

Theory of mind, attention, and executive function in kindergarten boys

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The present study explored the relationship between theory of mind (ToM), attention, and executive function in 66 kindergarten boys drawn from four rural school districts. Three stories designed to test understanding of first and second order mental states were administered. Executive function and attention were assessed, respectively, by scores on the Behavior Rating Inventory of Executive Function (BRIEF) and the Behavior Assessment Scales for Children, Second Edition (BASC-2). Analyses indicated that children identified by teachers as evidencing attention difficulties scored lower on false belief measures and were more likely to be identified as exhibiting behavioral difficulties associated with executive dysfunction than children identified as evidencing fewer attention difficulties. Attention and executive function were predictive of total ToM scores.

Keywords: Theory of mind; Attention; Executive function; False belief; Kindergarten boys; Teacher ratings

Soon after Premack and Woodruff (1978) introduced the term ‘theory of mind’ in primate studies, researchers applied the concept to children. Early studies with children focused on determining the age at which children are able to engage in false belief tasks successfully. For example, Wimmer and Perner (1983) found that only children over the age of three years are able to predict actions based on false belief correctly. Subsequent research (e.g. Leslie, 1992; Bloom & Markson, 1998) has been relatively consistent, and it culminates with Wellman *et al.* (2001) meta-analysis suggesting that the ability to impute beliefs to others and predict behavior does not emerge until around three years of age.

At this point, the consensus among researchers is that ToM development in typical children follows a gradual and predictable pathway. Although three-year-olds are able to understand the mental states of desires and beliefs, which have strong ties to everyday functioning, they may still have problems understanding other mental states (Yirmiya *et al.*, 1998). The emergence of the ability to solve problems and

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draw conclusions about behavior based on false beliefs at around the age of four, is now considered an established critical turning point in social cognition (e.g. Ruffman *et al.*, 1993).

Findings that prior to age four most children fail ToM tasks are accounted for by three major theories: theory-theory, mental modules, and mental simulation. Theory-theory is an acquired competence account that allows for some innate knowledge about mind, but purports that experience is solely responsible for ToM development (e.g. Shatz, 1994). According to theory-theory, the child constructs a sequence of domain-specific theories, which are abandoned and replaced by the accumulation of disconfirming evidence (Gopnik & Wellman, 1994). More specifically, Perner (1991) stated that prior to the age of four, children are situation theorists, who are able to represent their own mental representations for desired or real situations, but are not able to represent the mental representations of others.

Fodor (1983) and Leslie (1987, 1994) represent the modularity view of ToM development. This view, which is reminiscent of Chomsky (1968), asserts that children have an innate capacity to attend to mental states. As such, children do not acquire a theory at all, but have cognitive architecture that allows for the gradual and progressive development of ToM abilities. This view holds that passing ToM tests is an indication of unfolding biologically scripted performance capabilities rather than of a newly acquired ‘theory’.

The third major account explaining the development of ToM abilities is simulation theory. This theory has two main assumptions: first, we are able to perceive our current mental states; and second, we use simulation strategies to reason about our own future mental states, as well as the mental states of others (Surian, 1997). This theory, akin to Humphrey’s (1983) account of the origins of human consciousness, holds that persons have a unique perspective on their own inner states based on direct experience (e.g. their perceptions, desires, and beliefs). Observing another in a difficult plight, for example, might as a result of similar prior experiences move the observer to construct an internal simulation of how he or she might respond mentally in similar circumstances, prompting the observer to a form of empathy, a sort of vicarious acquisition, commonly called ‘putting yourself in another’s shoes’. Garson (2003) suggests that simulation theory is the most parsimonious account in that it uses ‘cognitive capacities already known to exist on independent grounds, such as being able to reason, to imagine a case different from our own, and to appreciate what is relevantly different about it’ (p. 499).

Research involving ToM abilities has not been limited to typically developing children, but has also included children with various clinical diagnoses, most notably autism (e.g. Baron-Cohen *et al.*, 1985; Baron-Cohen, 1989; Tager-Flusberg *et al.*, 1993). Baron-Cohen *et al.* (1997) have even asserted that ToM deficits were a unique feature of autism, although others (e.g. Dahlgren & Trillingsgaard, 1996; Yirmiya *et al.*, 1998) have not supported that claim. Specifically, in their meta-analysis of the literature, Yirmiya *et al.* (1998) concluded that MR groups were also impaired on ToM tasks, and so ToM deficits could not be characterized as unique to autism. Additionally, Yirmiya *et al.* (1998) suggest that ToM abilities in different

groups may be experienced for different reasons. For example, children with ADHD may have ToM difficulties associated with attention; whereas, the difficulties on ToM tasks experienced by children with autism may have more to do with language.

In order to make sense of conflicting results, Frith *et al.* (1994) have noted a need to examine ToM deficits, as they exist 'outside the lab'. Further, they investigated whether children with autism who passed ToM tests showed better social skills in daily living than those who failed the tests. In this study, both children with mild learning disabilities and typically developing children who failed false belief tasks showed adequate social functioning. However, the social abilities evidenced by the learning disabled and typically developing groups were 'strikingly absent' (p. 111) in children with autism. Frith *et al.* (1994) argued that failure on a false belief test did not relate to real life functioning.

The same sort of social difficulties found in children with autism are often also evidenced in children with attention deficit hyperactivity disorder. For example, Dodge (1986) found that children with ADHD have a great deal of difficulty in both adopting the perspective of others and evaluating others' intentions. This gives rise to the question of whether impairment in aspects of executive functioning may coexist in children with ADHD (e.g. Barkley, 1997).

Although executive functioning has been defined by some in such broad terms as to include almost all human cognition, and by others so narrowly as to overemphasize one area and completely overlook all others (e.g. Zelazo *et al.*, 1997; Perner & Lang, 1999; Carlson *et al.*, 2002), it remains an important construct. Ozonoff *et al.* (1991) explain executive function as 'the ability to maintain an appropriate problem-solving set for attainment of a future goal' (p. 1083), and note that executive function includes such behaviors as planning, impulse control, inhibition, set maintenance, organized search, and flexibility of thought and action.

Despite obfuscation in the construct, Hughes (2002) reported that there is a 'robust association shown in numerous studies between executive function performance and performance on tests of theory of mind ability' (p. 205). Hughes and Graham (2002) note that research has shown that when effects of age and IQ are controlled, normative differences in executive function and ToM are significantly correlated. For example, Carlson *et al.* (2002) found that inhibitory control related strongly to false belief performance even when working memory capacity was held constant. As early as 1991, Ozonoff *et al.* conducted a study exploring the connection between ToM and executive function and found that that executive function and second-order ToM deficits were 'significantly more widespread' (p. 1099) among the autistic subjects than those with other clinical deficits.

Exactly what this relationship is remains debated. Perner *et al.* (2002) find a strong correlation between false belief tasks and executive function but do not support the view 'that the observed relations between theory-of-mind and executive function tasks are due to problems of inhibition in the theory-of-mind tasks' (p. 764).

Alternatively, Müller *et al.* (2005) reported that language plays a central role in cognitive development, and may even ‘mediate the relationship between ToM and executive function’.

Shallice and Burgess (1991) predicted that impairment in executive function in children will manifest in behaviors such as distractibility, impulsivity, and perseverative errors when presented with changes to routine situations. These behaviors are seen in children with autism and are commonly seen in children with ADHD. In fact, Yirmiya *et al.* (1998) reported that children with ADHD have frequently been studied as a comparison group when examining executive function impairments in individuals with autism; however, children with ADHD have not yet been fully tested on ToM tasks. For example, Buitelaar *et al.* (1999) conducted a study of ToM and emotion recognition in children with autism, in which children with ADHD made up half of the control group. An important finding of the study was that children with ADHD performed significantly worse than other controls on second order ToM tasks. Related, Hughes *et al.* (1998) conducted a study aimed at exploring ToM, emotion understanding, and executive function in a group of children they termed ‘hard to manage’ preschoolers and found differences on some ToM tasks.

Charman *et al.* (2001) expressed the belief that theirs was the first empirical work to test directly both ToM and executive function in children with ADHD. This study aimed at exploring social competence, ToM ability, and two aspects of executive function (inhibition and planning) in boys with ADHD. No significant impairment on ToM abilities was found. Charman *et al.* (2001) reasoned that the conflict of findings between their study and the Buitelaar *et al.* (1999) and Hughes *et al.* (1998) studies would warrant further investigation of ToM abilities in children with ADHD.

Perner *et al.* (2002) reported that ‘only three studies have so far explored the association between ToM abilities and executive functions in 6 to 10 year old ADHD children’ (p.141). The studies cited were Charman *et al.* (2001) and Hughes *et al.* (1998), which have been previously discussed, and the work of Speltz *et al.* (1999), who examined the relationship between executive function, behavioral difficulties associated with oppositional defiant disorder (ODD) with or without ADHD, and verbal abilities. Perner *et al.* (2002) cautiously noted that findings among these three studies were inconsistent, used varying ToM tasks, and involved only small numbers of children. Still, they summarized the three studies by noting that children with ADHD appear to have no (or minimal) deficits in ToM tasks involving first order beliefs but called for further research on second order false belief tasks due to mixed results.

Based on this premise, Perner *et al.* (2002) themselves examined ToM and executive function in children deemed ‘at risk of ADHD’. Their study found impairment on several executive function tasks in the ADHD group, but failed to find impairment on the ToM tasks. Perner *et al.* (2002) suggested that this result speaks against the notion that later ToM development is a consequence of executive function improvements.

Perner *et al.* (2002) also reported, however, that there is some support for the notion that children with severe attention problems also evidence problems with ToM development. They noted that this data was not reported at length in their study due to the small number of children with predominately inattention features of ADHD. Perner *et al.* (2002) reported that these children have 'significantly more difficulties' (p. 155) compared to the other subtypes of ADHD (combined and predominantly hyperactive-impulsive), as well as with the control group.

Since the Perner *et al.* (2002) study was published a few other works dealing with ToM, executive function, and ADHD have appeared. For example, Fahie and Symons (2003) examined the relations between executive function and ToM in children referred to a clinic for attention and behavior problems. Using parent and teacher ratings for social and behavioral problems, Fahie and Symons (2003) found a negative correlation between reports of social functioning and both ToM and executive function. Likewise, Joe (2004) found that performance on a false belief task strongly correlated with inhibition processing in his sample.

Summary

ToM deficits are seen by many researchers as providing at least a partial explanation for the social impairment evident in autism, and by some as the central deficit in autism. In addition, research has indicated that children with autism also have executive function deficits. Whether these deficits exist independently, coincidentally, or one is the function of the other, remains a matter of debate.

Like autism, ADHD is a biologically based, developmental disorder. Children with ADHD often exhibit some of the same symptoms, with perhaps a lesser degree of severity, as children with autism. Children with ADHD have problems with social perspective taking as well as difficulty in social relationships. Several studies have now documented the impairment in executive function experienced by children with ADHD, and a handful of studies have explored the relationship between ToM, executive function, and ADHD. Results have varied, and questions remain regarding the role, if any, that attentional/behavioral problems and executive function (or components of executive function) play in ToM development.

Evaluating executive function in a 'real life' setting based on observations of activity may potentially yield a more accurate account of executive function (or dysfunction) than have previous experimental studies. Specifically then, we investigated whether children with attentional difficulties, as measured by the Attention Problems scale of the Behavior Assessment Scale for Children, Second Edition (BASC-2, Reynolds & Kamphaus, 2004), had developed ToM skills as measured by their understanding of false beliefs and second order thinking. Additionally, would children with deficits in executive function, as measured by the Behavior Rating Inventory of Executive Function (BRIEF, Gioia *et al.*, 1996a), experience difficulties in ToM? Last, could impairments in executive functioning and attentional difficulties predict ToM?

Method

Participants

After IRB approval, and with consent from campus administrators, male students enrolled in kindergarten classes in each of four rural school districts were selected as potential participants. The parents of these students received a letter explaining the proposed study, contact information, and consent forms. Sixty-eight students (36% of those eligible) participated. Students who were non-English speaking were not used in the study, resulting in the elimination of one participant, and one student was dropped due to an incomplete BRIEF, leaving a final count of 66 students. The mean age of the students was 75.14 months with a range of 69–80 months.

Materials

Behavior Assessment Scale for Children II (BASC-2). In this study, the BASC-2 (Reynolds & Kamphaus, 2004) was used to measure attention. The authors of the BASC-2 report that coefficient alpha reliabilities for males aged 6–11 range from 0.77 to 0.97 on various subscales. Test-retest reliabilities range from 0.87 to 0.94. Only the attention problems, hyperactivity, and developmental social disorders subscales were used.

The BASC-2 can be completed in approximately 10 to 20 min. Items are ranked on a four point scale ranging from ‘Never’ to ‘Almost Always’. The hyperactivity and attention problems sub-scales correspond with DSM IV-TR criteria for assessing ADHD. Though Reynolds and Kamphaus (2004) used the terminology ‘at risk’ to indicate scores from 60 to 69 and used the term ‘clinically significant’ for scores above 69, this study employed the scores as a continuous variable.

The Behavior Rating Inventory of Executive Function (BRIEF). The Behavior Rating Inventory of Executive Function (BRIEF) was developed by Gioia *et al.* (1996b), and was used to assess executive function in the sample. The BRIEF is a rating instrument designed to assess impairment of executive function in individuals aged 5 to 18. Reliability is reported in terms of internal consistency (ranging from 0.80 to 0.98), and test-retest reliability (ranging from 0.76 to 0.85). The BRIEF is easily administered to either parents or teachers and it provides clinical scales on various executive function components. In this study, only the teacher form was used. The BRIEF sub-scales follow.

The Inhibit scale assesses inhibitory control, which may be defined as the ability to resist impulses. The Shift scale assesses the ability to change from one situation or activity to another without difficulty. Problem solving flexibility, changing focus, and transition are key aspects of this scale. The Emotional Control scale ‘addresses the manifestation of executive functions within the emotional realm’ (Gioia *et al.*, p. 18). Children with problems in this area may cry or laugh with little provocation or may become upset over minor occurrences. The Initiate scale assesses the child’s ability to begin a new task or activity. The Working Memory scale assesses the capacity to

hold information in mind while completing tasks. The Plan/Organize scale measures the child's ability to manage task demands.

The Organization of Materials scale assesses the child's ability to organize workspace, play space, and storage spaces. The Monitor scale assesses the child's ability to check work and to evaluate his or her own performance.

These scales are further grouped to provide Behavioral Regulation (BRIEF-BR) and Metacognition (BRIEF-MC) indices, as well as a Global Executive Composite score (BRIEF-GEC). The Behavioral Regulation Index is comprised of the Inhibit, Shift, and Emotional Control scales. The Metacognition Index is composed of the Initiate, Working Memory, Plan/Organize, Organization of Materials and Monitor scales. The Global Executive Composite score is a composite score incorporating all eight scales of the BRIEF.

Procedure

Measurement of executive function and attentional difficulties. The first author met with teachers of the boys in this study in small groups and briefly reviewed the general purpose of the present study, specifying the role that the participating teachers would play in the research. The kindergarten teachers were then asked to participate in the study, and all teachers ($n=21$) from each District chose to participate.

Teachers received protocols for the BASC-2 and the BRIEF for each student enrolled in their classes who were participating. Materials were counterbalanced for order across teachers.

False belief tasks. In order to assess ToM, a series of false belief tests, including one first order and two-second order tasks, were presented via DVD counter-balanced across participants for sequence. The three ToM tasks were recorded in a classroom facility using a hand-held Sony® DCR-DVD201 Camera Recorder. A male, aged 60 (hereafter referred to as the narrator), narrated each task. For two of the tasks, village segments were built from Lego® blocks and included human and animal figures, similar to those used by Baron-Cohen (1989) and by Sullivan *et al.* (1994). A standard, cardboard Band-Aid® box, some crayons, a toy version of the 'Sulley' character from the movie, *Monsters, Inc.* (Lasseter *et al.*, 2001), and some Band-Aids® were used for the appearance-reality task. Professional technical services were employed in preparing the DVD, converting the original digital recording from the mini DVD disk, on which it was made, to a standard DVD disk for playback.

Presentation of the ToM tasks was carried out using laptop computers instantiating the Windows XP® operating system with Windows Media Player 9. The computer was placed on a child-sized table in front of the participant. Presentation was in color, and screen diagonal measurements for all computers used were 30.5 cm.

The DVD presentation included a false belief task similar to the Smarties® test as well as two-second order narrative tasks. The Smarties® candy box test (Perner *et al.*, 1989) asks children to predict the contents of the box based on prior knowledge of

what might be in a similar box. The participant is then shown the contents, which are contrary to what might be expected. For instance, instead of candy, the Smarties® box might contain crayons. The participant is then asked to guess what an absent participant might say is in the Smarties® box.

ToM tasks were carried out within 10 days of the teacher ratings for each child. On a prearranged day and time for testing, one of three experimenters, each well trained in the procedures of this study, greeted the participant at the door of his classroom. After gaining assent and escorting the child to the testing area, a small conference room or office, the examiner and the child sat at a table with a laptop computer and the child was told, 'I am going to show you a video and the person in the video will ask you some questions and give you time to answer them. I will write down your answers. If you need more time to answer the questions, I will stop the video for you. Do you have any questions?' Questions, if any, were answered and the DVD started.

For the first order false belief task the DVD showed a Band-Aid® box and the narrator asked, 'What do you think is in this box?' A pause in the DVD allowed the child to respond by choosing from three items shown simultaneously on the computer screen: Band-Aids®, crayons, and a large plastic toy (Sulley from the movie, *Monsters, Inc.*). The examiner recorded the child's answer. The child was then shown that the box contained crayons rather than Band-Aids®. The box was closed and the narrator asked, 'Now what do you think is in the box?' There was a pause for the child's answer and for the examiner to record the child's answer. Since the error was not predicted by the literature and was utterly unexpected, the answer, 'Sulley', was queried by the examiner and the response recorded. The narrator then asked the first false belief question, involving understanding of false beliefs of others. An adult female voice was heard off camera calling the narrator's name, who in turn looked off camera and said, 'Hey, here comes my friend, Mary. What do you think she will say is in the box?' The DVD again allowed the child to choose from the three items.

The second false belief question concerns children's understanding that they themselves had previously held a false belief. The narrator asked, 'What did you think was in the box when you first saw it?' The examiner recorded the child's answer, along with any commentary from the child. The same three-item scenario was shown for the child's choice. Children received one point for each correctly answered false belief question. Scores ranged from 0 to 2 on this task.

One of the second order tests was similar to that used by Baron-Cohen (1989) and again by Dahlgren *et al.* (2003). Necessary materials are four miniature toy people, two houses, a church, a fence to separate the park and the road, an ice cream van, and some trees. The park scene consisted of a swing set, merry-go-round, and a slide. Two extra children and a dog were at the park as well as a tricycle and a wagon. All materials were constructed with Lego® products. The presentation was again through DVD. The narrator paused after each question to allow the child time to answer and to allow the experimenter time to record the answer. The following story was narrated and questions asked:

This is John and this is Mary. They live in town. Which is John and which is Mary? [Pause for answer.] Here they are at the park. Along comes the ice cream man. John would like to buy an ice cream, but he has left his money at home. He is very sad. "Don't worry," says the ice cream man, "you can go home and get your money and buy some ice cream later. I'll be in the park all afternoon." "Oh, good," says John, "I'll be back here in the afternoon to buy an ice cream."

[Prompt question 1.] Where did the ice cream man say to John he would be all afternoon?

So John goes home. He lives in this house (pointing at house). Now, the ice cream man says, "I am going to drive my van to the church to see if I can sell my ice cream outside there."

[Prompt question 2.] Where did the ice cream man say he was going?

[Prompt question 3.] Did John hear that?

The ice cream man drives over to the church. On his way he passes John's house. John sees him and says, "Where are you going?" The ice cream man says, "I'm going to sell some ice cream outside the church." So off he drives to the church.

[Prompt question 4.] Where did the ice cream man tell John he was going?

[Prompt question 5.] Does Mary know that the ice cream man has talked to John?

Now Mary goes home. She lives in this house (pointed out on DVD). Then she goes to John's house. She knocks on the door and says, "Is John in?" "No," says his mother, "he's gone out to buy an ice cream."

[Second Order Belief question.] Where does Mary think John has gone to buy an ice cream?

[Justification question.] Why?

[Reality question.] Where did John really go to buy his ice cream?

[Memory question.] Where was the ice cream man in the beginning?

Responses on the justification question were coded according to Baron-Cohen's (1989) scoring system into one of three categories of belief attribution (second-order, first-order, or zero-order) according to whether the subject either implicitly or explicitly took account of: (a) John's and Mary's beliefs (second order), (b) John's or Mary's beliefs (first order), or (c) neither of their beliefs (zero-order). For example, in both Baron-Cohen's system and that of the current study, an answer such as, 'She thinks he doesn't know the ice cream man is at the church', takes into account both John and Mary's beliefs and would be scored as a second order belief. An answer such as, 'Because he knows it's at the church', only takes into account John's beliefs and would be scored as a first order belief. Answers such as, 'Because it's at the church', represent zero order beliefs. Two points were awarded on the two false belief questions and ranged from 0 for no correct answers to a maximum of 4 for correct answers to both questions. The final test corresponded to the material developed by Sullivan *et al.* (1994), based on the Perner and Wimmer 1985 study. The narrative in this false belief task involves a little boy who is getting a puppy for a birthday surprise. In the original story, the puppy is hidden in the cellar, but as

cellars are rarely found in Texas, the place the puppy is hidden was changed to the garage. Materials necessary are two toy houses, a toy garage, two toy telephones, a toy tricycle, toy dog, and toy people, including a boy, mother, and grandmother, all of which are Lego® products. Through the DVD, children were told the following story:

Tonight it's Peter's birthday and Mom is surprising him with a puppy. She has hidden the puppy in the garage. 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."

[Probe question 1.] "Did Mom really get Peter a toy for his birthday?"

[Probe question 2.] "Did Mom tell Peter she got him a toy for his birthday?"

[Probe question 3.] "Why did Mom tell Peter that she got him a toy for his birthday?"

Now, Peter says to Mom, "I'm going outside to play." On his way to play, Peter goes by the garage to get his bike. In the garage, 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 to the garage and find the birthday puppy.

[First Order Belief question.] "Does Peter know that his Mom got him a puppy for his birthday?"

[First Order Belief question.] "Does Mom know that Peter saw the birthday puppy in the garage?"

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 False Belief question.] "What does Mom say to Grandma?"

[Memory aid:] 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?"

Children were scored as described previously. At any point during these procedures for any of the three tasks that the child had not answered in the allotted time the researcher manually paused the DVD until the child gave an answer. If necessary, the researcher prompted the child to answer the question, and on the second attempt (if necessary) repeated the question verbatim as it was given on the DVD. If after two prompts, the child did not provide an answer, the presentation was resumed, and the child was given a score of 0 for that item.

Analysis. In order to describe the best way of combining the predictor variables to explain the largest amount of variance in the criterion variable, a series of multiple regression analyses were used. These regressions were used to assess

BASC-Attention sub-scale (BASC-ATN) and different sets of the BRIEF variables as predictors of ToM scores. Additionally, a potentially interesting finding, related to unexpected (Sulley) responses in the Band-Aid® scenario was analyzed post hoc.

Results

Total ToM scores were reported on a continuous scale with a range of scores from one to nine. The mean total ToM score was 4.71 with a standard deviation of 2.29. A score of 1 indicates that the student was able to successfully answer only one first order false belief question, while a score of 9 indicates that the student successfully answered all questions. Table 1 shows the correlations between age, total ToM scores, and selected variables of the BASC-2 and BRIEF.

Predicting ToM Scores

Regression analyses exploring the relationship between ToM, the BASC-ATN variable, and the BRIEF-GEC variable were used to predict total ToM scores. The standard multiple regression analysis resulted in a Multiple R of 0.347, $F(3, 61)=2.826$, $P=0.046$. In this model, the beta weight for no single variable was statistically significant, though the full model provided a significant account of ToM scores. A stepwise regression in which the BASC-ATN and BRIEF-GEC variables were used to predict ToM scores was based on an F -to-enter probability of 0.05. Only one variable was entered, BASC-ATN, resulting in a multiple R of 0.301, $F(1, 64)=6.390$, $P=0.014$. In order to understand the components of executive function better, the BRIEF-GEC variable was broken down into the two indices comprising the total score, the BRIEF-MC and BRIEF-BR variables. The BASC-ATN variable and the BRIEF-MC and BRIEF-BR variables were used to predict Total ToM scores. The regression equation resulted in a multiple R of 0.395, $F(4, 61)=2.825$, $P=0.032$. None of the beta weights for the individual variables were statistically significant; however, the full model provided a significant account for ToM scores. The stepwise multiple regression in which BASC-ATN, BRIEF-BR, and BRIEF-MC variables were used to predict ToM scores was based on an F -to-enter probability of 0.05. Only one variable was entered, BRIEF-MC, resulting in a multiple R of 0.314, $F(1, 64)=7.019$, $P=0.01$.

Of the two BRIEF indices, only the BRIEF-MC was shown to have significance. No further analysis of the BRIEF-BR was conducted. However, in order to determine which of the BRIEF-MC components were most responsible for the significance of the composite index, a third analysis was conducted. In the third analysis, the sub-components of the BRIEF-MC variable, Monitor, Initiate, Organization of Materials, Working Memory, and Planning and Organizing were used to predict ToM scores. The regression equation in which the BRIEF-MC components were forced into the equation resulted in a multiple R of 0.512, $F(6, 59)=3.494$, $P=0.005$. In this model, the beta weight for the Initiate variable was statistically significant, and the full model also provided a significant account of

Table 1. Correlations between AGE, BASC, BRIEF scales, and ToM

Variables	Age in months	BASC-2 attention	BASC-2 HYP	BASC-2 SOCD	BRIEF-GEC	BRIEF-BR	BRIEF-MC	BASC-2 INITIATE	BASC-2 WMEM	BASC-2 P/O	BASC-2 MONITOR	ToM
Age in months	–	–0.060	–0.063	–0.187	–0.180	–0.121	–0.205	–0.211	–0.204	–0.134	–0.102	0.193
BASC-2 attention		–	0.745**	.857**	0.812**	0.643**	0.857**	0.745**	0.859**	0.817**	0.660**	–0.301*
BASC-2 HYP			–	0.642**	0.827**	0.788**	0.789**	0.566**	0.701**	0.768**	0.747**	–0.138
BASC-2 SOCD				–	0.846**	0.704**	0.871**	0.834**	0.862**	0.832**	0.634**	–0.301*
BRIEF-GEC					–	0.925**	0.969**	0.827**	0.910**	0.952**	0.786**	–0.253*
BRIEF-BR						–	0.805**	0.614**	0.728**	.821**	.687**	–.134
BRIEF-MC							–	0.903**	0.956**	.963**	.786**	–.314*
BASC-2								–	0.889**	0.868**	0.613**	–0.428**
INITIATE												
WMEM									–	0.898**	0.716**	–0.308*
P/O										–	0.728**	–0.301*
BASC-2											–	–0.255*
MONITOR												
ToM												–

BASC-HYP=BASC-2 Hyperactivity; BASC-SOCD, BASC-2 Development of Social Disorders; BRIEF-GEC, BRIEF Global Executive Composite Index; BRIEF-BR, BRIEF Behavior Regulation Index; BRIEF-MC, BRIEF Metacognition Index; INIT, BASC-2 Initiate; BASC-WMEM, BASC-2 Working Memory; BASC-P/O, BASC-2 Plan/Organize variable; ToM, Theory of Mind score.

* $P < 0.05$; ** $P < 0.01$.

ToM scores. The stepwise multiple regression in which BRIEF-MC components were used to predict ToM scores was based on an F -to-enter probability of 0.05. Only one variable was entered, Initiate, resulting in a multiple R of 0.429, $F(1, 64)=14.397$, $P<0.001$.

The analyses indicated that of the variables composing the BRIEF-MC, the Initiate variable was the single best predictor of ToM scores. In an effort to identify the overall best predictor of ToM scores, the BASC-ATN, the BRIEF Initiate scale, and age were used to predict Total ToM scores. The regression equation resulted in a multiple R of 0.441, $F(3, 63)=5.061$, $P=0.003$. In this model, the beta weight for Initiate was statistically significant, and the full model provided a significant account of ToM scores as well. The stepwise multiple regression in which the BASC-ATN, Initiate, and age variables were used to predict ToM scores was based on an F -to-enter probability of 0.05. Only one variable was entered, Initiate, resulting in a multiple R of 0.428, $F(1, 65)=14.557$, $P<0.001$.

The Sulley effect

Wellman *et al.* (2001) meta-analysis found no significant effect based on the medium (real person, doll, videotaped person, storybook character, or puppet) in which false belief tasks were presented. Therefore, no effect was anticipated for the use of DVD in the false belief tasks. However, the testing experience seemed to indicate that such an effect might exist. In order to determine if either of the questions from the Band-Aid® task ('Now what do you think is in the box' and 'What will Mary say is in the box') that elicited 'Sulley' responses were related to ToM scores, a Pearson product moment correlation was completed using the two 'Sulley' items, age, and total ToM. The first question ('what do you think') was significantly (negatively) correlated with ToM ($P=0.026$) and with age ($P=0.012$).

Last, the responses of both questions were used to predict total ToM scores. The regression equation resulted in an R of 0.295, $F(2, 63)=2.992$, $P=0.57$. The full model did not provide a significant account of total ToM scores and the beta weights were not statistically significant. The stepwise multiple regression in which both items were used to predict ToM scores was based on an F -to-enter probability of 0.05. Only one variable was entered, the first question, ('what do you think'), resulting in a multiple R of 0.268, $F(1, 64)=4.971$, $P=0.029$.

Discussion

One of the main findings of the present study was that the Attention scale of the BASC-2 was both significantly correlated with, and predictive of, total ToM score. However, no significant correlation between ToM and the Hyperactivity scale was found. In this study, teachers rated the participating students on attentional problems based on behavioral observations made over a period of eight months. Higher scores on the attention problems scale were predictive of lower scores on ToM tasks. This finding is supportive of Perner *et al.*'s (2002) idea that children who are inattentive, as opposed to hyperactive, may evidence ToM delays. This finding

also supports Bloom and German's (2000) assertion that attention skills are an important factor in the various false belief tasks used for assessing ToM abilities.

The present study also examined the relationship between attentional difficulties, defined as elevated scores on the BASC-Attention sub-scale, and executive function as measured by the BRIEF. In multiple regression analysis the combined variables of BRIEF-GEC and BASC-ATN were found to be significant predictors of ToM. When the BRIEF scales were dissected into the two major indexes, Behavior Rating Index and Metacognition Index, only the Metacognition Index combined with the BASC-2 ATN variable was found to be predictive of ToM score. Further regression analysis involving the individual scales making up the Metacognition Index showed BRIEF Initiate to be principally predictive of total ToM score.

The Initiate scale on the BRIEF is comprised of questions concerning children's ability to initiate an activity. Children with high scores on this scale often have problems with homework, and even though they may be sufficiently motivated, beginning work on a project or task is problematic. The scale also contains items relating to problem solving abilities and generation of independent responses or ideas. This finding seems to add support to Zelazo *et al.* (1997) and Ozonoff *et al.* (1991), who defined executive function in terms of problem solving abilities. In Zelazo *et al.*'s (1997) model of executive function; four problem-solving steps are identified. The third step is 'execution', which consists of two sub-steps, intending a goal and rule use. It would seem that children with initiation problems might fit in with this step of the model.

Additionally, Gioia *et al.* (1996b) report that in terms of psychological assessment, initiation difficulties 'are often demonstrated in the form of difficulty with word and design fluency tasks' (p. 18). Bloom and German (2000) and Speltz *et al.* (1999) have suggested that false belief tasks require linguistic skills or verbal fluency. The correlation of poor initiation skills, as evidenced by word fluency problems, and impaired ToM abilities fits with these reports.

Zelazo *et al.* (1997) caution against a simplistic view of executive impairment and function. Their assertion that executive function should be viewed as a macroconstruct for subfunctions working together to produce a problem solving model should be kept in mind. Using multiple regressions, the Initiate variable, along with BASC-ATN, was predictive of total ToM scores. This would seem to indicate that, indeed, executive subfunctions might play various roles concerning ToM abilities.

A majority of ToM studies have supported a strong correlation between ToM abilities and age. In this study, age was not significantly related to ToM total score and did not add to predictive scores in multiple regression analyses. A likely explanation is the relatively close age range of the students.

Additional findings

According to Reynolds and Kamphaus (2004), behaviors associated with the BASC-2 Developmental Social Disorders (SocD) scale are deficits in social skills,

communication, activities, and interests. While high scores may be associated with symptoms of an autism spectrum disorder, they may also simply be an indication of poor social skills. In this study, the SocD variable was significantly correlated with the BASC-ATN variable and the total ToM score. Numerous researchers (e.g. Milich & Landau, 1982; Dodge, 1993; Barkley, 1998) maintain that social difficulties are a central component of ADHD. The implications of a relationship between social competence, attentional difficulties, and ToM are important for school counselors, clinical psychologists, and teachers.

As noted earlier, Wellman *et al.* (2001) report that the results of their meta-analysis indicated the 'medium' of false belief task presentation is not significant. Wellman *et al.* (2001) stated, 'It makes no difference if the protagonist is presented as a real person, a puppet, a doll, a pictured storybook character, or a videotaped person' (p. 664). However, an unexpected finding in this study had to do with the Band-Aid® story, and quite possibly the effect of DVD presentation. The Band-Aid® task is an appearance/reality task involving, perhaps, a perceived element of deception. After being shown that there were crayons in the box, the children were asked, 'Now what do you think is in the box?' To which 12 of the 66 children (17.9%) tested answered, 'Sulley'. Additionally, 15 of the 66 children (22.4%) answered 'Sulley' to the question, 'What do you think she [friend, Mary] will say is in the box?' Although a multiple regression analysis was not significant for the total model combining the two answers, multiple stepwise regression showed that the first answer was significantly related (negatively) to the total ToM score. The Sulley figure used in the DVD was at least three times the size of the Band-Aid® box and seemingly could have potentially been ruled out, even without fully developed conservation skills.

Boys who answered 'Sulley' to either or both of the questions were casually asked why they thought Sulley was in the box. Most of the answers appear to be related to the belief that the perceived deception of putting crayons in the box would continue. Indeed, several of the children expressed amazement that anyone could have crayons in a Band-Aid® box. One child shook his head in disbelief and commented, 'That's just *wrong!*' Another child noted that the narrator was 'magic', apparently due to his ability to produce crayons from the Band-Aid® box. Many of the children reported that the narrator was trying to 'trick' them. Verbatim comments included, 'He's tricky'; 'Gotta watch him'; 'He won't trick me next time'; and 'What's he going to do now?' Several children were surprised and somewhat disappointed that the examiner did not show them the contents of the box after asking, 'Now what do you think is in the box?' Apparently, they expected that the contents had changed from the crayons, which they had witnessed being placed back into the box.

The children who answered 'Sulley' seemed to reason about the situation in 'different' ways. One child noted that Sulley was 'next', seemingly following the logic that the choice of crayons had already been made, and, if this trick was to continue, Band-Aids® could be ruled out, leaving Sulley as the only plausible answer.

Despite the negative relationship between the Sulley answer and total ToM score, the argument could be made that children who answered, 'Sulley' based on an

expected deception, were employing ToM skills. They witnessed the examiner trick them, were given another guess, and predicted that the examiner would try to trick them again. The ability to predict another's action using experienced based expectations may be a functional ToM tool for social interactions. However, a more detailed analysis and further research would be required before placing this skill on the developmental continuum of ToM abilities.

Conclusions and implications

Our data suggest that children identified by teachers as evidencing attention difficulties scored lower on false belief measures and were more likely to be identified as exhibiting behavioral difficulties associated with executive dysfunction than children identified as evidencing fewer attentional difficulties. A combination of attention and executive function, specifically the inability to initiate tasks, were predictive of total ToM scores. Specifically, higher scores on the attention problems scale were predictive of lower scores on ToM tasks. Although the literature suggests that medium of presentation does not affect false belief tasks, the 'Sulley Effect' may be an artifact of DVD use.

Although there has been considerable research on ToM in schoolchildren, we are excited by the potential for such efforts to have real-world application. For example, the long-term negative effects of attention deficit hyperactivity disorder on children, including risk taking behaviors and involvement with legal authorities, is well documented. An important practical question then becomes, can we manipulate the early school environment in such a way as to foster the development of theory of mind skills? A growing number of studies indicate that environmental factors can positively influence the development of ToM skills. It may be that teaching social skills, such as perspective taking, empathy development, etc. may help us to avoid the negative social consequences that may be inherent for children with ToM deficits. Further research on social skills interventions in early childhood education seems called for.

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