

# THE RELATION BETWEEN THEORY OF MIND AND EXECUTIVE FUNCTIONS IN CHILDREN WITH FETAL ALCOHOL SPECTRUM DISORDERS

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## ABSTRACT

### Background

Children with Fetal Alcohol Spectrum Disorders (FASD) are faced with a range of physical, cognitive, behavioral, and/or learning deficits, as well as poor executive functioning and social skills. Theory of mind (ToM) is the ability to understand that one's own perspective may differ from the perspective of another individual. ToM develops around age 4 and is correlated with performance on executive functioning tasks.

### Objective

The goals of this study were to examine ToM performance in young children with FASD, how age was related to ToM performance, and whether ToM abilities were related to underlying executive function difficulties.

### Method

Fifty-three children (aged 4 to 8 years) participated: 25 children with FASD and 28 control children. All children were tested on measures of ToM, executive functioning, and receptive vocabulary.

### Results

More children in the FASD group (44%) failed one or both ToM measures than in the control group (25%). Older children with FASD performed worse on ToM than younger children, but this was not the case for the control group. For the FASD group, ToM performance was correlated with a measure of inhibition, but for the control group, ToM was correlated with visual-spatial working memory.

### Conclusions

Children with FASD have difficulty on ToM tasks, and this difficulty may be related to underlying deficits in inhibition.

**Keywords:** *Fetal Alcohol Spectrum Disorder (FASD), Theory of Mind (ToM), executive functioning*

**F**etal Alcohol Spectrum Disorder (FASD) is an umbrella term used to describe the array of physical, cognitive, behavioral, and/or learning deficits found in children whose mothers drank alcohol during pregnancy.<sup>1</sup>

Children with FASD display deficits in memory, attention, visual-spatial abilities, intelligence, processing speed, academic achievement, and language.<sup>2,3,4</sup> Executive functioning (EF),<sup>5</sup> adaptive functioning, and social skills<sup>6</sup> are also areas of impairment for children with FASD. One aspect of social-cognitive functioning commonly studied in children, and specifically those with developmental disabilities,

is theory of mind (ToM). However, ToM is poorly understood in children with FASD; thus the goal of the present study was to examine ToM in young children with FASD.

### Theory of Mind Development

ToM is the ability to attribute mental states (e.g., knowledge, beliefs, desires) to both oneself and others, and to understand that others can have thoughts, beliefs and knowledge that are different from our own. It develops rapidly during the preschool years, and by the age of 5 or 6, children are typically able to grasp another person's perspective. ToM is most often measured using

the false belief paradigm.<sup>7,8,9</sup> One type of false belief task (unexpected transfer) involves telling a child a story about an object being placed in an initial location by the main character, which is later moved to a new location unbeknownst to the main story character. The child is then asked to predict where the main character believes the object is located. To succeed on these tasks, the child must understand that their belief about the location of the object differs from the belief of another individual. Performance on this task greatly improves between 3 and 4 years of age which suggests a solidification of ToM understanding during the preschool years.<sup>7-12</sup>

The development of ToM appears to be strongly related to the development of EF, which is a set of processes that monitor, control, and supervise both thought and action.<sup>7,13,14</sup> The link between ToM and EF is well-established.<sup>11</sup> Carlson et al.<sup>7</sup> propose that several common findings support this supposed link: 1) both ToM and EF concepts improve significantly during the preschool years; 2) there appears to be an overlap in the brain regions involved in ToM and EF tasks; and 3) individuals with autism show deficits in both EF and ToM.<sup>15</sup>

Two components of EF that have received considerable attention with respect to the development of ToM are working memory and inhibition. In order to be successful on false belief tasks, children must first be able to retain all relevant information and hold two different perspectives in mind at once (working memory). Secondly, they must be able to suppress their own prepotent perspective and respond with a different, less salient perspective (inhibition).<sup>16</sup> Working memory is highly correlated with false belief performance among young children (3 to 5 years) even after controlling for age and verbal ability.<sup>17,18</sup> Young children's computational resources (such as working memory, language competence, and inhibition) are also related to false belief understanding and the development of ToM.<sup>19,20</sup> The ability to inhibit develops at around the same time as ToM.<sup>21</sup> Several studies have suggested that inhibition is significantly related to ToM, even after controlling for many other variables including age, gender, vocabulary, planning, motor sequencing, family size, and planning ability.<sup>15,22</sup> Carlson et al.<sup>7</sup> studied two different types of inhibition tasks in relation to

ToM: conflict tasks (e.g., the Whispers task), which involve suppressing a prepotent response and replacing it with a conflicting one; and delay tasks in which children must resist the temptation to give a salient response but do not need to provide a conflicting one. They found that only conflict tasks were significantly correlated with both working memory and ToM after age and intelligence were partialled out. Others have also concluded that a combination of working memory and inhibition is related to ToM.<sup>15,22,23</sup> Nevertheless, although both inhibition and working memory are likely involved in ToM development, the exact nature of their roles has not yet been established.<sup>16</sup>

Both ToM and EF are significant areas of difficulty in children with autism spectrum disorders<sup>24</sup> and there is a link between EF and ToM difficulties in these children.<sup>25</sup> ToM deficits have also been documented in children with Prader-Willi syndrome and Williams syndrome,<sup>12</sup> and children with ADHD.<sup>26</sup> Furthermore, ToM is correlated with EF among 6-7 years-olds with attention and behavioral problems<sup>27</sup> and 'hard to manage' preschoolers.<sup>28</sup> Finally, maltreated children both living with their biological families<sup>29</sup> and in foster care<sup>30</sup> have difficulty with ToM. Together, these studies show that many populations of atypical children display difficulties with EF and ToM, which may suggest that children with FASD also possess similar deficits.

### **Social and Executive Functioning among Children with FASD**

Children with FASD are often characterized as having poor social development. Caregivers of children prenatally exposed to alcohol report poorer social skills than those not exposed.<sup>31</sup> Whaley et al.<sup>6</sup> found that social behavior decreased with age (relative to the norm) among children aged 2 to 10 years with FASD, indicating that socialization deficits may become more pronounced with age. Similarly, another study comparing social abilities of children with Fetal Alcohol Syndrome (FAS) and matched controls (5 to 12 years) found that for the FAS group only, social deficits appeared to become more pronounced with age, and social abilities tended to plateau at the 4- to 6-year-old level.<sup>32</sup> Further, these social deficits were greater than expected

based on cognitive ability leading the authors to conclude that social abilities may be arrested, and not simply delayed, in FAS. These children showed most difficulty with interpersonal relationships.<sup>32</sup>

Children with prenatal alcohol exposure (PAE) have difficulties with establishing and sustaining social relationships.<sup>33</sup> Social communication is a significant area of difficulty for children with PAE and may be related to difficulties with language, social cognition, and EF.<sup>33</sup> Timler, Olswang, and Coggins<sup>34</sup> speculate that children with FASD may have ToM deficits, however, there has been no published research examining ToM performance among children with FASD.

EF, which is strongly linked to ToM,<sup>7,13</sup> is significantly impaired in children with FASD. For instance, children with FASD have been found to be impaired on a variety of EF tasks measuring cognitive flexibility, inhibition, verbal fluency, abstract thinking, deductive reasoning, hypothesis testing, problem solving, and concept formation.<sup>35</sup> Working memory is also a significant deficit among individuals with FASD.<sup>5</sup> Furthermore, EF impairments predict social skills deficits among children with FASD.<sup>36</sup>

### Current Study

The goals of this study were to examine ToM performance in young children with FASD, and to determine whether ToM abilities were related to EF difficulties. Children with FASD are impaired on many components of EF including both inhibition and working memory.<sup>5</sup> Due to the significant EF and social deficits in children with FASD and the strong connection between ToM and EF in other typical and atypical populations, we hypothesized that children with FASD would have difficulty on ToM tasks and that ToM performance would be related to underlying EF deficits. We also examined whether vocabulary skills were related to ToM as previous research indicates that both language and vocabulary are related to ToM.<sup>14</sup> Significant relations have been found between children's language abilities and their performance on false belief task in both typically developing children<sup>37-9</sup> and children with autism,<sup>40,41</sup> suggesting that these abilities are an important correlate of ToM ability. This relation may be due to the fact that most false-belief tasks are verbal.<sup>42</sup> In a meta-analysis examining the

relation between language ability and ToM, Milligan, Astington, and Dack<sup>43</sup> concluded that receptive vocabulary tests provide the purest measure of language ability, thus such a measure was included in our study. Finally, we examined how age was related to ToM performance among children with FASD, as previous research indicates that the social deficits among children with FASD may become more pronounced with age.<sup>6,32</sup>

## METHODS

### Participants

Fifty-three children aged 4 years, 2 months to 8 years, 9 months participated. There were 25 children (11 females) in the FASD group and 28 children (14 females) in the control group. There was no difference in age (in months) between the FASD ( $M = 76.68$ ,  $SD = 14.53$ ) and control group ( $M = 75.79$ ,  $SD = 10.55$ ),  $F(1, 51) = .07$ ,  $p = .80$ . An age range of 4 to 8 years, which is slightly older than ToM studies with typically developing children, was chosen for several reasons. First, it is very difficult to find children reliably diagnosed with FASD who are under the age of 4 years because FASD is very challenging to diagnose in preschool children. A diagnosis of FASD requires evidence of brain damage as indexed by impairment across a number of neurobehavioral domains, and there is currently a lack of appropriate and sensitive tests to measure the broad array of neurobehavioral deficits among preschool children. Second, the broad age range was selected to allow for the examination of age differences in ToM performance. Finally, because children with FASD are developmentally delayed (thus we expected to find ToM deficits) and we wanted to examine correlations between ToM and EF, a very young sample was not chosen in order to avoid floor effects which would preclude the examination of correlations.

All children in the FASD group had previously been medically diagnosed with an alcohol-related disorder falling under the umbrella term FASD (Neurobehavioral Disorder: Alcohol Exposed, or Alcohol Related Neurodevelopmental Disorder). In order to be diagnosed with any of the classifications that fall under FASD, children would have had confirmed prenatal alcohol exposure and cognitive deficits suggesting some

degree of brain dysfunction and thus would have met the contemporary diagnostic criteria for FASD. Diagnosis of FASD was formulated based upon the DPN (Diagnostic Prevention Network) model developed by Drs Astley and Clarren at the University of Washington<sup>44,45</sup> which is supported in the recently published Canadian Guidelines for Diagnosis of FASD.<sup>1</sup> Evidence of growth deficiency, facial dysmorphology, and brain dysfunction is evaluated in each case along with a reliable confirmation of prenatal alcohol exposure. All clinicians who diagnosed children with FASD in this study had been directly trained on the DPN model. The diagnostic information was obtained (with parental permission) from the health records of each child to confirm that a physician (typically a pediatrician) had diagnosed the child. FASD participants were recruited through a medical FASD diagnostic clinic and FASD community agencies. Most of the children in the FASD group either attended a specialized FASD academic program or a regular school program with extra supports and resources.

Control children were recruited in another city through a database of previous participants in studies who indicated their willingness to participate in future studies. Children in the control group attended regular school programs and none had FASD or any other developmental disability. Among the FASD group, 28% lived in a biological home (8% with a biological mother, 20% with a grandparent), and 72% lived outside of a biological home (60% with an adoptive parent, 12% with a foster parent). All control children were living with their biological parents.

### Procedure

Most participants with FASD were tested in a testing room at a hospital in Edmonton. However some children who were recruited through FASD education programs were tested in a private room at their school. Control children were tested in a private testing room at a university laboratory. All children were tested on two measures of executive functioning (Whispers task, Day/Night task), two subtests from the Working Memory Test Battery for Children (WMTB-C) (Block Recall, Digit Recall), one measure of verbal ability (Peabody Picture Vocabulary Test, Third Edition), and two ToM measures (Mark Story, Sally-Anne Story), conducted over 1-2 sessions.

### Theory of Mind

#### **The Mark Story** (adapted from Wimmer & Perner)<sup>46</sup>

This story is a measure of ToM. Children were presented a puppet show with two puppets, a piece of chocolate, a basket, and a purple box, and told the following story: “*This is Mark. Mark has a chocolate. Mark wants to save his chocolate for later and wants to go outside and play basketball with his friends right now. So Mark puts the chocolate in the basket and goes outside. This is Mark’s mom. While Mark is outside, his mother comes into the kitchen and moves the chocolate from the basket into the purple box. Then, she leaves to go have lunch. Mark comes home from playing basketball. He is very tired and hungry so he wants to eat his chocolate.*”

The examiner then asked the children the following questions:

- 1) “*Where will Mark look for his chocolate first?*”
- 2) “*Where does Mark think his chocolate is?*”
- 3) “*Does Mark know his mother moved his chocolate?*”

The answers were scored as either correct or incorrect. Passing the test required a correct answer on Question 1.

#### **The Sally-Anne Story** (adapted from Wimmer & Perner)<sup>46</sup>

This is a second measure of ToM. Children were told the story and were given a similar puppet show with two new puppets, a yellow box, and a green box: “*This is Sally. Sally places a ball into the yellow box. Then she leaves to go to ballet class. This is Anne, Sally’s friend. While Sally is gone, Anne takes the ball from the yellow box and places it in the green box. Then Anne goes outside to play. Sally comes home from ballet class. She wants to play with her ball.*”

Children were then asked the following questions:

- 1) “*Where will Sally look for her ball first?*”
- 2) “*Where was the ball when Sally went out?*”
- 3) “*Where is the ball now?*”

The answers were scored as either correct or incorrect. Passing the test required a correct answer on Question 1.

## **Executive Functioning**

### ***Whispers Task***<sup>47</sup>

The Whispers task is a measure of inhibition. Children were told: “*For this game, I need to see if you can whisper*” and each child was asked to *whisper* their names as a warm up. The experimenter then asked children to *whisper* the names of 10 cartoon characters presented on 10 different laminated cards. Six of the characters were familiar, and four were unfamiliar to most children (the cards were randomly mixed). Familiar and unfamiliar characters were confirmed with the parent or guardian before testing. Unfamiliar characters were used so that children might be more tempted to shout out the character’s name when a familiar one was shown. The experimenter spoke in a whisper throughout the task and reminded children to whisper after the first five trials. There were 10 trials in total. To score this task, children were given three points for correctly answering in a whisper, two points for answering in a normal voice, one point for answering in a mixed voice, and zero points for answering in a shout. This yielded a maximum possible score of 30.

### ***Day/Night Task***

The Day/Night task is a measure of inhibition.<sup>22</sup> Children were shown a card containing rows of 16 pictures of suns and moons arranged pseudorandomly. Children were instructed to say “sun” for a picture of a moon and “moon” for a picture of a sun. Practice trials were given until the child understood the task. Then the child was instructed to look across the rows on the sheet and say “sun” for a moon and “moon” for a sun for the 16 pictures on the card as quickly as possible. After each picture was viewed, the researcher recorded whether the child correctly or incorrectly responded to the picture. To score this component, children were given one point for answering correctly and zero points for answering incorrectly. Thus for this task, the maximum possible score was 16.

### ***Working Memory Test Battery for Children (WMTB-C)***

The WMTB-C is designed to assess working memory in children 5 through 15. Two subtests from the battery were used: a measure of the phonological loop (Digit Span), and a measure of

visual-spatial working memory (Block Span).<sup>48</sup> Each subtest yields a raw score as well as a standard score with a mean of 100 and standard deviation of 15. The WMTB-C has been validated against existing well-established tests of achievement.<sup>48</sup>

## **Verbal Ability**

### ***Peabody Picture Vocabulary Test – Third Edition (PPVT-III)***

The PPVT-III was used to assess children’s receptive vocabulary and verbal ability. For this test, children are shown a page with 4 pictures and asked to point to the picture that matches a word the examiner says. Standard scores range from 40 to 160 for individuals 2.5 to 90+ years old, with a mean of 100 and a standard deviation of 15. The PPVT-III has high reliability and validity scores.

## **RESULTS**

Group differences in ToM tasks were analyzed using Chi Square because the results on these tasks are categories (pass, fail). Data on the EF and vocabulary tests were analyzed using separate one-way ANOVAs comparing FASD to control children for each variable. Finally, partial correlations were conducted (with age partialled out) among performance on the ToM tasks and raw scores on the measures of EF and vocabulary. For correlations, we created a single ToM variable: children were given a score of 1 if they failed both questions, 2 if they failed one, and 3 if they passed both.

### **Theory of Mind Performance**

See Table 1 for the number of children responding correctly on the two separate ToM tests. Across both tests, 44% of children in the FASD group as compared to only 25% of the control group failed one or both of the tests, which approached significance,  $\chi^2(1, N = 52) = 3.48, p = .068$ . Next we examined whether group differences on the ToM task varied by age group. Children were divided into a younger and older age group: among those with FASD there were 14 children in the younger group and 11 in the older group and among the control group there were 15 in the younger group and 13 in the older group. Among the FASD group, ToM performance was poorer in older children, but this was not the case in the

control group (see Figure 1). There were significant group differences (FASD vs. control) among the older children  $\chi^2(1, N = 23) = 4.11, p < .05$ , but not among the younger children  $\chi^2(1, N = 29) = .86, p > .05$  (see Figure 1). Next, we wanted to rule out whether ToM performance was

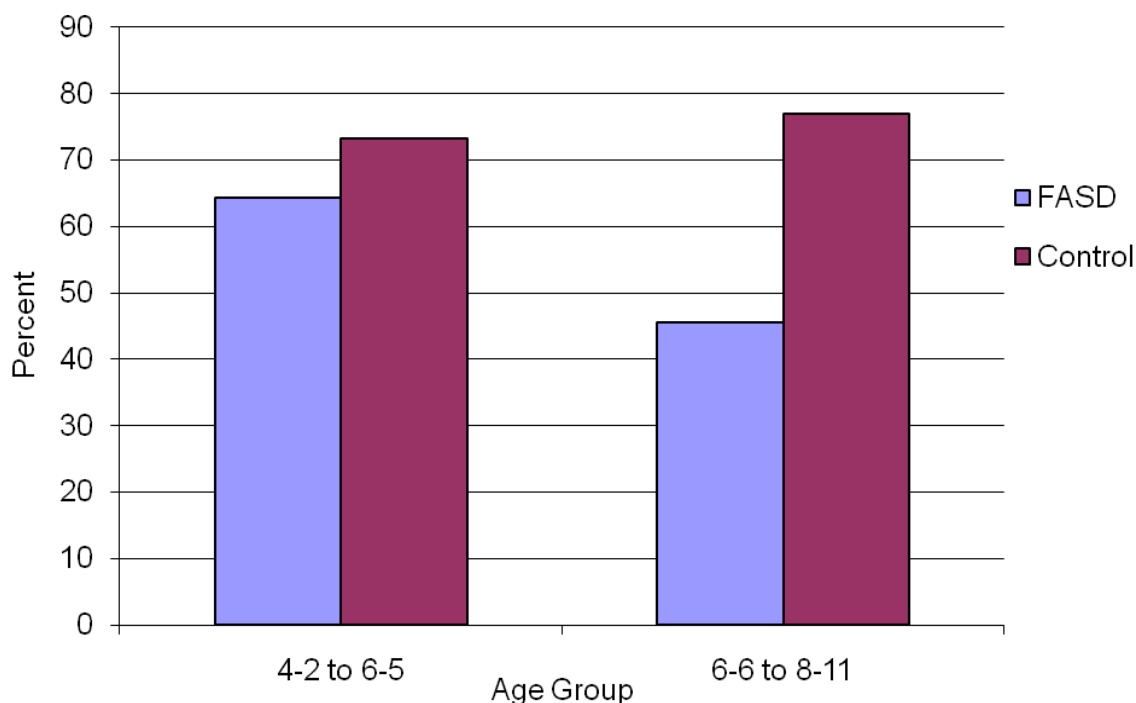
related to foster care status in the FASD group, as was indicated in Pears and Fisher.<sup>30</sup> Foster care was unrelated to ToM performance, as no correlation was found between ToM performance and children's living situation (biological vs. non-biological home),  $r(24) = .06, p = .78$ .

**TABLE 1** Percentage of Children in the FASD and Control Groups passing each Question on the ToM Tests

	FASD (25)	Control (28)
<b>Where will Mark look for his chocolate?</b>	<b>64% (16)</b>	<b>82% (23)</b>
Where does Mark think his chocolate is?	56% (14)	82% (23)
<b>Where will Sally look for her ball?</b>	<b>72% (18)</b>	<b>82% (23)</b>
Where was the ball when Sally went out?	64% (16)	71% (20)

*Note.* The primary ToM questions are highlighted in bold and answering these correctly would constitute passing the test.

**FIG. 1** Percentage of Children in FASD and Control Groups Passing both ToM Tests as a Function of Age Group



*Note:* Age groups are represented in years–months.

**Executive Functioning Performance**

Table 2 shows a comparison of the FASD and control group on inhibition, working memory, and verbal ability measures. Children with FASD performed significantly lower than the control group on both measures of inhibition (Whispers and Day/Night task) and on one measure of working memory (Block Recall). Differences on the PPVT-III and Digit Recall approached significance. Next we examined the correlations between ToM performance, inhibition, working memory, and verbal ability (with age partialled out, see Table 3). In the FASD group, ToM performance was correlated with performance on inhibition (Whispers task) but not with the other measures. The correlation between ToM and working memory (Digit Recall) approached

significance for the FASD group. Among the control group, the correlation between working memory (Block Recall) and ToM performance approached significance. To further investigate the relation between ToM performance and EF skills, we performed a hierarchical logistic regression analysis on children's pass/fail performance on the ToM tasks. Age and type of child (FASD vs. control) were entered in the first step, and Whispers task, Day/Night task, Block Recall, Digit Recall, and PPVT-III scores were entered in the second step. The overall regression model was significant,  $\chi^2(7, N = 53) = 18.1, p < .05$ . In the first step, type of child significantly predicted children's ToM performance ( $\beta = 2.02, Wald = 5.53, p < .05$ ). In the second step, children's scores on the Whispers task were a significant predictor of children's ToM performance ( $\beta = .68, Wald = 5.05, p < .05$ ).

**TABLE 2** Comparison of Mean (SD) Performance of the FASD and Control Groups on the Inhibition, Working Memory, and Verbal Ability Measures

	FASD	Control	F value
Whispers	27.83 (3.03)	29.82 (0.39)	11.85**
Day/Night	11.21 (3.97)	14.92 (2.04)	17.75**
Digit Recall	88.44 (13.64)	98.84 (14.53)	5.94*
Block Recall	84.80 (19.38)	69.16 (48.84)	2.14
PPVT-III	99.46 (9.13)	108.50 (10.26)	11.10**

Note: Raw scores are used for Whispers and Day/Night, and standard scores are used for Digit Recall, Block Recall, and PPVT-III; \* $p < .05$ , \*\* $p < .01$ .

**TABLE 3** Correlations among ToM, Inhibition, Working Memory, and Verbal Ability Scores for the FASD and Control Groups

Test	1	2	3	4	5	6
<b>FASD Group</b>						
1. Theory of Mind	--	.44*	-.01	.28	.06	.07
2. Whispers		--	.28	.18	.28	.49*
3. Day/Night			--	.26	.30	.28
4. Digit Recall				--	.24	-.09
5. Block Recall					--	.30
6. PPVT-III						--
<b>Control Group</b>						
1. Theory of Mind	--	.30	-.20	.19	.36	.19
2. Whispers		--	-.26	.01	.28	-.11
3. Day/Night			--	.09	-.31	.27
4. Digit Recall				--	.26	.44*
5. Block Recall					--	-.08
6. PPVT-III						--

Note: Raw scores were used and age was partialled out. \* $p < .05$ ,  $df = 21$  or  $23$ .

## DISCUSSION

The goals of this study were to examine ToM performance in young children with FASD, how age was related to ToM performance, and whether ToM abilities were related to underlying EF difficulties. Consistent with our hypothesis, children with FASD displayed difficulties on tests of ToM with 44% of the children failing either one or both of the ToM tests, as compared to only 25% of children in the control group. A failing rating of 44% among the FASD group (aged 4 to 8 years) is alarming given that previous research shows that 85% of normal 4-year-olds pass the Sally-Anne test.<sup>49</sup> Also, based on their meta-analysis of over 170 studies, Wellman, Cross, and Watson<sup>50</sup> predicted that approximately 75% of 4-year-olds should answer false-belief questions correctly and that by age 8, almost all children should succeed on these problems.

Foster care status among the FASD group was unrelated to ToM performance, suggesting that the poor ToM performance in these children cannot be attributed to foster care. Pears and Fisher<sup>30</sup> found that maltreated children living in foster care had poorer ToM performance than nonmaltreated children living in their biological homes (of similar age and SES), and concluded that being in foster care was associated with worse ToM. However, it is unclear whether the ToM deficits were due to being in foster care or being maltreated. Our results demonstrate that children with FASD display significant ToM deficits, regardless of whether they are in foster care, and that the ToM deficits among those with FASD go above and beyond any differences that would be attributed to foster care status.

Finally, ToM performance was actually worse among the older children than the younger children in the FASD sample, but not in the control group. Thus, it appears that ToM deficits may become more pronounced with age among children with FASD. Previous research has demonstrated that social functioning deficits also become more pronounced with age among children with FASD.<sup>6,32</sup> Such arrested development among children with FASD would negatively affect their behavioral, communication, and overall social capacity. These social and ToM impairments would become particularly detrimental during older childhood and

adolescence/adulthood when expectations and environmental demands increase, making it very difficult for individuals with FASD to function in and adapt to society. However, conclusions about age *changes* cannot be made in this study because it was not longitudinal, thus further longitudinal research on the developmental trajectory of ToM abilities of children with FASD is important.

Children with FASD showed significant impairments (relative to controls) on measures of working memory and inhibition. These findings are similar to previous research which has found that children with FASD have inhibition and working memory deficits.<sup>5</sup> We also examined whether ToM performance was related to performance on measures of inhibition (Whispers and Day/Night tasks), working memory (Digit and Block Recall), and verbal ability (PPVT-III). For children with FASD, ToM performance was correlated with performance on the Whispers task, but not with the other measures, although the correlation with Digit Recall approached significance. For the control children, the correlation between ToM performance and Block Recall approached significance. The current findings suggest that for children with FASD, inhibition appears to be particularly important for ToM, followed by working memory. These findings are consistent with previous studies which suggest that inhibitory control is strongly related to ToM abilities in typically developing children.<sup>7,22</sup> To answer false belief problems correctly requires children to suppress or inhibit a reference to reality and refer instead to the mental contents of the other person. In the present study, children's scores on the Whispers task (a measure of inhibitory control) predicted their ToM performance after age and type of child were partialled out. Although previous research has documented that children with FASD display difficulties in EF, no study has examined their ToM abilities. Previous research has shown that ToM and EF difficulties are related in children with autism<sup>25</sup> and children with behavioural problems.<sup>27</sup> Thus, the ToM difficulties in children with FASD may be related to underlying deficits in EF skills. The present study indicates that these children do have ToM difficulties as well as having deficits in EF. However, it is unclear whether these deficits in EF lead to difficulties in ToM performance or whether additional



socialization factors lead to these difficulties. Further research is needed to explore the relationship between EF deficits in children with FASD and ToM abilities.

It should also be noted that this study had a relatively small sample size and future studies with larger samples will help to further elucidate this relationship. Another limitation is the unavailability of information pertaining to drug exposure for the FASD group. Moreover, we were not able to obtain information on SES, abuse history, or IQ for all children. Such information would help to ascertain that our results are due to differences between children with and without FASD and not due to extraneous variables. However, it is very difficult to find an appropriate control group for children with FASD because it is very difficult to match on all the relevant extraneous variables (IQ, SES, home factors). Matching on some variables (e.g., IQ, SES, home factors) can result in unmatching on other potentially important variables.<sup>51</sup> Even if we were able to match on all of these relevant FASD-related variables it would be difficult to ascertain that our control group had not also been exposed to alcohol. We acknowledge that the inability to control for all of these extraneous variables limits the generalizability of our findings. Thus, replication of these findings across different samples and sites would be very valuable.

Nevertheless, this is the first published study to document ToM difficulties among children with FASD. ToM deficits pose many challenges for an individual in the areas of social communication and interpersonal relationships, and likely contribute to the very poor social skills displayed by children with FASD. Thus, more research is needed to further investigate and elucidate these deficits among children with FASD. The social implications of a poorly developed ToM are perhaps most important with regard to children with FASD. These children are faced with ample challenges, and social incompetence will only intensify their difficulties. An inability to understand that another person may have a different view point and that their own actions may have a negative affect on another person could result in difficulties developing and maintaining social relationship as well as understanding the consequences of actions. Thus, interventions that draw attention to the fact that

two individuals can and often do hold conflicting perspectives may be important to implement for children with FASD. For instance, intervention models such as that of Fisher and Happe,<sup>52</sup> which demonstrated that both EF and ToM training leads to improved ToM performance in children with autism, may be effectively applied to children with FASD. Although the research on ToM among children with FASD is sparse and still in its infancy, these findings indicate that more research is warranted and much may be learnt by applying theories and models from the abundance of previous research on ToM with other populations.

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performance, control group, FASD, children, executive functions in children, PPVT-III, theory of mind, working memory, understanding, difficulties, EF, Fetal Alcohol Syndrome, previous research, Canadian Society of Pharmacology and Therapeutics, inhibitory control, preschool children, verbal ability, autistic spectrum disorders, children with autism, Alcohol Clin Exp Res, extraneous variables, control children, Dunn J. Understanding, ToM, prenatal alcohol exposure, Mark Story, Lawrence Erlbaum Associates Publishers, false belief, longitudinal research, Riley E. Behavioral, Executive functioning, J Child Psychol Psychiatry, Child Dev, Fetal Alcohol Spectrum Disorder, Block Recall, Hala S, ToM performance, FASD Group, Control Groups, executive function

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