more children responded correctly to the memory question on the False Location tests than on the False Content tests. It is possible that the children showed better performance on the False Location memory question because responses were prompted by visual cues from the test materials, whereas children were asked to recall what they had said on the False Content test. The correlation between standard language scores and performance on the False Content test in the ASD population was very strong (r= 0.763). The correlation between standard language scores and performance on the False Belief test in the ASD population was not as strong (r=0.560). The children may have performed better on the False Location test because they did not require as much language skill as needed for the False Content test.

Another finding that is consistent with previous research was the positive correlations between expressive language standard scores and performance on the FB tests in the ASD population. This finding is consistent with previous research, which looked at verbal mental age (VMA) and performance on standard FB tests. Happé (1995) conducted an analysis on data collected between 1985 and 1993, which looked at the relationship between VMA (including both expressive and receptive language) and performance on perspective taking tests. Results of that analysis showed that VMA was a good predictor of, and was highly correlated with, performance on perspective taking tests among both children with ASDs and typically developing children. Although the sample in the present study is small, the results support Happé's finding of a positive correlation between language scores standard FB test performance in the ASD population.

However, in the present study, there were not significant correlations between the same variables in the control population. One explanation for this finding may be that the control population had a narrow range of variation in language ability, whereas the ASD population had a large range of language abilities. Perhaps if the control population showed the same variation in scores on the PLS-4, we would see a similar trend of better performance on the FB and GK tests as language ability improves.

We found no performance difference between the GK test and the FB tests. The GK test used during the present study improved upon previous research in that the seeing and knowing discrimination was refined from an individual wearing a paper bag over their head to individuals wearing opaque and translucent goggles. This had the advantage of limiting the discrimination to the Guesser’s and Knower's eyes. However, it is possible that children could still pass the test based on the visual discrimination between the purple and orange goggle rims associated with the roles of the Guesser and Knower throughout the test. Perhaps future versions of the test might consider alternative methods for enhancing child attendance to the eyes of the Guesser and Knower while minimizing superfluous stimuli. These test variations might include hand-covered eyes versus uncovered eyes, closed versus opened eyes, the Guesser turning around and the Knower facing the child, etc. Furthermore, future researchers might conduct multiple versions of the test to ensure that the children who pass are making the relevant discrimination between seeing and not seeing.

Finally, we found no qualitative differences between performance on perspective-taking tests between the control and ASD population. The amount of children passing both the FB and GK tests were quite similar in both populations. However, all of the control children were between the ages of 3-5 years 11 months. It is possible that many of the children were too young to understand the task at hand. The ASD population's age ranged from 5 years to 11 years 9 months. Previous research states that by the age of 3, a child understands that beliefs influence behaviours. After age 3, they understand that even when such beliefs are false, people will behave according to their beliefs (Siegler, 1986). Most typically developing children pass the above FB tests by age 4 (Baron-Cohen et al., 1985). Almost half (8/18) of the control population was under the age of 4, which may have created a population that was too young to properly evaluate perspective-taking skills in typically-developing children. Perhaps if the control population had been slightly older, the results may be different.

In summary, it appears that language ability and memory strongly influenced the performance of children with ASD on the FB tests, but did not have a strong effect for the control population. Children in both the ASD and control populations did not do better on the GK test than the FB tests. Further refinement of the Guesser-Knower test is needed.

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Tables

Table 1- Bobby- Anne False Location FB test

Belief Question	Where will Bobby look for the ball?
	Answer: Basket
Memory Question	Where is the ball really?
	Answer: Box
Reality Question	Where did Bobby and Anne put the ball before Bobby left?
	Answer: Basket

Table 2- Smarties False Content FB test

Prediction	What does (parent) think is inside the box?
	Answer: Smarties
Belief Question	What's really inside the box?
	Answer: Pencil
Reality Question	"Do you remember, when I took the box out of my bag and asked you what was in it, what did you say?").
	Answer: Smarties

Table 3- Procedural Checklist for Guesser Knower Test

	Attempt 1	Attempt 2
(1) Experimenter gave edible for attending behaviour		
(2) Partition set up		
(3) Guesser and Knower put on correct goggles		
(4) Experimenter holds up star and says "I'm going to hide the star"		
(5) Experimenter opens and closes each box in order		
(6) Experimenter places the star in the correct box		
(7) Partition is lifted		
(8) Guesser and Knower point to the correct boxes		
(9) Experimenter asks the child "Who knows where the star is?"		
(10) Child is given 15 s to respond. If no response trial is terminated after 15 s.		
(11) Experimenter opens corresponding container and shows the contents		
(12) Experimenter remains neutral following child response		

(13) Experimenter thanked the child for helping		
(14) Experimenter waits 15 s before starting a new trial.		

Table 4- Percent of children who passed the false belief tests and guesser knower tests

	FBFL	FBFC	GK
ASD	33% (6/18)	22%	28% (5)
Control	22%	22%	16%

Table 5- Correlations between language scores, chronological age, FB and GK tests

		FBFL	FBFC	GK
Control				
PLS		0.243	0.446	0.153
CAG		0.446	0.663*	0.287
ASD				
PLS		0.560*	0.763*	0.557*
CAG		0.306	0.490*	0.365

FBFL= False Belief False Location (Sally-Anne)
FBFC= False Belief False Content (Smarties)
GK= Guesser-Knower
** $p<0.05$*