Journal on Developmental Disabilities
Le journal sur les handicaps du developpment
JoDD
Volume 14, Number 3, 2008
page #40

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Keywords

autism,
cognitive development,
future thinking,
self,
Theory of Mind

Future Thinking in Children with Autism Spectrum Disorders: A Pilot Study

Abstract

This study examined future thinking ability in children with autism spectrum disorders (CWA) (11 males, 1 female; 4 years 8 months – 13 years 1 month (4;8 – 13;1). CWA show deficits in various aspects of their development, including theory of mind (ToM) understanding. In light of recent theorizing about the potential link between ToM and future thinking, we hypothesized that CWA should have greater difficulty making predictions about the psychological world and, notably, the "future self," than the physical/mechanical world. Results confirmed this hypothesis: CWA scored significantly lower on self than mechanical tasks. Although only a pilot study, these findings are an important addition to the body of autism literature which, to date, has not targeted future thinking skills.

Children with autism (CWA) exhibit deficient social interaction and communication skills, an unusual insistence on regularity, and abnormal adherence to repetitive patterns of behaviour (American Psychiatric Association [APA], 2000). With respect to social understanding, specifically, there is now consensus that CWA show deficits on tasks that assess Theory of Mind (ToM) (Tager-Flusberg, 2007). ToM skills are crucial to our understanding and assigning of mental states to self and other (Premack & Woodruff, 1978). According to the well-known ToM account of autism (Baron-Cohen, Leslie, & Frith, 1985), even the most high-functioning CWA develop only low-level ToM skills. This is in stark contrast to typically-developing children (TDC) who acquire an elementary understanding of mental states by age two, with further development in the preschool years (Wellman, Cross, & Watson, 2001; Wellman, Phillips, & Rodriguez, 2000). Without an intact ToM, CWA have difficulty using mental states to predict and explain others' behaviour (Frith, Happé, & Siddons, 1994). As a result, they are developmentally delayed in their ability to communicate with others, to form relationships, and to make sense of their social milieu.

Theory of Mind and Future Thinking

Future thinking is an important aspect of human cognition that, like memory (Tulving, 1984), can be divided into two types: semantic and episodic. Similar to episodic memory which allows an individual to re-experience an event, episodic future thinking allows an individual to pre-experience an event (Atance & O'Neill, 2001). Episodic future thinking encompasses more than simply imagining oneself in the future; it involves developing a plan that takes into account one's specific situation (Atance & O'Neill, 2001). Behavioural evidence indicates that episodic future thinking skills (and mental time travel more broadly) emerge around age 4 (Atance & O'Neill, 2005; Suddendorf & Busby, 2005). According to Levine et al. (1998), this episodic awareness supports the formulation of future-oriented goals, and supports the implementation of the behavioural guidance system necessary to achieve them.

A number of researchers have argued that the ability to mentally project oneself into the future (episodic future thinking) is related to ToM and, specifically, to the understanding that others can have different perspectives from one's own (Atance & O'Neill, 2005; Moore, Barresi, & Thompson, 1998; Suddendorf & Corballis, 1997). When projecting oneself into the future, the individual must adopt the perspective of a future self, rather than that of another person. Nonetheless, neurophysiological evidence indicates an overlap in the brain structures underlying these two forms of perspective-taking, supporting the notion that they are intimately related (Buckner & Carroll, 2006). As such, it is reasonable to conclude that individuals who have deficits in ToM abilities – as is the case with autism – may also show similar deficits in episodic future thinking or, simply put, in projecting the self into the future.

Evidence for a Future Thinking Deficit in Autism

Individuals with autism often demonstrate excessive dependence on repetitive and stereotyped behaviours and lack the behavioural flexibility seen in typical development (APA, 2000). It is plausible that such inflexibility stems from underlying difficulties with planning and future thinking (Suddendorf & Corballis, 1997). Interestingly, some patients with traumatic brain injuries are characterized by an inability to think about the future and also show behavioural similarities to individuals with autism. Specifically, these patients demonstrate impaired self-regulation, and their behaviour tends to be driven either by generic, learned rules about how one should behave or by irrelevant environmental goals, rather than by specific goals and intentions relating to their identity and future self. As a result, they often demonstrate inappropriate habits or routines (Levine et al., 1998). Given the evidence just discussed, it is reasonable to hypothesize that the often stereotyped and inflexible behaviour seen in individuals with autism may reflect an inability to mentally project into the future. However, whether CWA do indeed show deficits on tasks specifically designed to assess future thinking has not yet been examined.

Self-Based versus Mechanical-Based Tasks: A Pilot Study

Previous studies have found that CWA have significant deficits in episodic memory, another form of "mental time travel" that is similar to episodic future thinking (Powell & Jordan, 1993). Suddendorf and Corballis (1997) argue that these episodic memory deficits may be due to the inability to form a relationship between one's past and present self, and to dissociate from one's own current state. Since CWA show deficits in ToM skills and episodic memory, then one might also expect them to show deficits in episodic future thinking (cf. Suddendorf & Corballis). If so, then this would support the claim that CWA are impaired in their sense of past, present, and future selves.

In contrast, CWA may be less impaired on tasks that require them to make predictions about the physical world, which presumably does not rely on the capacity to envision the self in the future. Baron-Cohen (1997) found that CWA performed better than matched controls on tasks involving an understanding of physical causality. Other clinical and research reports suggest that CWA relate more effectively to physical objects and tasks than to psychological tasks (Binnie & Williams, 2003). Therefore, future thinking tasks which require predicting a physical, or mechanical, end state (hereafter referred to as mechanical-based future thinking tasks), rather than a psychological, or "personal", one (hereafter referred to as self-based future thinking tasks), may also be easier for these children.

In the current study, we decided to administer future thinking tasks that assessed the ability to think about the short-term, rather than the long-term, future. This is because thinking about the near future may rely less on imaginative capacity (which is known to be impaired in CWA) and in typical development, at least, seems to emerge prior to the capacity to contemplate the more remote future (Hudson, 2006).

Method

Participants

Ethical approval for this study was obtained from the Research Ethics Board at the University of Ottawa. Participants included 12 children (1 female) with a clinical diagnosis of an Autism Spectrum Disorder, who were recruited through posters and pamphlets distributed throughout a medium-sized metropolitan city. Participants were diagnosed by various independent clinicians, as reported by their parents. An additional 5 children were tested but were excluded for the following reasons: severely disruptive behaviour (3 children); a mental age, as measured by the Peabody Picture Vocabulary Test, 3rd Edition (PPVT-III; Dunn & Dunn, 1997), that was less than 3 (1 child); a score on the PPVT-III that was significantly higher than the mean ($z = 2.69$, $p < .01$) (1 child). The 12 participants who completed the study ranged in age from 4;8 to 13;1 ($M = 7;2$, $SD = 2;4$). The verbal mental ages of the participants ranged from 4;1 to 8;4 ($M = 5;11$, $SD = 1;4$).

The performance of the CWA group was also compared to a group of TDC (11 males, 1 female). These children were administered the same tasks as the CWA in the context of another investigation of future thinking in typically-developing preschoolers conducted in our laboratory, and were recruited in the same way as the CWA. The TDC were matched on the basis of sex and PPVT-III score to the CWA. Their ages ranged from 3;6 to 5;10 ($M = 4;9$, $SD = 0;9$), with verbal mental ages ranging from 4;3 to 8;5 ($M = 5;11$, $SD = 1;4$). Although the mean chronological age differed significantly between the two groups, $t(22) = 3.35$, $p < .01$, with the TDC's being lower, the mean verbal mental age did not, $t(22) = -0.08$, $p = .94$.

Procedure

We administered two self-based and two mechanical-based future thinking tasks that were designed specifically for this study. The surface structures of these tasks were well matched; each entailed the child making a choice between two courses of action, with only one leading to task success. In addition, none of the tasks required a verbal response. Importantly, however, success on the self-based tasks was hypothesized to require children to project themselves into the future to pre-experience an event, whereas success on the mechanical-based tasks was hypothesized to rely on the capacity to predict the outcome of a physical transformation.

Self-Based Tasks

Ernie's doggies. Three black binders were placed on the table and children opened each binder to reveal a different animal photograph (puppies, kittens, and ducklings). The experimenter told children that Ernie, from "Sesame Street", was coming to visit. She explained that Ernie was very afraid of puppies. Children were then asked if there was anything they should do to prepare for Ernie's visit. Children received a score of 1 if they hid the photograph of the puppies (by closing the binder), thus demonstrating that they had anticipated themselves in a future situation in which Ernie would be afraid (see Figure 1).

Ant costume. Two pieces of an "ant" costume were placed on the table: A child-sized blue t-shirt with six straws affixed to the front comprised the "ant body", while a blue hat with two long antennae, made of three straws taped together, comprised the "ant head." Children were asked to pretend that they would be putting on the costume, and were then asked which part they should put on first. Children received a score of 1 if they chose to put the ant body on first, thus demonstrating that they had anticipated that the ant body would not fit over the antennae on the ant head.

Mechanical-Based Tasks

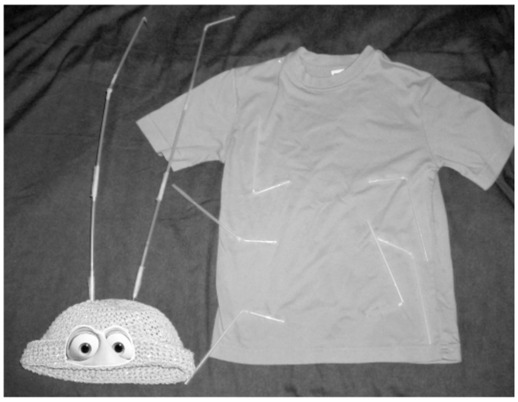
Balls and tubes. A wooden ramp and two detachable tubes – one wide, one narrow – were placed on the table. Children were shown that a small ball could roll down both the wide and narrow tubes and knock down a domino, whereas a large ball could only roll down the wide tube. On the test trial the narrow tube was placed below the wide tube. Children were then asked which ball they needed to choose (the small or the large) to knock over the domino. Children received a score of 1 if they chose the small ball, thus demonstrating that they had anticipated that the large ball would get stuck at the opening of the narrow tube.

Tapioca. A large container of small, white, tapioca beads, a small empty container, a large slotted spoon, and a small box without a lid were placed on the table. Children were instructed that they were to transfer tapioca beads from the large container to the smaller empty container. They were then asked which tool (the slotted spoon or the small box) they needed to use to accomplish this goal. Children received a score of 1 if they chose the small box, thus demonstrating that they had anticipated that the tapioca beads would slip through the "slots" of the spoon.

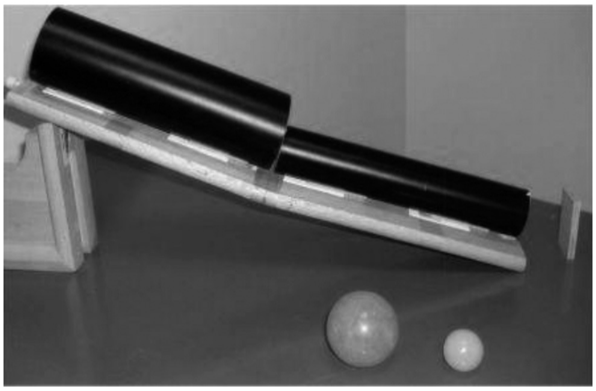
Results

Scores on the Ernie's Doggies and Ant Costume tasks were summed (range = 0 to 2) to form a "self" composite score, while scores on the Balls and Tubes and Tapioca tasks were summed to form a "mechanical" composite score (range = 0 to 2). Nonparametric analyses were used since the assumption of normality of distributions of the dependent variables was not met. The results of a Wilcoxon Signed Ranks test indicated that there were significantly more CWA who showed a lower self score than mechanical score than CWA who showed the reverse, $z = -2.49$, $p = .01$.

Ernies' doggies



Ant Costume



Balls and Tubes

Tapioca

Figure 1. Task set-ups

Table 1. Means, medians, and standard deviations for CWA and TDC

		Self	
Group	Mean	Median	Standard Deviation
CWA	.67	1.00	.65
TDC	1.42	1.00	.52

CONTINUED...

Table 1 continued...

		Mechanical	
Group	Mean	Median	Standard Deviation
CWA	1.50	2.00	.67
TDC	1.33	1.00	.65

Note. Medians are reported because means and standard deviations alone do not provide a useful description of the data due to the non-normal distributions of the variables.

tasks were summed (range = 0 to 2) to form a "self" composite score, while scores on the Balls and Tubes and Tapioca tasks were summed to form a "mechanical" composite score (range = 0 to 2). Nonparametric analyses were used since the assumption of normality of distributions of the dependent variables was not met. The results of a Wilcoxon Signed Ranks test indicated that there were significantly more CWA who showed a lower self score than mechanical score than CWA who showed the reverse, $z = -2.49$, $p = .01$. In contrast, TDC did not show a difference in performance on the two types of tasks, $z = -.33$, $p = .74$ (see Table 1).

Discussion

The results of this study suggest that CWA have more difficulty succeeding on tasks that require them to make predictions about the future self than on tasks that require them to make predictions about the outcome of physical transformations. This result is consistent with previous studies which have shown that CWA have greater ease reasoning about the physical/mechanical world than the psychological world (Baron-Cohen, Leslie, & Frith, 1986). In contrast, the TDC performed similarly across both types of tasks. This makes it unlikely that CWA performed worse on the self tasks because these were more difficult than the mechanical tasks. Rather, the findings are consistent with the hypothesis that CWA show a specific impairment in projecting the self into the future and hence a deficit in episodic future thinking skills.

As argued in the Introduction, this deficit in episodic future thinking ability in CWA may be attributable to their overarching deficit in ToM skills. Before this conclusion is fully warranted, however, it will be important to conduct additional research with both typically-developing children and CWA since the FT tasks described here may also differ on a number of other dimensions, including the type of executive function (EF) skills required. EF skills have also been shown to be impaired in CWA (Hill, 2004) and it could be these, rather than ToM skills, specifically, that could account for an impairment in future thinking. Interestingly, however, each of the four tasks arguably require a certain level of EF skill. For example, in the Tapioca task, children need to inhibit the associative, or automatic, link between "spoon" and "scooping," to choose the box, while in the Ant Costume task, children need to inhibit the tendency to put on the more interesting looking hat before the shirt. Despite this, CWA performed better on the mechanical tasks than the self tasks, suggesting that EF difficulty alone cannot account for our pattern of findings.

Future research should assess the extent to which ToM and EF tasks relate to these FT tasks, as well as examine whether there is evidence of convergent validity between these FT tasks and other existing FT tasks (e.g., Atance & Meltzoff, 2005). It will be especially important to include tasks that assess children's ability to think about the more distant future, since the tasks used in this study focus primarily on immediate future situations. Additionally, to determine whether the pattern of findings obtained in this study is unique to CWA, studies of future thinking ability should include larger samples of CWA within a more restricted age range and matched control groups of TDC, as well as children with other, non-autistic, delays.

Interestingly, a deficit in future thinking skills in autism may help to explain the autistic symptoms that are not readily explained by Baron-Cohen et al.'s (1985) ToM account alone. The ToM account offers a plausible explanation for only two of the main autistic deficits outlined in the Introduction: deficient social interaction and deficient communication skills. It does not fully explain the third symptom set: insistence upon regularity (Bushwick, 2001). However, a deficit in episodic future thinking skills might help explain this third set of symptoms. Without the capacity to re-direct our thinking away from the present and towards the future, we would be unable to delay gratification, plan ahead, or anticipate future events. As such, our behaviour in the present would be unusually restricted, inflexible, and seemingly irrational. This may be the case for individuals with Autism Spectrum Disorders. Thus, a deficit in future thinking skills in autism is not at odds with the ToM account. Rather, it helps to explain the third, unaccounted for, symptom set: insistence upon regularity.

This study is an important first step in examining future thinking ability in children with autism. Some important limitations highlight the need for replication of these results, however. In future studies, it will be important to confirm children's diagnoses through a statement from a professional, or direct measurement, rather than relying solely on parental report. Additionally, future studies should include samples with more females to examine any possible sex differences.

Further investigation of a possible deficit in episodic future thinking skills will help to clarify the clinical picture of autism, and will be helpful in identifying behaviours and skill sets to target in intervention programs. Finally, from a theoretical standpoint, increased knowledge in this area will help us to better understand the nature of future thinking skills, and their connection with ToM skills in typical and atypical development.

Acknowledgments

We are grateful for financial support from the Canadian Institutes of Health Research (CIHR), in the form of a Master's Award granted to the first author. We thank the parents and children who volunteered their participation. We also thank Isabelle Boutet for her helpful comments on an earlier version of this manuscript. Portions of this data were presented at the 2008 International Meeting for Autism Research in London, England. Correspondence concerning this article should be addressed to Laura K. Jackson: School of Psychology, University of Ottawa, 120 University, Room 415, Ottawa, Ont., Canada, K1N 6N5, ljack033@uottawa.ca

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