# Executive Functioning and Theory of Mind in Children with Attention and Disruptive Behaviour Problems

by

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## Abstract

The present study examined the relation of theory of mind to executive functioning in a sample of children referred for attention/behaviour problems. Theory of mind tasks included mistaken identity and contents, unintended transfer, and emotional false belief. Attention was assessed using parent and teacher reports (Conners' Rating Scales, Achenbach questionnaires), and child Continuous Performance Test (CPT) errors. Impulsivity was assessed using parent and teacher reports, Dimensional Change Card Sort, Luria's Hand Game, and CPT errors. Working memory was assessed using the Woodcock-Johnson-Revised. Average scores for attention, impulsivity, and working memory were created and an overall executive functioning average across the three components. Theory of mind was related to the individual components and to the overall average of executive functioning. Correlations were found for theory of mind and ratings of social problems suggesting that executive functioning and theory of mind are fundamental to social skills in children with attention/ behaviour problems.

# Executive Functioning and Theory of Mind in Children with Attention and Disruptive Behaviour Problems

Over the past decade, there has been an increased interest in the relation between executive functioning and theory of mind development (Frye, Zelazo, and Palfai, 1995; Hughes 1998ab; Ozonoff, Pennington, and Rogers, 1991; Russell, Mauther, Sharpe, and Tidswell, 1991). Executive functioning consists of three main components: working memory, attention, and impulse control (Denckla, 1996; Hughes 1998b; Welsh & Pennington, 1988). These cognitive components are thought to underlie theory of mind development, which is considered to be the basis for social understanding as measured by false belief tasks (Flavell, Flavell, & Green, 1983; Gopnik & Astington, 1988; Gopnik & Graf, 1988; Wimmer & Perner, 1983). A child with executive functioning deficits should also have relatively slower theory of mind development, and may show these kinds of deficits within their own social domain.

The relation between executive functioning and theory of mind development has been investigated within typically developing children as well as children with autism who show a wide range of severe social impairments (Baron-Cohen, 1989; Baron-Cohen, 1991; Bowler, 1992; Hughes & Russell, 1993; Ozonoff et al., 1991). Children with attention problems and disruptive behaviour are another clinical sample who typically have deficits in attention and impulse control and have been repeatedly found to demonstrate significant social problems (Barkley,1990). However, relations between executive functioning and theory of mind development have not been widely examined in this clinical population. In fact, little research has examined theory of mind development in children with Attention Deficit Hyperactivity Disorder (ADHD).

In keeping within the framework of developmental psychopathology, it is important to recognise the value of examining atypical populations to further enhance our knowledge of normal development (Cicchetti, 1989). Not only does the examination of abnormal populations lead to the identification of risk factors, it also provides an understanding of the mechanisms and processes in which risk factors lead to the emergence of a disorder (Rutter, 1988). Longitudinal studies (see Farrington, Loeber, & van Kammen, 1990) have shown that hyperactive-inattentive behaviour is a risk factor for later antisocial behaviour, particularly for that which persists into adulthood. It is quite common for children with ADHD to display inattentive and hyperactive traits, and they are thus at a higher risk for later life antisocial behaviour. Moffitt (1993) has suggested that there is a life course persistent variety of antisocial behaviour that is seen most often in males and is typically characterized by the first manifestations of markedly disruptive behaviour in the preschool years. There are also traits of hyperactivity-inattention, poor peer relations, difficult behaviour traits, and mild cognitive impairment within this life course persistent variety. These children are thought to suffer from deficits in neuropsychological abilities such as executive functions including receptive reading, listening, problem solving, speech writing, and more importantly memory, attention, and impulsivity (Moffitt, Caspi, Dickson, Silva, & Stanton, 1996).

The goal of the current study was to examine relations of executive functioning development in children referred to a mental health clinic for attention problems and disruptive behaviour. A multi-method approach was used to assess the components of executive functioning, as well as theory of mind. Perner and Lang (1999) reviewed nine separate studies that have actually found specific links between executive functioning and

theory of mind. However, these studies have typically used single measures for either theory of mind or executive functioning, and have investigated only one or two aspects of executive functioning (e.g., working memory and/or impulse control). In the present study, teacher and parent reports of behaviour, specific child tasks, and computer based measures were aggregated to assess components of executive functioning, and a variety of false belief tasks were aggregated to assess theory of mind to provide reliable developmental constructs (e.g., Rushton, Brainerd, & Pressely, 1983). This population of children was selected because they were expected to have greater variability of scores than typical children, as well as deficits in social behaviour. This potential for variability in executive functioning to be higher than in typical samples enhances potential relations with other constructs.

Theory of Mind Development

There are many questions regarding children's knowledge about how mental states are causally linked to perceptual inputs, behavioural outputs, and to the mental states of others. Young preschoolers do not yet possess a mental representation of the mind (Flavell, 1999, 2000). However, by age four, children typically understand that another person may have a belief that is different from either their own belief or from reality (Flavell, 2000; Gopnik & Astington, 1988; Gopnik & Graf, 1988; Wimmer & Perner, 1983). When children can attribute intentions, desires, and beliefs to themselves as well as to others, then they are said to have a theory of mind, and can thereby better understand and predict behaviour (Buitelaar, Van Der Wees, Swaab-Barneveld, & Van Der Gaag, 1999).

Theory of mind is more generally known as the awareness of the perspective of

others, and is typically measured through false belief tasks. These activities include a misleading objects and content task where objects are not what they appear (e.g., a candle that looks like an apple), or objects have unexpected contents (e.g., a Smarties box containing rocks rather than candy). There is also the unintended transfer of objects task, in which the participant knows a true set of scenarios, but a story character has an incorrect set of beliefs about the same situation (Flavell, 1999; Wimmer & Perner 1983). If the participant reports that the character will act upon his or her mistaken understanding he or she therefore has the understanding that others can have mental states, such as beliefs, that differ from their own. The level of awareness can range from zero-order in which participants do not refer to the character's mental state, first-order in which the participant refers to the character's mental state ("Mary thinks that..."), second order in which the participant refers to a character's mental state in regards to another character's mental state ("Mary thinks that John thinks that..."), and so on.

Many theories have been put forth to explain how children come to possess the ability to take on the perspectives of others, thus displaying a theory of mind. The domain-specific view suggests that the development of mental state understanding occurs independently of other changes in thinking and reasoning (Bartsch & Estes 1996; Eslinger, 1996; Leslie & Thaiss, 1992); this is otherwise known as the "theory theory." The counter perspective maintains that mental state comprehension develops within the more general circumstances of changes in reasoning and problem solving (Carlson, Moses, & Hix, 1998). More specifically, this view includes a recent theory which proposes that differences in the acquisition of theory of mind are related to the development of children's executive functioning skills (Frye et al., 1995; Russell et al.,

1991). Historically, the cognitive construct of executive functioning is thought to include a heterogeneous collection of various abilities such as attention, working memory, and inhibitory control (Denckla, 1996; Hughes 1998b; Welsh & Pennington, 1988) which aid in planning and performing rule-based actions (Zelazo, Carter, Reznick, & Frye, 1997). Although this theory has been generally accepted, how closely these two constructs are related and in what manner remain unresolved.

What is Executive Functioning?

Several approaches have been taken in trying to effectively define executive functioning. The information processing approach has repeatedly found rule use to be at the core of a theory of action, and thus explains behaviour in terms of rules that are presumed to underlie and cause it (Zelazo & Reznick, 1991). Specifically, the information processing perspective (Borkowski & Burke, 1996) explains several components of executive functioning, which are thought to be related to specific strategies that are required in order to be able to obtain goals (Zelazo et al., 1997). According to this theory, the first and most essential component of executive functioning is problem representation, which is assessing the situation and possible task requirements using skills such as insight. This component is also considered to be a requirement for the proper execution of the second component, strategy selection, as well as the third component which consists of sequencing actions in time. For a plan to be successfully executed, the plan must be kept in mind long enough to guide either action or thought and actually carry out a behaviour. This is referred to as rule use (Zelazo et al., 1997). After the execution phase, the fourth and final phase is the evaluation of the problem solving

strategy. This includes error detection and error correction. The evaluation phase entails the possible revisions of one or more of the previous stages in problem solving.

Given this approach, executive functions are generally defined as the control processes involved in goal-oriented problem solving behaviour (Zelazo, Frye, & Rapus, 1996). Underlying this process of goal directed behaviour, there are fundamental constructs required in order for successful completion. These include inhibitory control, attention, and working memory (Denckla, 1996; Hughes 1998b; Welsh & Pennington, 1988).

Relation Between Theory of Mind and Executive Functioning

Although there is a widely held belief that there is a relationship between the development of theory of mind and executive functions (Frye et al., 1995; Hughes 1998b; Ozonoff et al., 1991), questions of specificity (how exactly are they related?) and similarity (how closely are they related?) remain. There is the idea that children must first acquire a theory of mind for executive skills to develop in that an understanding of mind leads to impulse control (Wimmer & Perner 1983). This relationship could also be the reverse in that executive functioning is responsible for the improvement of problem solving skills that are fundamental to theory of mind development (Hughes, 1998b). Although these two theories are possible, there could also be an additional unknown factor, that when taken into consideration, accounts for this relationship.

The notion that executive skills are a prerequisite for the understanding of mental states is supported by a longitudinal study conducted by Hughes (1998b). In this study, fifty typically developing preschoolers were assessed on verbal ability, executive functioning, and theory of mind, and then tested on the same measures a year later. One

of the goals of this study was to determine whether individual differences in early executive functioning could predict later differences in theory of mind or visa versa. Executive functioning was assessed from tasks including the detour-reaching box, Luria's hand game, the set-shifting task (e.g., similar to the Wisconsin Card Sort Test), the noisy book working-memory task, and the Tower of London task. Theory of mind development was measured through the use of appearance-reality tasks, an object transfer task, a peer transfer task, and a false belief explanation task. Although the results indicated that early executive functioning significantly predicted performance on theory of mind tasks a year later, children's overall theory of mind scores were related to concurrent scores on three executive functioning tasks at time one, and on all five executive functioning at time two. Once age and verbal ability were partialled out, theory of mind scores were significantly related to concurrent set shifting ability for time one and to performance on the Luria's hand game, set shifting, and the Tower of London for time two. Therefore, there was no evidence for modularity of functioning for executive functioning and theory of mind. Overall, these results support the idea that executive functioning is central to theory of mind development. Furthermore, these results suggest that even normal variation in executive functioning may have consequences for young children's "mentalizing" ability (Hughes, 1998b).

Previous research has attempted to isolate specific components of executive functioning and examine possible links to theory of mind development. For example, it has been suggested that the executive function of working memory could be related to theory of mind in that young children's memories are not fully developed, and therefore cannot maintain the required information long enough to pass a theory of mind task

(Kinderman, Dunbar, & Bentall, 1998). Typically with theory of mind tasks, a child has to remember the original location of an object before it was moved (unintended transfer), or what they thought an object was before the true nature of the object is revealed (misleading object). Although memory questions within the theory of mind tasks control for remembering specific task parameters, they do not assess a more general memory construct. In a study conducted by Kinderman et al. (1998), undergraduate students completed an attribution questionnaire along with a memory and theory of mind measure. The theory of mind tasks consisted of a series of five stories, four of which involved complex social situations that required participants to understand the perspective and intentions of the actors, and a fifth story that involved only one actor in one situation. Participants were asked questions concerning theory of mind elements of the stories and memory for details. There was a positive relation between memory and theory of mind errors. Although these results appear to support the notion that memory is related to theory of mind ability, it is not clear if this is true for the *development* of theory of mind in children. This study used undergraduates reading complicated story lines and memory tasks. Typically, research investigating theory of mind development has examined memory within theory of mind tasks but has not specifically examined this memory component of executive functioning as a separate entity.

More recently the majority of research on executive functioning has been focused on impulse control and the development of theory of mind in children. It is important to note that the acquisition of increasingly complex rule systems coincide with an increase in age, which is similar to the age-related pattern, found for the acquisition of theory of mind in children (e.g., Zelazo et al., 1996). At a very young age (approximately three

years), children are unable to inhibit an initial response and switch to an alternate response pattern (Zelazo et al., 1996). This has been found in studies using the Dimensional Change Card Sort (DCCS; Frye et al., 1995; Jacques, Zelazo, Kirkham, & Semcesen 1999; Zelazo et al., 1996). The DCCS requires the switching of response strategies, for example, sorting cards by shape, and then switching rules to sort them by color. Children have to inhibit their initial sorting strategy in order to implement the new strategy and pass the task. Most of the research with the DCCS has used three to five-year-olds (Zelazo & Jacques, 1996), and demonstrated inhibition problems in the younger ages (Frye, et al. 1995). Children approximately three-years-old can use the first rules they are provided with, but they cannot switch rules despite being told the new rules on every trial. However, the majority of children ages four to five years successfully switch to the new pair of rules (Jacques et al., 1999). This executive failure in younger children may be attributed to an inability to inhibit inappropriate pre-switch rules (Zelazo et al., 1996).

An increase in executive functioning complexity between three and five years of age permits children to use higher order rules to determine which of the two incompatible pairs of rules to use (Zelazo et al., 1996). This corresponds to increases in metacognition and reflection, and results in increased control over thought and action. Not only does impulse control play a part in children's ability to switch procedures, but this control requires reflective awareness and use of a higher order rule in order to select appropriate rules (Zelazo et al., 1996). Being able to reflect on color or shape rules, or rules of any other dimension, is necessary to form a coherent category or dimension. Executive failure thus results from a lack of reflection on rules (Frye et al., 1995).

These increases in control and reflection have widespread consequences for children's reasoning in social and nonsocial domains (Frye et al., 1995). Being able to reflect on the relation among different perspectives via a higher order rule would seem to be required to comprehend the dimension of belief (Zelazo et al., 1996). It has been suggested that the same increase in reflection required to switch between rule pairs is required to coordinate two incompatible perspectives on appearance-reality tasks and other standard theory of mind activities. In this conceptualization, increases in self-understanding, self-control, and social interaction are due to increases in the ability to reflect on one's rules (Zelazo et al., 1996). Therefore, self-awareness and the awareness of the perspectives of others would appear to be related to executive functioning (Barkley, 1996).

In one study, Carlson and Moses (1999) examined the relationship between theory of mind and executive functions, including inhibitory control and working memory. Children between the age of three and four years completed ten measures of inhibitory control (Stroop-like and delayed response measures) and measures of theory of mind (false-belief, appearance-reality, and deception). The correlation between overall executive functioning and theory of mind was significant and remained so even after the effects of age, gender, and receptive vocabulary were controlled. However, the possibility still remained that this relation could have been found to exist because successful performance on both inhibitory control and theory of mind task requires a certain amount of working memory, planning, and other measures of intelligence besides receptive vocabulary. Two additional studies addressed these issues (Carlson & Moses, 1999). One re-examined the relation between theory of mind and inhibitory control, and included

measures of both verbal (WPPSI-R vocabulary and arithmetic subscales) and nonverbal (WPPSI-R block design and picture completion subscales) intelligence, as well as working memory capacity. Once again, a significant relation was found to exist between executive functioning (inhibitory control and working memory) and theory of mind even when age, gender, and intelligence were controlled. Upon examining the components of executive functioning separately, significant intercorrelations were found between inhibitory control, working memory, and theory of mind. However, the relation between working memory and theory of mind did not hold up once the effects of age, gender, and intelligence were taken into account, whereas the other intercorrelations remained significant. More importantly, the significance of the relation between inhibitory control and theory of mind remained even when age, gender, intelligence and working memory were considered. From these results it was determined that the relation between inhibitory control and theory of mind is neither a byproduct of general intelligence, nor does it exist because both require some degree of working memory.

However, before concluding that the inhibitory processes are the main determinant of the executive function-theory of mind relation, Carlson and Moses (1999) conducted a second study to examine the planning component of executive functioning with respect to inhibitory control and theory of mind. There were three tasks designed to measure planning abilities, and these were combined with inhibitory control tasks for a general measure of executive function. This overall score of executive functioning was significantly correlated to theory of mind even when controlled for the effects of age, gender, and verbal ability. Examined as a separate construct, planning was found to be related to both inhibitory control and theory of mind, with inhibitory control significantly

related to theory of mind. However, when age, gender and verbal ability were taken into account, the only significant correlations were between inhibitory control and planning and theory of mind. These effects were independent of age, gender, verbal ability, and planning. From this study there appears to be a robust relation between inhibitory control and theory of mind that is not only independent of age, gender, verbal ability, and intelligence but also of planning and working memory. Carlson and Moses (1999) suggested that the ability to inhibit over-learned yet incorrect response appears to be central to the relation between executive functioning and theory of mind.

This theory that younger children are unable to resist over-learned behaviours has been further explored in a series of experiments using several variations of a dimensional change card- sorting task. In one experiment (Zelazo et al., 1996), children age three and four years were told to sort cards first by one dimension (e.g., color) and then by a different dimension (e.g., shape). Almost all of the three-year-olds continued to perseverate using the pre-switch rules during the post-switch phase, even though they were capable of pointing to the correct location when asked about each rule. This suggests that although younger children may know rules, they also may have a difficult time overriding the urge to act upon previously learned behaviour (Carlson et al., 1998; Jacques et al., 1999). These results were repeated in the second experiment despite the fact that only one pre-switch trial was permitted. In the final experiment the effect of response modality was explored. However, the results did not differ. Dissociation between knowledge of rules and action based upon rules was still present when verbal responses were required rather than manual responses. Young children could answer knowledge questions correctly, but then proceeded to sort the cards incorrectly when told

to play the card-sorting (pro-switch) game. Overall, these results indicated that young children's difficulty in switching between rules is not a consequence of difficulty inhibiting an over-learned response, and that knowing rules is sometimes not sufficient to permit their usage.

These results are further explained by the Cognitive Complexity and Control (CCC) theory (Frye, Zelazo, & Burack, 1998; Zelazo et al., 1996; Zelazo & Frye, 1998). It is thought that younger children can represent the post-switch rule consciously, but the knowledge is not enough to allow its use when faced with conflicting information. An adequate amount of intentional action must distinguish between consciousness and the capacity for conscious control (Zelazo et al., 1996). Control requires reflective awareness and the use of a higher order rule. Dissociations occur in younger children because they fail to integrate incompatible rules into an embedded rule system. As children increase in age, the complexity of children's rule systems increases through increasing the number of embedded rules. This increase in complexity corresponds to increases in reflection and results in control over thought and action. Therefore, young children (e.g., 3-years-old) who know both the pre- and post-switch rules in the dimensional change card sort do not have a higher order rule that permits them to correctly select the rule pair (e.g., shape vs. color rules) and then figure out the specific embedded rule (e.g., "Yellow ones go here."). However, by the age of four or five years, children are aware that two pairs of rules can apply to the same situation and thus construct a higher order rule that manages the lower order rules (Zelazo et al., 1996). Considering this theory, executive functions such as inhibition can be characterized as a consequence of failing to reflect on and integrate one's knowledge into a more complex rule system.

Furthermore, these increases in the ability to reflect on one's rules allow for increases in self-understanding, self-control, and social interaction. According to the CCC theory, 3-year-olds cannot handle complex embedded rule systems because they lack the required degree of self-reflection (Zelazo & Frye, 1998). The same increase in reflection required to switch between rules pairs is also required to coordinate two incompatible perspectives on typical theory of mind tasks. On false belief tasks, children are required to cognitively distance themselves from reality to enable them to reflect on the mental states of others and thus employ a higher order rule to determine the correct perspective under consideration and then make a judgment (Frye et al., 1998; Zelazo et al., 1996). For example, the misleading objects and contents task requires children to make judgments from either their former or current perspective: "What did you think this was *before* you held it, an apple or a candle?" as well as distinguish between belief of self and others: "Another boy hasn't held this in his hands before. What will he think this is when he first sees it, an apple or a candle?" Given this theory there should be a relationship between children's ability to understand mental states, as measured by false belief tasks, and tasks that tap into executive functioning, mainly impulse control, such as the DCCS. Recent research has found that this relationship does indeed exist (Carlson et al., 1998; Frye et al., 1995). This leads to the assumption that better cognitive self-control enhances the opportunity for successful social interactions and may contribute to more sophisticated social understanding and thus theory of mind development.

ADHD, Executive Functioning, and Theory of Mind

It is interesting to note that although research has repeatedly shown how the development of cognitive self-control appears to be at least related to, if not a prerequisite

for, the development of theory of mind, little research has been conducted specifically on children whose impulse control and social skills are problematic. While theory of mind researchers have often examined executive functioning and theory of mind development in typically developing preschoolers (Bartsch & Estes, 1996; Call & Tomasello, 1999; Carlson et al., 1998; Dunn, Brown, Slomkowski, Telsa, & Youngblade, 1991; Flavell et al., 1983; Gopnik, & Astington, 1988) as well as autistic populations (Baron-Cohen, 1992; Bowler, 1989; Buitelaar et al., 1999; Ozonoff et al., 1991; Hughes & Russell, 1993), little work has been done with children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). Previous literature has demonstrated executive functioning deficits in children with ADHD (Buitelaar et al., 1999), but little research has specifically examined these deficits in relation to theory of mind in children who have attentional problems.

In one notable exception, Hughes, Dunn, and White (1998) examined forty preschoolers who were rated as "hard to manage" by their parents. They were compared to a matched control group on theory of mind, emotion understanding, and executive functioning measures. Behaviour ratings were obtained from parents on the Strengths and Difficulties Questionnaire (SDQ). All of the hard to manage preschoolers were above the 90$^{th}$ percentile for the SDQ hyperactivity subscale, and the majority of the group (80%) also scored above the 90$^{th}$ percentile for the conduct problems subscale. This study assessed working memory from a visual search task and an auditory sequencing task. Attention was measured by using a simple color/shape set-shifting task. Impulse control was assessed through the use of the "detour-reaching box" designed by Hughes and Russell (1993) and Luria's "fist and finger" hand game. Theory of mind

development was measured from tasks including appearance-reality stories, false belief explanation stories, two deception tasks (e.g., children were required to conceal or provide false information to characters in a story), and two emotion false belief tasks. The hard to manage preschoolers were shown to have significantly lower understanding of emotion, poorer false belief understanding, and lower levels on all three aspects of executive control, compared to the matched controls. In addition to these findings, executive function was found to be related to performance on theory of mind tasks, but only for the hard to manage preschoolers ($r = .35$). This suggests that executive dysfunction is associated with impairments in developing a theory of mind, particularly in children with behavioural problems. Although the "hard to manage" preschoolers resemble children with Attention Deficit Hyperactivity Disorder (ADHD) or Conduct Disorder (CD), this classification was based on only one questionnaire that contained 25 items. These children were not diagnosed with a behaviour disorder but were seen to be more disruptive than the control children.

Preschool children with ADHD are known to have poor social skills, behave aggressively, and have inappropriate levels of attention, impulsiveness, and hyperactivity but show no more difficulties than other preschoolers with respect to sustained attention and language (Barkley, 1990; Houlihan & Van Houten, 1989). However, as a child with ADHD develops, executive functioning deficiencies are more apparent in that they have limited self-control, hindsight, and forethought in comparison to their typically developing peers (e.g., Barkley, 1996). Not only do children with ADHD have issues with self-control, over 50% of children with ADHD have problems with peer interaction (Barkley, 1990). Previous studies have indicated that children with ADHD are viewed by

their peers as significantly more aggressive, disruptive, domineering, intrusive, noisy, and socially rejected than controls (see Frankel, Myatt, Cantwell, & Feinberg, 1997; Johnston, Pelham, & Murphy, 1985). These children have problematic relationships with their peers, as indicated by difficulty making and keeping friends, and deficiencies of appropriate social behaviour (Pfiffner & McBurnett, 1997; Twoey, 1997).

As previously mentioned, there has been a relation found to exist between theory of mind and executive functioning development, particularly impulse control. Recently, there has been a fundamental shift in explaining the deficits experienced by those with ADHD. It has been suggested that ADHD does not represent a disturbance in selective or sustained attention, but rather inappropriate levels of impulsivity and delay of gratification (Barkley, 1996; Schachar and Logan 1990). Furthermore, it has been suggested that research into executive functions, particularly response inhibition, should find these functions either as deficient or developmentally delayed in those children with ADHD (Barkley, 1996). Within the neuropsychological literature, numerous studies have explored and confirmed that children with ADHD are delayed when it comes to impulse control (Boucugnani & Jones 1989; Chelune, Ferguson, Koon, & Dickey, 1986; Shue & Douglas, 1992). For example, Chelune et al., (1986) did in fact find that children with ADHD were developmentally delayed in response inhibition compared to a matched control group. These results were specifically related to performance on the Wisconsin Card Sorting Task (WCST) in that although both groups demonstrated age-related changes, further exploration of the data suggested that children with ADHD made appropriate maturational gains but at a level approximately two years behind the age-matched cohorts.

It is noteworthy to consider that no research, in the thousands of studies on ADHD to date, directly address these issues of impulse control and theory of mind development in children with ADHD (Barkley, 1996; but see Buitelaar et al., 1999). Given the relationship between impulse control and the development of theory of mind, children with ADHD should not only do poorly on tasks assessing executive functioning, but they should also show delays or deficits in the awareness of mental states. Children with attention and/or behaviour problems have not specifically been studied using theory of mind tasks, but they have been examined as part of a psychiatric control group in a few studies (Buitelaar et al., 1999; Ozonoff et al., 1991). Research by Buitelaar et al. (1999) explored theory of mind and emotion recognition development in children ages eight to eighteen years, who were either diagnosed with autism, Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS), or were from a clinic or community control group. They also partitioned the clinic control groups according to specific diagnoses (i.e., ADHD $\underline{n} = 9$, Conduct Disorder $\underline{n} = 4$, dysthymia $\underline{n} = 7$). These groups were assessed on first and second order theory of mind tasks, as well as an emotion recognition task. All groups were significantly different on the second order theory of mind tasks and emotion recognition, with the community control group performing the best. The clinic control was second best, followed by the PDD-NOS group and finally by the autistic group. A post-hoc analysis of the clinic control group alone was conducted to determine if the three groups contributed to the group score to an equal degree. The ADHD group was found to have significantly lower scores than the children with either conduct disorder or with dysthymia on second order theory of mind tasks, and a non-significant trend in the same direction was also found for emotion recognition. In

comparison to the community control group, the children with ADHD performed significantly worse on second order theory of mind tasks and emotion recognition. The children with either conduct disorder or dysthymia performed at about the same level as the community controls. Children with ADHD were not significantly different from either the autistic children or those diagnosed as PDD-NOS on all measures.

Buitelaar et al. (1999) suggested that children with ADHD have difficulty with theory of mind tasks, and may be functioning at the same level of mental awareness as those children with autism. A major problem with their study is the small sample size for all groups. Plus, if trying to determine how theory of mind develops, if it does at all, in children with ADHD it would also be important to include a younger sample of children than the one used by Buitelaar et al. (1999) when attention and behaviour problems are typically diagnosed. In that way, the clinical sample is free of treatment effects.

Although this study provides some evidence supporting the theory that children with ADHD have poor theory of mind development, it does not attempt to link the understanding of mental states to executive functioning development within this clinic population. Specifically, there are no measures of impulse control, attention, or memory to determine which constructs of executive functioning are related to the acquisition of theory of mind. Considering executive functioning consists of these components, children referred for disruptive behaviour problems should show difficulty on tasks that tap into these areas, as well those focusing on theory of mind development. The goal of the present study was therefore to examine the development of executive functioning and theory of mind in young children first referred for disruptive behaviour and attention problems.

Present Study

In the present study, the three components of executive functioning were used to predict performance on theory of mind tasks. The relations of attention, working memory, and impulse control with false belief task performance, were examined in a sample of young children referred to an outpatient mental health clinic for behaviour and attention problems. There were three main goals and related predictions for the present study.

First, all components of executive functioning were hypothesized to be related to theory of mind development. Relatively higher attention, memory and impulse control were expected to be associated with the ability to understand the perspective of others. Second, although assessing theory of mind development provides information regarding a child's understanding of the perspective of others, it was thought that a broader sampling of information, such as parental and teacher ratings, would also provide a good understanding of how participants were functioning in everyday social situations. Therefore it was expected that these ratings would be related to children's performance on theory of mind tasks. In other words, the lower the performance on theory of mind tasks, the less likely the children are functioning adequately within social situations according to teacher and parent reports of behaviour.

The last goal concerns methodological issues of aggregation. It has been suggested that the sum of a set of multiple measurements is a more stable and representative estimator than any single measurement. More explicitly, this increased representative transpires due to the averaging out of the error associated with measurement which leaves a clearer view of underlying relationships (Rushton, et al., 1983). In keeping with this

perspective, this is the first study to date to employ a multi-method assessment of executive functioning and theory of mind based on computer tasks, administered tasks, and parental and teacher observations. The separate tasks for each construct were combined to provide a multi-method aggregate for attention, memory, impulse control, and false belief understanding. It was therefore thought that a clearer understanding of the hypothesized relationships would be obtained through using these aggregates as opposed to using single measures of each construct.

## Method

### Participants

Participants were 26 clinically-referred children (21 males, 5 females) four to nine years of age (range = 4:9 to 9:1 months, M = 6:6, SD = 11 months). Children's education ranged from preschool to grade three (preschool n = 1; primary n = 8; grade one n = 14, grade two n = 2; grade three n = 1). Clinically-referred children of this age range typically display some combination of behaviour and attention problems. Referral sources in this sample included parents and legal guardians (n = 7), teachers in conjunction with parents (n = 11), and family physicians (n = 8). The participants were recruited (see Appendix A) from child and adolescent outpatient mental health clinics (Valley Regional Hospital n = 20; Middleton Mental Health Clinic n = 6). The Socio-economic Status (SES) of this sample was derived from the Blishen Scale (Blishen, Carroll, and Moore, 1987), which is based on Canadian labor force census data. This measure incorporates income, education level, and social status typically associated with occupations. The scale ranges from 17 (low SES) to 101 (high SES). For two-parent families, the SES of both parents were averaged to give a total SES for the family. There was no information regarding SES for

six families. The mean SES for the other 20 families was 47.71 with a standard deviation of 15.14. The majority of these children (66%) came from two-parent families. Others lived with their mother and step-father (11%), their mother only (15%), their father only (4%), one grandparent (4%).

Measures

Receptive language. All participants completed the Peabody Picture Vocabulary Test (PPVT-III) (Dunn & Dunn,1997) to assess receptive vocabulary. This test is designed for persons aged 2 ½ through 90 years. The starting point is determined by the individual's age. There are 12 items in a series of sets, if the participant makes 2 or more errors in the starting set, the set prior to their starting point is also administered. The individual achieves their ceiling set when they have made eight or more errors in one set, and then the testing is terminated. The raw score is obtained by subtracting the number of errors from the highest number in the ceiling set. This score was converted into a standard score. This test has good test-retest reliability ($r = .95$), according to test authors.

Attention Measures. Attention was assessed using three different sources: 1) participant omission error scores on the Conners' Continuous Performance Test (CPT); 2) two parental rating measures (Conners' Parent Rating Scales and the Child Behaviour Checklist); and, 3) two teacher rating measures (Conners' Teacher Rating Scale and the Teacher Report Form).

The CPT is a visual vigilance/attention task in which each child is required to watch a series of letters on computer monitor and respond to every letter presented on the screen except for the target letter (Conners, 1995). This test was presented in a game-like

format that started with instructions and a two-minute practice session. This computer program's inter-stimulus interval (ISI) was between one and four seconds with a display time of 250 milliseconds. There were six blocks, with three sub-blocks each of twenty trials. Each sub-block had different ISIs that consisted of one, two, or four seconds. The order of the ISIs varied between blocks. This study used the "standard" mode where participants pressed the spacebar for all presented letters *except* for the letter "X" for approximately fourteen minutes. Therefore, to receive scores within the average range, participants were required to inhibit responding (i.e., not pressing spacebar) when the letter "X" appeared on the screen, and to respond to all of the non-target letters when they appear on the screen (i.e., press spacebar for other letters such as "N"). There were two versions of the CPT used (CPT 3.0 DOS version on laptop and desktop, and CPT-II) due to age constraints with the release of the new version of the CPT (i.e., CPT-II did not have norms for ages 4 and 5 years). These versions are similar in all aspects of time, presentation rate, and score output (Conners, 1995). Each version has a full set of both clinical (CPT 3.0 DOS $\underline{n} = 670$, CPT-II $\underline{n} = 601$) and non-clinical (CPT 3.0 DOS $\underline{n} = 520$, CPT-II $\underline{n} = 1920$) normative data, including child and adult data from various backgrounds. The CPT scores for the present study were compared to non-clinical norms, given that no children had yet received a clinical diagnosis.

Each participant's attention was measured from his or her omission errors. Omission errors are the number of targets the child did not respond to (i.e., not pressing the spacebar when a non-target letter is presented on the computer monitor). The original scoring for the measure is a percentile. This is considered to be a good measure of attending skills (Conners, 1995).

The Conners' Parent Rating Scale (CPRS; Conners, 1990) is an 80-item scale completed by the child's parent or guardian. Each item had four possible responses (not at all, just a little, pretty much, very much) that are coded as 0, 1, 2, and 3, respectively. There are fourteen subscales: a) Oppositional, b) Cognitive Problems, c) Hyperactivity, d) Anxious-Shy, e) Perfectionism, f) Social Problems, g) Psychosomatic, h) ADHD Index, i) Conners' Global Index: Restless-Impulsive, j) Conners' Global Index: Emotional Lability, k) Conners' Global Index: Total, l) DSM-IV Symptoms Subscales: Inattentive, m) DSM-IV Symptoms Subscales: Hyperactivity-Impulsive, and n) DSM-IV Symptoms Subscales: Total. This instrument has well-accepted reliability and validity and is considered to be standard in ADHD diagnosis as noted by Barkley (1991) in his previous research on the ecological validity of this measure. Separate norms are available for males and females, in three years intervals for age 3 years to 17 years (i.e., 3-5 years, 6-8 years). A large normative sample ($n = 4,908$) was taken from various sites across Canada as well as the United States (Conners, 1990). The CPRS T-score for the DSM-IV Symptoms Subscales: Inattention was included as a parent rating of attention problems with higher scores indicating more problems. An Average rating would be a T-score of 55 and below, T-scores between 56-60 are Slightly Atypical (should raise some concern), scores between 61-65 are Mildly Atypical (possible significant problem), scores between 66-70 are Moderately Atypical (indicates significant problem), and scores 70+ are considered to be Markedly Atypical (indicates significant problem).

The Conners' Teacher Rating Scale (CTRS; Conners, 1990) is an 80-item rating in which each item has four possible responses (not at all, just a little, pretty much, very much) that are coded as 0, 1, 2, and 3, respectively. The same 13 subscales can be derived

from the CPRS as the CTRS with the exception of the CPRS Psychosomatic subscale as it is not part of the CTRS. This instrument also has well-accepted reliability and validity. The CTRS T-score for the DSM-IV Symptoms Subscales: Inattention was also included as a measure of attention. The normative sample (n = 3,870) was taken from the same sites as the CPRS and was also partitioned by child age and gender. Descriptions of T-scores were identical to those used for the CPRS.

The Child Behaviour Checklist (CBCL; Achenbach, 1991a) is a questionnaire completed by the child's parent/guardian with 20 items measuring competence and 118 items focusing on potential problem areas. The 20 competence items comprised the three competence scales of Activities, Social, and School scales. The norms for the Competence scales are derived from various regions across the United States (n = 1,168) are separated into two groups for age (6-11 years and 12-18 years) and then by gender. There are no norms for children age 4-5 years for the Competence scales are assigned T-scores where lower T-scores (T < 30) are more of a concern. The Syndrome Scales consist of Withdrawn, Somatic Complaints, Anxious/Depressed, Social Problems, Thought Problems, Attention Problems, Delinquent Problems, and Aggressive Behaviour. The norms for these scales included children ages 4 years to 18 years (n = 2,368) with specific norms separate for males and females ages 4-11 years, and 12-18 years. The Syndrome Scales are also converted into T-scores where T-scores at and above 60 are considered to be within the clinical range. The reliability and validity of this rating scale is considered to be adequate. The T-score for the Attention Problems Scale was used to assess participants' attention level. This scale has been shown to have stability over time and can discriminate between referred and non-referred children, with

significantly more referred children scoring within the clinical range as compared to the non-referred children (Achenbach, 1991a).

The Teacher Report Form (TRF; Achenbach, 1991b) is a questionnaire completed by the child's teacher and consists of ratings in performance in academic and adaptive areas as well as 118 items for specific problems in the school setting. The age for this rating scale ranges from 5-18 years with a normative sample of 1,613 children across the United States. The norms for this rating scale are partitioned for males and females and into two separate age groups (5-11 years and 12-18 years). The Academic areas consist of Academic Performance, Working Hard, Behaving Appropriately, Learning, Happy, and Total Sum of items which are converted into T-scores where the lower the T-score ($T < 40$), the more likely this area is a problem at school. The Syndrome Scales consist of Withdrawn, Somatic Complaints, Anxious/Depressed, Social Problems, Thought Problems, Attention Problems, Delinquent Behaviour, and Aggressive Behaviour, which are converted into T-scores, with T-scores above 65 indicative of a problem. The reliability and validity of the questionnaire is considered to be adequate (Achenbach, 1990b). The Attention Problems scale was used to assess attention levels of participants. The Attention Problems scale for the TRF has also shown stability over time and can be used to discriminate between referred and non-referred with clinical-level scores obtained more frequently by the referred children than the non-referred children (Achenbach, 1990b).

Working Memory Tasks. Two subtests from the Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R; Woodcock & Johnson, 1990) were used. Numbers Reversed and Memory for Words subscales were used to provide two measures of

working memory. As reported by the authors, these subtests were found to have a correlation of .35 within a sample of 6-year-old children, indicating that they measure similar but different aspects of working memory. The Numbers Reversed subtest measures the ability to repeat a series of random numbers backwards presented from an audiotape. After hearing the numbers, the participant must say the numbers in the reverse order. The participant must maintain each number sequence in memory while reorganizing that sequence. Difficulty increases as more numbers are added to the series. This task mainly measures working memory although it has been suggested that perceptual reorganization is also assessed from this task and some attention is necessary. Memory for this test is defined as the ability to attend and semantically store information in immediate auditory memory and orally recall it correctly. The norms for the Numbers Reversed subtest were derived from a sample of 1,159 people ranging from 6 years to 79 years of age. This subtest has good internal consistency with reliabilities ranging from 0.77 to 0.89 across the various ages, as reported by the authors.

The second subtest completed was Memory for Words. This is a serial auditory memory task requiring the participant to recall, in correct sequence, a list of words presented via tape player. Each word sequence is grouped into three units with a ceiling obtained whenever a unit of three word groups of the same length is missed. The sequences of words in the first group begin with three and increase to seven. There is objective scoring with each word group scored as 0 or 1. This task also measures working memory and attention. The WJ-R contains age-matched norms for each subtest and performance is reflected as a standard score on each subtest. Higher scores reflect better memory performance. The norms for the Memory for Words subtest were derived from a

sample of 1,848 people ranging from 6 years to 79 years of age. As reported by the authors, this subtest has good internal consistency with reliabilities ranging from 0.69 to 0.89 across the various ages.

Impulse Control Measures. There were three sources used to provide measures of impulsivity for each child: 1) three kinds of behavioural data from each participant (commission errors on CPT, Dimensional Change Card Sort, Luria's Hand game); 2) parental ratings on the CPRS; and, 3) teacher ratings on the CTRS.

The commission errors derived from the CPT (previously explained) were defined as the number of times the child responded to the non-target, the letter "X" (i.e., pressing the spacebar when an "X" is displayed on the computer monitor). This original unit of measurement was given as a T-score. The higher the commission errors, the higher the T-score, and the more likely the participant has responded impulsively.

Each participant also completed the Dimensional Change Card Sort (DCCS) and the Luria's Hand Game (Luria, Pribram, & Homskaya, 1964) as measures of impulse control. The DCCS was constructed by Frye et al. (1995). In this task, two target cards (e.g., yellow car and a green flower) were presented, and the test cards used, matched one target card on one dimension, and the other target card on the other dimension (e.g., yellow flowers and green cars). During the pre-switch phase, children were told to sort cards according to only one dimension (e.g., color). After sorting the cards to these rules for six trials, children were asked to switch and sort the cards according to the alternate dimension (e.g., shape). There were two sets of cards; one set consisted of red and blue rabbits and boats, and the other set included yellow and green cars and flowers. For each set, there were two target cards (e.g., yellow car and green flower) and 14 test cards (7

yellow flowers and 7 green cars). Materials and scripts for this task were obtained and used from Sophie Jacques (Zelazo & Jacques, 1996).

There was a pre-switch phase and a post-switch phase. The target cards were each attached to two small boxes. First, the examiner gave the rules for separating the cards on one dimension, "*All the yellow ones go here, but only the green ones go in that box*," and then sorted one test card into each box. The participants were required to sort the remaining 6 test cards. During the pre-switch trials, the examiner repeated the pre-switch rules for each trial, randomly selected a test card, labeled it by the relevant dimension only (e.g., "*Here's a yellow one*"), and then asked the participants, "*Where does this go in the _____ (e.g., color) game?*" The participants were then required to place the card into one of the boxes. After six completed trials, the participants were asked to stop playing the first game and switch to a new game: "*Okay, now we're going to switch and play a new game, the shape game. We're not going to play the color game anymore. No way. We're going to play the shape game. The shape game is different.*" The participants were then asked to sort an additional six test cards according to the alternate dimension (see Appendix B for the full script and directions). The total time of administration was approximately 10 minutes. In previous literature, children were considered as passing the DCCS if they sorted at least 4 out of 5 cards correctly both on the pre- and post-switch phases of this game (Zelazo et al., 1996). However, for the present study the total percent error for the post-switch trials (the number of failed responses divided by the total number of post-switch trials) was calculated for each participant as a measure of impulsivity.

Children also completed the Luria's Hand Game, which was first developed to examine executive function deficits in inhibitory control among adults with frontal lesions (Luria et al., 1964). More recently this task has been used to assess inhibitory control in hard to manage preschoolers (Hughes et al., 1998). There were two conditions included in this task. At the beginning of this task, the participants were asked to copy the experimenter as she points a finger and then models a fist. This was repeated until the child confidently produced both actions. There were two conditions of this task. The imitative condition was introduced to the participants as follows: "*First we both put our hands; now when I show my hand I want you to make the same shape as me. So if I make a fist you make a fist, and if I point a finger you point a finger. What do you do if I point a finger?...and if I make a fist?*" The conflict condition was introduced by the experimenter saying "*Now, if I point a finger, I want you to show a fist, and if I show a fist I want you to point a finger, so we're not making the same shapes. What do you do if I show a fist?...and if I point a finger?*" The order of imitation and conflict conditions was counterbalanced across children. On each trial the participants were rated as successful if they produced the correct hand-action immediately or if they self-correct their action with no delay and without prompting from the experimenter. Children were considered successful if they made no more than one error over the ten trials for each condition. For the present study the percent of failed trials was calculated for each participant as a measure of impulsivity.

The T-scores Conners' Global Index: Restless-Impulsive, from the CPRS and CTRS were also included as parental and teacher reports of impulsivity.

Theory of Mind Tasks. There were four kinds of theory of mind tasks: emotion

false belief, mistaken identity and contents, and unintended transfer of objects, and unintended transfer of caregivers. The emotion false belief task consisted of an emotion false belief story developed by Harris, Johnson, Hutton, Andrews, and Cooke (1989). Children were first introduced to two toy monkeys, Mickey and Pingu, before they were told the following story about these two characters:

*"This is a story about two friends, Mickey and Pingu. Mickey is a very naughty monkey, and likes to play tricks on his friend Pingu. Now Pingu really likes Coke. In fact it's his favorite drink. Look! Here's Pingu's can of Coke. (Q1: How does Pingu feel when he drinks a can of Coke? Q2: Why?). One day, Pingu went out for a walk, and naughty Mickey decided to play a trick on his friend. Now Mickey knows that Pingu really hates milk. Yuk! He doesn't like milk. So Mickey went to the fridge and got out some milk. He poured out the Coke "Pssshhhh!" and he poured the milk in the can "Glug-glug-glug." Then he puts the milk away, and went outside to wait for Pingu. Now Pingu comes home. He's really thirsty. He can just see the can on the table, but he can't see what's inside, can he? (Q3: Before Pingu looks inside the can, how does he feel? Q4: Why? Q5: What does Pingu think is inside the can? Q6: What's in the can really? Q7: How does Pingu feel after he takes a drink- happy or not happy? Q8: Why?)."*

In previous literature, the scoring of this task has been partitioned into two separate measures; false belief and emotion understanding. To ensure children understood the concept of false belief, they had to have passed the false belief question (Q5), as well as the reality control question (Q6). To pass the emotion understanding children were required to pass the emotion question (Q3), the reality control question (Q6), and all emotion contingency questions (Q1, 2, 7, & 8), as well as justifying the answer sufficiently (i.e., Why?). For example, a correct emotion answer consisted of saying that Pingu would feel happy/excited before he looks into the can because he thinks it is filled with Coke which is his favorite drink. Scores consisted of combining the percent pass

from the false belief and emotion understanding sections to achieve a broader conceptualization of false belief understanding.

The mistaken identity and contents tasks (Gopnik & Astington, 1988; Symons, McLaughlin, Moore, & Morine, 1997), consisted of six misleading objects: an egg carton filled with forks, a Smarties box containing rocks, a candle that looks like an apple, an eraser that looks like a marker, a milk carton containing water, and a flashlight shaped like a pen. For each stimulus, the child was first shown the object, asked what they thought it was or what it contained. Then the actual nature of the object or its contents was then explained/shown to the participants. After this, two questions were asked regarding the child's own belief prior to the exposure of reality (representational change) and one question regarding what a peer would think about the objects, considering that the peer should not know the true nature of the objects (false belief):

*Child's belief:* e.g., "What did you think was inside the box before I poured it, milk or water?

*Peer's belief:* e.g., "Another boy hasn't seen me pour this before. What will he think is inside this when he first sees it, water or milk?

To have been considered as having passed the task, the participant had to only have answered the false belief question correctly for each item (see Appendix C for the complete script and instructions). Scores consisted of the percentage of six tasks passed, however, if a child knew what the misleading object was prior to explanation (i.e., knew that object was a candle not an apple) no further questions were asked of that object, and scoring was adjusted (i.e., percent out of five instead of six).

There were five unintended transfer tasks. Two unintended transfer tasks (see Symons et al., 1997) were based on Wimmer and Perner (1983) and included objects as the sought item. Each task was acted out with LEGO and DUPLO blocks, an age- and gender-neutral main character (e.g., Jody), who finds an object (e.g., marble) places it in a particular location (e.g., drawer), and once he or she leaves the room, a foil relocates the object. When the central character returns to the scene participants were asked to have the character search for the object. The participants were then asked the following sequence of questions:

(1) Show me what Jody will do next. (False belief question)

(2) Where will Jody look for the marble? (Back up false belief question, necessary only if Jody did not look for the marble after the open ended prompt),

(3) Where did Jody leave his/her marble? (First memory control question),

(4) Where did the clown hide the marble? (Second memory control question), and

(5) Was Jody in the room or outside the room when the clown hid the marble? (Third memory control question).

Children that made the character search where they had originally left the item and answered the three memory control questions correctly were considered to have an understanding of false belief and therefore passed the task. Those children who had the character search for the object where it actually was located were considered to have failed the task. The memory control questions helped to determine if there was a lack of understanding theory of mind or a memory problem (see Appendix D for the complete script and instructions). Scores for the unintended transfer of objects consisted of the percentage of the two tasks passed.

There were also three unintended transfer tasks that used a caregiver in which the search was now for a parent as opposed to an object (Symons et al., 1997). Mother and father characters were used and relocated in these scripts for unintentional reasons. For example, one scenario consisted of a child character shopping with his or her mother. They are both in a changing room with the child trying on a shirt, then the child leaves to get another shirt to try on. While the child is looking for another shirt, a janitor asks the parent to move to the other changing room in order for him to be able to clean the mirror. The participants were then asked the following sequence of questions:

(1) Show me what Terry will do next. (False belief question)

(2) Where will Terry look for his mother? (Back up false belief question, necessary only if Terry does not initially look for his mother after the open ended prompt),

(3) Where was Terry's mother when Terry left to get the new shirt? (First memory control question),

(4) Where did Terry's mother move to? (Second memory control question), and

(5) Was Terry in the changing room when the janitor asked his mother to move to the other room? (Third memory control question).

As previously mentioned, children that have the character search in the changing room where the mother was originally and answer all of the three control questions correctly were considered to have an understanding of false belief. Those children who have the character search for the mother in the changing room where she actually is were considered as failing the task. There were three scenarios for the caregiver unintended transfer task: the house, the beach and the changing room. Scoring procedures were identical to that of the unintended transfer of objects in that children that made the

character search where the caregiver was originally located and answered the three memory control questions correctly passed the task. Those children who had the character search for the caregiver where he/she actually was located were considered to have failed the task. Unintended transfer of caregiver task scores consisted of the percentage of the three tasks passed.

Social Problems. The social functioning of each participant was measured through the parent and teacher ratings. The T-score from the Social Problems Subscale from the CPRS, CTRS, CBCL and TRF was used with the higher T-score ($T > 65$) indicative of problems frequently experienced in social situations. Items from the CPRS and CTRS scales include: Has no friends; does not know how to make friends, has poor social skills. Items from the CBCL and TRF scales include: Acts too young for his/her age; doesn't get along with other kids (pupils); and gets teased a lot.

## Procedure

The PPVT-III was the first measure administered to all children, and took approximately ten to fifteen minutes as a warm up task. Each set of tasks (memory, attention, theory of mind, and impulse control) was counterbalanced and administered in blocks. Within the working memory block, the order of administration of Numbers Reversed and Memory for Words was counterbalanced across all participants. This block took approximately twenty minutes. The attention block only contained the CPT and administration time was slightly over fourteen minutes. Within the impulse control block, the order of administration for the DCCS and the Luria's Hand game was counterbalanced across participants. This section of the study lasted about twenty minutes. Sets of the theory of mind tasks (i.e., mistaken identity and contents,

unintended transfer of objects, unintended transfer of caregivers, and emotion false belief) were counterbalanced with a total duration of approximately twenty minutes. Overall, the single testing session took approximately 90 minutes.

Upon referral, parents were sent questionnaires and schools were expected to provide behaviour ratings as part of the assessment process. On average, parents returned the questionnaires 23 days (SD = 38) before their child was to be assessed, and teachers returned the behavioural ratings 17 days (SD = 35 days) before their student was to be assessed. The majority of parental ratings were completed by mothers (92%), with the rest completed by fathers (4%) and grandmothers (4%). These children were diagnosed within two months of the study by a clinician in the mental health setting according to DSM-IV criteria. Children were ultimately diagnosed as either ADHD-Combined Type (n = 8), ADHD Not Otherwise Specified (n = 2), Oppositional Defiant Disorder (n = 2), Child-Parent Relational Problems (n = 4), Relational Problems Not Otherwise Specified (n = 2), Phase of Life Problem (n = 1), or a Learning Disorder (n = 1). There were six cases where no diagnosis was given or the diagnoses were not available. These diagnoses were not made until after the assessment sessions took place, rating scales scored, and intakes conducted by clinical staff were completed with parent and child. Clinical staff had access to all measures administered during the assessment session except for the theory of mind measures. Two children from this sample were seen twice at these clinics prior to participating in this research study, but no child had otherwise been previously assessed, diagnosed, or had mental health contact.

# Results

## Descriptive Statistics and Data Aggregation

The participants' receptive vocabulary, as measured by the PPVT-III, ranged from a standard score of 76 to 123 ($M$ = 97.92, $SD$ = 13.31). This mean is considered to be at an average level. The majority of the participants (84.6%) achieved scores within the Average range (standard score = 85-115) or higher. The rest of the sample (15.4%) obtained Moderately Low scores (standard score = 70-85).

Attention Problems. The original unit of measurement for the CPT omission error rate (percentile rank) was transformed into a T-score (see Table 1 for mean and standard deviation). The parent and teacher ratings were given as T-scores. The majority of participants obtained a rating which equated to a T-score of 60 or higher for the CPRS (73.1%) and CTRS (69.2%) Inattentive subscales. The majority of this sample also achieved elevated ratings (T-score of 60 and above) on the CBCL (69.2%) and TRF (76.0%) Attention Problems subscale. As seen in Table 1, the mean T-scores for the attention problem measures ranged from 65.04 to 67.58 indicating that these children had difficulties with attention as the higher the T-score the more likely there are problems with attention.

Once the measures within each construct were converted into the same unit, Cronbach's Alpha was calculated. The inter-correlation coefficients for the various attention measures ranged from $r$ = 0.11 to $r$ = 0.70, with an alpha of 0.77 (see Table 2). Average attention was calculated by averaging the T-scores for CPT omission error rate, CPRS: Inattentive subscale, CTRS: Inattentive subscale, CBCL Attention Problems

subscale, and the TRF Attention Problems subscale to obtain an overall average score for attention problems. For one participant the aggregation of the attention problem measures was slightly different in that no data was provided for the TRF therefore, the average attention problems consisted of the averaging the remaining four measures. Descriptives for the average attention problems score can also be found in Table 1.

Working Memory. There were no conversions required for the measures tapping into working memory (see Table 1). The standard scores for Numbers Reversed ranged from 60 to 113 and from 67 to 123 for Memory for Words. Despite modest relation ($\underline{r} = 0.15$), the two T-scores of the Woodcock-Johnson Cognitive Battery (Numbers Reversed and Memory for Words) were also averaged (see Table 1) to create a more reliable measure of working memory.

Impulsivity. The DCCS and the LHG percent failure (one minus the number of correct responses divided by the total number of cards/trials) were transformed into T-scores (see Table 1 for means and standard deviations). Overall, the T-scores for impulsivity ranged from 45 to 97 with the majority of CTRS Restless-Impulsive (69.2%), and CPRS Restless-Impulsive (61.5%), scores reaching T-scores of 65 and above. A small portion of the sample (11.5%) obtained commission error T-scores of 60 and above, along with DCCS T-scores (15.4%) and Luria's Hand Game T-scores (15.4%) of 60 and above. The T-scores for DCCS percent failure, LHG percent failure, CTRS Restless-Impulsive, CPRS Restless-Impulsive, and CPT Commission T-score were averaged to obtain an average measure of impulsivity (see Table 1). The impulse control measures had a large correlation coefficient range from $r = -0.01$ to $\underline{r} = 0.50$ and had a Cronbach's alpha of 0.42 (see Table 3).

Table 1

Descriptive Statistics for Measures of Executive Functioning

| Executive Function Measures | Descriptive Statistics | | |
|---|---|---|---|
| | M | SD | Range |
| Attention Problems | | | |
| CPRS Inattentive | 65.0 | 10.3 | 42 to 81 |
| CBCL Attention Problems | 65.5 | 10.9 | 50 to 86 |
| CTRS Inattentive | 67.6 | 12.1 | 44 to 97 |
| TRF Attention Problems | 67.4 | 12.4 | 50 to 92 |
| CPT Omission Error | 50.0 | 10.0 | 28.6 to 59.6 |
| Average Attention | 63.1 | 8.0 | 49.3 to 78.6 |
| Working Memory | | | |
| Memory for Words | 85.9 | 14.0 | 62 to 123 |
| Numbers Reversed | 91.5 | 14.2 | 60 to 113 |
| Average Memory | 88.7 | 10.8 | 65 to 112.5 |
| Impulsivity | | | |
| CPRS Restless-Impulsive | 73.0 | 12.2 | 45 to 91 |
| CTRS Restless-Impulsive | 71.4 | 11.6 | 53 to 101 |
| CPT Commission Error | 51.3 | 7.0 | 32 to 61 |
| DCCS Percentage Fail | 50.0 | 10.0 | 45.2 to 75.3 |
| LHG Percentage Fail | 50.0 | 10.0 | 43.5 to 82.1 |
| Average Impulsivity | 59.1 | 5.9 | 49.7 to 76.2 |

Note. CPRS = Conners' Parent Rating Scale, CBCL = Child Behaviour Checklist, CTRS = Conners' Teacher Rating Scale, TRF = Teacher Report Form, CPT = Continuous Performance Task, DCCS = Dimension Change Card Sort, LHG = Luria's Hand Game.

Table 2

Internal Consistency Correlation Matrix for Measures of Attention

| Measure | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CPT Omission | — | | | | |
| CBCL Attention Problems | .22 | — | | | |
| TRF Attention Problems | .11 | .54 | — | | |
| CTRS Inattentive | .18 | .35 | .58 | — | |
| CPRS Inattentive | .22 | .70 | .60 | .51 | — |

Note. CPT = Continuous Performance Test, CBCL = Child Behaviour Checklist, TRF = Teacher Report Form, CTRS = Conners' Teacher Rating Scale CPRS = Conners' Parent Rating Scale. N = 25, missing data for TRF for one participant.
Cronbach's alpha = 0.77.

Table 3

Internal Consistency Correlation Matrix for Measures of Impulsivity

| Measure | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| DCCS | — | | | | |
| LHG | .10 | — | | | |
| CPT Commission | .14 | -.01 | — | | |
| CTRS: RI | .32 | .03 | -.32 | — | |
| CPRS: RI | .31 | .21 | .01 | .50 | — |

Note. DCCS = Dimension Change Card Sort; LHG = Luria's Hand Game, CPT = Continuous Performance Test, CTRS: RI = Conners' Teacher Rating Scale: Restless-Implusive, CPRS: RI = Conners' Parent Rating Scale Restless-Implusive. N = 26.
Cronbach's alpha = 0.42.

Theory of Mind. The four types of false belief tasks were all expressed as percent correct (see Table 4 for means and standard deviations). For the mistaken identity and contents task, the majority (66%) of the participants did not know the true identity of the objects and contents and thus all six items were used to calculate their score. However, 19% of the participants knew the identity of one of the contents/objects and were scored out of five and the other 15% correctly guessed the identity of two items/contents and were scored out of four. All of the theory of mind tasks were moderately related to one another with correlation coefficients ranging from $\underline{r} = 0.34$ to $\underline{r} = 0.63$ and Cronbach's alpha was 0.82 (see Table 5). The percent correct for all of the theory of mind tasks were averaged to create an overall theory of mind score.

Social Problems. None of the measures for social problems were required to be converted as all original units of measurement were given as T-scores. As seen in Table 6, the mean T-score ranged from 60.88 to 64.50 indicating that many of these children were considered to have some difficulty interacting in social situations. More specifically, many participants achieved T-scores of 60 or higher on the CPRS (50%), CBCL (42.3%), CTRS (50%), and TRF (56.0%) Social Problems scales.

The ratings of the four reports of social problems were found to have inter-correlation coefficients ranging from 0.15 to 0.65, with a Cronbach's alpha of 0.68 (see Table 7). The T-scores for the parent and teacher ratings relevant for social problems were averaged to give an overall score of social problems. For one participant the aggregation of the attention measures was slightly different in that no data were provided for the TRF therefore, the overall score for social problems consisted of averaging the remaining three measures.

Table 4

Descriptive Statistics for Theory of Mind Tasks

| | Descriptive Statistics | | |
|---|---|---|---|
| Theory of Mind Tasks | M | SD | Range |
| Mistaken Identity and Contents | | | |
| False Belief | 79.6 | 32.7 | 0 to100 |
| Representational Change | 69.2 | 38.3 | 0 to 100 |
| Unintended Transfer of Objects | 80.8 | 34.9 | 0 to100 |
| Unintended Transfer of Caregivers | 62.8 | 43.6 | 0 to100 |
| Emotion False Belief | 76.9 | 38.0 | 0 to100 |
| Total Theory of Mind | 74.4 | 30.5 | 8.0 to100 |

Note. All scores are percent pass.

Table 5

Internal Consistency Correlation Matrix for Measures of Theory of Mind

| Measures | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Mistaken Ident. /Cont. | | — | | |
| Emotion False Belief | .60 | — | | |
| Unintended Tran. Objects | .34 | .63 | — | |
| Unintended Tran. Caregiver | .43 | .63 | .56 | — |

Note. Mistaken Ident./Cont. = Mistaken Identity and Contents task. Unintended Tran. Object = Unintended Transfer of Objects task and Unintended Tran. Caregiver = Unintended Transfer of Caregiver task. N = 26, Cronbach's alpha = 0.82.

Table 6

Descriptive Statistics for Social Problems

| | Descriptive Statistics | | |
|---|---|---|---|
| Social Problem Measures | M | SD | Range |
| Conners' Parent Rating Scale | 61.3 | 16.4 | 45 to 111 |
| Child Behaviour Checklist | 62.2 | 13.4 | 50 to 97 |
| Conners' Teacher Rating Scale | 64.5 | 20.8 | 44 to 140 |
| Teacher Report Form | 60.9 | 7.0 | 51 to 72 |
| Total Social Problems | 62.3 | 10.1 | 49 to 89 |

Note. All ratings are T-scores for social problems

Table 7

Internal Consistency Correlation Matrix for Measures of Social Problems

| Measures | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| CPRS: SP | — | | | |
| CTRS: SP | .15 | — | | |
| TRF: SP | .25 | .46 | — | |
| CBCL: SP | .65 | .16 | .42 | — |

Note. CPRS: SP = Conners' Parent Rating Scale Social Problems, CTRS: SP = Conners' Teacher Rating Scale Social Problems, TRF: SP = Teacher Report Form Social Problems, CBCL: SP = Child Behaviour Checklist Social Problems. N = 25, missing data for TRF for one participant. Cronbach's alpha = 0.68

Correlations of Executive Functioning Components and Theory of Mind.

All constructs were examined by correlating individual measures within a construct as well as average scores. In addition to bivariate correlations, partial correlations controlling for age and receptive language were conducted. A multiple regression analysis was also conducted to determine the unique contributions of each executive functioning component to predict theory of mind performance.

Attention Problems and Theory of Mind. Examination of the bivariate correlations between the measures of attention problems and theory of mind tasks revealed two significant correlations in Table 8. One of these was no longer significant as a partial correlation. Although this one significant correlation may be a chance occurrence, all twenty correlations in this table were in the predicted direction. Correlations of the total scores produced three additional significant correlations. Teacher ratings of attention problems (CTRS) were related to poor overall theory of mind performance, and overall attention problems were related to poor emotion false belief understanding. In addition, total attention problems was related to poor overall theory of mind performance, even controlling for age and receptive language.

Working Memory and Theory of Mind. Bivariate and partial correlations were completed for individual and average working memory and theory of mind measures in Table 9. The Numbers Reversed subtest was significantly related to all four theory of mind tasks and total theory of mind scores. The Memory for Words subscale was unrelated to any theory of mind measure, although all relations were in the expected positive direction. Memory total score was highly related to theory of mind total score even controlling for age and receptive language.

Table 8

Zero-Order (R) and Partial (R') Correlations Between Measures of Attention Problems and Theory of Mind Tasks

| | | Attention Problem Measures | | | | | |
|---|---|---|---|---|---|---|---|
| Theory of Mind Tasks | | CPRS Inattentive | CBCL Att. Prob. | CTRS Inattentive | TRF Att. Prob. | CPT Omission | Average Attention |
| Mistaken Ident./Cont. | R | -.17 | -.27 | -.30 | -.13 | -.17 | -.25 |
| | (R') | (-.08) | (-.24) | (-.26) | (-.05) | (-.07) | (-.16) |
| Unintended Tran. Object | R | -.21 | -.09 | -.39* | -.13 | -.25 | -.29 |
| | (R') | (-.16) | (-.22) | (-.30) | (-.30) | (-.25) | (-.34) |
| Unintended Tran. Caregiver | R | -.35 | -.23 | -.29 | -.21 | -.14 | -.33 |
| | (R') | (-.29) | (-.29) | (-.26) | (-.30) | (-.15) | (-.34) |
| Emotion False Belief | R | -.29 | -.28 | -.60** | -.29 | -.28 | -.49** |
| | (R') | (-.27) | (-.40) | (-.54)** | (-.36) | (-.16) | (-.48)** |
| Average Theory Of Mind | R | -.31 | -.24 | -.46* | -.26 | -.36 | -.43* |
| | (R') | (-.27) | (-.33) | (-.36) | (-.34) | (-.29) | (-.44)* |

Note. *$p < 0.05$, **$p < 0.01$. Partial correlations control for age and PPVT-III standard scores. CPRS = Conners' Parent Rating Scale; CTRS = Conners' Teacher Rating Scale; CBCL Att. Prob. = Child Behaviour Checklist Attention Problems Subscale; TRF Att. Prob.= Teacher Report Form Attention Problems Subscale, CPT = Continuous Performance Task. Mistaken Ident./Cont. = Mistaken Identity and Contents Task. Unintended Tran. Object = Unintended Transfer of Objects task and Unintended Tran. Caregiver = Unintended Transfer of Caregiver task.

Table 9

Zero-Order (R) and Partial (R') Correlations Between Working Memory Tasks and Theory of Mind Tasks

| | | Memory Tasks | | |
|---|---|---|---|---|
| Theory of Mind Tasks | | Memory for Words | Numbers Reversed | Average Memory |
| Mistaken Ident./Cont. | R | .10 | .55** | .45* |
| | (R') | (.09) | (.40)* | (.31) |
| Unintended Tran. Object | R | .22 | .59** | .55** |
| | (R') | (.32) | (.54)** | (.56)** |
| Unintended Tran. Caregiver | R | .20 | .59** | .55** |
| | (R') | (.26) | (.55)** | (.52)** |
| Emotion False Belief | R | .16 | .73** | .61** |
| | (R') | (.18) | (.59)** | (.50)* |
| Average Theory of Mind | R | .29 | .73** | .67** |
| | (R') | (.36) | (.65)** | (.63)** |

Note. *$p < 0.05$, **$p < 0.01$. Partial correlations control for age and PPVT-III standard scores. Mistaken Ident./Cont. = Mistaken Identity and Contents Task. Unintended Tran. Object = Unintended Transfer of Objects task and Unintended Tran. Caregiver = Unintended Transfer of Caregiver task.

Impulsivity and Theory of Mind. Bivariate and partial correlations were completed for individual and total impulsivity and theory of mind measures and are presented in Table 10. There were seven significant correlations in the expected direction found between the individual measures of impulsivity and theory of mind. However, once the effects of age and receptive verbal ability were partialled out, only three significant correlations remained. Teacher ratings of impulsivity (CTRS) were related to emotion false belief understanding. Impulsivity on the DCCS was related to poor unintended transfer scores for both objects and caregivers. When the average scores were considered, seven significant correlations were found. However, only four remained significant after controlling for the effects of age and receptive language. Average impulsivity was related to theory of mind performance on unintended transfer of objects, emotion false belief, and theory of mind total score.

Social Problems and Theory of Mind. Bivariate and partial correlations were conducted between individual and average social problem and theory of mind scores in Table 11. Parent ratings of social problems on the CPRS were negatively related to the unintended transfer of caregiver task and theory of mind average once age and language were partialled out. Teacher ratings of social problems on the CTRS were negatively related to unintended transfer of caregiver task, and theory of mind total score. Total social problems was highly related to unintended transfer of caregiver task ($r = -0.54$, $p < 0.01$), and total theory of mind ($r = -.48$, $p < 0.01$).

Multiple Regression. Because the executive functioning constructs were found to be inter-correlated, a hierarchical regression analysis was conducted to determine how much each would uniquely contribute in explaining theory of mind variance over and

Table 10

Zero Order (R) and Partial (R') Correlations for Measures of Impulsivity and Theory of Mind Tasks

| | | Impulsivity Measures | | | | | |
|---|---|---|---|---|---|---|---|
| Theory of Mind Tasks | | CPRS Rest-Imp. | CTRS Rest-Imp. | CPT Com. | DCCS | LHG | Average Impulsivity |
| Mistaken Ident./Cont. | R | -.31 | -.22 | -.21 | -.18 | -.27 | -.42* |
| | (R') | (-.22) | (-.17) | (-.15) | (-.00) | (-.27) | (-.28) |
| Unintended Tran. Object | R | -.31 | -.43* | .21 | -.46* | -.40* | -.54** |
| | (R') | (-.29) | (-.35) | (.20) | (-.49)* | (-.10) | (-.42)* |
| Unintended Tran. Caregiver | R | -.25 | -.19 | .04 | -.49* | -.50** | -.50* |
| | (R') | (-.19) | (-.08) | (.02) | (-.48)* | (-.37) | (-.38) |
| Emotion False Belief | R | -.35 | -.56** | .03 | -.51** | -.12 | -.57** |
| | (R') | (-.26) | (-.56)** | (.13) | (-.40) | (.09) | (-.43)* |
| Average Theory Of Mind | R | -.36 | -.35 | .04 | -.51** | -.43* | -.63** |
| | (R') | (-.29) | (-.27) | (.08) | (-.46)* | (-.30) | (-.50)** |

Note. *$p < 0.05$, **$p < 0.01$.CPRS Rest-Imp. = Conners' Parent Rating Scale Restless-Impulsive Subscale; CTRS Rest-Imp. = Conners' Teacher Rating Scale Restless-Impulsive Subscale; CPT Com. = Continuous Performance Task Commission error rate; DCCS = Dimension Change Card Sort; LHG = Luria's Hand Game. All impulse control measures are T-scores and theory of mind tasks are percentage pass. Partial correlations control for age and PPVT-III standard scores. Mistaken Ident./Cont. = Mistaken Identity and Contents Task. Unintended Tran. Object = Unintended Transfer of Objects task and Unintended Tran. Caregiver = Unintended Transfer of Caregiver task.

Table 11

Zero-Order (R) and Partial (R') Correlations Between Measures of Social Problems and Theory of Mind Tasks

| | | Social Problems Measures | | | | |
|---|---|---|---|---|---|---|
| Theory of Mind Tasks | | CPRS Social Pbs. | CBCL Social Pbs. | CTRS Social Pbs. | TRF Social Pbs. | Average Social Pbs. |
| Mistaken Ident./Cont. | R | -.18* | -.11 | -.34 | -.22 | -.32 |
| | (R') | (-.18) | (-.03) | (-.25) | (-.10) | (-.21) |
| Unintended Tran. Object | R | -.15 | .11 | -.40* | -.16 | -.27 |
| | (R') | (-.33) | (-.03) | (-.21) | (-.13) | (-.27) |
| Unintended Tran. Caregiver | R | -.39 | -.17 | -.47* | -.26 | -.52** |
| | (R') | (-.48)* | (-.27) | (-.43)* | (-.22) | (-.54)** |
| Emotion False Belief | R | -.15 | -.04 | -.56** | -.24 | -.40 |
| | (R') | (-.37) | (-.15) | (-.39) | (-.12) | (-.32) |
| Average Theory of Mind | R | -.30 | -.10 | -.56** | -.26 | -.49** |
| | (R') | (-.48)* | (-.21) | (-.41)* | (-.17) | (-.48)** |

Note. *$p < 0.05$, **$p < 0.01$. CPRS Social Pbs. = Conners' Parent Rating Scale, Social Problems subscale; CBCL Social Pbs. = Child Behaviour Checklist Social Problems subscale; CTRS Social Pbs. = Conners' Teacher Rating Scale Social Problems subscale; TRF Social Pbs. = Teacher Report Form Social Problems subscale. All rating scale measures are T-score, all theory of mind tasks are percentage pass. Partial correlations control for age and PPVT-III standard scores. Mistaken Ident./Cont. = Mistaken Identity and Contents Task. Unintended Tran. Object = Unintended Transfer of Objects task and Unintended Tran. Caregiver = Unintended Transfer of Caregiver task.

above age and receptive verbal ability. In the first step, age and receptive verbal ability were found to significantly account for 36.4% of the variance for theory of mind performance, $F(2, 23) = 6.58$, $p < 0.01$. In the second step, the three average components of executive functioning were entered into the model. They significantly increased the portion of explained variance in theory of mind, $F(5,20) = 8.44$, $p < 0.001$, with the amount of explained variance increasing to 67.8%. When looking at individual variables, not only was age a significant predictor of theory of mind performance $t = 2.49$, $p < 0.05$, working memory appeared to be a significant executive functioning construct to predict theory of mind performance $t = 2.98$, $p < 0.01$. Attention and impulse control did not explain significant levels of unique variance.

Average Executive Functioning, Theory of Mind, and Social Problems.

Considering that executive functioning is comprised of working memory, attention, and impulse control, these three averages were correlated to determine how closely they were related. Prior to this aggregation, the average attention problems, the average impulsivity score, and the average social problems score were negatively re-coded to provide measures of average attention, impulse control, and social functioning where higher scores reflect higher levels of executive functioning (i.e., attention and impulse control) and social competence. Although the average attention was highly correlated to the average impulse control ($r = .68$, $p < 0.001$), it was not correlated to working memory ($r = .31$, $p > 0.05$) when age and verbal ability were controlled. The average impulse control was also not correlated to the average working memory ($r = .47$, $p < 0.05$) when age and verbal ability were controlled. These three components were then averaged to obtain an overall executive functioning score across the three components (Cronbach's alpha

= 0.76). Overall executive functioning was significantly correlated to average attention $r = .71$, $p < 0.001$, average working memory $r = .60$, $p < 0.01$, impulse control average $r = .96$, $p < 0.001$, false belief average $r = .62$, $p < 0.01$, and average social problems $r = .77$, $p < 0.001$, after age and verbal ability were partialled out. The false belief average was also significantly related to the average social problems $r = .48$, $p < 0.05$.

Diagnostic Differences. It was thought that participants diagnosed with attention disorders would differ from those participants who either did not receive a diagnosis or who were seen as having relationship problems. To test this theory, t-tests were used to examine the differences in executive functioning and theory of mind development between these two groups. The Attention/Behaviour Problem (ABP) group consisted of 12 children diagnosed with attention and oppositional disorders (ADHD-Combined Type $n = 8$; ADHD-Not Otherwise Specified $n = 2$; and ODD $n = 2$). The Non-Attention/Behaviour Problem group (NABP) consisted of 11 children, two without diagnoses and the others were diagnosed with either a relational, phase of life or learning problem (child-parent relational problem $n = 4$; relational problem not otherwise specified $n = 2$; phase of life problem $n = 1$; and learning disorder $n = 2$). These groups did not significantly differ in receptive verbal ability, SES, family composition or gender. However, the NABP group was significantly younger than the ABP group $t(21) = -2.05$, $p < 0.05$, which may reflect a diagnostic bias (i.e., clinicians might be more hesitant to provide an ADHD diagnosis to young children).

The examination of possible differences between the ABP and NABP groups on executive functioning, theory of mind, and social competence totals revealed one significant difference between the groups, attention problems were significantly lower for

the NABP group in comparison to the ABP group, $\underline{t}$ (21) = 3.38, $p < 0.01$. As clinical staff had access to measures from this study, this is not a remarkable finding.

Post hoc Analysis.

Examination of the two measures of working memory revealed significant correlations for theory of mind measures and the Numbers Reversed subscale only (see Table 9). Considering these two measures had a low inter-correlation coefficient (Cronbach's alpha = .15) but remained as the only significant predictor of theory of mind, correlations were repeated with the working memory components kept as separate entities. Although both Numbers Reversed and Memory for Words were highly related to the working memory average ($\underline{r}$ = .73, $p < 0.001$ and $\underline{r}$ = .78, $p < 0.001$ respectively), only Numbers Reversed was significantly related to average attention $\underline{r}$ = .57, $p < 0.01$, impulse control average $\underline{r}$ = .63, $p < 0.001$, average theory of mind $\underline{r}$ = .69, $p < 0.001$, and overall executive functioning $\underline{r}$ = .76, $p < .001$, with age and verbal ability controlled. Re-examination of the multiple regression with the working memory components entered separately in the second step along with attention and impulse control, revealed that between these measures of working memory only numbers reversed significantly predicted theory of mind performance $\underline{t}$ = 2.54, $p < 0.05$. The remainder of the results was similar to those conducted with the two working memory components averaged together in that age and verbal ability accounted for 36.4% of the variance in theory of mind performance $F(2,23) = 6.52$, $p < 0.01$ and then significantly increased to 70.1% with the addition of the three components of executive functioning $F(6,19) = 7.74$, $p < 0.001$. Age also remained a significant predictor of theory of mind performance $\underline{t}$ = 2.11, $p < 0.05$.

# Discussion

The present study investigated the relationship between executive functioning and theory of mind development in a sample of children referred to mental health clinics for attention problems and disruptive behaviour. This study took a developmental psychopathology approach in that typical developmental processes were investigated in a clinical sample where high variability in performance was expected (Cicchetti 1989; Rutter 1988). The majority of research in this area has typically focused on a limited number of measures of executive functioning in relation to social understanding (Perner & Lang, 1999). However, the present study was the first to examine three components of executive functioning and the respective relations to false belief understanding. Attention, working memory, and impulse control were assessed using a multi-method approach including a variety of child tasks, computer-based measures, and parent and teacher ratings of behaviours in home and school settings.

Significant relations were found between attention, working memory, impulse control, and theory of mind. In each instance, relations were found between an average score for the respective executive functioning component, and overall theory of mind performance. However, there were few significant relations found between individual measures within each component and specific types of theory of mind tasks. Despite this weak pattern of relation between the individual measures, total scores were related due to a more reliable and diverse sampling from the relevant constructs (Rushton et al., 1983).

Overall, average executive functioning was found to be related to overall theory of mind performance, which supported the first hypothesis of the study. The results were similar to a study by Hughes et al. (1998), which examined total theory of mind and

executive functioning development in a sample of hard to manage preschoolers and their typically developing peers. A significant correlation was found in the hard to manage group between overall theory of mind performance and total executive functioning, in which their study executive functioning consisted of working memory and planning, inhibitory control, and attentional flexibility. Although the children from the Hughes et al. (1998) study were rated as hard to manage, the children from the present study were actually referred to a mental health clinic due to their behaviour difficulties and attention problems. Even within the present sample, some children were harder to manage than others as reflected by behaviour ratings.

The examination of the separate components of executive functioning in relation to theory of mind also provided further support for the first hypothesis. For example, total attention was related to overall theory of mind performance. However, only teacher ratings on the CTRS were significantly related to emotion false belief scores. If attention was only examined with one measure (e.g., the CPT), a significant relation between attention and theory of mind performance would not have been found. However, the multidimensional view of attention taken by the present study showed it was highly correlated to the overall theory of mind performance. This example demonstrates the importance of grouping variables measuring different dimensions of the same construct into an average score. Without this method, important information would have been missed had only the single correlations been taken into account.

The average of the Numbers Reversed and Memory for Words subtests was related to overall theory of mind performance. These two subtests used to measure working memory were apparently measuring different aspects of memory, one of which

is more related to executive functioning and theory of mind development. Post hoc analysis revealed that these correlations were due to the Numbers Reversed subtest, which was found to be not only related to all types of theory of mind measures but also to the impulse control, attention, working memory, and executive functioning averages. The multiple regression examining which of the two subtests was the strongest predictor of theory of mind performance revealed that the Numbers Reversed task was the only predictor of theory of mind performance. The study by Davis and Pratt (1995) investigated the working memory hypothesis as an explanation of theory of mind development. In their study, 3 to 5 year-old children completed a backward digit span task similar to Numbers Reversed, a forward digit span task similar to Memory for Words except for the items used for recall, as well as two tasks assessing false belief understanding. Davis and Pratt (1995) reasoned that false belief tasks require a child to consider two representations of a situation and integrate them into a single mental model. They further hypothesized that backward digit span would strongly predict variance in theory of mind performance beyond that predicted by age and verbal ability and the forward digit span task would be a weaker predictor of false belief understanding than the backward digit span task. The results of Davis and Pratt (1995) reflected those found in the present study in that the working memory hypothesis was supported, the backwards digit span task significantly predicted theory of mind performance over and above age and verbal ability. In addition to these findings, the forward digit span task like the Memory for Words subtest, did not correlate with theory of mind performance and thus was not found to be a significant predictor of theory of mind performance.

Impulse control was related to overall theory of mind performance. Of the

impulse control measures, teacher ratings of impulsivity on the CTRS were related to the emotion false belief performance, and the DCCS was related to the unintended transfer of both objects and caregivers as well as to the overall theory of mind performance. Similar results were found by Hughes (1998b) in her longitudinal study of relationships between executive functions and theory of mind in typically developing children. At time one of her study, a theory of mind aggregate was significantly correlated ($r = 0.31$) to a set-shifting task that was similar to the DCCS, controlling for age and verbal ability. This partial correlation remained significant at time two ($r = .30$) of this study, in addition to a strong ($r = .54$) partial correlation found between the overall theory of mind performance and the percent correct on Luria's Hand Game. In the present study, there was some evidence that the DCCS and LHG were related to the average theory of mind performance. However, the relation between LHG and average theory of mind performance did not reach significance once age and receptive verbal ability were controlled. Unlike the Hughes (1998b) study, the present study also averaged the separate measures of the components of executive functioning, and thus provided a robust correlation between the average impulse control score and the overall theory of mind performance.

In the current study, the addition of parent and teacher ratings of social problems provided further information regarding participants' social functioning in other environments. The hypothesis that performance on theory of mind tasks would be negatively related to parent and teacher ratings of social problems was supported. Again, these relations were found for overall scores and not individual measures per se. These results indicate that children's social functioning in the "real world" is reflected in their

theory of mind performance. This supports claims of researchers that social understanding has meaningful consequences for how children get along with others. Perspective-taking and empathy are constructs that are relevant to getting along with peers as well as theory of mind development.

Age and receptive verbal ability significantly accounted for 36.4% of the total variance for theory of mind performance. This supports the well-established age effect of theory of mind development in that older children do better on false belief tasks. Although there was a significant increase in the portion of explained variance in theory of mind when the three executive functioning components were added to this model, the only significant predictor of theory of mind performance was working memory. This is despite the fact that memory control questions address whether children were confused by the salient features of the task. Attention and impulse control did not explain significant levels of unique variance above and beyond memory, although the three constructs were inter-related. The results of this regression analysis are similar to one conducted in the longitudinal study by Hughes (1998b). In her study, the total executive functioning score at time one was found to predict overall theory of mind performance over and above the effects of age and verbal ability a year later at time two. The executive functioning tasks accounted for 20% of variance in theory of mind performance one year later. However, only the impulsivity measure showed independent predictive relations for later TOM development. Although these findings appear to be conflicting with the results of the present study, it is important to note that the measures of working memory resembled the Memory for Words task and not the Numbers Reversed subtest in that children were required to recall items in a forward sequence.

Findings from the present study as well as Hughes (1998b) support the "domain general theory" as opposed to the "theory theory" (i.e., "domain specific theory") of theory of mind development. The "theory theory" is based on the idea that children's theory of mind represents the acquisition of domain specific knowledge through general processes of theory construction and revision (Bartsch & Estes 1996; Eslinger 1996; Leslie & Thaiss, 1992). However, this study suggests an interdependence of theory of mind and executive functioning in that higher levels of self-control, attention, and working memory allow for greater understanding of one's own mind and better insight into the perspectives of others. This supports the "domain general theory " where executive functioning development plays an important role in the formation of children's theory of mind development (Carlson et al., 1998; Frye et al., 1995).

To clarify the debate between the domain general theory and the domain specific theory for the acquisition of theory of mind, future efforts should attempt to increase false belief understanding through helping children to increase attention, working memory, and impulse control. It is arguable that for children to be successful on theory of mind tasks, a certain amount of working memory and attention capacity is needed. Impulse control would also seem to play an important role in understanding the concept of false belief, considering everyday social interactions require children to regulate their behaviour. Therefore, the domain-general theory would be further substantiated if training in executive functioning produced increases in the performance on theory of mind tasks. However, if this parallel increase in performance does not occur, support would be given to the domain specific theory.

There were no significant differences found between children formally diagnosed with ADHD versus those children who were not. These non-significant results could be due to the limitations of this study. Data collection took place during long sessions, approximately 90 minutes per participant. In addition, there was a small sample size with the majority (73%) of the participants under the age of seven years. Although younger children were the target sample, it is possible that some clinicians are unwilling to diagnose children at young ages with ADHD, opting for less severe diagnoses such as "relationship problems." Considering that half of this sample were either not given a diagnosis ($n = 6$) or were diagnosed as having some type of relational problem ($n = 7$) this may reflect diagnostic biases confounded by age.

There was also no community control group. However, interesting differences emerged when false belief performance from the present study is compared to non-clinical samples of previous studies. Call and Tomasello (1999), for example, made comparisons between their own results of four and five-year-olds on a change location task (similar to unintended transfer of objects task), and children of other studies using the same type of false belief task. The current method was duplicated to further understand how the clinic-referred children of the present study performed in relation to their typically developing peers of various ages. Although the mean percent correct for the clinic-referred children is slightly lower ($M = 81\%$) than the typical children ($M = 90\%$) of the same age in the meta-analysis found in Call & Tomasello (1999), the scores do not appear to be very different.

A more appropriate comparison for theory of mind performance of typical children using comparable methods is with Symons et al. (1997). This study used the

unintended transfer of objects task and the mistaken identity and contents tasks with identical scripts. The results of that study for the object location task showed that five-year old children had an average percent pass of 90%. Although the children from the present study were, on average, approximately a year and six months older then the sample from Symons et al. (1997), they were very similar in the average percent pass for the unintended transfer of objects task. For the mistaken identity and contents task the clinic-referred participants had a comparable performance to the typically developing children. The best estimate for children in the current study is that their theory of mind performance is 1 to 2 years behind typically developing children.

Previous studies have examined theory of mind development in young children to determine children's social functioning. However, the present study is the first to relate theory of mind to parent and teacher ratings of children's everyday social interactions. The strong relation between these measures suggests that theory of mind tasks actually tap into clinically meaningful information regarding social problems experienced by children who are referred to mental health clinics for attention and behaviour problems. Furthermore, the results of this study suggest that the measures of executive functioning as well as theory of mind may ultimately be useful screening tools for children with social problems, and help understand overall functioning. Given that the children in the current study were about to receive intervention of some kind, it would be interesting to determine how intervention may influence executive functioning, theory of mind, and ratings of social behaviour. This kind of study would enhance our understanding of social understanding in clinical samples of children.

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# Appendix A
## Research Consent Form

Our service is conducting a study to improve our understanding of children with disruptive behaviour. It involves having your child undergo special tests in addition to the ones we usually give.

This study is for:
- Children aged 4 to 6 years referred for assessing disruptive behaviour
- Those not on any significant medication

The tests include measures of:
- Visual attention
- Working memory
- Reading skills (vocabulary)
- Social and emotional understanding
- Parent ratings

This session will take approximately 90 minutes

### What about the results?
The results will help us understand more about how your child pays attention, and about things which may interfere with your child's attention. The results of the testing will be given to you clinician to help him/her make a diagnosis. By signing this consent form, you understand that we will have access to background information from your child's file. You will be given feedback on the results.

All the test information is completely confidential. For research purposes, your child will be assigned a number so that this label can be used rather then his/her name. The results will averaged over all the participants so no one can know what score any individual obtained.

### Other issues
There are no known risks to any of the tests involved. You are free to withdraw your child at any time. Refusal or withdrawal WILL NOT affect the service your child will receive: he or she will still undergo our standard battery of tests for assessing disruptive behaviour.

I am willing to allow my child, _____, to undergo the additional testing in this research study.

_____ _____

Signature of Parent Signature of Witness

Date:_____ Clinican:_____

### Contact Information
If there are any concerns or possible questions regarding this research study please feel free to contact the persons below.


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# Appendix B
## Child DCCS Scoresheet

DEMOGRAPHIC INFORMATION

Name _____ Subject # ____ Chronological Age _____ (mos.)

Date of Testing _____ (mos./day/yr.) Date of Birth _____ (mos./day/yr.)

Gender Female Male

COUNTERBALANCING VARIABLE

Dimension Order: Color Shape

INSTRUCTIONS

**Preswitch Phase**

[Put each target card on the backside of the trays.]

**We are going to play a game. This is the COLOR game. In the COLOR game, you put all the red ones in this box and you put all the blue ones in that box** [point to appropriate target cards]. **You don't put any blue ones in this box, only the red ones go in here** [point to appropriate target cards]. **And you don't put any red ones over there, only the blue ones go in there** [point to appropriate target cards]. **So all the red ones go in this box, and all the blue ones go in that box** [point to appropriate target cards]. [Model the responses for two test cards, one with each type of test card]

**Let me try a couple of turns first. All the red ones go here, and all the blue one go there** [point to appropriate target cards].**Here's a red one. I'll put it in this box because that's where the red ones go in the COLOR game** [put in appropriate tray].
**Let me try another. All the red ones go here, and all the blue one go there** [point to appropriate target cards]. **Here's a blue one. I'll put it in this box because that's where the blue ones go in the COLOR game** [put in the appropriate tray].
**Now it's your turn. Remember you put all the red ones here and all the blue ones there. Here's a ????**

Repeat instructions before every trial (e.g. "*Put the red ones here and the blue ones there. Here's a ???, where does it go?*
Label the test cards by relevant dimension only.
Give 8 trials, four for each type of test card.

Appendix B
Child DCCS Scoresheet

Present test cards in pseudo-random order, with no more than two consecutive trials with the same type of test card

| | LEFT | RIGHT | |
|---|---|---|---|
| Target Cards: | _____ | _____ | (dimension of target card e.g., red and blue) |
| 1. | _____ | _____ | |
| 2. | _____ | _____ | |
| 3. | _____ | _____ | |
| 4. | _____ | _____ | (dimension for test cards in correct side) |
| 5. | _____ | _____ | |
| 6. | _____ | _____ | |

**Postswitch Phase**

**Okay, now we are going to switch. We are not going to play the COLOR game anymore; we are going to play the SHAPE game. The SHAPE game is different from the COLOR game. In the SHAPE game, you put all the cars in this box and you put all the flowers in that box** [point to appropriate target cards]. **You don't put any flowers in this box, only the cars go in here** [point to appropriate target cards]. **And you don't put any cars over there, only the flowers go in there** [point to appropriate target cards]. **So all the cars go in this box, and all the flowers go in that box** [point to appropriate target cards].

**So remember, you put all the cars here and you put all the flowers there. Here's a ???**

**NOTE: Do NOT model cards in the postswitch phase.**

Appendix B
Child DCCS Scoresheet

| | LEFT | RIGHT | |
|---|---|---|---|
| Target Cards: | _____ | _____ | (dimension of target card e.g., red and blue) |
| 1. | _____ | _____ | |
| 2. | _____ | _____ | |
| 3. | _____ | _____ | |
| 4. | _____ | _____ | (dimension for test cards in correct side) |
| 5. | _____ | _____ | |
| 6. | _____ | _____ | |

---

(Example of how to score)

**Correct Responding**

| | LEFT | RIGHT | |
|---|---|---|---|
| Target Cards: | CAR_ | FLW_ | (dimension of target card e.g., car and flower) |
| 1. | CAR_ | _____ | |
| 2. | _____ | FLW_ | |
| 3. | _____ | FLW_ | |
| 4. | CAR__ | _____ | (dimension for test cards in correct side) |
| 5. | _____ | FLW_ | |
| 6. | CAR__ | _____ | |

# Appendix C
## SCRIPT FOR MISTAKEN IDENTITY AND CONTENTS TASK

**PRACTICE TASK:** (Present box) Here's the first thing I want to show you. Let's open it up to see what's inside. OK. Now we'll do this. (Remove button, put pencil in box, and close box).

1. What's inside the box now? (pencil)

2. What was inside the box before we opened it, a button or a pencil?

**EGG CARTON:** Present egg carton. Here's another thing I want to show you. Let's open it up. What's inside here? (Child responds)

These are forks. See? These aren't eggs. These are forks.

RC) What did you think was inside this before you opened it, eggs or forks?

FB) Another boy/girl hasn't opened this before. What will he/she think is inside when he/she first sees it, forks or eggs?

**SMARTIES:** Present Smarties. OK, here's something else. (Shake box). Let's open it up and see what's inside. What's inside here? (Child responds)

These are rocks. See? These aren't really Smarties. These are rocks. (Put rocks back in box)

FB) Another boy/girl hasn't opened this before. What will he/she think is inside this when he/she first sees it, rocks or Smarties?

RC) What did you think was inside this before you opened it, Smarties or rocks?

**CANDLE:** Present candle. I have another thing to show you. You can hold it now. What is it? (Child responds).

This is a candle. See? This is the wick that we light with a match so that the candle can burn. We can't eat this. This isn't an apple. This is a candle.

FB) Another boy/girl hasn't held this in his/her hands before before. What will he/she think this is when he/she first sees it, an apple or a candle?

RC) What did you think this was before you held it in your hands, a candle or an apple?

# Appendix C
## SCRIPT FOR MISTAKEN IDENTITY AND CONTENTS TASK

**ERASER:** Present eraser. OK, here's something else. (Take cap off) Now you can hold it in your hands. What is it? (Child responds)

This is an eraser. (Write with it). See? It doesn't write like a marker. (Draw line). I can draw a line with my pencil and rub it out with the eraser. This isn't a marker. This is an eraser.

FB) Another boy/girl hasn't held this in his/her hands before before. What will he/she think this is when he/she first sees it, a marker or an eraser?

RC) What did you think this was before you held it in your hands, an eraser or a marker?

**MILK:** Present milk. I have another thing to show you. (Shake milk carton). Now we'll pour it into this cup. What's in here? (Child responds).

This is water. See? This isn't milk. This is water. (Pour water back into carton).

FB) Another boy/girl hasn't seen me pour this before. What will he/she think is inside this when he/she first sees it, water or milk?

RC) What did you think was inside this before I poured it, milk or water?

**FLASHLIGHT:** Present flashlight. This is the last thing I have to show you. You can hold it in your hands. What is it? (Child responds).

This is a flashlight. See? We press the clip to make the light shine. We can't write with this. This isn't a pen. This is a flashlight.

RC) What did you think this was before you held it in your hands, a pen or a flashlight?

FB) Another boy/girl hasn't held this in his/her hands before before. What will he/she think this is when he/she first sees it, a flashlight or a pen?

# Appendix D
## SCRIPT FOR UNINTENDED TRANSFER

I have a game where I tell you about what happened to some people one day, and I am going to ask you questions about them.

**SCENARIO ONE: JODY, CLOWNS AND MARBLES**
Materials: DUPLO 1540 Jennifer's bedroom

Jody is a four-year old boy/girl. He/she entered a room and began to look for some toys. He /she looked first in the top drawer of a chest over here by the dog, said there were no toys in there, and then went on to discover a marble in the drawer under the television. He/she next put the marble back inside the drawer and left the room, saying he/she was going to get his other marbles and that he/she would come back to play with all his/her marbles together.

Now Jody is gone. While Jody is gone, a clown entered through the side door, discovered the marble in the drawer, and said she was going to play a trick on Jody. She hid the marble in the top drawer, placed some rocks in the drawer underneath the television, and left.

Jody came back in the room with his/her other marbles. "Hey, here is Jody again! He /she is going to play with his/her other marbles and his/her new marble!"

FB1) Show me what Jody will do next? (Does Jody go to the top drawer, or the television drawer then the top drawer? Note that there are two other drawers he/she could systematically search as well).

_____ **Drawer under TV**
_____ Top drawer by dog
_____ Bottom drawer by dog

FB2) Where will Jody look for the marbles (Necessary if Jody did not look for the marbles after open-ended prompt)

M1) Where did Jody leave the marble?

M2) Where did the clown hide the marble?

AP) Was Jody in the room or outside the room when the clown hid the marble?

# Appendix D
## SCRIPT FOR UNINTENDED TRANSFER

### SCENARIO 2: TERRY, THE MONKEY, AND THE RADIO

Materials: DUPLO 2551 Grandma's kitchen

Terry is a four-year old boy/girl. He/she entered a room and discovered a birthday present in this drawer (left) underneath the telephone. It was a toy radio. However, he/she found that it was broken. He/she next put the toy radio back in the drawer and left the room to find some glue so that he/she could fix it.

Now Terry is gone. While Terry is gone, a monkey appeared and replaced the broken radio with some flowers. The monkey put the broken radio in this box (fridge laid on its side) and left.

Terry came back with some glue. " Hey, here is Terry again! He/she is going to fix the radio!"

FB1) Show me what Terry will do next? (Does Terry go to the box or the drawer, or the drawer then the box?)

_____ **Left drawer under phone**
_____ Toy box
_____ Right drawer under the phone
_____ Top drawer
_____ Bottom drawer

FB2) Where will Terry look for the toy radio? (necessary only if Terry did not look for the toy radio after the open-ended prompt)

M1) Where did Terry leave the radio?

M2) Where did the monkey put the radio?

AP) Was Terry in the room or outside the room when the monkey switched the toys?

### SCENARIO 3: NICKI, HIS/HER MOM, AND THE CHANGING ROOM

Nicki is a four-year old boy/girl. He/she is with his/her mother at the clothes store. Nicki goes with his/her mother into this changing room (left) to try on a shirt. Nicki decides he/she wants to try on a different color shirt and goes back to the clothing rack to get it, telling his/her mom he/she will be right back to show her the new color.

## Appendix D
## SCRIPT FOR UNINTENDED TRANSFER

Now Nicki is gone. While Nicki is gone a janitor enters and asks Nicki's mother is she could move to this changing room (right) over here so she can clean the mirror in this one. Nicki's mother moves to this changing room over here. The janitor cleans the mirror and leaves.

Nicki came back with his/her new shirt. "Hey here's Nicki again! He/she is going to show his/her mother the new shirt!"

FB1) Show me what Nicki will do next?

_____ **Changing room one**
_____ Changing room two

FB2) Where will Nicki look for his/her mother?

M1) Where was Nicki's mother when Nicki left to get the new shirt?

M2) Where did Nicki's mother move to?

AP) Was Nicki in the changing room when the janitor asked his/her mother to move to the other room?